Post Opening Project Evaluation

M6 Junction 8-10a Smart (Managed) Motorway Scheme - Five Years After

August 2017

Notice

Foreword

Highways England's motorways are some of the safest in the world. Our road network carries a third of road traffic and we have seen demand grow by a quarter since 2000 with continued growth forecast.

One reason for the introduction is smart motorways is because there are more vehicles on the road. By making use of the full width of the road, smart motorways add that extra capacity to carry more vehicles and ease congestion.

They have evolved from **Controlled Motorways** (with variable speed limits) to **Dynamic Hard Shoulder Running** (opening the hard shoulder as a running lane to traffic at busy periods) to **All Lane Running** (permanently removing the hard shoulder and converting it into a running lane).

Compared to a traditional motorway widening they deliver:

- Increased capacity at significantly less cost than traditional motorway widening.
- New technology and variable speed limits to improve traffic flow.
- Less congestion and more reliable journeys for customers.
- Environmental benefits of not taking an extra corridor of land to use as new road.
- A safety record that's at least as safe, if not safer than conventional motorways.

The M6 J8 to 10a is a part of the key strategic route through the West Midlands and was one of the earlier generation of smart motorways with a conversion to dynamic hard shoulder running (opening the hard shoulder as a running lane to traffic at busy periods). Before this scheme, customers experienced delays in both the north and southbound directions, particularly during the peak afternoon period. The objectives of the scheme were to **reduce congestion**, **reduce the impact of accidents**, have a **neutral environmental impact** and **improve driver comfort**.

The evaluation report has shown that after five years, this scheme has helped to make customer's journeys more reliable and they have become quicker for those travelling during the busiest times of the day.

Personal injury collisions on the strategic road network are very rare and can be caused by many factors. Due to their unpredictable nature, we monitor trends over many years before we can be confident that a real change has occurred as a result of the scheme.

Within the first five years of operating the scheme, there has been a reduction in the number of personal injury collisions, particularly fatal and serious injury collisions compared to the road before the scheme was built. The report finds that over the timeframe for this study, the national trends for motorways have shown reductions in personal injury collisions. When taking the national trends into account in calculations, the report found there was an increase in the personal injury collisions. This relates to an average reduction of two collisions per year compared to the traditional motorway the scheme replaced.

Since this scheme, smart motorways have evolved. More recent all lane running schemes have demonstrated that they are making journeys more reliable for those travelling during congested periods, enabling us to operate the road at a higher speed limit for longer periods, whilst maintaining safety.

We're working to continually improve our smart motorways so that they work better for customers. Our Traffic Officers work around the clock to operate our smart motorways, keeping customers safe from the control room and attending incidents the road. We've committed to additional signs and more visible markings for emergency areas and our latest set of standards will ensure that there's a safe place to stop in an emergency every mile on our upcoming schemes. All of this helps to provide one of the most modern and safe road environments in the world.

January 2020

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Executive summary

Scheme Description

The M6 junction 8 to 10a is a smart (managed) motorway scheme in the West Midlands which opened to traffic in March 2011. Highways England refers to this scheme in previous documentation as the Birmingham Box Managed Motorway Phase 2 (BBMM2). Managed motorway schemes are now referred to as '*smart motorways'*. '*Smart motorways'* better reflects the use of technology to manage traffic and provide journey information to road users.

The BBMM2 scheme comprises Variable Mandatory Scheme Limits (VMSL), Hard Shoulder Running (HSR) and Through Junction Running (TJR). HSR has been provided on all mainline lines, TJR through junction 10 and VMSL along the length of the scheme. The HSR system defaults to a 60mph speed limit on the four-lane running (using the hard shoulder) which is directed by mandatory signals above the carriageway. Prior to BBMM2, BBMM1 (M40 (J16 – M42 J3A northbound), M42 (J7 – J9), M6 (J4 – J5)) was implemented and in April 2014, BBMM3 (M6 J5-8) was opened to traffic. The key findings in this section draw on findings from before (2008) and five years after opening (2017).

Objectives

Objectives (Outline Business Case 2007)	Has the scheme objective been achieved?
Reduce congestion thereby increase mobility of people and goods	✓
Reduce the impact of accidents.	X
Have a globally neutral environmental impact.	✓
Improve driver comfort.	✓

Key Findings

This Five Years After (FYA) report has the following key findings:

- On the scheme section, traffic flows have increased by between 8% and 13%, predominantly during the peak hours. The longer-term impacts of the scheme have been complemented by the completion of both BBMM1, BBMM3 and M6 junction 10a to 13. It is likely that completion of these neighbouring schemes will draw additional traffic to this strategic route.
- The scheme appraisal assumed that when the scheme was active (i.e. when the HSR was in operation), the increase in capacity would be 14%. The average flow increase along the length of the scheme and all time periods is 11% which is slightly below what was forecast in the appraisal which was based on the M42 ATM Pilot.
- After taking into account background trends in collision reduction, there has been an increase in collision numbers, but a large reduction in the severity of the casualties.
- The scheme's impact on the environment sub-objective is generally as expected.

Summary of Scheme Impact

Traffic

Traffic Flows

- Traffic flow increases (average weekday traffic, AWT) on the scheme section between pre- and post-scheme vary between 8 and 13% depending on the section of the scheme. Taking into account background growth of up to 5% on the surrounding highway network, these results suggest that the scheme may have reassigned traffic onto the M6 in some locations. The lowest increase (8%) has been observed between junction 8 to 9, northbound. The highest increase (13%) has been observed between junction 8 to 9, southbound. These findings are in line with the One Year After (OYA) report.
- On wider motorway links, for the same time-period, there has been an increase in traffic flows on the M6 Toll and through M6 junction 3 to 3A traffic flows have remained relatively consistent when taking background growth into consideration.
- Since the OYA report was completed, smart motorway schemes on adjacent sections of the M6 have also been completed, which are likely to have drawn additional traffic to the M6 corridor.
- The largest increase in traffic flows between pre- and post-scheme has been observed in the AM and PM peak periods, with smaller increases during the Inter Peak. Overnight there have been minimal changes in traffic flow.

Traffic Forecasting

- The scheme appraisal assumed that when the scheme was active (i.e. the HSR was in operation) an increase in capacity would be 14%. The average flow increase along the length of the scheme and all time periods is 11% which is slightly below what was forecast in the appraisal which was based on the M42 ATM Pilot.
- The scheme appraisal also assumed that the scheme would only be operational during weekday peak periods. There has been traffic growth in the Inter Peak, and a corresponding use of the scheme during this time period. The appraisal of managed motorway schemes now use an alternative appraisal methodology to take this into consideration.

Scheme Utilisation

- The scheme appraisal also assumed that the scheme would only be operational during weekday peak periods. There has been traffic growth in the Inter Peak, and a corresponding use of the scheme during this time period. The appraisal of managed motorway schemes now use an alternative appraisal methodology to take this into consideration. Analysis of smart motorway operational data has shown that the scheme is utilised more than assumed in the appraisal. For example, on an average weekday, scheme utilisation in the southbound direction between junction 9 and 10 is consistently as high as 90% throughout the whole day.
- Analysis of MIDAS data has shown that the hard shoulder is used by vehicles across the scheme length, including in through junction 10 in the through junction running section.

Journey Time Impacts

- Journey time savings of 10% have been achieved in the southbound direction during the AM Peak; this represents a reduction of approximately 147 seconds. This is compared to a forecast journey time saving of 335 seconds.
- Northbound, the largest journey time saving was observed in the AM Peak (21% improvement). In terms of change in journey time between pre- and post-scheme, the largest savings were observed between junction 10 and 10a. Increases across the whole scheme for the AM and PM are lower than the forecast increase in journey times of 100 seconds.
- The variability of journey times has reduced as a result of the scheme. The inter-quartile ranges of journey time have reduced in all periods. The Planning Time Index (PTI) score has also reduced by between 23-24% by direction. These measures provide a good indication of an improvement in journey time reliability as a result of the scheme.

Safety

Collisions

- In the five years after opening between junction 8 and 10a, taking into account a national background trend of falling collision numbers, there is an increase in collisions of 34%, which is statistically significant. Conversely, there has been an improvement in the collision severity index from 11% (pre-scheme) to 4% (post-scheme), showing that the casualties are less severely-injured.
- Taking into account the increase in traffic flows, the collision rate along the length of the scheme has increased by 26%. This is only just statistically significant. At OYA, no change in collision rate was observed. The scheme has not performed as forecast in terms of reducing the collision rate (PICs per km).
- Analysis of the recorded collision causation factors does not reveal differences between pre- and post-scheme.

Environment

Noise and Air Quality

- Traffic speed data suggests that it is likely that the noise climate as a result of the scheme is generally worse than expected, although the junction 9 to 10 southbound link is likely to be as expected.
- It is considered that between Junction 8 and 9, local air quality as a result of the scheme is likely to be worse than expected based on both the AADT and traffic speed data for this link.
- Between Junction 9 and 10, air quality is likely to be as expected based on the AADT data, while on the southbound link between junction 10 and 10a, air quality may be better than expected, based on the AADT data.
- The outturn carbon impact is 1% higher than forecast, which is likely to be due to the scheme being switched on during the Inter Peak when this was not originally forecast to be the case. Taking into consideration the accuracy of the methodology used to calculate these values, it is considered that the impact on greenhouse gases is as expected.

Landscape and Townscape

- Mitigation measures, including the retention of existing vegetation and the reinstatement of planting where vegetation was not able to be retained, were incorporated into the scheme to avoid, minimise, or reduce potentially adverse impacts.
- The coverage and condition of the retained vegetation continues to perform a screening function and integrate the scheme within the established landscape framework. Plant establishment and development within the single planting plot able to be observed during the FYA site visit is as would reasonably be expected, and evidence of previous maintenance operations was apparent.
- No records of maintenance operations or any specific issues arising during the Aftercare Period have been made available for this evaluation.
- In line with the OYA findings, the scheme has resulted in some increased urbanisation that is generally limited to the motorway corridor. The Townscape character of the areas adjacent to the motorway have not changed significantly as a result of the scheme.

Biodiversity

- While there is no reason to suspect that impact of the scheme on species is likely to be anything other than as expected, further information is required to confirm this.
- While the coverage and condition of the retained vegetation continues to provide habitat, the establishment and performance of the majority of new planting plots and the presence of new hibernacula has not been able to be confirmed.

Heritage and Water

- There is no evidence to suggest that the effects of the scheme on Cultural Heritage or water quality and drainage are anything other than as expected at this time.

Journey Ambience

- Traveller Care - ERA's are clearly signed, and electronically provided information on the availability and maximum speed limits for each lane across the carriageway, along with detailed pictorial and text information, is clear.
- Traveller Views - Retained vegetation has continued to provide a landscape framework for the motorway corridor, and the adverse effects of any increase in highway 'clutter' and perceived urbanisation of the route corridor on Traveller Views are not considered significant in isolation.
- Traveller Stress - The increased capacity of the M6 when HSR is in operation is likely to provide more opportunities for the safe overtaking of slower vehicles and a greater likelihood of free-flowing traffic. The significant improvement in journey time reliability will also contributed to reduced traveller stress. The provision of clearly signed ERA's and clear, informative signage is considered to have had a beneficial effect of perceived safety and on route uncertainty. There has been a decrease in the severity of collisions along the length of the scheme, indicating that the scheme is partly fulfilling its objective to reduce the impact of collisions.

Accessibility and Integration

- It is considered that the AST rating of neutral for option values, severance and access to the transport system sub-objectives is appropriate given the outturn impact of the scheme.
- The scheme has not impacted the provision of public transport interchange, so the forecast rating of neutral has been upheld.
- The scheme integrates well with the objectives set out in the regional policies and contributes to improving the reliability of the transport system in the region. Therefore, the outturn assessment is scored in line with forecast, as neutral.

Summary of Scheme Economic Performance

		Forecast*	Outturn Reforecast*
Costs	**PVC (including Indirect Tax impact)**	**£105.1m**	**£126.3m**
Benefits	Journey time benefits	£346.0m	£217.9m
	Safety Benefits	£16.6m	-£83.8m
	Vehicle Operating Costs	£15.3m	
	Carbon benefits	£0.62m	
	User Charge	-£0.2m	
	PVB subtotal	**£378.4m**	**£149.8m**
	Indirect Tax Revenue	£5.4m	
Summary	PVC without Indirect Tax Revenue	£99.7m	£120.9
	PVB with Indirect Tax Revenue	**£383.7m**	**£155.2m**
	BCR (with indirect tax in PVC)	3.6	1.2
	BCR (with indirect tax in PVB)	**3.8**	**1.3**

*Figures presented in the table above are for BBMM1 and BBMM2 combined

Present Value Benefits (PVB)

- The outturn PVB is £149.8m compared to a forecast of £378.4m. The lower benefits in the outturn is primarily as a result of a safety dis-benefit. There was an observed increase in the annual number of PICs across the study area, in comparison to the without scheme counterfactual scenario. This approach to monetisation does not account for any changes to the severity of collisions as a result of the scheme, it only considers the average collision. The safety analysis of this scheme has demonstrated that although there are more collisions, the severity of these has decreased. Collisions rated as serious and fatal have a higher monetary value, and so had the impact of these been modelled in more detail then the dis-benefit to safety would have been lower.

- The journey time benefits are also lower than forecast, due to the lower than forecast saving/increase in the AM peak southbound and PM peak northbound. Despite an enforced reduction in speed limit when the scheme is operational, there are still substantial journey time benefits and improvements to reliability across the scheme section.

Costs

- The outturn PVC (£126.3m) is approximately 20% higher than that forecast (£105.1m), whereas the undiscounted investment costs are relatively similar. This difference can be explained by a difference in assumed spend profiles. The scale of this difference suggests that the scheme appraisal did not convert the forecast scheme costs into market prices. This is just an assumption as no data is available to suggest an alternative explanation.
- After discounting, outturn investment costs were higher (23%) than forecast at £111.8m.

Benefit Cost Ratio (BCR)

- The forecast BCR was 3.58 and the outturn BCR is 1.3. The outturn BCR is lower than that forecast due to the higher than forecast PVC and lower than forecast PVB.

1. Introduction

Background

1.1. This report presents the Five Year After (FYA) opening evaluation of the M6 junction 8 to 10a Managed Motorway scheme in the West Midlands, which opened to traffic in March 2011. This scheme is more commonly referred to as the Birmingham Box Managed Motorway Phase 2 (BBMM2), and therefore will hereafter be referred to as such for this report, for consistency with other scheme documentation. The scheme forms part of a wider strategy to relieve congestion on the highway network in the vicinity of Birmingham through the implementation of 'Smart' Motorways which involve the use of technology to control speed limits on motorways and make use of the hard shoulder as a running lane.

1.2. The evaluation has been prepared as part of Highways England's Post Opening Project Evaluation (POPE) programme. The purpose of this report is to build upon the initial findings presented in the One Year After (OYA) report published in April 2014.

Scheme Location

1.3. The M6 forms part of a key strategic route through the West Midlands, connecting the M1 to the north-east of Rugby, with the North West (Manchester, Liverpool and Preston). Junctions 8 to 10a of the M6 form a 10.2km link, approximately 13km, to the north-west of Birmingham. This section of the M6 forms part of Route E5 of the Trans-European Network of Roads[1]. The main alternative to the M6 here is the M6 Toll, which joins the M6 at junctions 3 and 11.

1.4. Junction 10a provides access to the M54 (towards Telford and Shrewsbury), a key route for traffic from the West Midlands travelling towards Mid- and North Wales. In October 2013, construction began on the M6 Junction 10a to 13 Smart Motorway scheme, which has now been completed. Additional information on this scheme is provided in later in this introductory chapter.

1.5. Junction 10 includes a grade-separated roundabout with A454 Black Country Route and A454 Wolverhampton Road. The A454 Black Country Route provides access from junction 10 towards Wolverhampton. The A454 Wolverhampton Road provides access from junction 10 into Walsall. Walsall Council is currently working with Highways England to improve this junction, to address congestion and safety around the junction and replace two bridges with two new four lane bridges. As of 2017, this is in the planning process, with the aim of starting construction in 2018[2].

1.6. Junction 9 is a standard grade separated roundabout providing access to, and from the A461 which links Walsall to the north and Wednesbury to the south. This junction also provides access to a large retail park (Gallagher Retail Park) which has a range of retail outlets including IKEA. Junction 9 of the M6 was subject to an improvement scheme as part of the Pinch Points programme. The scheme involved upgrading the traffic signals on the roundabout to full Microprocessor Optimised Vehicle Actuation (MOVA) control and was finished in June 2013.

1.7. Junction 8 provides access onto the M5 towards West Bromwich, Bromsgrove, Worcester and the South-West. Junction 4A to 6 of the M5 are currently being upgraded to an All Lane Running smart motorway. Additional information on this scheme is provided in later in this introductory chapter.

1.8. The geographical location of the scheme in relation to the region and the surrounding highway network is shown in **Figure 1-1** and **Figure 1-2.**

[1] https://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/maps_en

[2] http://roads.highways.gov.uk/projects/m6-junction-10-improvement/

Geographic and Socio-Economic Context

1.9. The scheme is located in an urban area, surrounded by large towns and residential areas, including Wolverhampton, Wednesbury, Walsall and Bloxwich.

1.10. Junctions 9 and 10 provide access to Wolverhampton and Walsall. Wolverhampton is a city and metropolitan area with a population of approximately 250,000[3]. Walsall is a large town with a population of approximately 270,000[2].

Problems prior to scheme

1.11. Prior to scheme implementation, this section of this M6 was reported to have experienced severe congestion in both directions, particularly during the afternoon peak period, with some links experiencing congestion for up to 12 hours a day[4]. On the northbound carriageway, it was reported that the volume and movement of traffic joining the M6 from the M5 North at junction 8, and that leaving the M6 at junction 9, resulted in severe congestion between junction 8 and 10. This was also reported to be the case for traffic joining the M6 at junction 9 and leaving at junction 10[3].

1.12. The southbound carriageway was also reported to have experienced congestion during both the AM and PM peak periods and much of the Inter Peak period. The weaving sections on the short link lengths between merges and diverges caused congestion, especially at junction 9. The southbound slip road at junction 9 onto the M6 is short in length and has a relatively steep uphill gradient which is reported to have resulted in vehicles, especially HGVs, arriving at the merge point at a slower speed than the main carriageway[3].

Objectives

1.13. The objectives of the scheme, as set out in the Outline Business Case (September 2007) are as follows[5]:

- **Reduce congestion, thereby increasing mobility of people/goods;**
- **Reduce the impact of accidents;**
- **Have a globally neutral environmental impact; and**
- **Improve driver comfort.**

1.14. Additional objectives were also provided, which were specific to the wider benefits of the scheme for local businesses and the economy[4], as follows:

- Support agglomeration of business activity;
- Support the mobility and flexibility of the labour market;
- Increase international competitiveness and trade through improving east of movement of goods and services;
- Increase the network resilience and choice for business users; and
- Increase accessibility to other firms – allowing them to share knowledge and operations and offer accessibility to a large pool of workers.

[3] 2011 Census

[4] M6 J8 (West) – J10a Improvement Study: Phase 2 Study Summary (Issue A, August 2007), Mouchel Parkman

[5] TIF Productivity Bid – Birmingham Box ATM Phases 1&2 Outline Business Case (September 2007), Mouchel Parkman

Figure 1-1 Scheme Location (Local)

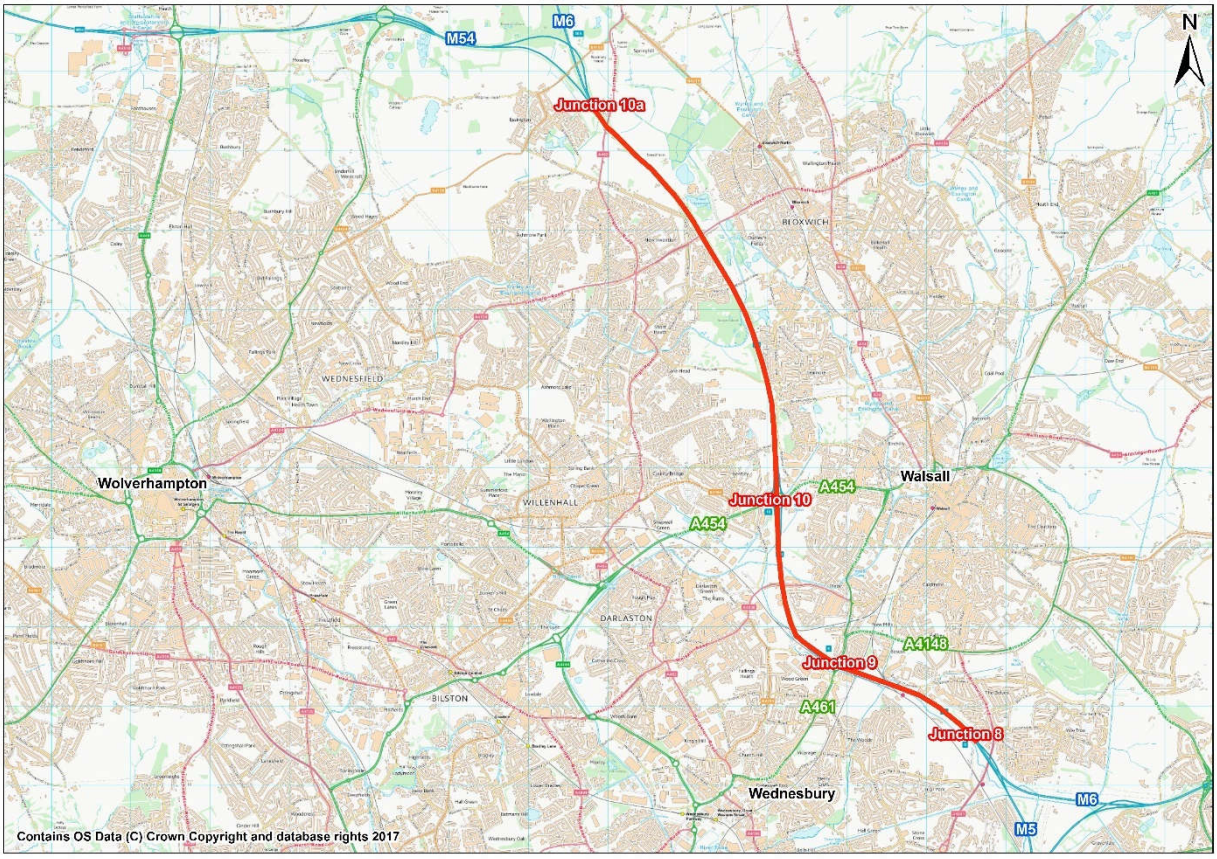
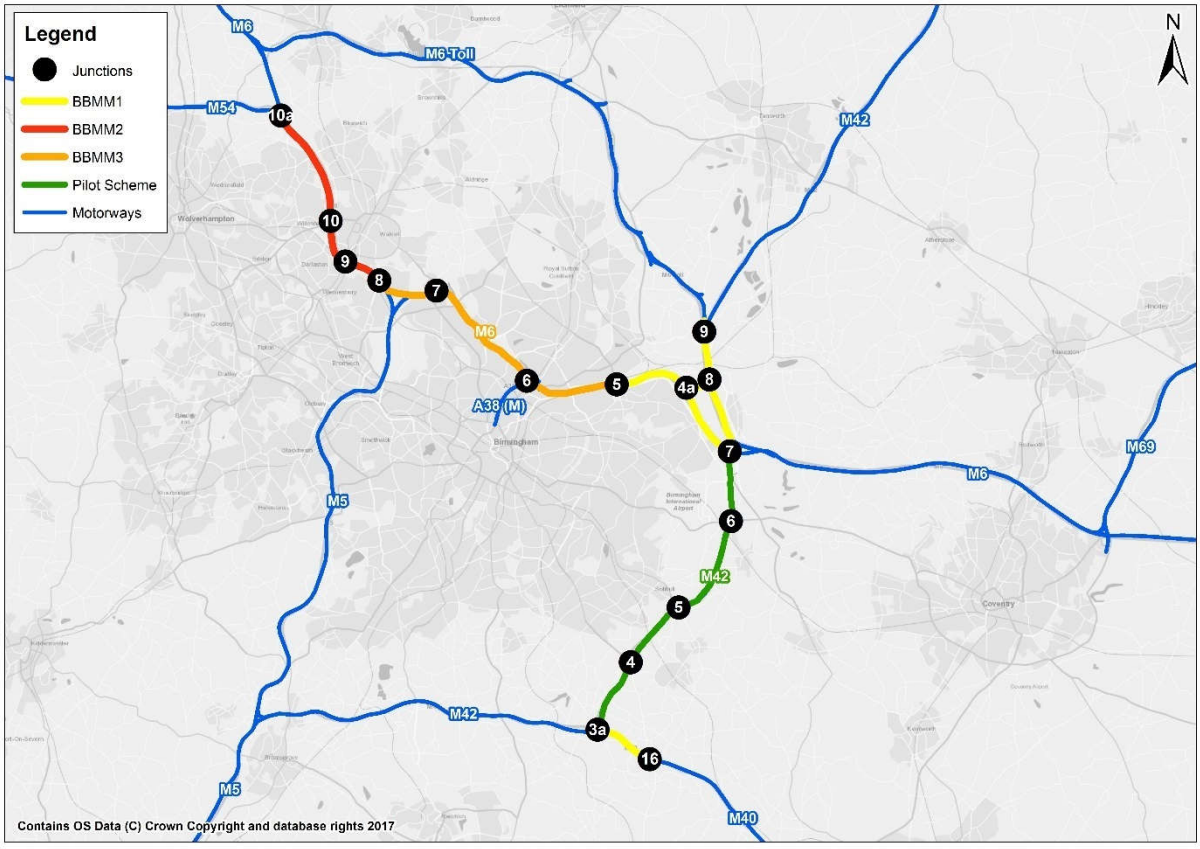


Figure 1-2 Scheme Location (Regional)



1.15. The scheme appraisal stated that the '*biggest component of the wider economic benefits generated as a result of the implemented of the ATM scheme on the Birmingham Motorway Box are the agglomeration benefits'* which were generated as a result as of firms in the West Midlands have increased accessibility, which allows them to be more productive compared to the Without ATM scenario. The POPE evaluation methodology does not typically consider agglomeration benefits related to the mobility and flexibility of the labour market. Therefore, this evaluation will focus on the objectives listed in **Paragraph 1.14.**

Scheme Description

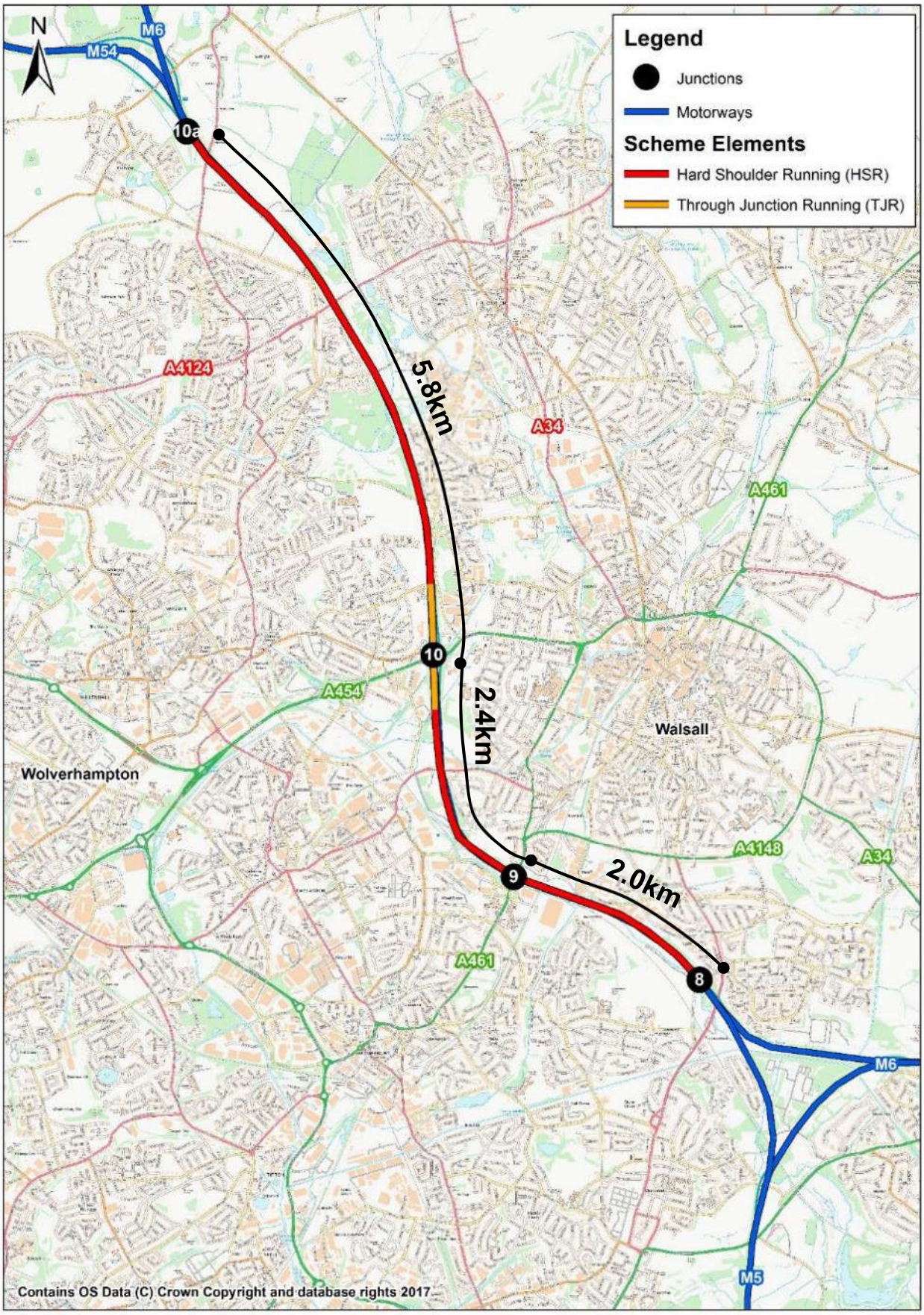
1.16. The scheme provided 10.2km of managed motorway between Junction 8 to the south and junction 10a to the north. This managed motorway scheme includes Variable Mandatory Speed Limits (VMSL), Hard Shoulder Running (HSR) and Through Junction Running (TJR). HSR has been provided on all mainline links, TJR through junction 10 and VMSL along the length of the scheme. The HSR system defaults to a 60mph speed limit on four lane running (using the hard shoulder) which is directed by mandatory signals above the carriageway.

Figure 1-3 TJR (Junction 10) with VMSL gantry

Figure 1-4 HSR with VMSL gantry

1.17. A summary of the key features of the scheme is provided overleaf in **Figure 1-5.**

Figure 1-5 Key Features of the Scheme



Scheme History

1.18. This scheme was initially developed as part of a bid for funding from the Productivity Transport Innovation Fund (TIF). The Productivity TIF focussed on schemes of national importance that would increase productivity through a reduction in congestion. The scheme appraisal considered BBMM1 and BBMM2 as part of the same Productivity TIF bid. Therefore, traffic forecasts and economics were not produced for BBMM2 in isolation. As per the OYA report methodology, the forecast impact of BBMM2 has been isolated from BBMM1 to allow an evaluation of BBMM2 only.

1.19. The West Midlands Multi-Modal study published in October 2001 recommended that Active Traffic Management (ATM) should be implemented on the M5, M6 and M42 motorways around the region. ATM provides a range of features to provide more reliable journey times, reduced congestion, enhanced information to drivers and quicker response time to incidents, for example, hard shoulder running and driver information signs. A feasibility report published in March 2008, concluded that implementation of dynamic hard shoulder running in addition to ATM could provide a large proportion of the benefits at a considerably lower cost. The specific sections identified as a potential priority for the dynamic use of the hard shoulder were in three phases from the M6 Junction 4 to Junction 10a. **Table 1-1** provides details of each phase of the Birmingham Box Scheme. BBMM1 was already in operation at the time of BBMM2 scheme development. **Figure 1-2** presents the location of each of the phases.

Table 1-1 Birmingham Box Managed Motorway

Phase	Opening Date	Description of Location	Post Opening Evaluation Stage
1 (BBMM1)	November 2009	M40 Junction 16 to M42 Junction 3a: • 3.2km of Controlled Motorway (CM) with Hard Shoulder Incident Management (HISM) M42 Junction 7 to 9: • 6.8km of CM, with some sections comprising of five lanes plus the hard shoulder in each direction M6 Junction 4 to 5: • HSR implemented, except the link between Junction 4A and 4 in the southbound direction where CM is used. Total link length of 7.9km.	N/A
2 (BBMM2)	March 2011	M6 Junction 8 to 10a	OYA (published April 2014) FYA (this evaluation report)
3 (BBMM3)	April 2014	M6 Junction 5 to 8: • Dynamic Hard Shoulder Running (DHSR) with through junction running (TJR) at Junction 5. Total link length of 15.6km. • Four lane all lane running (ALR) with no hard shoulder between Junction 7 to 8, eastbound. • Three lanes with variable speed limits between Junction 7 and 8, westbound.	OYA (evaluation report in production)

1.20. Monitoring and evaluation has already taken place on the scheme as part of an ongoing assessment of managed motorways[6]. Where relevant, the conclusions of this monitoring will be incorporated into this report.

1.21. A brief history of the key events involved in the development of the scheme is provided in **Table 1-2.**

Table 1-2 Scheme History

Date	Event
October 2001	West Midlands Area Multi-Modal Study Report recommended introduction of ATM on M5, M6 and M42 motorways around West Midlands.
May 2002	Feasibility Study completed by Atkins.
July 2003	Secretary of State asked Highways England (then Highways Agency) to consider the feasibility of implementing ATM on Birmingham Box Motorways.
September 2006	Preliminary Business Case Produced
2007	Outline Business Case Produced and Business Case submitted to DfT
March 2009	To build on the EAR and to understand the impact on other aspects highlighted within the New Approach to Appraisal (NATA), roll out forecast was revised as reported in 2009 in the BBATM Phases 1 and 2 -Modelling of the Impact of Rollout report. At this time the locations of on-road ATM infrastructure for Phase 2 was not finalised. The operational modelled of Phase 2 “With ATM” was postponed until finalised drawings were available. Report took into account the findings to date from M42 ATM. Revised AST produced.
August 2009	**Construction Began**
November 2009	Addendum to ATM Roll Out Phases 1 and 2 Transport Modelling Report produced which provides methodology and conclusions for the remainder of the operational modelling of Phase 2 and formed an addendum to the document produced in March 2009.
March 2011	**Scheme Opened to Traffic**
April 2014	One Year After Opening (OYA) report published
July 2017	Five Years After Opening (FYA) report published

Nearby Schemes

1.22. There are a number of Highways England network improvements which are noted to have been implemented in the vicinity of the scheme as summarised in

[6] BBMM Phase 1&2 Monitoring and Evaluation. Milestone 1: Phase 2 After Construction Traffic Data Analysis Report (March 2012)

1.23. **Table** 1-3**.** Those presented in **Table 1-3** are those which considered to be the most relevant at this stage of the analysis. A full table and map is provided in **Appendix B (**the numbers in the table correlate to those shown on this figure). It is important to understand the impact that these schemes may have had on the data collection for this evaluation.

1.24. The construction and opening of these schemes will have an impact on the operation of BBMM2. The traffic management in place during the construction of the neighbouring schemes will have impacted on the performance of BBMM2, whereas increased capacity up and downstream of the scheme may increase traffic flows and scheme utilisation. The impact of these schemes will be considered in additional detail in **Chapter 2** of this report.

Table 1-3 Nearby Schemes on the Motorway network

	Scheme	Description/Impact on Traffic	Start of Construction	Scheme Opening
1	M6 Junction 9 Traffic Signal Upgrade (Pinch Point Programme)	Implementation of MOVA traffic signals at the roundabout of M6 junction 9.	April 2013	June 2013
2	BBMM3 (M6 Junction 5 to 8)	Smart Motorway implemented between junction 5 to 9, including M5 link roads.	January 2012	April 2014
3	M6 Junction 10a to 13	Smart Motorway implemented between junctions 10a and 13, with dedicated slip roads on interchanges with M54 and M6 toll.	October 2013	February 2016
4	M6 Walsall Canal Bridge Southbound re-surfacing (Junction 9-10)	Phase 1 of this work replaced joined and re-waterproofed the deck of Walsall canal bridge between junctions 9 and 10.	April 2014	July 2014
6	M6 Northbound Junction 7 to 10 Carriageway re-surfacing and bridge expansion	The carriageway was re-surfaced between junction 7 and 10 (northbound) to improve safety and road conditions. There were overnight closures of the M6 northbound between junction 7 and 10.	February 2015	April 2015
7	M6 J8 to M5 Link Southbound re-surfacing (waterproofing)	The bridges on the link road between the southbound M6 to the M5 required re-surfacing. Traffic management was in place throughout the construction period, with single lane running. There were some overnight closures in January 2017 to complete the works.	January 2015	January 2017
14	M6 northbound (Junction 7 and 8)	Structural repairs to damaged concrete and waterproofing on northbound carriageway. Work taking place in hard shoulder and lane one to minimise disruption. Overnight and weekend closures of slip roads and main carriageway. Enforced stepped speed limit from 70mph, to 50mph and 40mph through the work area, with fully signposted diversions between Junction 7 and 8.	February 2017	Scheduled April 2017
15	M5 Junction 1 to 2 Oldbury Viaduct	Preparation work for major concrete work and waterproofing in advance of main scheme which started in April/May 2017. This was carried out using overnight lane closures and weekend overnight full closures of slip roads and the main carriageway.	January 2017	Scheduled Autumn 2018

Overview of POPE

1.25. Highways England is responsible for improving the strategic highway network (motorways and trunk roads) through the Major Schemes programme. At each key decision stage through the planning process, schemes are subject to a rigorous appraisal process to provide a justification for the scheme's continued development.

1.26. When submitting a proposal for a major transport scheme, the Department for Transport (DfT) specifies that an Appraisal Summary Table (AST) is produced which records the degree to which the Government objectives for Transport have been achieved. These objectives are Economy, Environmental, Safety, Accessibility and Integration). The contents of the AST allow judgements to be made about the overall value for money of the scheme. The AST for this scheme is presents in **Appendix A** of this report.

1.27. POPE studies are carried out for all Major Schemes to evaluate the strengths and weaknesses in the techniques used for appraising schemes, to allow for improvements to be made in the future. The is achieved by comparing information collected before and after the opening of the scheme to traffic, against predictions made during the planning process. The outturn impacts of the scheme are summarised in an Evaluation Summary Table (EST). The contents of the EST summarise the extent to which the objectives of a scheme have been achieved. The EST for this scheme can be found in **Appendix A** of this report.

1.28. A OYA report was produced in August 2014, the key findings of which are summarised below:

- In the first year of opening, the average journey times reduced, although not to the extent forecast, and as indicated by a reduced spread of speeds across all time periods, an improvement in journey time variability was also observed;
- Traffic flows have increased along the scheme section, against a general reduction in traffic over the same period at other locations along the M6 which was suggested to have come from local traffic patterns;
- It was found that traffic forecasting at the appraisal stage was generally consistent with traffic flows observed in the first year of opening, apart from assumptions relating to the scheme only being operational during weekday peaks, which was not the case for this scheme. This assumption has now been superseded and appraisals of smart motorway schemes take a more detailed approached to estimating hours of operation;
- Changes in collision rates was demonstrated to be insignificant after accounting for background trends in collision reductions. A reduction in the ratio of Killed and Seriously Injury (KSI) collisions was observed. Although the severity of collisions has reduced more than forecast, the collision rate remained unchanged; and
- Monetary benefits were found to be slightly lower than expected, with outturn present value benefits of £316.4m compared to £371.1m.

Contents of this Report

1.29. Following this introduction, the report is divided into eight further chapters as follows:

- **Chapter 2** – Traffic Impact Evaluation;
- **Chapter 3** – Safety Evaluation;
- **Chapter 4** – Economic Evaluation;
- **Chapter 5** – Environmental Evaluation;
- **Chapter 6** – Accessibility and Integration Evaluation;
- **Chapter 7** – Scheme EST and AST; and
- **Chapter 8** – Conclusions.

2. Traffic Analysis

Introduction

2.1. This section examines traffic data from a range of sources to provide a pre-scheme, and five year after opening (post-scheme) comparison of traffic flows and journey times along the length of the scheme. The purpose of this section of the evaluation is to understand whether changes in traffic flows and journey times are attributable to the scheme.

2.2. This chapter includes the following:

- A summary of the data sources used to complete this section of the evaluation;
- An overview of national, regional and local background traffic trends;
- A detailed comparison of before and five year after (FYA) traffic flows on the scheme section;
- A detailed comparison of the FYA traffic flows with those forecast;
- An overview of changes on other key routes in the study area likely to be affected by the scheme; and
- An analysis of scheme utilisation and lane usage.

Data Sources

2.3. Traffic Data used in this section of the report has been obtained from a range of sources to understand the pre- and post-scheme analysis of changes in traffic volumes and journey times attributable to the scheme. The locations of the traffic count data sites from the different sources are shown in **Figure 2-1**.

Traffic Count Data

2.4. Traffic count data has been extracted for the strategic highway network (M6, M6 Toll, M5, M54) from the Highways England WebTRIS[7] database for a period before construction (May 2008) and five years after opening (April 2017, excluding holidays). To avoid planning overnight maintenance works on various sections of the scheme during March 2017, and issues surrounding data availability in other months, April 2017 has been used for the post-scheme opening traffic count data. The post-scheme opening dates avoid the construction of neighbouring major schemes, and correspond with the figures presented in the OYA opening report for M6 10a to 13. It is considered that this provides a robust indication of traffic flows and patterns on the scheme during the post-opening period.

2.5. This evaluation report does not present traffic count data (from WebTRIS) for junction 10 to 10a northbound due to issues surrounding data availability on this section and ongoing errors with long term count sites. In order to calculate the economic benefits of the scheme, the economy section of this report has used traffic flows for this section, adjusted according to the northbound: southbound split from OYA, in order to present a like for like comparison with the forecast data.

2.6. Data relating to HGVs has not been presented in this evaluation due to there being no comparable data available for pre- and post-scheme. In addition, the scheme appraisal did not forecast the impact of the scheme on HGVs.

Journey Time Data

2.7. Satellite navigation data for M6 junction 8 to 10a has been used to determine if there has been a change in the average journey times and speeds. It has also been used to understand whether the distribution of journey times has changed since the scheme opened. Journey times for all months in 2008 (before opening) have been compared to March 2017. As this

[7] WebTRIS database is maintained by Highways England and contains long term traffic count data for England's strategic road network.

analysis is only carried out across the AM, Inter Peak and PM Peak periods, the overnight works (21:00 – 06:00) carried out along the scheme section throughout March 2017 did not affect these flows.

2.8. For post-opening data, one month of data has been used to avoid the construction periods of neighbouring schemes which may affect journey times through the scheme section.

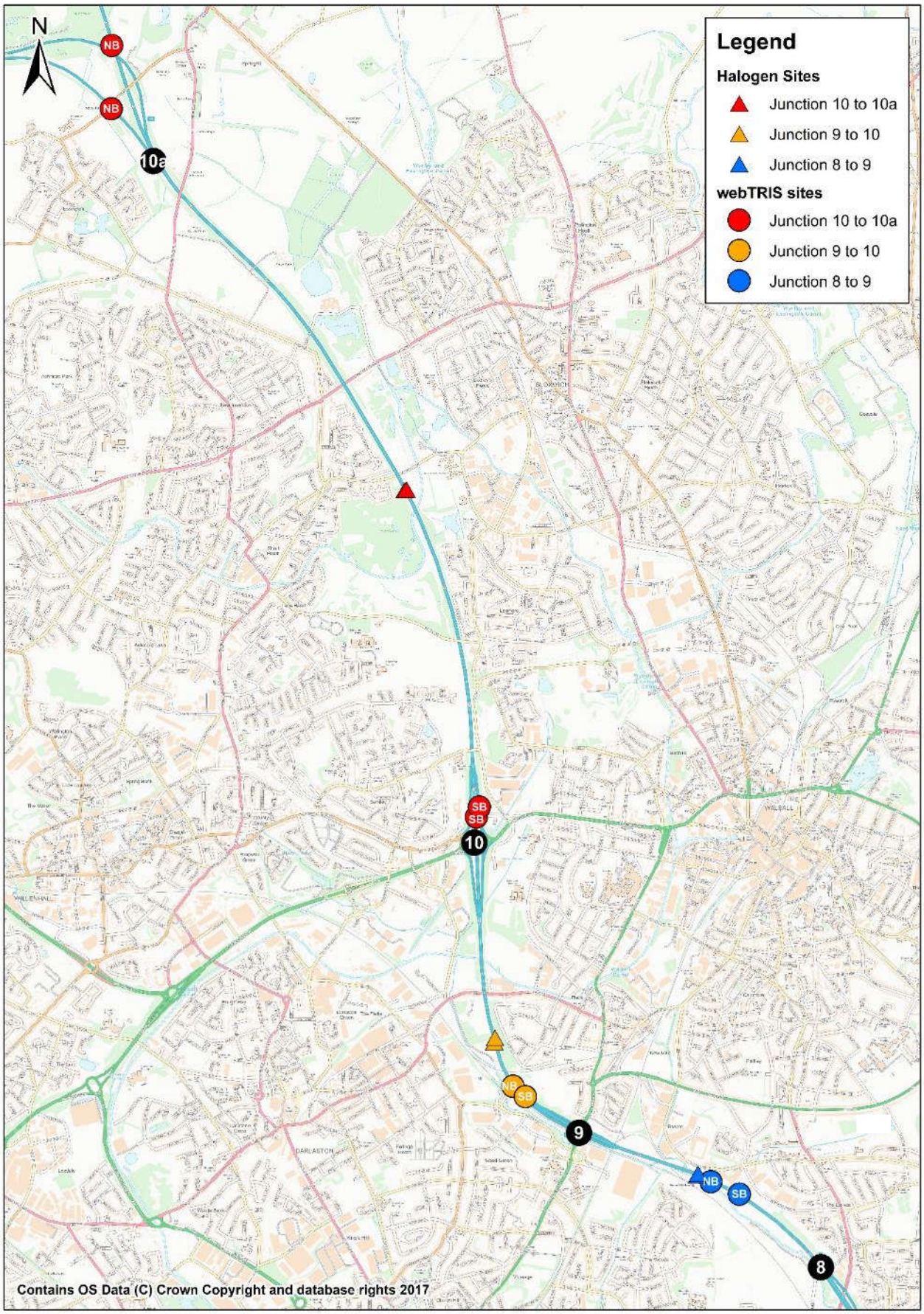
Halogen Data

2.9. Halogen data is available from Highways England (Halogen Information Services web portal) and can be downloaded from the message screens displayed on overhead gantries forming part of a Smart Motorway scheme. The data can be used to determine when, and for how long, the hard shoulder was open for traffic and the different speed limits in place as part of the variable speed limit (queue protection) used in Smart Motorways. Data from March 2017 has been used in this analysis. As this analysis is only carried out across the AM, Inter Peak and PM Peak periods, the overnight works carried out along the scheme section throughout March 2017 did not affect this analysis.

Motorway Incident Detection Automated Signalling (MIDAS) Data

2.10. MIDAS technology forms part of the operation of Smart Motorways. Data is available from Highways England and provides lane by lane traffic flows and speeds. This data along with the settings from the overhead gantries, obtained from Halogen data (e.g. whether the hard shoulder is open and the Variable Mandatory Speed Limit in operation) can provide additional insight into the operation of the Smart Motorway. As MIDAS and Halogen data form part of the technology of Smart Motorways, it is not possible to undertake pre- and post-scheme analysis using this data, but it does help inform the evaluation of the performance of the scheme. Data from March 2017 has been used in this analysis. As this analysis is only carried out across the AM, Inter Peak and PM Peak periods, the overnight works carried out along the scheme section throughout March 2017 did not affect this analysis.

Figure 2-1 Traffic Count Locations



Traffic Analysis

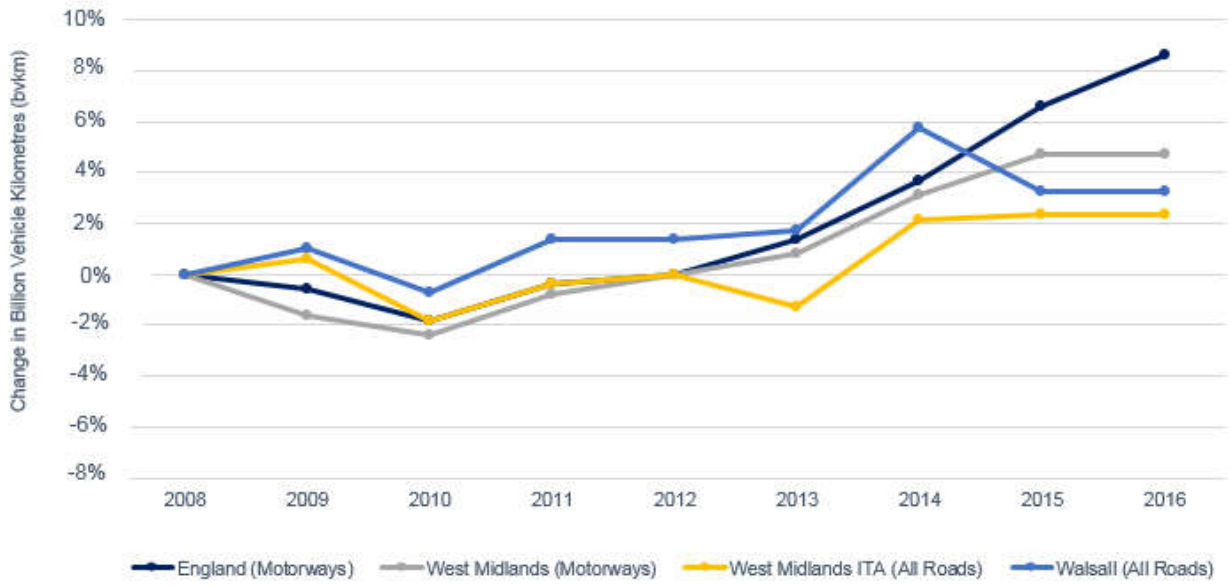
Background Changes in Traffic

2.11. In previous POPE reports, evaluations have taken into account background traffic growth so that the traffic flows are directly comparable with the post opening counts. However, in light of the economic climate over the last decade, which saw widespread reductions in motor vehicle travel in the United Kingdom (UK) between 2008 and 2010, it is no longer deemed appropriate to use this method of factoring. More recently, POPE studies have taken a more considered approach to assessing changes in the vicinity of the scheme, within the context of national, regional and locally observed background changes in traffic.

National and Regional Trends

2.12. The Department for Transport (DfT) produces observed annual statistics for all motor vehicles in by road type[8]. Data between 2008 (pre-scheme) and 2016 (latest available at the time of writing) has been used to understand changes in traffic volumes compared to a base year of 2008. **Figure 2-2** shows the nationally observed trends for motorways and all roads at different geographic levels.

Figure 2-2 Nationally and Locally Observed Trends (change from 2008)



2.13. **Figure 2-2** shows that since 2008 until 2014, traffic levels on motorways in the West Midlands have steadily increased by approximately 5%. Since then, they levelled off and remained consistent from 2015 to 2016. In England, since 2010, traffic levels have continued to increase until approximately 9% in 2016. It is considered that for this scheme, the regional trends are of higher relevance than those at a national level.

2.14. For all other road types, **Figure 2-2** shows that since 2008, traffic levels have generally increased on these roads, in both Walsall and West Midlands Integrated Transport Authority (ITA), with dips in 2010 and 2013. Since 2014, traffic levels have levelled off and remained consistent between 2015 and 2016. There has generally been more growth on roads in Walsall than across the wider West Midlands area.

[8] Traffic Volume – kilometres (Table TRA0202): https://www.gov.uk/government/statistical-data-sets/tra02-traffic-by-road-class-and-region-kms

Traffic by local authority - vehicle kilometres (Table TRA8904): https://www.gov.uk/government/statistical-data-sets/tra89-traffic-by-local-authority

Local Trends

2.15. This scheme involved a major upgrade of a long stretch of the strategic highway network. It is therefore useful to understand the wider traffic trends on the M6.

2.16. **Figure 2-3** shows the long-term average weekday traffic (AWT) from a site on M6 mainline between Junction 3-3a, has been investigated between January 2005 and April 2017. **Table 2-1** shows the AAWT for 2008 to 2017, and the percentage change since 2008.

Figure 2-3 M6 Junction 3 to 3A – Long Term Trends (monthly AWT)

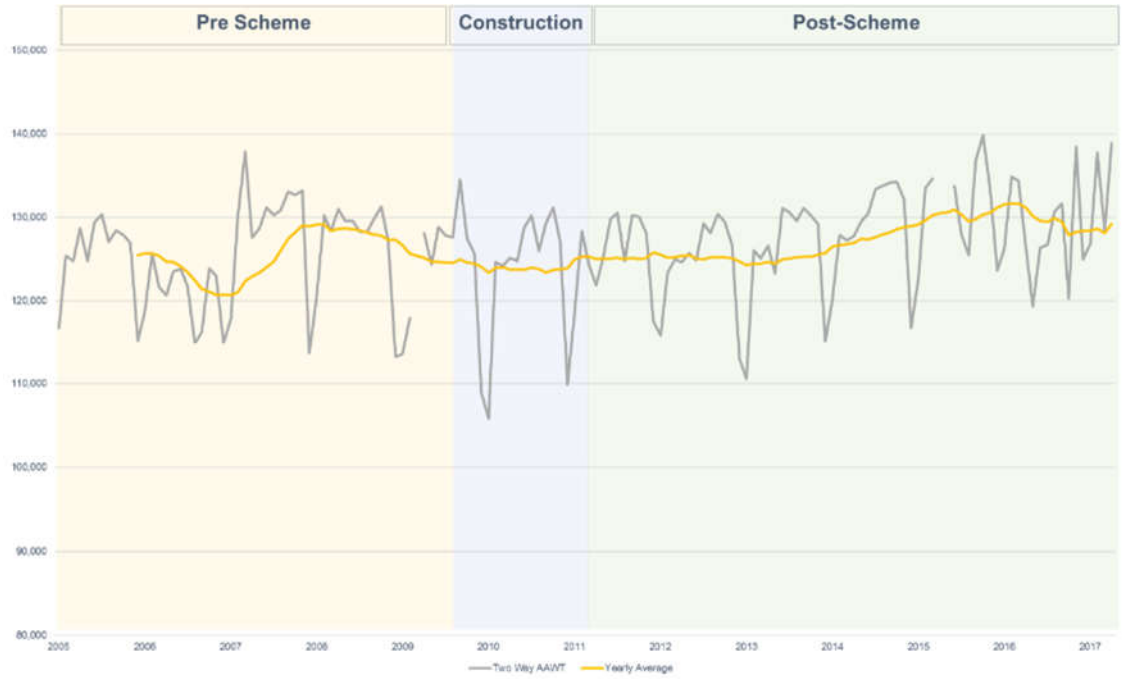


Figure 2-4 M6 Toll – Long Term Trends

Table 2-1 Long Term Trends on Strategic Road Network

Year	Junction 3 – 3A (24 hour AAWT)	% Change Since 2008	M6 Toll (24 hour AAWT)	% Change Since 2008
2008	127,300	-	37,200	-
2009	124,100	-3%	35,800	4%
2010	123,900	-3%	35,000	0%
2011	125,800	-1%	33,500	-2%
2012	124,700	-2%	33,300	-6%
2013	127,100	0%	37,300	-7%
2014	128,900	1%	38,200	4%
2015	130,700	3%	41,100	7%
2016	128,400	1%	42,600	15%
2017**	133,000	4%	40,400	19%

*Values in table have been rounded. **2017 value is January to April data only.

2.17. **Figure 2-3** and **Table 2-1** show that prior to construction, traffic levels on the M6 between Junction 3 and 3a experienced a dip through 2006 and 2007, and then slowly decreased from 2008 to 2011/12. During the construction period of this scheme (BBMM2), traffic levels remained consistent, suggesting that this did not considerably impact the strategic routing of traffic. Post-scheme, traffic levels have increased which supports the notion that more traffic has been drawn to the M6 following implementation of this scheme and the neighbouring smart motorway schemes (M6 junction 5 to 8, and 10a to 13). Since 2008, there has been between 1% and 4% increase in AWT on this section of the M6. This is broadly in line with the regional trends presented in **Figure 2-2.**

2.18. The M6 Toll is a strategic alternative to the M6 between junction 4 and 11a. **Figure 2-4** presents the long-term AWT for January 2008 to April 2017. **Table 2-1** shows the AAWT for 2008 to 2017, and the percentage change since 2008.

2.19. The M6 Toll has experienced an increase in traffic volumes in recent years, following a decrease between 2012 and 2013. Construction on the neighbouring smart motorway schemes started in January 2012, and since then there has been ongoing construction works for BBMM2, BBMM3 or M6 junction 10-13, until February 2017. This could explain the increase in traffic flows on the M6 Toll, as vehicles may use this route to avoid construction works elsewhere on the M6.

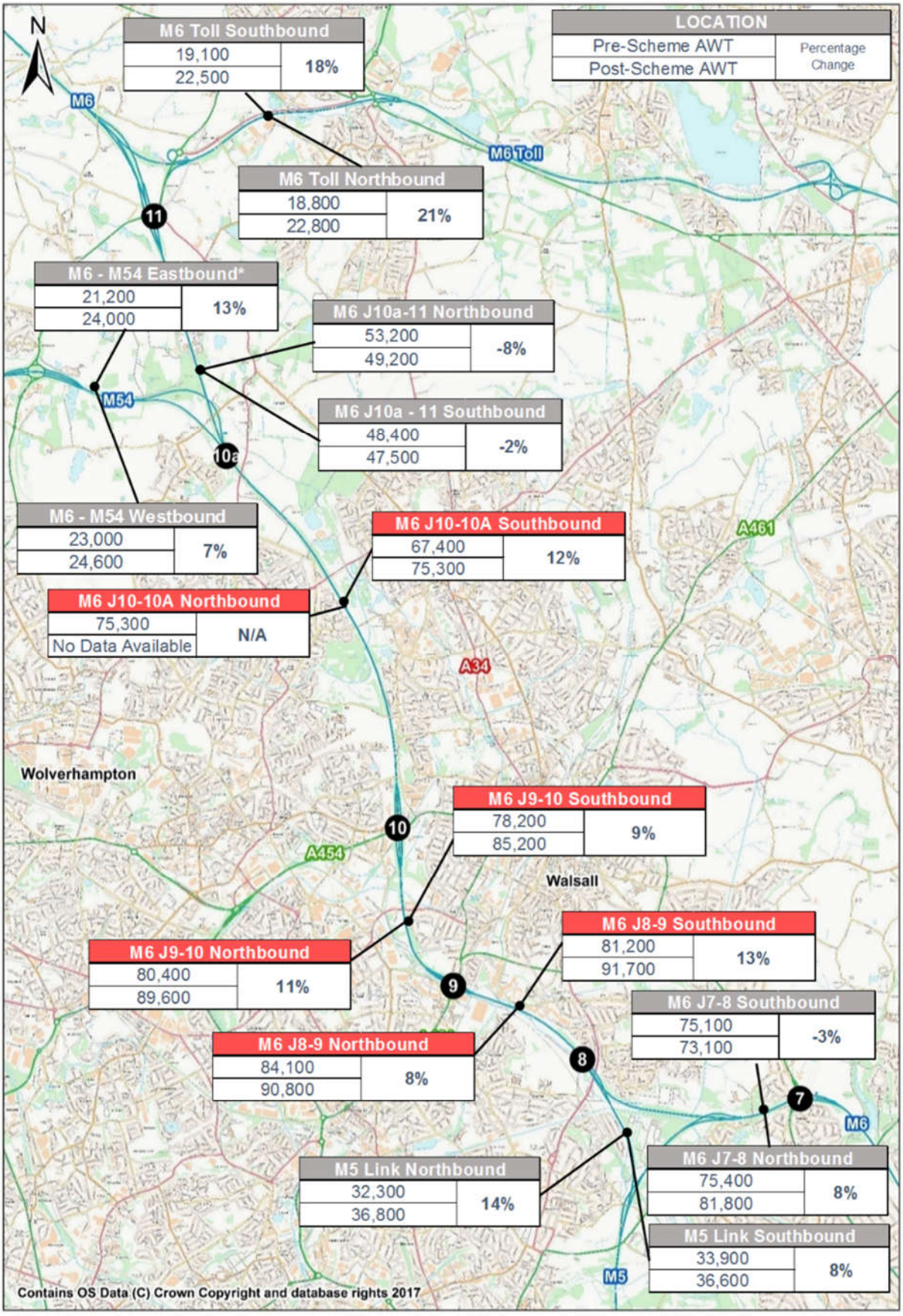
2.20. Traffic data from 2008 and 2017 will be used in this report to carry out an evaluation of the impact of the scheme. Based on the information presented in this section, it is reasonable to suppose that any changes in traffic flows more than the observed change of 5%, are as a result of the scheme, rather than background changes to traffic in the region.

Observed Traffic Flows

Scheme Section

2.21. **Figure 2-5** presents the average weekday traffic (AWT) for the scheme section and surrounding strategic highway network, by direction. The values presented in this figure have been rounded. The red boxes indicate the flows on the scheme section, and grey are those on wider motorway links.

Figure 2-5 Average Weekday Traffic - Scheme and Surrounding Strategic Network



2.22. The key observations to note from **Figure 2-5** are as follows:

M6 Scheme Section

- Traffic increases of between 8-13% have been observed on all sections and directions. Taking into account background growth of up to 5%, these results suggest that the scheme may have reassigned traffic onto the M6 in some locations.
- The greatest increase in traffic flows is observed between junctions 9 and 10 northbound (11%) and junctions 8 and 9 southbound (13%). On both sections, the traffic flow has increased by more than 9,000 vehicles per day (vpd). This is line with the findings from the OYA evaluation report.

Wider Motorway Links

- There has been a considerable increase between pre- and post-scheme opening on the M6 Toll, of more than 18% in both directions. This could be used as an alternative to the M6 between junction 4 and 10a. However, earlier analysis has shown that since 2011/2012 there has been a gradual increase in traffic volumes on this route.
- North of the scheme section, there has been a small decrease in traffic volumes on the M6, of between 2 and 8%. There has also been an increase in traffic levels on the M54, of 7% travelling eastbound and 13% travelling westbound.
- Between junction 7 and 8 in a southbound direction a 3% decrease has been observed but the reasons for this are unclear.
- Observed changes in traffic flow on the M6 scheme section cannot be accounted for by changes to the strategic road network alone. Therefore, they may be affected by changes to local traffic movements in the vicinity of the scheme.

Local Roads

2.23. **Figure 2-5** shows that the observed changes in traffic cannot be explained by changes to the strategic highway network alone, as explained above.

2.24. At OYA, analysis was not carried out the understand the precise nature of these changes due to difficulties obtaining local traffic data which was free of the impact of construction periods for neighbouring schemes, and due to local traffic patterns being likely to change as a result of other highway improvement schemes.

2.25. Analysis of traffic count data for a number of local roads surrounding junction 9 and 10 has been conducted as part of this FYA evaluation report, between 2007 and 2017. This data has been sourced from SPECTRUM, a database that collates traffic counts conducted by local authorities. The traffic data available from SPECTRUM was only available for one week of data every two years. This analysis did not show a consistent pattern of change between 2007 and 2017. Based on this information and the limitations of the database, it is not considered that this data provides sufficient evidence to draw a robust and valid conclusion as to how local traffic flows have changed in the vicinity of the scheme.

2.26. There was insufficient data available for pre- and post-scheme on WebTRIS for the on/off slips at these junctions to use this data as an alternative.

Scheme Section Hourly Flows

2.27. As discussed earlier in the report, the scheme is not active all the time, and is only put into operation when the traffic conditions require it to provide additional capacity. As such, this section considers the temporal distribution of the traffic flow increases described above.

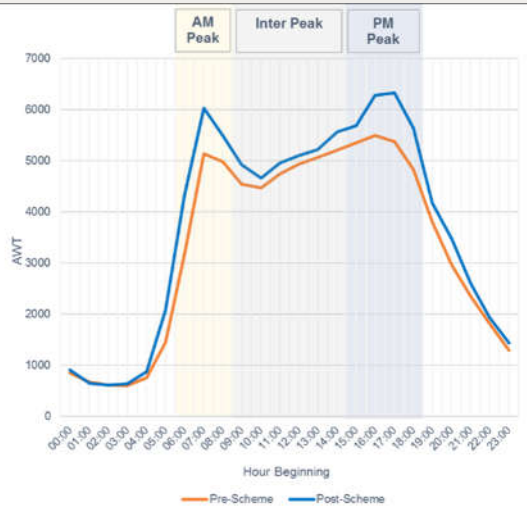
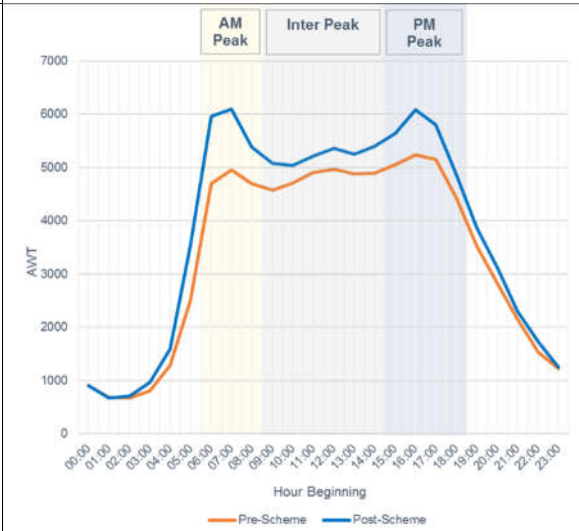
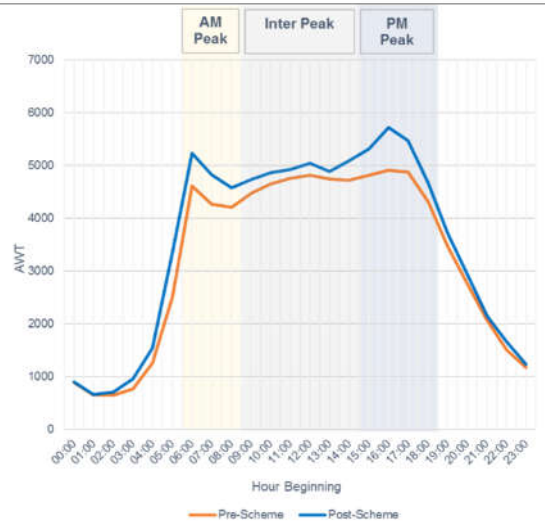
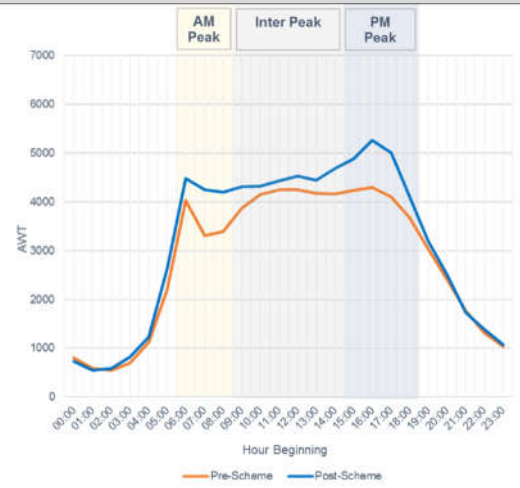
2.28. **Table 2-2** presents the average weekday profiles for pre- and post-scheme, by direction and scheme section. As previously discussed, due to issues surrounding data availability, the profile for junction 10-10a northbound has not been presented. For these graphs, the key observations to note are as follows:

- Pre-scheme, traffic flows were highest during the AM and PM peak periods, which are understood to have experienced the most congestion prior to the introduction of the scheme. These peak periods are more-well defined, with clearer definition between the AM,

Inter Peak and PM peak periods. In general, the largest increases post-scheme have been observed during the AM and PM peak periods, with smaller increases during the Inter Peak. In addition, there is no strong tidality observed, pre- or post-scheme. These changes are in line with those observed at the OYA evaluation stage.

- Between junction 8 and 9, the flows are balanced between the AM and PM peak, whereas between junctions 9 and 10a the traffic flows in both directions are higher during the PM peak than the AM peak.
- There have been minimal changes observed overnight, where the traffic flows are lower and the scheme is less likely to be in operation.

Table 2-2 Hourly Flows on the M6

	M6 Junction 8 to 9	M6 Junction 9 to 10	M6 Junction 10 to 10a
Northbound			
Southbound			

Forecast Traffic Flows

2.29. To ascertain the accuracy of forecasts made during the pre-scheme appraisal process, modelled forecast flows have been compared with observed flows. As part of the pre-scheme appraisal process for the scheme, traffic flows for the without ATM (Do Minimum [DM]) and with ATM (Do Something [DS]) scenarios have been calculated. The DM scenario provides traffic flows had the scheme not been implemented, conversely, the DS scenario reflects traffic flows following scheme implementation.

2.30. The DM network was based on the PRISM base year model for 2001 updated to include a number of network changes which were known to have been implemented as well as interventions that were '*committed or provisionally committed'* to be implemented by 2021 in the West Midlands Local Transport Plan (LTP). The assumed land use development (population and employment are in line with DfT's TEMPRO projects at a WM region level. Within the WM region, the distribution is taken from the Regional Spatial Strategy (RSS) information. This ensures consistency with national forecasts, but also local level detail in growth forecasts.

2.31. At the appraisal stage, the traffic forecasts were produced from the 2006 Base West Midlands Policy Responsive Integrated Strategy Model (PRISM) for two future years, 2016 and 2026.

2.32. The forecast traffic flows have been reproduced from the Birmingham Box Active Traffic Management Phases 1 and 2: Modelling of the Impact of Roll Out (March 2009). This document also provides details of the assumptions used in the forecasting. Although the appraisal considered both BBMM1 and BBMM2 together, the traffic impacts of the scheme are remote and therefore the appraisal presents these separately. This document is a revision of the initial traffic forecasting with forecast years of 2016 and 2026.

Forecasting Assumptions

2.33. In order to explain any potential differences between observed and forecast flows, it is key to develop an understanding of any assumptions made in the appraisal process.

2.34. In the DS scenario, the BBMM2 HSR scheme was modelled by assuming that there was a higher capacity on the M6 for the length of the scheme. This was assumed to be a 14% capacity increase, with sensitivity tests for 7% and 23% also modelled. A 14% increase on a 3-lane section was assumed to equate to DS capacity of 5,700vph, and on a 4-lane section to equate to 6,500vph. The previous business case (2007 Productivity TIF) assumed an increase of 23%, which was lowered for the final stages of appraisal following observed increases on the M42 ATM pilot and discussions with the Highways England Project Manager. The modelling assumed that link with ATM and CM would have a speed limit of 60mph, as advised by Highways England.

2.35. Due to the operational managed nature of hard shoulder running, the scheme is only utilised as necessitated by traffic conditions. Forecasting was produced for all time periods (AM, Inter Peak, PM and Off Peak), even though the scheme was assumed to be operational in the AM and PM periods only. The following time periods were used:

- AM Peak (07:00 – 08:00)
- PM Peak (17:00 – 18:00)
- Inter Peak (Average hour between 09:30 – 15:30)
- Off Peak (Average hour between of 19:00 – 07:00)

2.36. The observed traffic flows presented earlier in this chapter show that the impact of the scheme extends beyond the assumed AM and PM peak periods. The forecasting showed the impact of the scheme in the off peak to result in '*insignificant'* impacts.

2.37. The without ATM network was formed based on a number of approved schemes in the local area, which were included as part of the 2016 and 2026 future year networks. It is understood that at the time of writing this report, these schemes have all been successfully implemented.

Forecast vs. Outturn Traffic Flows

2.38. This section presents a comparison between forecast and observed traffic flows for the AM peak, inter peak and PM peak periods, as shown in **Table 2-3** to **Table 2-5** . These are based on the time periods used in the forecasting and detailed above, apart from the Inter Peak which takes an average of (10:00 – 16:00). This is due to the hourly intervals at which traffic data is available at. The off-peak period has not been considered in this analysis. OYA flows have been presented for junction 10 to 10a for comparison purposes.

Table 2-3 AM Peak Forecast and Outturn Traffic Impacts (07:00 – 08:00)

		Forecast				Observed			
		DM	DS	DS-DM	% Change	2008	2017	2017-2008	% Change
J8-9	NB	5,100	5,800	700	12%	5,500	6,000	500	8%
	SB	5,100	5,800	700	12%	5,000	6,100	1,100	18%
J9-10	NB	5,100	5,800	700	12%	5,200	6,000	800	13%
	SB	5,200	5,700	500	10%	4,300	4,800	500	10%
J10-10a	NB	5,100	5,700	600	11%	4,600	5,100*	500*	11%*
	SB	5,000	5,300	300	5%	3,300	4,200	900	21%

*Based values from OYA report (2011/2012) due to data availability issues at FYA

Table 2-4 Inter Peak Forecast and Outturn Traffic Impacts (Average of 10:00 – 16:00[9])

		Forecast				Observed			
		DM	DS	DS-DM	% Change	2008	2017	2017-2008	% Change
J8-9	NB	5,100	5,100	0	1%	5,200	5,300	100	2%
	SB	5,100	5,100	0	0%	4,900	5,300	400	8%
J9-10	NB	5,100	5,100	0	0%	5,000	5,300	300	6%
	SB	5,100	5,100	0	0%	4,800	5,000	200	4%
J10-10a	NB	5,000	5,000	0	0%	4,600	4,700*	100*	3%*
	SB	5,100	5,100	0	0%	4,200	4,500	300	7%

*Based values from OYA report (2011/2012) due to data availability issues at FYA

Table 2-5 PM Peak Forecast and Outturn Traffic Impacts (17:00 – 18:00)

		Forecast				Observed			
		DM	DS	DS-DM	% Change	2008	2017	2017-2008	% Change
J8-9	NB	4,800	5,400	600	12%	5,200	6,100	900	15%
	SB	5,200	6,000	800	13%	5,100	5,800	700	12%
J9-10	NB	5,100	5,800	700	12%	5,400	6,300	900	14%
	SB	5,400	5,700	300	6%	4,900	5,500	600	11%
J10-10a	NB	5,100	5,800	700	12%	5,400	5,500*	100*	2%*
	SB	5,400	5,600	200	5%	4,100	5,000	900	18%

*Based values from OYA report (2011/2012) due to data availability issues at FYA

2.39. **Table 2-3** to **Table 2-5** show that the average observed flow increases between the AM, PM and Inter Peak periods varies between 2 and 21%. The average of percentage flow increases along the length of the scheme and all time periods is 11% which is slightly below the capacity

[9] This varies from the time periods presented in the forecasting due to the intervals at which data was available.

increase which was forecasts as a result of the M42 ATM Pilot which assumed a 14% increase. There are some observations which stand out, as follows:

- At junction 10 to 10a southbound an increase of 21% has been observed in the AM peak and an increase of 18% in the PM peak. Travelling southbound, this section typically has the lowest flows and so the same increase in number of vehicles results in a higher percentage increase.
- There has been a larger increase in observed traffic flows during the AM and PM peak periods, than the Inter Peak. It was forecast for there to be no change in traffic flows during the Inter Peak, but observed data shows that there had been an increase of between 2 and 8% across the scheme section.

Table 2-6 Forecast vs. Observed Traffic Flows

		AM Peak		Inter Peak		PM Peak	
		DM-2008	DS-2017	DM-2008	DS-2017	DM-2008	DS-2017
J8-9	NB	8%	3%	2%	4%	8%	13%
	SB	-2%	5%	-4%	4%	-2%	-3%
J9-10	NB	2%	3%	-2%	4%	6%	9%
	SB	-17%	-16%	-6%	-2%	-9%	-4%
J10-10a	NB	-10%	-11%*	-8%	-6%*	8%	-5%*
	SB	-34%	-21%	-18%	-12%	-24%	-11%

*Based values from OYA report (2011/2012) due to data availability issues at FYA

2.40. **Table 2-6** compares the DM and pre-scheme flows, and DS and post-scheme flows. A negative value indicates that the observed values are lower than those forecast. Those with more, or less than 10% difference are highlighted. The key findings are as follows:

- The largest disparity between observed and forecast values is for junction 10 to 10a southbound. In the forecast, this section had the lowest flows, which is also reflected in the observed traffic flow data, so the same increase in the number of vehicles results in a higher percentage increase. Nevertheless, the observed values for pre- and post-scheme are much lower than those forecast for both DM and DS in all time periods.
- The scheme has had a larger scale of impact during the inter peak (between 2% and 18%) than expected on all sections, but in particular between junctions 10 and 10a, southbound. An average weekday flow increase of 5% was observed which suggests that the scheme should have considered the likelihood of the scheme being utilised in the inter peak period. Guidance now recommends the use of the IFRIIT (Initial and Full Responsive Intervention Investment Tool)[10] spreadsheet, which considers the traffic flow profile across the year and uses this to determine the number of hours a year that the scheme is likely to be switched on. This uses observed data.

2.41. In summary, the larger differences in forecast and observed traffic flows could be caused by a range of factors, not limited to but including not forecasting the use of the scheme during the inter peak period, the local routeing, the economic climate and reassignment of traffic from other routes.

Scheme Utilisation

2.42. This section presents analysis of Halogen and MIDAS data for post-scheme opening to enable understanding of the utilisation and operation of the scheme.

[10] Interim advice note 159/12 Guidance Note for Traffic Consultants on the Economic Assessment of MM-HSR schemes.

2.43. The scheme utilisation discussed in this section only considers the length of time which the scheme was switched on/Hard Shoulder is open, and does not consider the level of traffic using the hard shoulder. This is considered in the following section. When the hard shoulder is switched on, the M6 between junction 8 and 10a has a greater capacity. This allows more traffic to use this section of the motorway. Analysis presented earlier in the report shows that the volume of traffic on the M6 has increased between pre- and post-scheme.

2.44. Increased traffic on the M6 affects the economic and agglomeration benefits of the scheme. These benefits should be balanced out against the journey time impact of the lower speed limit that is enforced whilst the HSR is in operation. In terms of economics, it is more efficient to have HSR on for longer periods rather than more frequent shorter periods. This is because there is an operational cost of switching the HSR on and off.

Smart Motorway Operation (Halogen Data)

2.45. Halogen data provides information about how often the Hard Shoulder Running (HSR) was in operation for a specific time-period and what speed limits were set.

2.46. **Figure 2-6** overleaf, presents the utilisation of the scheme for an average weekday in March 2017. These graphs are for the Hard Shoulder, and so for any given hour (06:00 – 19:00) the bars show the percentage of time for which the HSR is switched on and the percentage of time for which each speed limit is enforced. For example, between junction 10 and 10a northbound, 07:00 – 08:00, the HSR is switched on for 90% of the time, or approximately 54 minutes in every hour. Of the time that HSR is switched on, in every hour 6% of the time a speed limit of 40mph is enforced, 28% of the time a 50mph speed limit is enforced and 56% of the time a 60mph speed limit is enforced.

2.47. From **Figure 2-6,** we can see that between junctions 8 and 9, in both directions, the HSR is in operation for over 90% of the time in all hour periods, apart from 06:00 to 07:00. During the AM and PM peak periods, a speed limit of 50mph is enforced for the majority of the time.

2.48. Between junctions 9 and 10, HSR is also in operation for more than 90% of each hour, apart from between 06:00 and 07:00. **Figure 2-6** shows that in general, a lower speed limit is enforced southbound compared to northbound, in particular during the AM and PM peak periods.

2.49. Between junctions 10 and 10a, HSR is not in operation as frequently as other scheme sections, in particular during the Inter Peak period. Northbound, the highest utilisation of HSR is during the AM and PM peak periods (aside from 06:00 to 07:00), with all hour periods reporting over 90% utilisation of HSR. Southbound, use of HSR is lower during the AM peak, with highest utilisation reported during the PM peak. Similarly, to between junction 9 and 10, lower speeds are typically enforced southbound.

2.50. The scheme appraisal assumed that the scheme would only be in operation during the AM and PM peak periods, and that during these times HSR would have 100% utilisation. Note, that during the forecasting, the AM peak was assumed to be 07:00 to 08:00 and the PM peak was assumed to be 17:00 – 18:00. **Figure 2-6** shows there is a consistently high degree of scheme utilisation during the AM and PM peak periods (especially the AM peak). Although not operational for 100% of the time, it is consistently above 95% during these time periods for all sections and directions, apart from junction 10 to 10a southbound in the AM peak. **Table 2-6** shows that this route and time-period had the largest difference between forecast and observed traffic flows. This suggests that the traffic flows, which were lower than observed, are not high enough for the HSR to be activated.

2.51. As noted in the OYA evaluation, since scheme appraisal Highways England have released a spreadsheet based tool known as IFRIIT which calculates the annualization factors for forecast years to determine how much an HSR scheme would be used.

2.52. **Figure 2-6** also shows the percentage of time for which certain speed limits were in place whilst the hard shoulder was open. In general, lower speed limits were displayed on the

southbound, than the northbound carriageway, especially between junction 10 and 10a and 9 and 10. More specific observations are drawn as follows:

- For junction 10 to 10a, for the majority of the time the hard shoulder was open and a 60mph speed limit was displayed, apart from southbound during the AM peak where 40mph was displayed for approximately 66% of the time.
- For junction 9 to 10, northbound, a speed limit of 60mph was displayed for the majority of the time, apart from during the PM peak, where a 50mph speed limit was displayed for approximately 69% of the time. Southbound, speed limits of 40mph were displayed for the majority of the AM and PM peak, whereas during the inter peak it was mostly displayed as 60mph.
- For junction 8 to 9 in both directions, for the majority of the AM and PM peak periods the hard shoulder was open a 50mph speed limit was displayed.

2.53. The directions and time periods which have the highest use of hard shoulder and lowest speed limits displayed, correlate with the sections which have the highest observed traffic flows.

Flows and speeds by Lane (MIDAS Data)

2.54. MIDAS data provides traffic flows and spot speeds, by lane, to understand the operational aspects of the scheme. Graphs showing how traffic flows and speeds vary by lane and time-period are shown overleaf in **Figure 2-7** and **Figure 2-8**, respectively. Where there is a break in the hard shoulder line, this represents there being no hard shoulder lane provided.

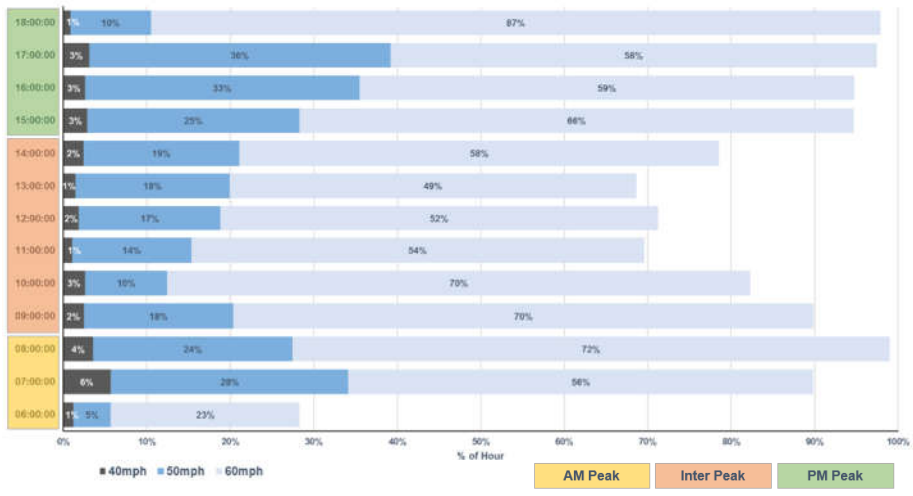
2.55. The time periods used in this analysis match those used in the journey time analysis section of this report, as follows:

- AM Peak (06:00 – 09:00)
- Inter Peak (09:00 – 15:00)
- PM Peak (15:00 – 19:00)

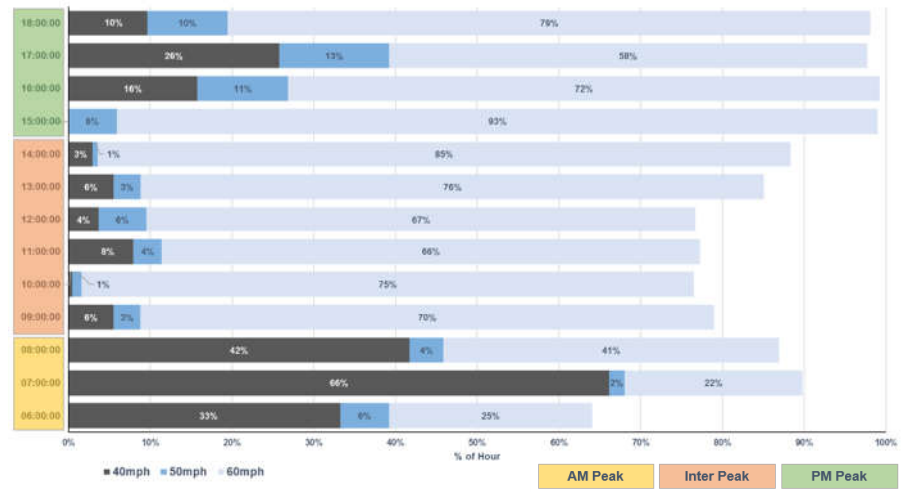
2.56. Analysis of lane by lane flows for the M6 between junction 8 and 10a show the following:

- Northbound, use of the hard shoulder increases up to junction 10 and 10a, in all time periods and directions, reflecting the use of the hard shoulder by vehicles leaving the motorway at junction 10 and 10a. This also reflects the information presented in **Figure 2-7** showing that this section also has the lowest utilisation of HSR, in particular during the AM and Inter Peak periods.
- Use of the southbound hard shoulder also increases between junction 9 and 8, reflecting the use of the hard shoulder by vehicles leaving the M6 onto the M5 at junction 8. These periods also have the highest utilisation of HSR as shown in **Figure 2-7.**
- Northbound, lanes 2 and 3 consistently carry the highest volume of traffic until between junction 10 and 10a. On the approach to the junction 10a off-slip volumes of traffic on the hard shoulder increase.
- Southbound, between junction 10 and 10a, lane 1 has the highest flow. On the approach to the junction 10 off-slip traffic flows on the hard shoulder increase, and total traffic flow drops.

Figure 2-6 HSR Utilisation (Monday – Friday)

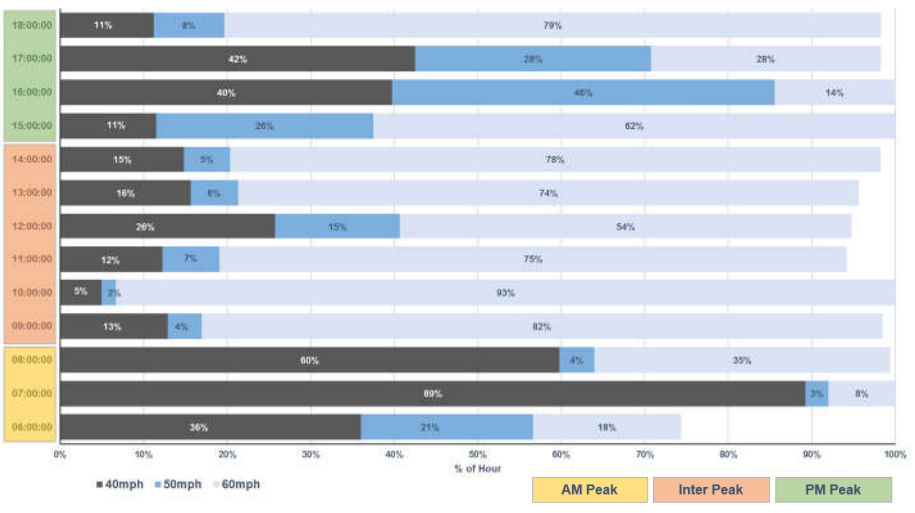


Junction 10 to 10a Northbound

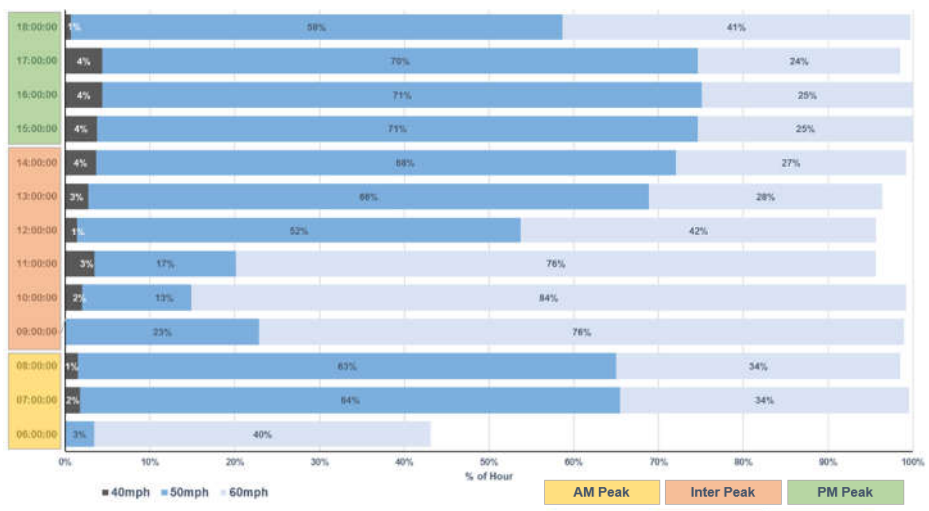


Junction 10 to 10a Southbound

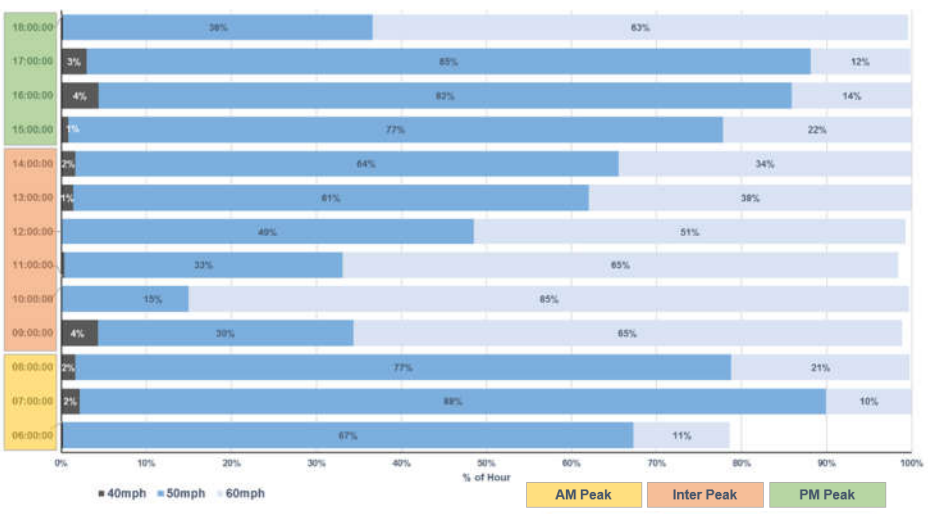
Junction 9 to 10 Northbound



Junction 9 to 10 Southbound



Junction 8 to 9 Northbound



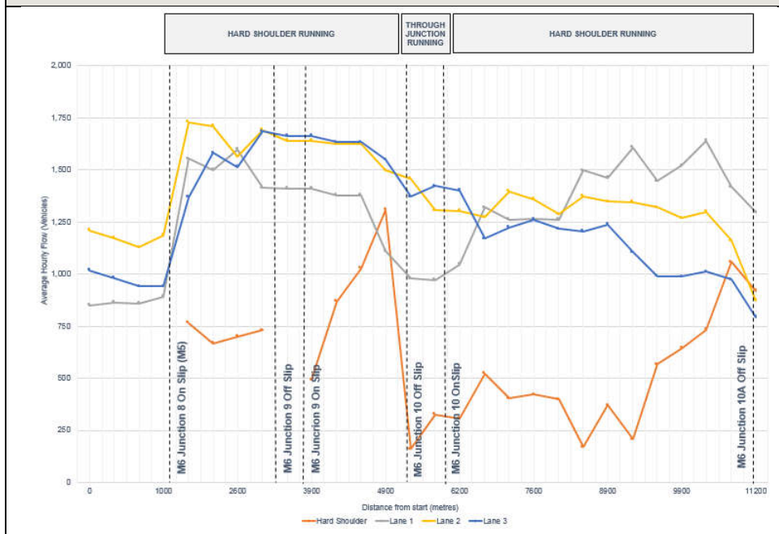
Junction 8 to 9 Southbound

2.57. Analysis of spot speeds for the M6 between junction 8 and 10a show the following:

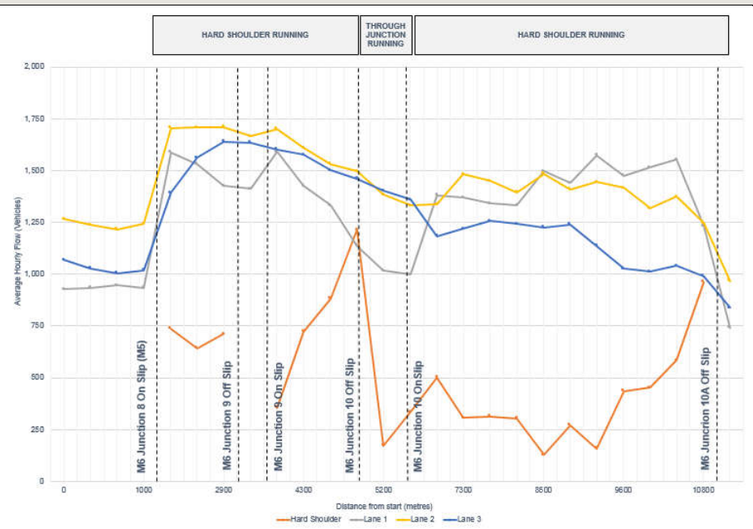
- In all time periods, speeds in both directions remain below 60mph. **Figure 2-8** shows that for the majority time between junction 8 and 10, HSR is in operation, and therefore the speed is restricted to 60mph. Typically, the hard shoulder has the lowest speeds and lane 3 has the highest speeds.
- Southbound, during the PM and Inter Peak, speeds in all lanes are generally decreasing until after junction 9 on slip, and then increase up to junction 8. **Figure 2-8** shows that southbound between junction 10a and 9 there are lower enforced speed limits which explains these observations.
- For each lane, the lowest speeds generally occur at the times with the highest flow. In the AM Peak, speeds reduce at a faster rate to a lower speed than in other time periods.
- Northbound, during the PM and Inter Peak, speeds generally increase after the M5 on-slip at junction 8, with similar speeds recorded in the hard shoulder and lane 1.

Figure 2-7 Lane by Lane Average Hourly Flow by Direction (MIDAS)

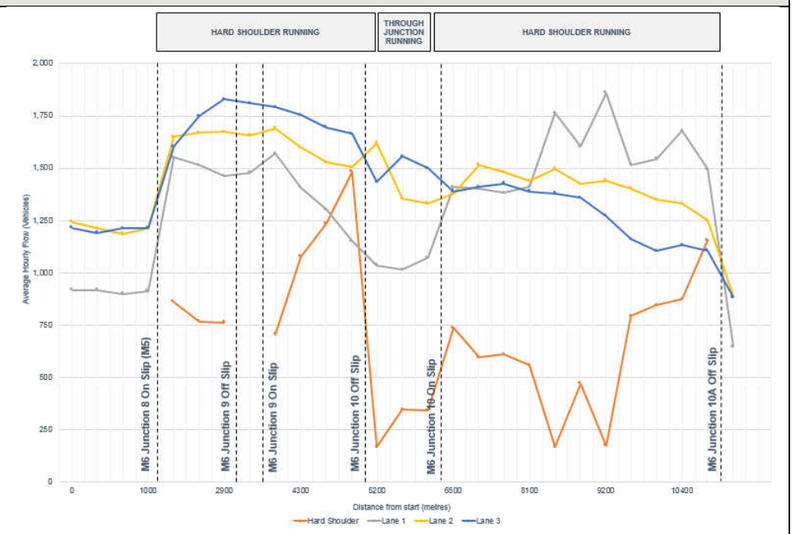
AM Peak (06:00 – 09:00) M6 Junction 8 to 10a (Northbound)



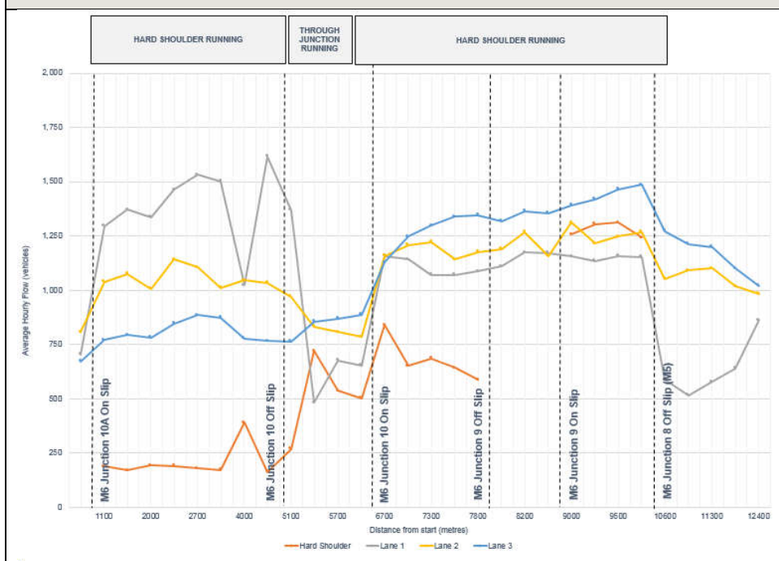
Inter Peak (09:00 – 15:00) M6 Junction 8 to 10a (Northbound)



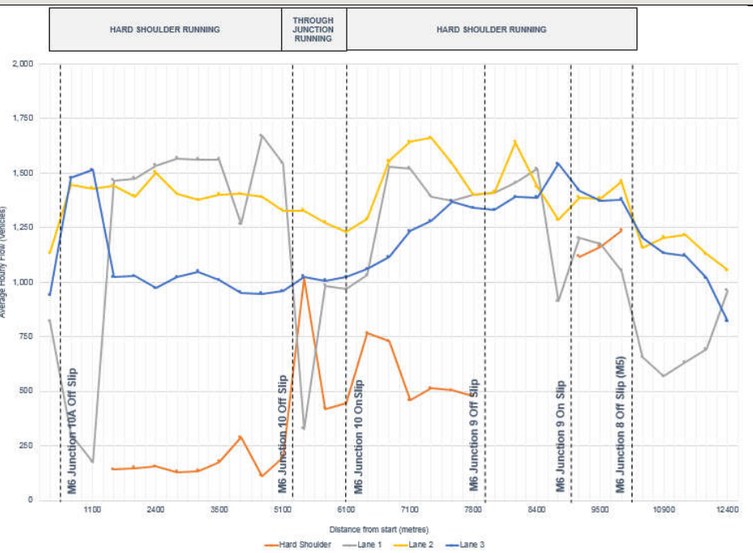
PM Peak (15:00 – 19:00) M6 Junction 8 to 10a (Northbound)



AM Peak (06:00 – 09:00) M6 Junction 10a to 8 (Southbound)



Inter Peak (09:00 – 15:00) M6 Junction 10a to 8 (Southbound)



PM Peak (15:00 – 19:00) M6 Junction 10a to 8 (Southbound)

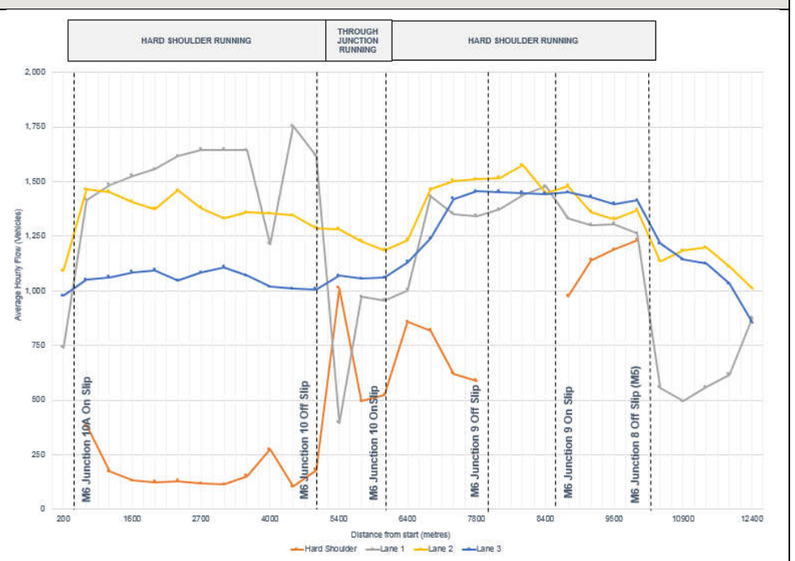
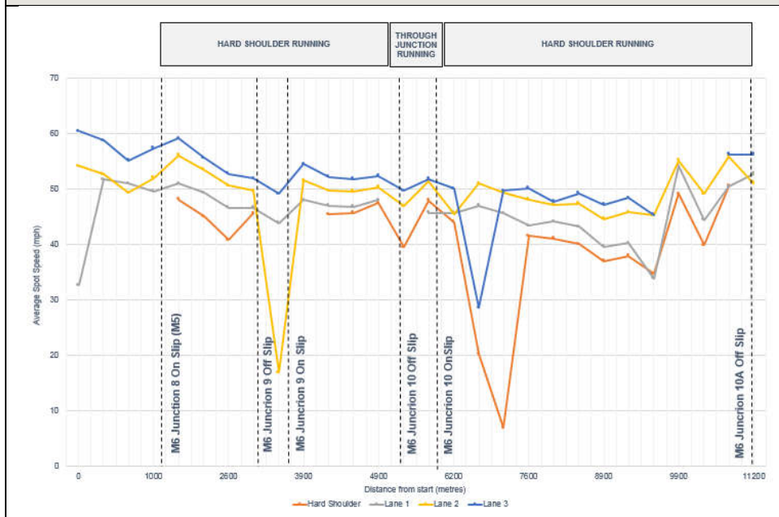
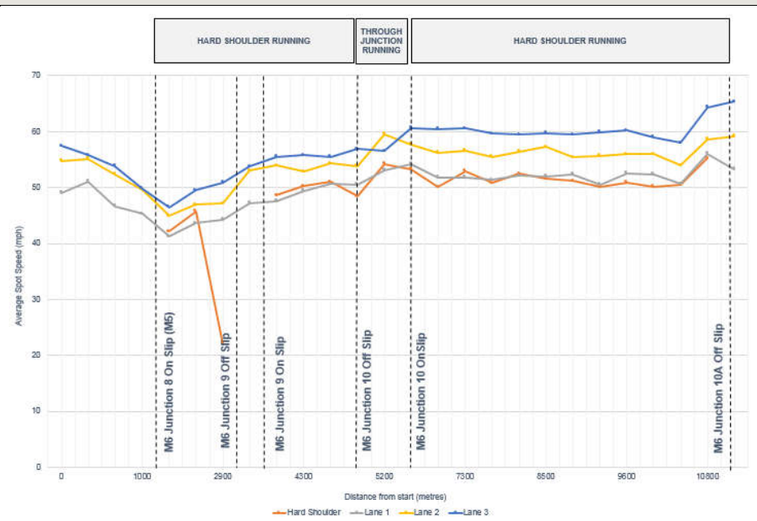


Figure 2-8 Lane by Lane Spot Speeds by Direction (MIDAS)

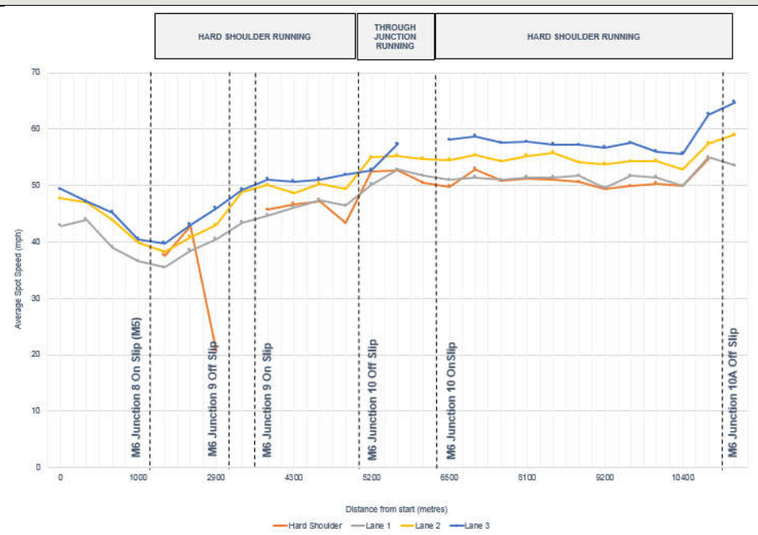
AM Peak (06:00 – 09:00) M6 Junction 8 to 10a (Northbound)



Interpeak (09:00 – 15:00) M6 Junction 8 to 10a (Northbound)

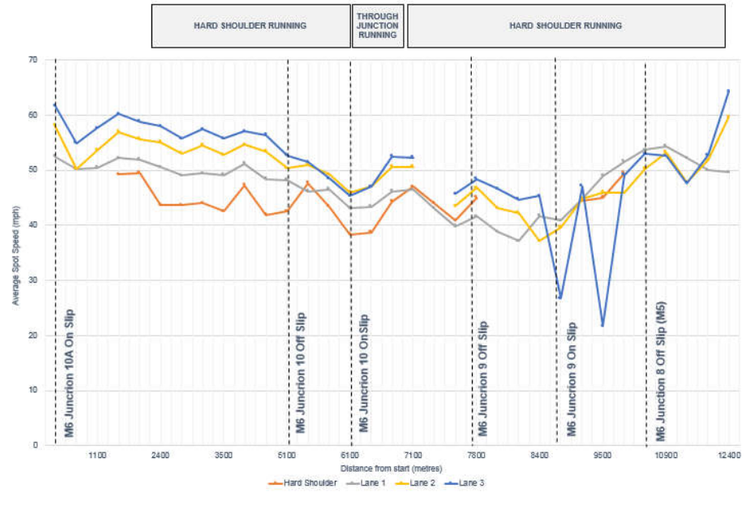


PM Peak (15:00 – 19:00) M6 Junction 8 to 10a (Northbound)

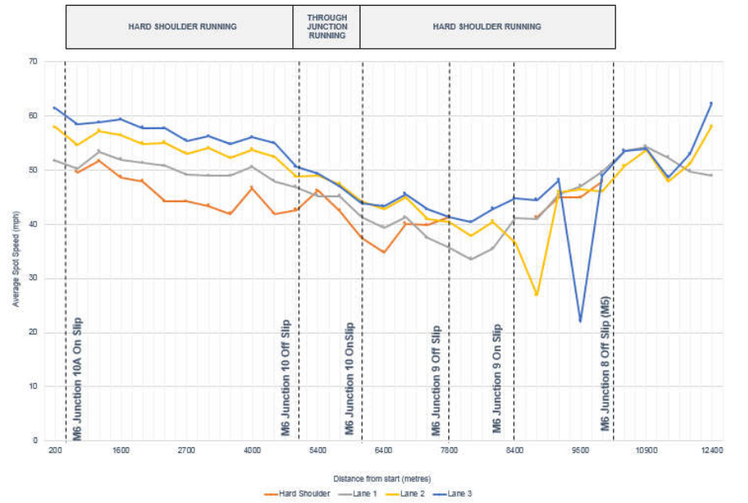


AM Peak (06:00 – 09:00) M6 Junction 10a to 8 (Southbound)

Interpeak (09:00 – 15:00) M6 Junction 10a to 8 (Southbound)



PM Peak (15:00 – 19:00) M6 Junction 10a to 8 (Southbound)



Journey Times

2.58. This section of the report considers the impact of the scheme on journey times along the length of the scheme. The analysis compares the differences in journey time between M6 junction 8 and 10a, pre- and post-scheme. These journey times are also compared to the forecast journey time impacts.

2.59. Journey times have been collected for the following time periods:

- Weekday AM Peak (06:00 – 09:00)
- Inter Peak (i), Monday to Friday (09:00 – 11:30)
- Inter Peak (ii), Monday to Thursday (11:30 – 15:00)
- Inter Peak (iii), Friday (11:30 – 15:00)
- Weekday PM (15:00 – 19:00)

2.60. This analysis focusses on journey times during the Weekday AM Peak (AM), Monday to Thursday Inter Peak (IP M-T), Friday Inter Peak (IP (F)) and Weekday PM Peak (PM).

Speed Analysis

2.61. **Figure 2-9** presents that pre- and post-scheme speeds (kph) by direction for the AM and PM peaks. It shows that the scheme has generally improved traffic speeds along the length of the scheme, with a few exceptions, for example between junction 10 and 10a during the AM and PM Peak (northbound). This is because the scheme is a managed motorway, which manages and reduces congestion by applying variable speed limits to make traffic speeds more uniform. This reduces stop and go traffic. Taking into consideration the Halogen analysis presented earlier in this section, the southbound carriageway in general has a lower speed limit enforced for a higher percentage of the time (compared to northbound). It is the southbound carriageway which also consistently has a higher speed post-scheme than pre-scheme. This suggests that the VMSL is effectively managing the speeds, making traffic speeds more uniform rather than stop and go traffic. This conclusion is in line with that drawn as part of the OYA evaluation.

2.62. **Table 2-7** and **Table 2-8** present the traffic speeds for the mainline M6, with a comparison between pre- and post-scheme. A negative value in the '*change'* rows indicates a decrease in speeds.

Table 2-7 Average Speeds (kph) Northbound[11]

Scenario	Time Period	J8-9	Through J9	J9-10	Through J10	J10-10a	Average
Pre-Scheme	AM	75	86	85	99	98	89
	IP (M-T)	76	88	88	97	97	89
	IP(F)	62	77	79	90	91	80
	PM	57	66	70	81	87	72
Post-Scheme	AM	78	85	84	85	87	84
	IP (M-T)	76	84	85	90	85	84
	IP(F)	63	79	83	87	83	79
	PM	67	76	77	84	77	76
Change	AM	3	-1	-1	-14	-12	-5
	IP (M-T)	0	-4	-3	-7	-13	-5
	IP(F)	1	2	4	-3	-9	-1
	PM	10	10	7	3	-10	4

[11] Note – 60mph is approximately 97kph.

Scenario	Time Period	J8-9	Through J9	J9-10	Through J10	J10-10a	Average
	AM	4%	-1%	-1%	-14%	-12%	-6%
	IP (M-T)	0%	-4%	-4%	-7%	-13%	-6%
	IP(F)	2%	2%	5%	-3%	-9%	-1%
% Change	PM	17%	16%	10%	4%	-11%	6%

Table 2-8 Average Speeds (kph) Southbound[12]

Scenario	Time Period	J8-9	Through J9	J9-10	Through J10	J10-10a	Average
	AM	63	41	38	30	36	42
	IP (M-T)	74	64	68	69	82	71
	IP(F)	67	47	48	43	50	51
Pre-Scheme	PM	71	56	58	55	68	62
	AM	69	47	40	30	46	46
	IP (M-T)	79	73	77	82	89	80
	IP(F)	75	59	54	55	85	65
Post-Scheme	PM	76	64	63	62	78	69
	AM	7	6	2	0	10	5
	IP (M-T)	4	10	9	13	7	9
	IP(F)	8	12	6	12	35	15
Change	PM	5	8	4	7	10	7
	AM	11%	14%	5%	1%	28%	12%
	IP (M-T)	5%	15%	14%	19%	9%	12%
	IP(F)	12%	25%	12%	29%	69%	28%
% Change	PM	6%	15%	8%	12%	15%	11%

2.63. From **Table 2-7** and **Table 2-8** we can draw the following observations:

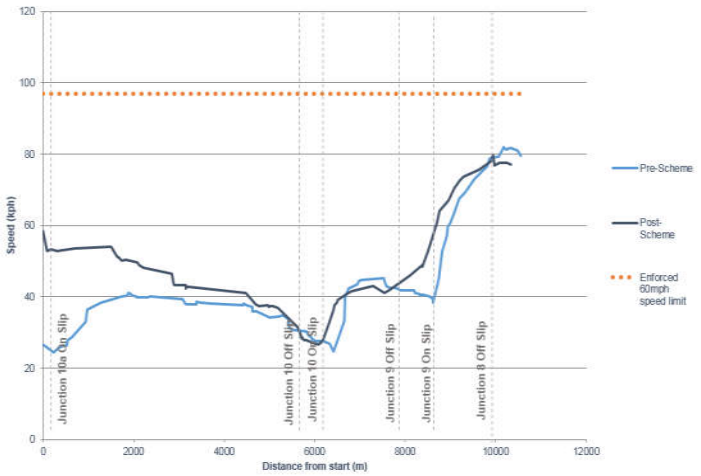
- **Southbound -** In general, an increase in speeds has been observed in the southbound direction. Findings by time-period and scheme section are summarised below.
  - During the AM Peak, speeds have increased between 1% (through junction 10) and 28% (junction 10 to 10a). **Figure 2-9** shows that during the AM Peak, pre-scheme were lowest between junction 10 to 10a. This indicates that there was likely to have been congestion on this section pre-scheme, so the use of HSR and VMSL will manage the flow of the traffic, resulting in an increase in speeds on this section.
  - Inter Peak (Monday to Thursday) and during the PM Peak, a similar level of journey time savings have also been observed, approximately 12% across the whole section. The largest saving has been observed between junction 9 and 10 in both time periods. Earlier analysis has demonstrated that this section of the scheme has amongst the lowest enforced speeds. This shows that the utilisation VMSL and HSR on this section has effectively managed traffic conditions and congestion, resulting in an increase in speeds.
  - It is during the Inter Peak (Friday) that the largest improvement in speeds have been observed. Across the scheme section, a 28% saving has been achieved. A 69% increase in speeds have been observed between junction 10 and 10a.

[12] Note – 60mph is approximately 97kph.

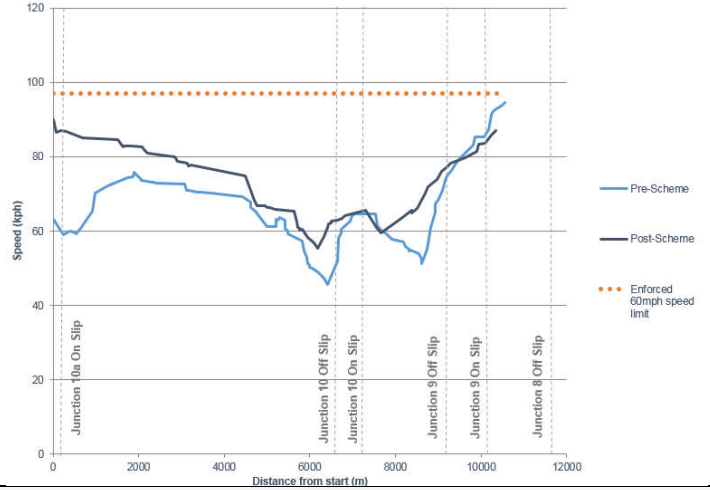
- **Northbound -** Analysis has shown that in general between pre- and post-scheme average speeds have decreased across the whole section. Findings by time-period and scheme section are summarised below.
  - During the AM Peak, the greatest decrease in speeds is observed through junction 10 (approximately 14%). Between junction 10 and 10a, a decrease of 12% has been observed. **Figure 2-9** showed that it is during this time-period and scheme section where the pre-scheme speeds were higher than post-scheme. Typically, on this section average pre-scheme speeds were above 60mph indicating free-flow traffic conditions. HSR, which has been shown to be in operation for a high percentage of the time, (over 90% of the time 07:00 – 09:00) enforces a speed limit lower than that which was travelled pre-scheme implementation.
  - In the Inter Peak (Monday to Thursday, and Friday) there has also been a decrease in speeds. On a Friday, a decrease has only been observed north of junction 9. Between junction 8 and 10, speeds have increased between 2% and 5%.
  - During the PM Peak, between junction 8 and 10 there has been an increase in speeds, of approximately 6% over the whole scheme section. A 16% increase in speeds were observed through junction 9. Between junction 10 to 10a, there has been a decrease in speeds observed.

2.64. These speeds are generally consistent with the trends shown in spot speed analysis presented in **Figure 2-8** and also with the findings at OYA.

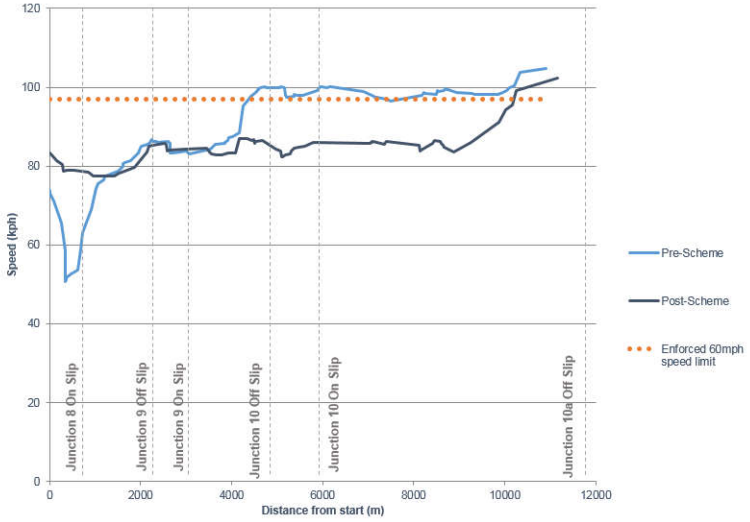
Figure 2-9 Average Speeds by Direction



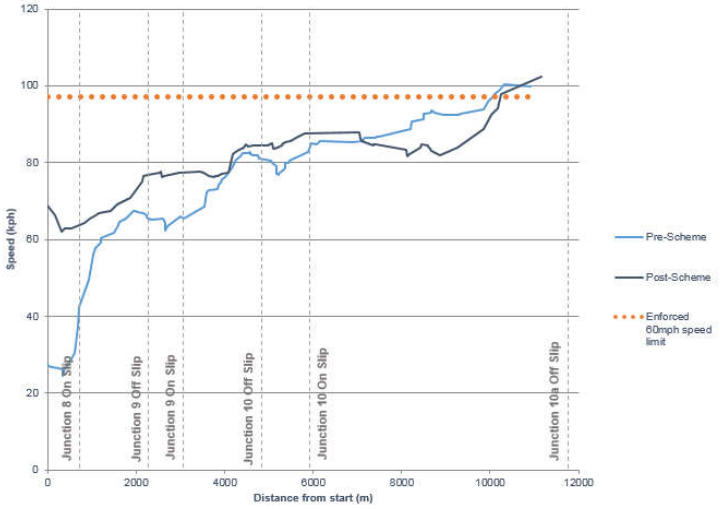
AM Peak Southbound



PM Peak Southbound



AM Peak Northbound



PM Peak Northbound

Journey Time Analysis

2.65. **Table 2-9** and **Table 2-10** present a comparison of journey times along the length of the scheme, by direction. A negative value in the '*change'* rows indicates a journey time saving has been achieved.

Table 2-9 Journey Times (seconds) Northbound

Scenario	Time Period*	J8-9	Through J9	J9-10	Through J10	J10-10a	Total
Pre-Scheme	AM	63	30	64	37	150	345
	IP (M-T)	63	29	62	38	151	343
	IP(F)	78	33	69	41	161	382
	PM	84	39	78	45	170	415
Post-Scheme	AM	68	28	67	46	207	416
	IP (M-T)	70	28	66	44	202	411
	IP(F)	85	30	68	45	208	436
	PM	79	31	73	47	208	439
Change	AM	4	-2	3	9	57	72
	IP (M-T)	7	-1	4	6	51	68
	IP(F)	7	-3	-1	4	47	54
	PM	-4	-8	-5	1	39	24
% Change	AM	7%	-5%	5%	24%	38%	21%
	IP (M-T)	11%	-2%	7%	15%	34%	20%
	IP(F)	9%	-9%	-1%	10%	29%	14%
	PM	-5%	-19%	-6%	3%	23%	6%

*M-T – refers to Monday to Thursday, F refers to Friday

Table 2-10 Journey Times (seconds) Southbound

Scenario	Time Period*	J8-9	Through J9	J9-10	Through J10	J10-10a	Total
Pre-Scheme	AM	81	66	151	107	535	939
	IP (M-T)	68	43	86	46	233	474
	IP(F)	76	58	121	74	381	709
	PM	71	48	100	57	280	556
Post-Scheme	AM	82	55	133	139	383	792
	IP (M-T)	73	35	70	50	196	424
	IP(F)	77	44	100	75	206	501
	PM	75	40	86	67	223	491
Change	AM	2	-11	-17	32	-152	-147
	IP (M-T)	5	-6	-16	5	-37	-50
	IP(F)	1	-14	-21	2	-175	-208
	PM	4	-8	-14	10	-57	-65
% Change	AM	2%	-17%	-12%	30%	-20%	-10%
	IP (M-T)	7%	-15%	-18%	11%	-8%	-7%
	IP(F)	1%	-24%	-17%	2%	-39%	-25%
	PM	6%	-17%	-14%	17%	-13%	-8%

*M-T – refers to Monday to Thursday, F refers to Friday

2.66. From **Table 2-9** and **Table 2-10** we can draw the following observations.

- **Southbound -** In general, there have been greater journey time savings for vehicles travelling southbound than northbound, which represents an improvement in traffic conditions. By time-period the findings/conclusions are as follows for southbound traffic:
  - In the AM Peak, across all sections journey times have improved by 10%, with the largest savings being observed between junction 10 to 10a (20% saving) and through junction 9 (17% saving). There have been small increases in journey time between junction 8 and 9 (2%) although through junction 10 journey times have increased by 30%. One of the objectives of the scheme was to improve congestion, and thereby improve the mobility of people and goods. This considerable decrease in journey times for journeys into Birmingham City Centre, demonstrates the extent to which the scheme has fulfilled this objective.
  - During the Inter Peak (both Monday to Thursday, and Friday), journey times have also improved, apart from between junction 8 and 9 and through junction 10. In general, larger journey time savings have been observed on a Friday than Monday to Thursday.
  - In the PM Peak, similar patterns have been observed to those in the AM Peak. The greatest journey time saving has been observed through junction 10 to 10a.
  - **Figure 2-9** shows that post-scheme speeds are higher than those observed pre-scheme. Earlier analysis has also shown that the scheme is in operation slightly more often southbound, than northbound, with lower enforced speed limits. This suggests that there is more congestion for vehicles travelling southbound than northbound, so this route is more likely to have greater journey time savings.
- **Northbound -** In general, a journey time dis-benefit has been observed for vehicles travelling northbound through the scheme section. By time-period, the findings/conclusions are as follows for northbound traffic:
  - During the AM Peak, across all sections, apart from through junction 9, a journey time dis-benefit has been observed. The greatest increase of 38% was observed between junction 10 and 10a. **Figure 2-9** showed that it is during this time period and scheme section where the pre-scheme speeds were higher than post-scheme. Typically, on this section average pre-scheme speeds were above 60mph indicating free-flow traffic conditions. HSR, which has been shown to be operation for a high percentage of the time, (over 90% of the time 07:00 – 09:00) enforces a speed limit lower than that which was travelled pre-scheme implementation, increasing journey times.
  - During the Inter Peak (both Monday to Thursday, and Friday), journey times have also increased, with the largest increase again being observed between junction 10 and 10a. In general, a larger increase in journey times has been observed on a Monday to Thursday, than Friday. This was not the case through junction 9, where a journey time decrease was observed.
  - In the PM Peak (on 3 of the 5 scheme sections), journey times have increased but not to the level observed in other time periods. Across the whole scheme section there has been an increase of approximately 6%, with a 23% increase between junction 10 to 10a. These increases in journey time can be attributed to the VMSL element of the scheme which has reduced mainline flow speeds, and therefore increased journey times.
  - Traffic statistics provided earlier in this report, show that there is consistently higher traffic volumes northbound than southbound during all time periods. The higher the volume of traffic, the more likely it is for HSR and VMSL to be switched on, enforcing a speed limit of 60mph. This can partly explain the increase in journey times northbound.

Forecast vs. Outturn Journey Times

2.67. The scheme appraisal used an operational model to determine journey time benefits. The model forecast a decrease in journey times in the southbound direction of 335 seconds in the AM peak and 30 seconds in the PM peak. In the northbound direction, increases in journey time of 100 seconds in both the AM and PM peak were forecast.

Table 2-11 Forecast and Outturn Journey Time Savings (seconds)

Change in Time (s)		Forecast	FYA Observed
AM Peak	NB	100	72
	SB	-335	-147
PM Peak	NB	100	24
	SB	-30	-65

2.68. **Table 2-11** presents the difference between forecast and outturn journey time savings. A negative number for forecast/observed values indicates a journey time saving, a positive number indicates an increase in journey time.

2.69. From **Table 2-11** we can draw the following conclusions:

- Northbound during the AM Peak, 72% of the journey time increase has been realised at outturn. This means that the observed journey time increase was lower than that forecast. Utilisation of the scheme is particularly high in this direction and time period, which explains this finding.
- Southbound during the AM Peak, 44% of the forecast decrease has been realised. This decrease in journey time is likely to be as a result of the lower speed limit enforced when the scheme is in operation, effectively managing the congestion on this section improving flow and traffic conditions. This may not have been realised to the level forecast as the scheme has not been in operation for 100% of the time, especially between junction 10 and 10a.
- Northbound, during the PM peak, 24% of the journey time saving has been realised at outturn.
- In the southbound direction during the PM peak, the forecast journey time saving has been achieved, by over twice that which was forecast. This suggests that the implementation of VMSL and HSR through the scheme has been effective at improving traffic conditions and managing traffic flow during the PM peak, southbound.

Journey Time Reliability

2.70. One of the key objectives of the scheme was to reduce congestion, which can be understood by evaluating the impact of the scheme on journey time reliability.

2.71. Reliability can be measured by understanding the degree of variability in journey times. It is also important to recognise that variability is primarily influenced by congestion caused by the volume of traffic on the scheme section, both of which are taken into consideration in this section.

2.72. Reliability can also be influenced by the occurrence of collisions and incidents. This will be taken into consideration in the next section of this report.

Journey Time Variability

2.73. The scheme appraisal stated that the introduction of ATM can impact both journey times and journey time variability, both on the scheme section and on adjacent non-motorway routes. It was forecast that the scheme would have a greater benefit to journey time reliability on the scheme section than adjacent non-motorway routes. This evaluation only considers the impact of the scheme on journey time variability on the scheme section itself. The appraisal only provided details of the monetised impact on journey time variability.

2.74. Satellite navigation data has been used to determine the average journey time variability along the route, and distribution of journey times by percentile ranges. **Figure 2-10** and **Figure 2-11** present this for northbound and southbound, respectively. This is presented for the whole

route, rather than splitting down into smaller sections. It is important to note that the scales on the graph for northbound and southbound are different.

2.75. From **Figure 2-10** and **Figure 2-11**, we can draw the following conclusions:

- There is much greater variation in journey times for vehicles travelling southbound, than northbound, especially during the weekday AM peak. This variation has been reduced post-scheme, but there is still more variation for vehicles travelling southbound.
- The interquartile range, 25th and 75th percentile has reduced for all time periods, apart from northbound during the weekday AM peak and weekday inter peak (M-T). This shows that there is less variation in the time it takes to traverse the scheme section, and therefore, that journey time reliability has improved. Travelling northbound, there is greater variation in journey times during the weekday inter peak (Friday) and weekday PM peak. Southbound, there is greater variation in journey times during the weekday AM peak than other time periods. This reflects that the time periods in which each direction experiences the highest traffic flows.
- The median (50th percentile) travel time has either reduced or remained consistent between pre- and post-scheme during all time periods, apart from Weekday Inter Peak (Monday to Thursday) northbound.

Figure 2-10 Northbound Journey Time Variability (M6 junction 8 to 10a)

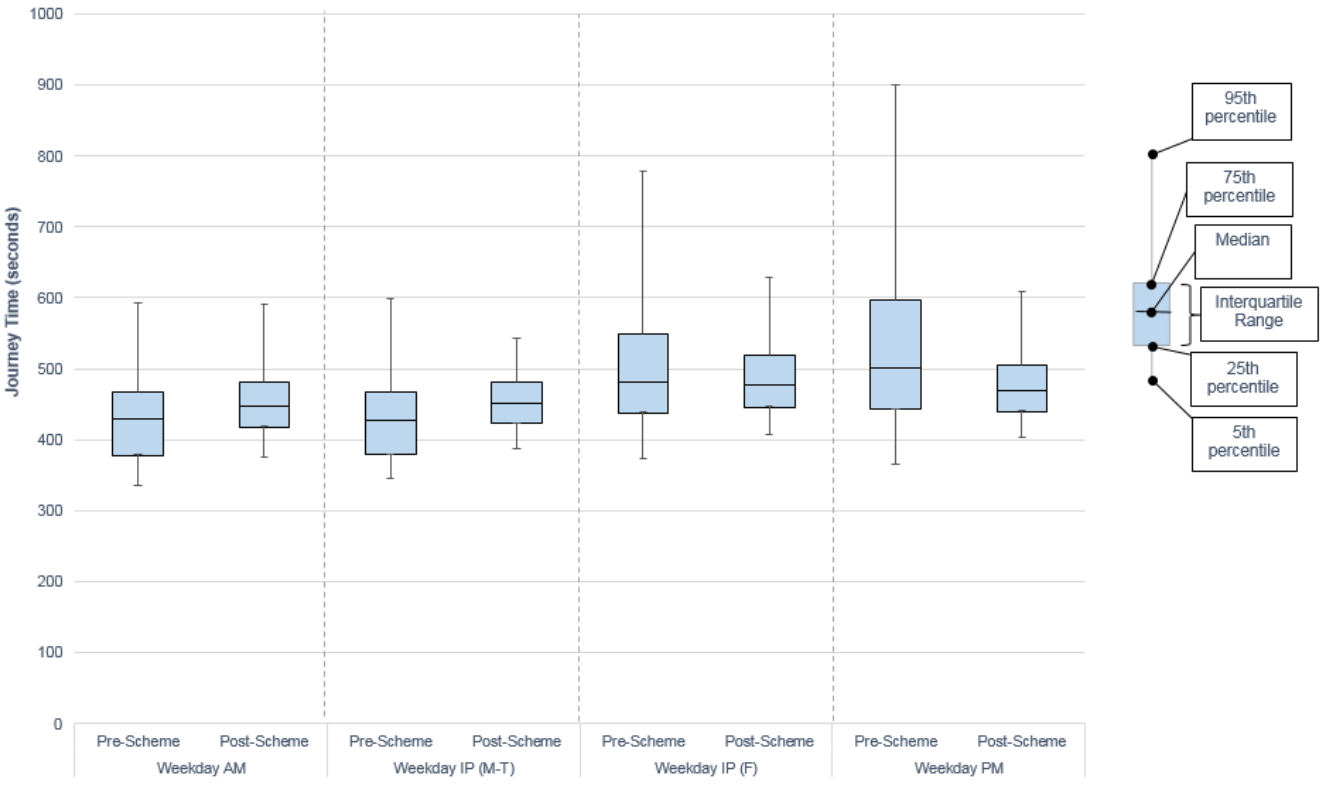
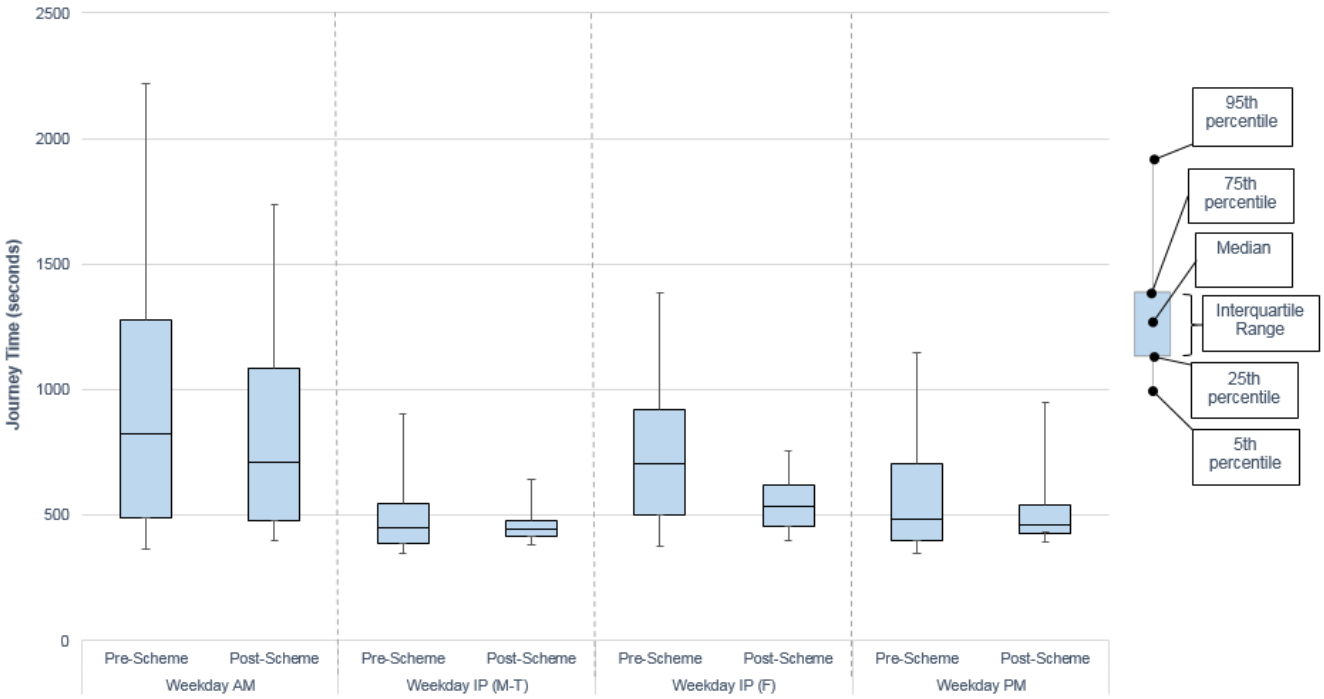


Figure 2-11 Southbound Journey Time Variability (M6 junction 8 to 10a)



Planning Time Index

2.76. Another metric that can be used to understand journey time reliability is planning time index (PTI). This metric indicates how much additional time road users need to allow to ensure that they arrive at their destination on time. It is a ratio of the 95th percentile journey time to the free-flow journey time. As it uses the extreme end of the journey time distribution, it will reflect those who have the lowest journey times. A low planning time index means that a road delivers a consistently good journey time.

2.77. The PTI has been calculated for this scheme based on the journey time data collected for 2008 (pre-scheme) and March 2017 (post-scheme), for all time periods. Flow weighted speeds have been calculated using traffic flow data for junction 9 to 10 (April 2017), which is considered to be representative of traffic volumes on the scheme section. This is presented in **Table 2-12.**

Table 2-12 Planning Time Index (PTI)

		Flow Weighted PTI	% Change
Pre-Scheme	NB	1.78	N/A
	SB	2.94	
Post-Scheme	NB	1.38	-23%
	SB	2.23	-24%

2.78. **Table 2-12** shows that post-scheme the PTI value is lower than pre-scheme for journeys in both directions, by approximately 24%. This indicates that there has been a marked improvement in the slowest journey times experienced through the scheme section. The PTI value is lower for vehicles travelling northbound, than southbound. This indicates that across an average week, there is greater variation in the slowest journey times for vehicles travelling southbound than northbound.

Key Points – Traffic

Traffic

- Traffic flow increases (AWT) on the scheme section between pre- and post-scheme vary between 8 and 13% depending on the section of the scheme. Taking into account background growth of up to 5%, these results suggest that the scheme may have reassigned traffic onto the M6 in some locations. The lowest increase (8%) has been observed between junction 8 to 9, northbound. The highest increase (13%) has been observed between junction 8 to 9, southbound. These findings are in line with the OYA report.
- On wider motorway links, for the same time period, there has been an increase in traffic flows on the M6 Toll while on the M6 junction 3 to 3A, traffic flows have remained relatively consistent when taking background growth into consideration.
- Since the OYA was completed, further schemes on the adjacent network have also been completed, which are likely to have drawn additional traffic to the M6 corridor.
- The greatest increase in traffic flows has been observed in the AM and PM peak periods, with lower increases during the Inter Peak. Overnight there have been minimal changes in traffic flow.

Traffic Forecasting

- The scheme appraisal assumed that when the scheme was active (i.e. the HSR was in operation) the increase in motorway capacity would be 14%. A comparison of peak hour pre- and post-scheme traffic flows indicates that this assumption is broadly consistent with the increase traffic flows in observed at outturn.
- The scheme appraisal also assumed that the scheme would only be operational during weekday peak periods. Such an assumption is now superseded in the appraisal of a managed motorway scheme through the use of the IFRIIT spreadsheet. There has been traffic growth in the Inter Peak, and a corresponding use of the scheme during this time period.

Scheme Utilisation

- The scheme is utilised more than assumed in the appraisal. For example, on an average weekday, scheme utilisation in the southbound direction between junction 9 and 10 is consistently as high as 90% throughout the whole day.
- The hard shoulder is used well across the scheme length, including in through junction 10 in the through junction running section.

Journey Time Impacts

- Journey time savings of 10% have been achieved in the southbound direction during the AM Peak; this represents a reduction of approximately 147 seconds. This is compared to a forecast journey time saving of 335 seconds.
- Northbound, journey times have increased by between 6% and 21% by different time periods. These are generally low on most sections within the scheme, apart from between junction 10 to 10a. Increases across the whole scheme for the AM and PM are lower than the forecast increase in journey times of 100 second.
- The variability of journey times has reduced as a result of the scheme. The inter-quartile ranges of measured journey time have reduced in all periods. The Planning Time Index (PTI) score has also reduced. These measures provide a good indication of an improvement in journey time reliability as a result of the scheme.

3. Safety

Introduction

3.1. This section of the report considers the impact of the scheme with regards to its success in addressing the objective of reducing the impact of accidents[13].

3.2. In order to assess the impact of the scheme on collisions, this section analyses change in personal injury collisions (PICs) recorded the five-year pre-construction period, and the five years post-opening period. Evaluation of the scheme's impact on personal security has been undertaken through observations made whilst on a site visit and desktop analysis.

Data Sources and Methodology

Forecast Safety Data

3.3. At appraisal, forecasts for change in the number of PICs per km were provided. The appraisal for this scheme did not distinguish the forecast safety benefits from BBMM1 and BBMM2. This evaluation compares the observed to forecast change in collision rate, rather than calculating the safety benefits of each scheme individually.

Observed Safety Data

3.4. Collisions by their very nature include a random element and are somewhat unpredictable events. Due to timescale constraints, a full five years of post-opening data was unavailable at the time of writing this report, however it is considered that the four years ten months of data is a sufficient timescale to analyse trends and measures the schemes success against objectives. Collision data was obtained from the Managing Area Contractor (MAC) to cover all time periods shown in **Table 3-1.** This dataset has been validated with the local authority. The study area used is the mainline M6 along the length of the scheme to provide consistency with the appraisal.

Table 3-1 Collision Study Periods

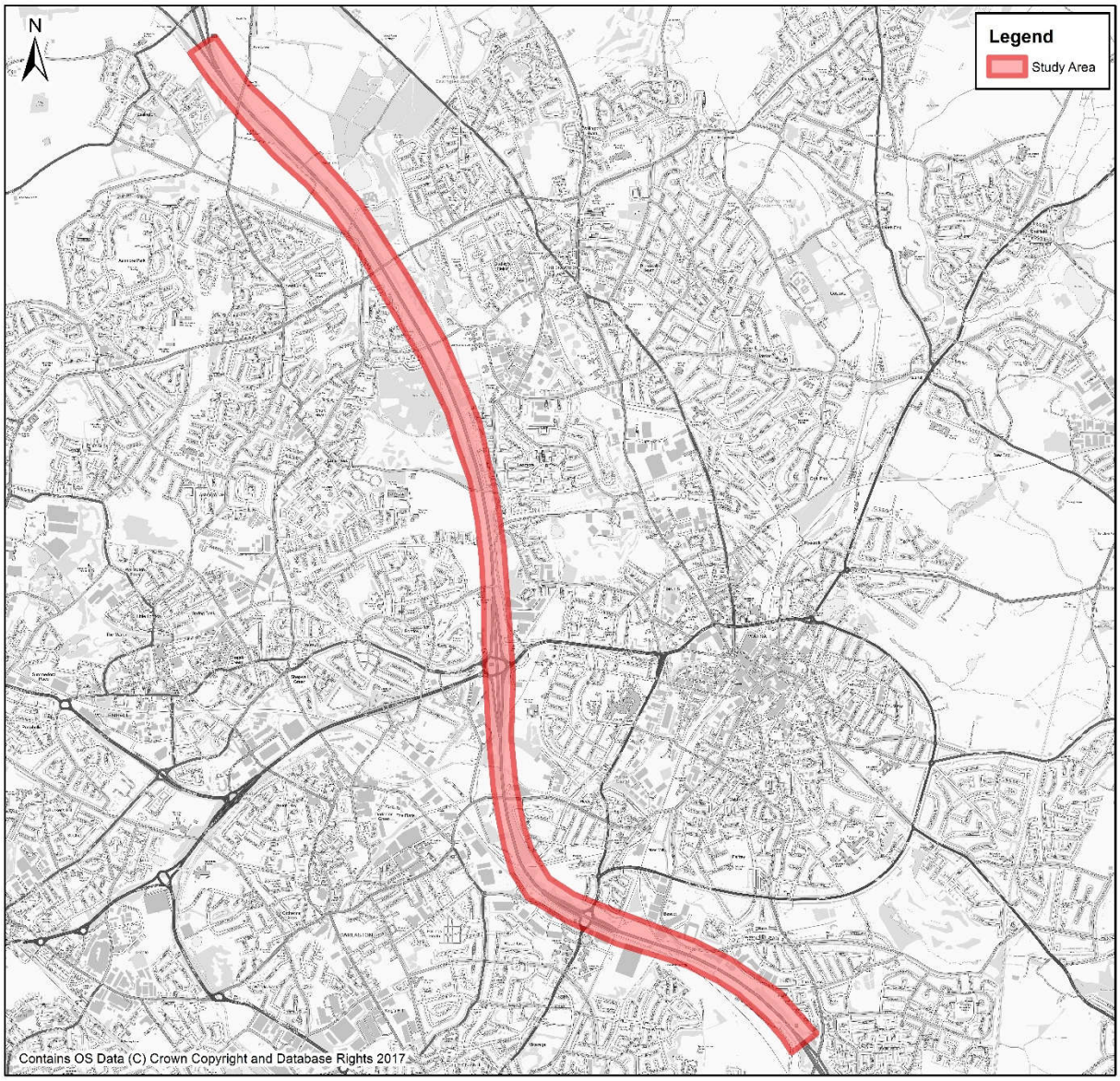
Study Period	Dates
Pre-Scheme	1st August 2004 to 30th July 2009 (5 years)
Scheme Construction	1st August 2009 to 28th February 2011 (2 years, 6 months)
Post-Scheme	1st March 2011 to 31st December 2015 (4 years, 10 months)

3.5. The collision data is based on the records of PICs (i.e. collisions that involve injuries to one or more persons) recorded in the STATS 19 data collected by the police when attending collisions. Collisions that do not result in injury are not included in this dataset and are therefore not considered in this evaluation. The study area for the analysis is shown in **Figure 3-1** – covering the M6 mainline between junction 8 to 10a. The study areas has been used to align with that used in the scheme appraisal.

3.6. The scheme may have resulted in a safety benefit on other alternative routes in the vicinity scheme, as a result of traffic re-routeing onto the scheme due to improved journey time reliability. However, based on the data available it would be difficult to ascertain whether changes in the safety record are as a result of the scheme itself.

[13] Accidents now referred to as collisions in line with Highways England naming convention

Figure 3-1 Safety Analysis Study Area



Personal Security

3.7. The assessment of personal security has been undertaken based on a site visit conducted on Wednesday 17th May 2017, and desk based research.

Background Collision Reduction

3.8. It is widely recognised over most of the course of the last decade, that there has been a year-on-year reduction in the number of PICs on the road network. This has continued against a trend of increasing traffic volumes during much of that period. The reasons for this are wide-ranging and include improved safety measures in vehicles and reduced numbers of younger drivers. Consideration of the background trends in collisions is required when understanding the changes in collision numbers and rates in the study area, pre- and post-scheme. If the scheme had not been built, collision numbers in the study area are still likely to have reduced, in line with wider trends.

3.9. In this analysis, the number of collisions in the study area pre- and post-scheme periods have been compared. It is considered that the best way to do this is to assume that if the scheme had not been built, the number of collisions on roads in the study area would have dropped at

the same rate as they did on motorways nationally during the same period[14]. This is known as the 'counterfactual' scenario. A comparison can then be made between the counterfactual 'without-scheme' scenario on a like for like basis with the observed post-opening data (which is the 'with scheme' scenario). The difference between the number of collisions in these two scenarios can then be attributed to the scheme, rather than national trends. This result will inform the calculation of monetised safety benefits by the scheme as discussed in the economy section of this report.

Collision Rate

3.10. In order to examine the impact of the scheme on collisions taking into account the change in traffic volumes, an evaluation can consider the change in collision rates by distance travelled. This section considers the change in collision rates between pre- and post-scheme. A collision rate is calculated as the number of collisions per million vehicle kilometres (mvkm). A comparison between pre- and post-scheme collision rates are provided in **Table 3-2. Table 3- 2** also provides the national average motorway rate calculated from the DfT Data[15].

Table 3-2 Collision Rate over M6 mainline links

	Collision Rate (PIC/mvkm)	Calculated Average motorway collision rate (from DfT Data[15])
Pre-Scheme (Aug 2004 – Jul 2009)	0.093	0.078
Post-Scheme (March 2011 – December 2015)	0.082	0.055
Net collision rate change	-0.011	-0.024
Without scheme (adjusted for counterfactual trend)[15]	0.065	N/A
Collision Rate Change (based on counterfactual)	0.017	N/A
Percentage Change (%)	**26%**	**-30%**

3.11. Pre-scheme (not taking into account the without scheme counterfactual scenario), the collision rate for the scheme section was above the national average. Both nationally and on the scheme section there has been a decrease in the collision rate between pre- and post-scheme, but on the scheme section the decrease has been smaller than that nationally.

3.12. After accounting for background trends in collision reduction, **Table 3-2** shows that the without scheme counterfactual collision rate is 0.065 PICs per mvkm, compared to 0.082 PICs per mvkm post-scheme. Therefore, we can conclude that we can see a slight increase (0.017 PICs per mvkm) in the collision rate along the length of the scheme. This is taking into account that the traffic along the scheme section has also increased between pre- and post-scheme.

3.13. To determine whether the changes in collision rates pre- and post-scheme are statistically significant, chi-squares tests have been carried out. These tests use the collision rate (taking into account the counterfactual) and traffic flows for five years' pre-scheme, and all available data post-scheme to establish if the changes are significant, or are likely to have occurred by chance. In terms of the collision rate, for the study area, the changes which have been

[14] Background (counterfactual) adjustment factor in collision rates for motorways across the study period was 0.698

[15] National trends in collisions is sourced from DfT Table RAS10002

observed are statistically significant (i.e. we can be more than 95% confident that the changes are not just chance[16]).

3.14. National average collision rates by road type are provided by the DfT. **Table 3-2** shows that both the pre- and post-scheme collision rate is higher than the DfT national average for motorways (all severities) for the same time-period. To conclude, between pre- and post-scheme the collision rate has increased, a change which is only just statistically significant. This follows standard POPE methodology, taking into account the background trends for a reduction in collisions over time. At OYA, there was found to be observed reduction in the collision rate.

Collision and Casualty Numbers

3.15. This section analyses the observed changes in numbers of PICs, following the implementation of the scheme. One of the stated objectives of this scheme was to reduce the impact of collisions.

Collisions

3.16. An analysis of the pre- and post-scheme collision numbers by year, for the scheme length is shown in **Table 3-3.** The severity of a collision is defined by the most serious injury incurred. **Table 3-3** also includes the counterfactual without scheme collision values, which is comparable to the after data. It should be noted that where periods of less than one year have been displayed, the number of collisions for that period have been extrapolated to provide an equivalent number of collisions per year, the number of collisions added as a result of this extrapolation are shown by the grey stacked columns in **Figure 3-2.**

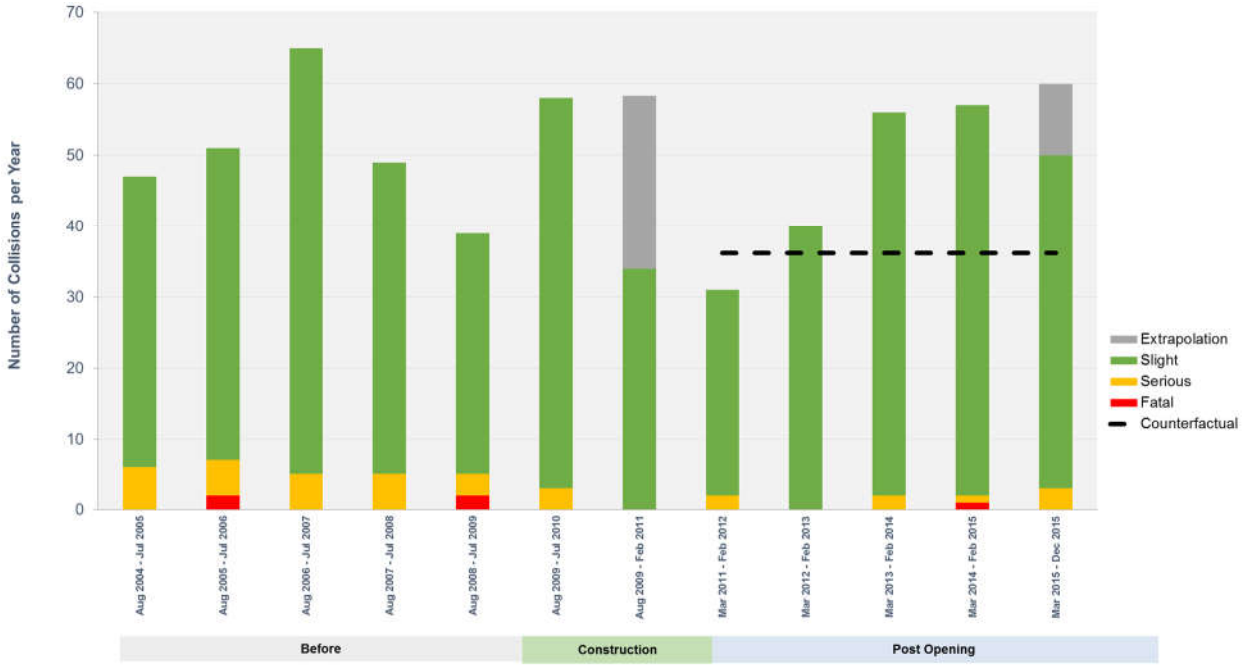
Table 3-3 Number of Collisions by Severity

Study Period	From	To	Fatal	Serious	Slight	Total	Annual Average
Pre-Scheme	August 2004	July 2005	0	6	41	47	50.2
	August 2005	July 2006	2	5	44	51	
	August 2006	July 2007	0	5	60	65	
	August 2007	July 2008	0	5	44	49	
	August 2008	July 2009	2	3	34	39	
Without Scheme Counterfactual (adjusted for background reduction)[17]							36.2
Construction	August 2009	July 2010	0	3	55	58	58.4
	August 2010	July 2009	0	0	34	34	
Post-Scheme	March 2011	February 2012	0	2	29	31	48.4
	March 2012	February 2013	0	0	40	40	
	March 2013	February 2014	0	2	54	56	
	March 2014	February 2015	1	1	55	57	
	March 2015	December 2015	0	3	47	50	
Saving (without scheme counterfactual – post-scheme)							-12.2
Percentage Change							34%

[16] In order to be 95% significant the chi-squared value should be above 3.84. At outturn, the chi-squared value is 3.995

[17] Background (counterfactual) factor in collision numbers for Motorways across the study period was 0.799

Figure 3-2 Number of Collisions



3.17. From **Table 3-3** and **Figure 3-2**, the following can be observed:

- Pre-scheme, there was an annual average of 50.2 collisions per year which remained relatively consistent post-scheme, with an annual average of 48.4 collisions per year.
- After accounting for background trend of a reduction in the number of collisions on motorways we can see that there has been an increase in collisions along the length of the scheme by approximately 34% (12.2 collisions).

3.18. To determine whether the changes in collision numbers pre- and post-scheme are statistically significant, chi-squares tests have been carried out. These tests use the numbers of collisions and traffic flows for five years' pre-scheme, and all available data post-scheme to establish if the changes are significant, or are likely to have occurred by chance. It is based on the counterfactual collision numbers.

3.19. In terms of the number of collisions, the chi-squared test shows that we can be 99% confident that the increase in the number of collisions post-scheme would not have occurred by chance. It is therefore concluded that the increase in the number of collisions is likely to be linked to the scheme.

3.20. At OYA, it was concluded that after accounting for a background trend of a reduction in the number of collisions, there was a slight increase in collisions of approximately 7%. This was found to not be a statistically significant trend, given the available data at that time. It is interesting to take this into consideration, in conjunction with the result of this analysis.

3.21. This analysis has followed the standard POPE methodology to account for a background trend of a reduction in PICs had the scheme not been implemented. Without the application of the background reduction, there was little to no change in collision numbers. Therefore, the net change shown in this analysis is primarily as a result of the background trend in the reduction in collisions on motorways.

Casualties

3.22. An analysis of pre- and post-scheme casualty numbers by year is shown in **Table 3-4.** It includes the counterfactual without scheme numbers, which is comparable to the after data.

Table 3-4 Number of Casualties by Severity

Study Period	From	To	Fatal	Serious	Slight	Total	Annual Average
Pre-Scheme	August 2004	July 2005	0	6	62	68	70.4
	August 2005	July 2006	2	8	62	72	
	August 2006	July 2007	0	7	83	90	
	August 2007	July 2008	0	7	56	63	
	August 2008	July 2009	2	5	52	59	
Without Scheme Counterfactual (adjusted for background reduction)[18]							52.1
Construction	August 2009	July 2010	0	4	71	75	74.9
	August 2010	July 2009	0	0	43	43	
Post-Scheme	March 2011	February 2012	0	3	47	50	74.7
	March 2012	February 2013	0	0	57	57	
	March 2013	February 2014	0	7	76	83	
	March 2014	February 2015	1	1	91	93	
	March 2015	December 2015	0	8	70	78	
						Saving	-22.6
						Percentage Change	43%

3.23. From **Table 3-4,** we can observe following:

- The average number of casualties of all severities post-scheme was 74.7 per annum, and this represents an increase (22.6 casualties) when compared to the without-scheme counterfactual average, in which there are an average of 52.1 casualties.

3.24. Further analysis of the most seriously injured casualties is shown in **Table 3-5**.

Table 3-5 Number of Casualties (Fatal and Seriously-injured)

	Total Casualties in period
Pre-Scheme (Aug 2004 – Jul 2009)	37
Without scheme (adjusted for counterfactual)[19]	26
Post-Scheme (March 2011 – December 2015)	20
Change in number of Fatal and Seriously-injured casualties	-6

3.25. **Table 3-5** shows that the number of casualties which were classified as fatal or serious have decreased between pre- and post-scheme, taking into account the background wider trends. However, these numbers are small hence statistical analysis has shown that this change is not significant at this time.

[18] Background (counterfactual) factor in casualties numbers for motorways (all speed limits) across the study period was 0.721

[19] Background (counterfactual) adjustment factor in KSIs for motorways across the study period was 0.701

Collision Severity Index

3.26. The collision severity index is the ratio of the number of collisions classed as serious or fatal, compared to the total number of collisions.

3.27. **Table 3-6** presents a summary of the pre- and post-scheme collision severity indices for the study area. No adjustment is made for background trends. This shows that the severity index for BBMM2 has reduced from 11% to 4%.

Table 3-6 Collision Severity Index

			Severity Index	Average Severity Index
Pre-Scheme	August 2004	July 2005	13%	11%
	August 2005	July 2006	14%	
	August 2006	July 2007	8%	
	August 2007	July 2008	10%	
	August 2008	July 2009	13%	
Construction	August 2009	July 2010	5%	3%
	August 2010	July 2009	0%	
Post-Scheme	March 2011	February 2012	6%	4%
	March 2012	February 2013	0%	
	March 2013	February 2014	4%	
	March 2014	February 2015	4%	
	March 2015	December 2015	6%	

3.28. From this information, it is clear that the scheme has partly fulfilled its objective to reduce the impact of collisions, based on the information available at this stage of evaluation.

Fatalities and Weighted Injuries

3.29. The Fatalities and Weighted Injuries (FWI) metric is a combined measure of casualties based on the numbers of fatal, serious and slight casualties. The FWI for the scheme section, for the three years before and the available post-opening period (as per standard POPE methodology), is presented in **Table 3-7.**

3.30. To take into account the increased traffic flow on the scheme section post-opening, **Table 3-7** also presents the FWI rate per billion vehicle kilometres (bvkm). It is important to note that these figures do not take into consideration any background reduction in casualties.

Table 3-7 Fatalities and Weighted Injuries

Period	FWI/collision	FWI/year	FWI/bvkm
Pre-scheme	0.038	1.94	3.6
Post-scheme	0.027	1.31	2.2

3.31. **Table 3-7** shows that the severity of collisions has reduced post-opening by approximately 30% (0.038 to 0.027 FWI/collision), whilst the number of fatal and serious injuries per year, and per bvkm have reduced by approximately 32% and 38% respectively. This indicates that the scheme is partly fulfilling its objective to reduce the impact of collisions.

Figure 3-3 Pre-Scheme Collisions by Severity

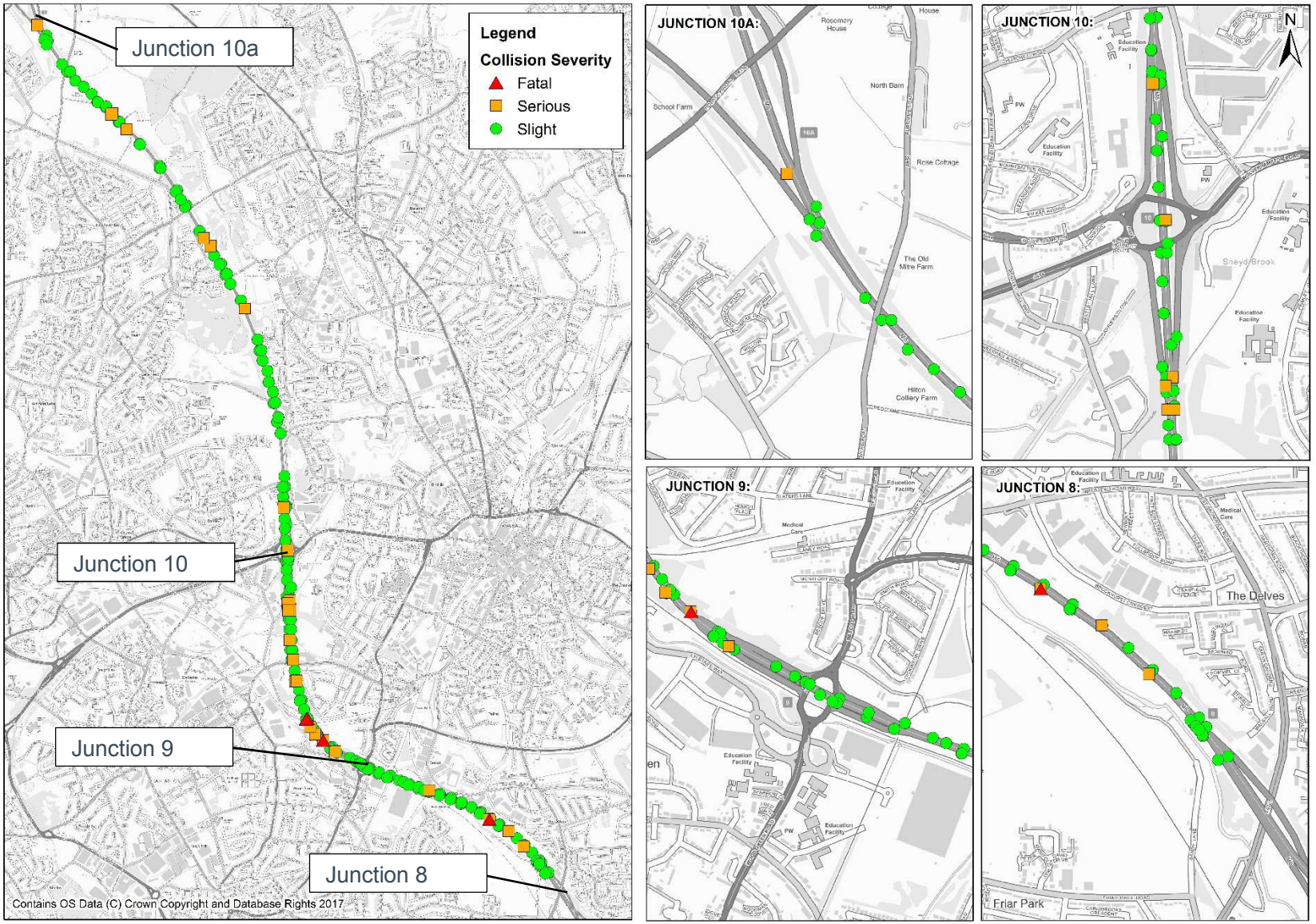
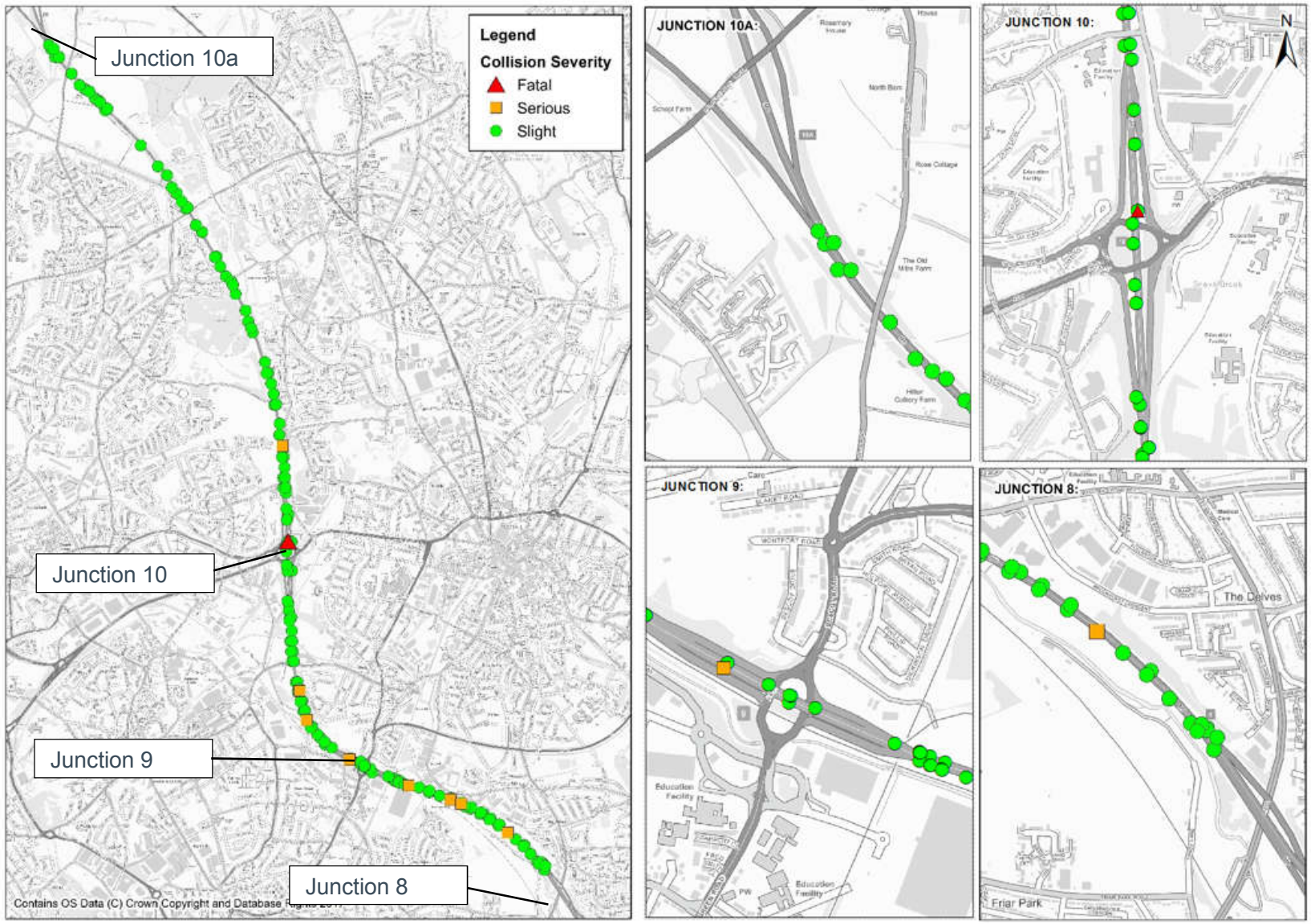


Figure 3-4 Post-Scheme Collisions by Severity



Further Collision Analysis

3.32. This section conducts a more detailed analysis on the collisions which occurred in terms of weather, lighting, locations and causation factors. Maps showing the locations of these collisions are provided in **Figure 3-3** and **Figure 3-4**.

3.33. **Figure 3-3** and **Figure 3-4** suggest that there has been no change in the spread of the locations of recorded PICs between pre- and post-scheme.

3.34. Between pre- and post-scheme there were a comparable percentage of collisions which occurred in darkness and daylight. Pre-scheme there were no collisions reported in darkness lights unlit, but post-scheme 3% of collisions (15 collisions) were reported during these conditions. However, as there are no considerable changes for this metric, it is considered that any changes to lighting as a result of the scheme have not had a detrimental impact on safety.

3.35. In terms of weather conditions, further analysis has been carried out that provides no indication that the scheme has impacted the occurrence of collisions during certain weather conditions.

3.36. Further analysis has been carried out to compare the causation factors provided for collisions pre- and post-scheme. There has been no clear change in the composition of causation factors recorded, with the highest percentage of causation factors being reported as follows:

- Following too close
- Failed to look properly
- Failure to judge other person's path or speed
- Poor turn or manoeuvre

Forecast vs. Observed Collision Savings

Forecast Collision Savings

3.37. The appraisal did not distinguish between the forecast safety benefits for BBMM1 and BBMM2. Forecasts were provided for the change in the number of PICs per km, and a change in the collision rate (as collisions per km). This section considers the change in the collision rate. The scheme appraisal reports provided information regarding the forecast change in the number of collisions, and the change in annual PICs per km. In order to isolate the impact on BBMM2, the change in annual PICs per km has been used in this comparison to observed, assuming a consistent saving across both schemes.

3.38. MACSEM has been used to calculate the safety benefits of the scheme. This is a simplified alternative to the use of COBA, developed by Mott MacDonald. The scheme appraisal states that this spreadsheet has been demonstrated to produce comparable results to COBA for relatively simple link based applications. For this scheme, link data from the PRISM model was used to produce estimates of collision savings in MACSEM. This process was validation against observed collision data from the ATM trial section.

3.39. The appraisal calculated safety benefits using MACSEM, which provides a link based assessment of safety benefits, and does not include changes in junction related accidents, so many underestimate overall benefits in this respect. However, in order to provide a like-for-like comparison, accidents at junctions have also been excluded from the outturn assessment of safety.

3.40. In addition, the appraisal also compared the forecast safety impact of BBMM1 and BBMM2 to that observed on the M42 ATM trial. These results are presented here for comparison against the observed impact of BBMM2, which was based on data from two years post-opening. It is not known whether this analysis accounts for background changes in collision rates.

Table 3-8 Forecast safety impact and comparison against M42 ATM Trial

	M42 ATM Trial (Observed)	BBMM1 and BBMM2 2016 (Forecast)
Change in annual PICs per km	-1.97	-0.14
Fatal	4%	1%
Serious	18%	12%
Slight	78%	87%

Source: ATM Roll Out Phases 1 and 2 Transport Modelling Report Table 3-9 (March 2009) - Table 3-4.

3.41. **Table 3-8** shows that the scheme was forecast to reduce the collision rate and that in 2016 with implementation of the scheme 87% of collisions were forecasts to be slight, 12% classified as serious and 1% classified as fatal.

Comparison to Observed

3.42. **Table 3-9** shows the observed safety impact of the scheme, using the same indicators as forecast. The pre-scheme values have taken into account the background counterfactual reduction in accidents.

Table 3-9 Observed safety impact (BBMM2 only – 10.3km)

	Pre-Scheme (2004 to 2009 Average)	Post-Scheme (2011 – 2015 Average)	Change (After-Before)
Annual PICs per km	1.21	1.61	0.41
PIC Severity:			
Fatal	1.6%	0.4%	-1.1%
Serious	9.6%	3.4%	-6.1%
Slight	88.8%	96%	7.3%

3.43. **Table 3-9** shows that between pre- and post-scheme there has been an increase in the collision rate, but a decrease in the severity of collisions along the length of the scheme. **Table 3-10** compares the forecast impact of the scheme against the observed impact of the scheme.

Table 3-10 Forecast vs. Observed Safety Impact

	BBMM1 and BBMM2 Forecast (M6 mainline only)	BBMM2 Observed (M6 mainline only)
	2016	Change between pre- and post-scheme
Change in annual PICs per km	-0.14	0.41
Fatal	1%	0.4%
Serious	12%	3.3%
Slight	87%	96%

3.44. From **Table 3-10**, it is clear that the outturn impact is different from that forecast, in that there has been an increase in the annual PICs, after accounting for the background trend in collision reduction. **Table 3-10** also shows that the observed severity is lower than that forecast.

3.45. The scheme appraisal only specified a reduction in the annual PICs per km, as shown in

3.46. **Table 3-8.** In order to determine the difference between the forecast and outturn collision numbers, the values in **Table 3-10,** have been applied to the before collision dataset (without the counterfactual adjustment to account for background trends in collisions).

Table 3-11 Safety Impact of BBMM2 scheme

	Before Observed: Annual Average	Forecast: 2016 (1)	Outturn Observed: Annual Average (2)	% Difference between (1) and (2)
Annual average PICs per km	1.21	1.53[20]	1.61[21]	5%

3.47. **Table 3-11** shows that the observed collision rate in the opening year was 5% higher than what might have been expected, had the forecast collision impact been realised. Since the OYA evaluation report has been completed there is a larger dataset of post-opening data so this is potentially more likely to reflect long term trends.

Security

3.48. The aim of this sub-objective is to consider any changes in security and the likely number of users affected by the changes. For highway schemes, security issues may arise from the following:

- On the road itself (e.g. being attacked whilst broken down);
- In service areas, car parks, lay-bys (e.g. vehicle damage whilst parked at a service station, being attacked whilst walking to a parked car); and
- At signals or junctions (e.g. smash and grab incident whilst queuing at lights).

3.49. The primary indicators for highway schemes include surveillance, landscaping, lighting and visibility, emergency call facilities and cyclist facilities.

Forecast

3.50. **Table 3-12** provides a summary of the impacts identified in the scheme appraisal[22].

Table 3-12 Security Sub-Objective Appraisal

Indicator	Appraisal Assessment
Formal Surveillance	New CCTV provides a new focussed security function. Gantry mounted CCTV will be able to monitor hard shoulder when HSR is in operation.
Informal Surveillance	No change
Landscaping	Some removal of vegetation to build Emergency Refuge Area (ERAs) will improve sight lines. Replanting will not affect sight lines.
Lighting and Visibility	Lighting provision will continue to be provided at regular intervals. ERAs will be provided with additional lighting, as required.
Emergency Call	Provision and location of facilities is not considerably different, but location is more formalised and clearer to drivers.

[20] Calculated by applying the forecast saving for BBMM1 and BBMM2 (-0.14) to the collision rate (PICs/km) before counterfactual has been applied (1.61).

[21]Calculated by dividing the annual average number of PIAs by the length of BBMM1 and BBMM2.

[22] Birmingham Box Active Traffic Management Phases 1 and 2: Modelling of the Impact of Roll Out (March 2009)

Indicator	Appraisal Assessment
Pedestrian and cycle facilities	Not applicable.

3.51. The appraisal took into consideration the number of daily journeys and chance of break down as part of the assessment. It assumed that across BBMM1 and BBMM2 there would be approximately 110,000 daily users, and that 4% of motorists break down on the motorway each year. The appraisal states that if you apply this rate to daily users (assuming a uniform distribution of vehicle breakdowns between motorways and other road classes) gives a total of 4,400 users who would suffer a breakdown in a given year. Assuming users would break down once in a year, this means that 0.01% of annual motorway trips would involve a breakdown, which equates to 12 vehicle breakdowns per day.

3.52. Based on this information, it was forecast that the scheme would have a **slight beneficial** impact on security.

3.53. The assumptions that the appraisal made with regard to chances of breaking down provide an over-estimate, as they assume that people would break down on BBMM1 and BBMM2, when in reality they could break down anywhere on the motorway network. However, it is not considered that alteration of this assumption would change the forecast impact of the scheme.

Evaluation

3.54. **Figure 3-5** shows a range of security facilities which have been implemented on the scheme section. ERAs are provided at regular intervals along the scheme section (approximately 800m), in both directions, with clear visibility from the main carriageway. Lighting has been provided at regular intervals along the main carriageway, as well as in ERAs. There are also emergency telephones provided in the ERAs. CCTV, provided along the main carriageway and on the gantries, are also visible to motorists. Based on a desktop study and the findings from a site visit, it is considered that the security facilities have been introduced as proposed.

Figure 3-5 Security Facilities

3.55. Therefore, based on the information presented above, it is considered that the outturn assessment supports the forecast impact of slight beneficial.

Key Points – Safety

Collisions

- In the five years after opening on the scheme section (BBMM2), an increase in the observed annual average PICs has been observed (34%), which is statistically significant. This includes a reduction in the collision severity index from 11% (pre-scheme) to 4% (post-scheme).
- Taking into account the increase in traffic flows, the collision rate along the length of the scheme has increased by 26%. This is only just statistically significant. At OYA, no change in collision rate was observed.
- The scheme has not performed as forecast in terms of reducing the collision rate (PICs per km), and at outturn has been found to increase the collision rate (PICs per km). However, the severity is lower than that forecast.
- The composition of collision causation factors does not differ between pre- and post-scheme.

Security

- The impact of the scheme on security at outturn is as forecast, that is **slight beneficial**, largely due to the installation of CCTV cameras and direct emergency call to operators at the Emergency Refuge Areas.

4. Economy

Introduction

4.1. This section evaluates how the scheme is performing against the economy objective, which consists of the following sub-objectives:

- Public Accounts
- Transport Economic Efficiency (TEE) for business users, transport providers and consumers.
- Journey Time Reliability
- Wider Economic Impacts

4.2. The study area for the scheme appraisal consisted of both BBMM1 and BBMM2. This section has used the same methodology as that adopted at OYA, to split the benefits for BBMM1 and BBMM2.

4.3. The scheme appraisal used TUBA (Transport User Benefits Appraisal) as well as outputs from the West Midlands strategic model, PRISM, to calculate the economic benefit of the scheme. The safety benefits were calculated using the MACSEM model, as detailed in **Chapter 3.**

4.4. This section provides a comparison between outturn costs and benefits and the economic impacts. Outturn journey times and safety economic impacts are based on the observed results presented in previous sections of this report, and re-forecast to a 60-year period.

4.5. As outlined previously in this report, there are a number of neighbouring schemes which have been in construction since BBMM2 has opened. The benefits arising from this scheme are likely to be affected by the construction of BBMM3 and M6 junction 10-13. However, the impact is limited to when traffic management is in place affecting the flow and speed on the scheme section, and it is considered that the impact would have been greater without BBMM2 in place.

Data Sources

4.6. The economic forecasts of the scheme have been taken from the following reports:

- Productivity TIF Phase I and II, Impact on the Economy, September 2007
- BBMM ATM Phases 1 and 2 Modelling of the Impact of Roll Out, March 2009

4.7. The outturn spend profile for this scheme was obtained from the Highways England Regional Finance Manager for the purposes of the OYA evaluation, and has been used again in this FYA evaluation. All the costs presented in this report are in 2002 prices and values.

4.8. **Table 4-1** outlines the evaluation approach undertaken in this report. A ‘yes’ indicates that a certain element has been considered in this evaluation. A ‘no’ indicates that the forecast impact has been used in place of a full evaluation at this stage.

Table 4-1 Economic Benefits of Scheme (2002 prices and values), BBMM1 and BBMM2 combined

Benefits in £m 2002 market prices, discounted	Forecast £m	% of predicted benefits	Evaluate ?	Evaluation Approach/Comments
Journey Time (TEE business and consumer users)	£346.0m	91%	Yes	Use of traffic and journey time data for pre- and post-scheme, and applying the rule of half, to calculate the outturn journey time benefits.
Safety	£16.6m	4%	Yes	Based on observed reduction in collision numbers, which are statistically significant.
Vehicle Operating Costs (VOC)	£15.3m	4%	Yes	Net change in fuel consumption in first five years has been monetised to calculate proxy outturn re-forecast value of VOC.
Revenue/User Charges	-£0.2m	0%	No	Not within the remit of POPE and represents a small proportion of the scheme benefits.
Carbon Benefits	£0.7m	0%	Yes	Ratio between forecast and outturn opening year carbon impact used to calculate 60-year re-forecast.
Indirect Tax Impact	£5.4m	1%	Yes	Calculate outturn change in fuel consumption in the first five years and use ratio to apply forecast change to re-forecast 60 year benefit
Total PVB	**£383.8m**	**100%**		

Present Value

4.9. Cost benefit analysis of a major scheme requires all the costs to be considered for the whole of the appraisal period and they need to be expressed on a like-for-like basis with the benefits. This basis is termed Present Value. Present Value is the value today of an amount of money in the future. In cost-benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value. This is split into present value costs (PVC) and present value benefits (PVB)

Methodology for Splitting Impacts from BBMM1 and BBMM2

4.10. The scheme appraisal did not consider BBMM2 in isolation, and outturn scheme costs are only available for BBMM1 and BBMM2 combined. In line with the methodology applied at OYA, it is not practical to distinguish the benefits and costs for BBMM1 and BBMM2 for all components of the appraisal and evaluation.

4.11. It is important to note, that it is not possible to complete a comparison between forecast and outturn for BBMM2 in isolation, as the appraisal documentation did not provided sufficient detail on the contribution of individual schemes towards the total benefits. Therefore, this evaluation can be considered to be indicative of the difference between the forecast and

outturn impacts of BBMM2 – focussing on the difference between the values, rather than the values themselves.

4.12. The main benefit of a managed motorway scheme is the additional capacity it generates, and the subsequent ability to facilitate a greater throughput of traffic. When the managed motorway element is 'switched on' and a speed limit of 60mph enforced, the capacity of the motorway is increased as traffic is able to travel at a more consistent speed, preventing the build-up of congestion[23].

4.13. In order to support the splitting of forecast economic benefits of BBMM1 and BBMM2, **Table 4-2** shows the key features of the two schemes.

Table 4-2 Key Features of BBMM1 and BBMM2

	BBMM1	BBMM2
Scheme Description	M40 (J16 – M42 J3A northbound), M42 (J7 – J9), M6 (J4 – J5)	M6 (J8 – 10a)
Scheme Components	Controlled Motorway	Managed Motorway (MM)* – comprising of hard shoulder running, variable speed limit and through junction running
Scheme Outline	Assists flow during congestion through selecting variable speed limits (50mph, 60mph)	Increases capacity during peak traffic flow through allowing the use of hard shoulder as a running lane. Through junction running at junction 10 allows hard shoulder running to continue through the junction

*Previously known as Active Traffic Management (ATM), now referred to as Smart Motorways

4.14. The scheme appraisal used operational modelling (VISSIM) for both BBMM1 and BBMM2. One output from this software is the total distance travelled. This measure is considered to give a good indication of the increased capacity of the scheme, which can then be used to demonstrate the relative benefits of each scheme. BBMM2 provides an increase in capacity through HSR, but this increase in traffic may limit any speed improvement for the following reasons:

- Traffic increases, making use of the additional capacity provided through the use of HSR. The use of HSR enforces a 60mph speed limit. If the traffic was in free-flow prior to the HSR being opened, this may result in reduced speeds and increased journey times.
- Traffic increases, which due to the relationship between speed and flow may lower the speeds.

4.15. The forecast traffic changes for each scheme section presented in these outputs have been used to distinguish the economic benefits for BBMM1 and BBMM2. This is in line with the methodology used at OYA.

4.16. **Table 4-3** presents the calculation has been used to split the scheme benefits for BBMM2 in isolation.

[23] http://www.highways.gov.uk/smart-motorways-programme/

Table 4-3 BBMM1/BBMM2 Comparison taken from scheme appraisal for distance travelled in miles

Distance travelled (miles)	BBMM1	BBMM2	Total
AM Peak without MM	57,417	70,462	127,879
AM Peak with MM	65,627	88,503	154,130
PM Peak without MM	55,768	82,345	138,113
PM Peak with MM	64,428	100,391	164,819
Total without MM	113,185	152,807	265,992
Total with MM	130,055	188,894	318,949
Increase with MM	16,870	36,087	52,957
% of total increase	32%	68%	100%

4.17. **Table 4-3** shows that there is a 68:32 split of the benefits for BBMM2:BBMM1. This means that of the forecast benefits for BBMM1 and BBMM2 combined, it is assumed that 68% of the benefits are attributable to BBMM2.

Evaluation of Journey Time Benefits

4.18. The observed change in annual vehicle hours over the scheme section (mainline M6 junction 8 to 10a) has been used to derive economic benefits. The forecast economic benefits for this scheme were assessed using the TUBA model (version 1.7b). TUBA assesses the scheme life costs and benefits against the do minimum scenario. The forecast TEE benefits over the 60-year appraisal period have been taken from the modelling output report, and are shown in **Table 4-4**, based on the 68:32 split of benefits between BBMM2:BBMM1.

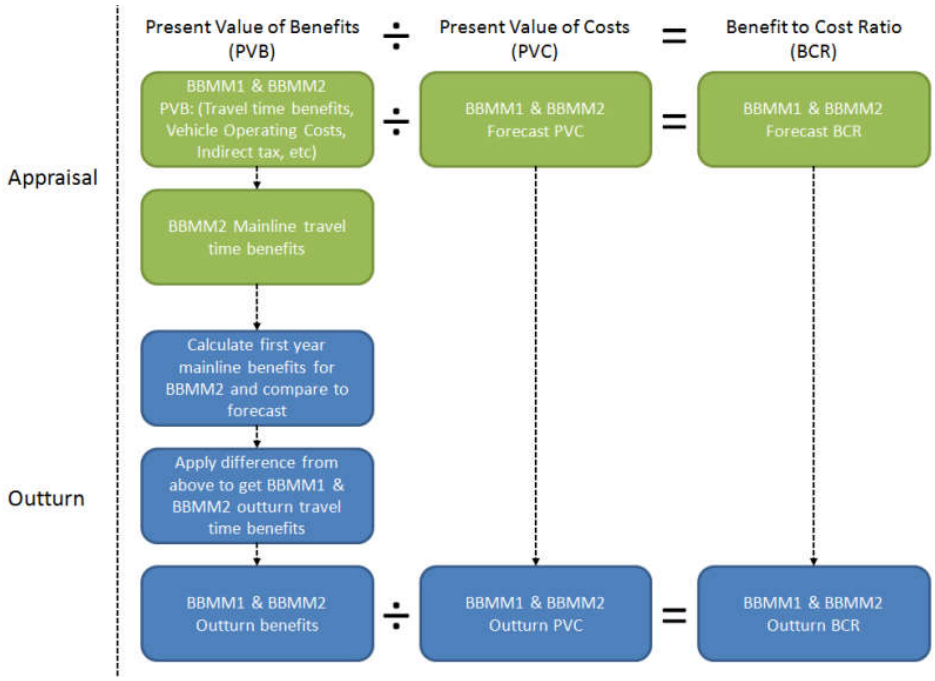
Table 4-4 TEE Forecast 60-year appraisal

	BBMM1 & BBMM2	BBMM2 Only
Total	£346.0m	£235.3m

*2002 values and prices

4.19. The approach for this evaluation is to apply the comparison between forecast and outturn journey time benefits for BBMM2 to the forecast for the combined BBMM1 and BBMM2, as reported in the scheme appraisal documentation. The methodology has been carried out as shown in **Figure 4-1**, and in line with that used at OYA.

Figure 4-1 Economic Approach



4.20. Traffic flows and journey times have been taken by direction for pre- and post-scheme for each time period. The pre-scheme data is taken from 2008, and the post-scheme data is for April 2017 for traffic flows and March 2017 for journey times. Journey time data excludes bank holidays. This evaluation only considers weekdays to ensure a like-to-like comparison to forecasts.

4.21. To calculate the outturn journey time benefits, the 'rule of a half' has been applied to the traffic flows and journey time data, to address the change in demand resulting from journey time changes caused by the scheme i.e. the existing traffic volumes get 100% of the benefit, and new traffic drawn to the route is given 50% of the benefit. The value of time for the relevant vehicle type (lights/heavies) was then applied to the journey time changes to calculate a monetised journey time impact.

4.22. The forecast economy results were based on the strategic PRISM model, which also considers the impact on non-scheme links. Therefore, it is not appropriate to compare the monetised journey time benefits calculated using the above methodology to those presented in the scheme appraisal. Therefore, the above methodology has been applied to the forecast changes in traffic flows and journey times. The scheme appraisal documentation provided these for 2011 and 2021. To calculate forecast values which correspond to the outturn data, a value for 2017 has been calculated by interpolating between values presented for 2011 and 2021. The forecast and outturn mainline journey time benefits have then been compared to determine the extent to which the scheme has performed against the forecast level of benefit.

Table 4-5 Observed vs. Forecast Journey Time Benefits per week (Weekdays)*

	Monetised Vehicle Hour Savings	% Difference
Forecast	£67,536	63%
Observed	£42,537	

*Based on 2011 values, 2010 prices from WebTAG.

4.23. **Table 4-5** shows that the outturn benefits for the M6 junction 8 to 10a are only 63% of that forecast.

4.24. The reasons for the differences between forecast and outturn journey time benefits are as follows:

- The scheme appraisal assumed that the scheme would not be used during the Inter Peak hours. As previous analysis has shown, the scheme is used frequently during the Inter Peak period. The enforced speed limit is likely to increase the journey time in these time periods.
- The scheme appraisal assumed an operational speed limit of 60mph. The VMSL element of this scheme means that in periods of heavy traffic flow, lower speed limits may be enforced. The enforcement of a 60mph speed limit when the HSR is in operation protects the journey time, preventing flow break down. In periods with particularly heavy flows, the speed may be reduced to 40mph or 50mph. Earlier analysis has shown this to be the case on some scheme sections, particularly in the southbound direction. This lower speed limit in the outturn will reduce the observed journey time benefits. Assuming a default of 60mph in the scheme appraisal has provided a higher level of benefits that what has been realised.

4.25. The 63% difference between forecast and outturn journey time benefits has been applied to the forecast travel time benefits from BBMM1 and BBMM2 presented in **Table 4-4**. This comparison between forecast and outturn journey time saving is presented in **Table 4-6**.

Table 4-6 Journey Time Saving and Monetary Benefit

	Forecast	Outturn
Total	£346.0m	£217.9m

*2002 prices and values

Evaluation of Safety Benefits

Forecast Safety Benefits

4.26. The forecast safety benefits for this scheme were derived using MACSEM, a simplified spreadsheet application that, at the time of appraisal, was used as an alternative to COBA. The outputs from MACSEM were validated against post-opening collision date from the M42 ATM pilot. Link data from the PRISM model was used to produce estimates of collision savings[24].

4.27. The monetised benefit for BBMM1 and BBMM2 combined is shown in **Table 4-7.** To calculate the monetised benefit for BBMM2 in isolation, the 68:32 split (BBMM2:BBMM1) based on distance travelled on each scheme (presented in **Table 4-3)** has been applied to the benefits for the two schemes combined. This is also shown in **Table 4-7.**

Table 4-7 Forecast Monetised Safety Benefits*

	2016	2026	60-year monetary benefit
Collision Benefits (BBMM1 and BBMM2 combined)	£0.3m	£0.4m	£16.6m
Collision Benefits (BBMM2 only)	£0.2m	£0.3m	£11.3m

*2002 prices and values

4.28. The scheme appraisal also provided details of the change in collisions and casualties for each of the modelled years and 60-year appraisal period. The 68:32 split (BBMM2:BBMM1) has also been applied to these values, as shown in **Table 4-8,** to calculate the outturn value.

[24] ATM Roll Out Phases 1 and 2: Transport Modelling B (March 2009)

Table 4-8 Forecast Change in Number of Collisions

	2016 (savings)
Number of PICs (BBMM1 and BBMM2 combined)	-4.2
Number of PICs (BBMM2 only)	-2.9

Evaluation of Safety Benefits

4.29. **Section 3** of this report considered the safety impact of the scheme in detail. The overall conclusion was that whilst there had been a reduction in the severity of collisions, there has been an increase in the collision rate.

4.30. At the OYA evaluation stage, it was observed that there was no change in the collision rate and therefore, there was no economic benefit from safety.

4.31. The methodology for evaluating the outturn of economic value of benefits arising from the safety benefits is based on a comparison of forecast change to the number of collisions and the observed difference between the number of collisions in the post-opening period and those in the counterfactual scenario based on observed pre-scheme data. It is assumed that the observed safety impact for the 4 years 10 months of post-opening data available is indicative of what will be achieved over the remainder of the 60-year appraisal period. The ratio between the number of collisions saved in the first 4 years 10 months, to the forecast 60 year benefits is then used to generated a re-forecast safety economic benefits for BBMM2 in isolation. To allow for a like-for-like comparison to the rest of the components of PVB, the ratio between the forecast and outturn for BBMM2 in isolation has then been applied to the forecast for BBMM1 and BBMM2.

4.32. To monetise the savings, the following methodology has been followed:

- Calculating the net difference between the forecast opening year saving and the observed annual average net impact on collision numbers in the study area, allowing for the counterfactual without scheme scenario.
- Monetising the net difference using average value for a motorway collision specified in the PAR method, which values collisions saved by road type and gives factors for capitalisation of 60 years based on expected traffic growth.
- Calculating the monetary 60-year outturn benefits by combining the forecast for the whole study area with the outturn assessment of the net difference.

4.33. **Table 4-9** shows the evaluation of monetary benefits, with all monetary values shown in 2002 prices discounted to 2002. It demonstrates that the scheme has been re-forecast to have a dis-benefit to safety, as a result of the application of the counterfactual.

Table 4-9 Comparison of Forecast and Re-forecast collision benefits

Forecast	Forecast Collision Saving in opening year	(a)	2.9
	Forecast value of saving (60 years)	(b)	£11.3m
Observed	Annual Average Collisions Pre-Scheme	(c)	50.2
	Annual Average Collisions Post-Scheme	(d)	48.5
	National Index of Change on collision numbers (Counterfactual)	(e)	0.721
	Average Annual Collision Saving (based on adjusted counterfactual)	(f) = (c*e) - (d)	-12.2
	Net Difference between forecast and observed	(f) – (a)	-15.1
	Monetisation of net difference for opening year	(h)	-£1.3m
	Monetisation of (f) into 60-year impact of net difference between forecast and observed (using PAR 5 guidance)	(i)	-£68.3m
	Outturn 60-year benefit	**(b) + (i)**	**-£57.0m**
% Difference between forecast and observed:			**-505%**

4.34. The -505% difference between forecast safety benefit and outturn safety dis-benefits has been applied to the forecast safety benefits from BBMM1 and BBMM2 presented in **Table 4-9**. This comparison between forecast and outturn journey time saving is presented in **Table 4-6**.

Table 4-10 Safety Saving and Monetary Benefit

	Forecast	Outturn
Total (BBMM2)	£11.3m	-£57.0m
Total (BBMM1 and BBMM2 combined)	**£16.6m**	**-£83.8m**

*2002 prices and values

4.35. Across BBMM1 and BBMM2, it was forecast for there to be a £16.6m safety benefit over the 60-year appraisal period. At outturn, there has been a dis-benefit across the 60-year appraisal period of -£83.8m. There is a difference between forecast and outturn due to the outturn evaluation demonstrating an increase in the annual number of collisions on the key links of the scheme between pre- and post-scheme. This change between pre- and post-scheme has been demonstrated to be statistically significant.

4.36. This approach to monetisation does not account for any changes to the severity of collisions as a result of the scheme, it only considers the average collision. The safety analysis of this scheme has demonstrated that although there are more collisions, the severity of these has decreased. Collisions rated as serious and fatal have a higher monetary value, and so had the impact of these been modelled in more detail then the dis-benefit to safety would have been lower.

Evaluation of Journey Time Reliability

Forecast Journey Time Reliability Benefits

4.37. The scheme appraisal included monetisation of reliability benefits for the scheme, but this type of value is not included in the standard BCR as set out in WebTAG guidance. Typically reliability includes the impact of the scheme on incidents and journey time variability, this scheme appraisal only considered the impact of the scheme on day-to-day journey time variability.

4.38. To calculate the impact of the scheme on journey time variability, the appraisal used standard deviation for the M6 mainline journey times and completed detailed reliability modelling for the local highway network. These were converted into a monetised value using value of time information from WebTAG.

4.39. The forecasting considered that there would be first, and second order benefits for journey time reliability as a result of the scheme. First order benefits are those benefits on journey time variability realised on the motorway sections where the scheme is in operation. Second order benefits are those which result in the 'ripple effect' of improved reliability on the motorway, attracting traffic from adjacent non-motorway routes. This in turn, was expected to improve congestion and reliability on non-motorway routes as well.

4.40. The monetised impact of journey time variability from the scheme appraisal equated to £0.16 per £1 of journey time saving, providing a 60-year benefit of £50.3m (in 2002 values and prices).

Evaluation of Journey Time Reliability Benefits

4.41. Analysis presented earlier in this report has shown that the scheme has improved journey time reliability (reducing journey time variability) for all scheme sections and time periods. For example, during the AM peak, the interquartile range reduced by over 20% in both directions, and in the PM peak, it reduced by approximately 60% in both directions. Given the limited data presented in the scheme appraisal documents it is not possible to quantify this improvement, in line with the forecasting methodology. Therefore, at this stage of the evaluation, in the absence of any additional information and based on the substantial improvements in journey time reliability demonstrated in earlier analysis, it is considered that the impact has been *'as expected'*.

4.42. This analysis has not presented journey time analysis on local roads so it is not possible to consider this in comparison to the forecast.

4.43. In line with the OYA evaluation, as a sufficiently robust evaluation approach could not be followed with the data available, the impact on journey time reliability has not been included within the Present Value Benefits (PVB) in this chapter. This is consistent with the appraisal.

Indirect Tax Revenue

4.44. Indirect Tax revenue is the expected change in the indirect tax revenue to the Government due to changes in the transport sector as a result of the scheme, over the appraisal period. For highways schemes, the tax impact is primarily derived from the monetisation of the forecast changes in fuel consumption over the 60-year period. A scheme may result in changes in fuel consumption due to:

- Changes in speed resulting in greater or lesser fuel efficiency for the same trips
- Changes in distance travelled
- Increased road use through induced traffic or the reduction of trip suppression.

Forecast Indirect Tax Revenue Impact

4.45. Forecasting the impact of the scheme on indirect tax was done in TUBA and modelled for BBMM1 and BBMM2 combined. Changes to indirect tax was forecast to be -£5.394m (2002

values, 2002 prices). This indicates that the scheme was expected to result in a decrease in indirect tax revenues to the government as a result of smoother flowing traffic meaning that journeys become more fuel efficient and/or shorter journeys through rerouting over the wide area.

4.46. At the time of appraisal, changes to indirect tax were considered as part of the scheme cost, rather than a benefit. Current guidance (AMCB, Analysis of Monetised Costs and Benefits) in WebTAG now considers costs only in terms of the 'broad transport budget', i.e. costs directly affect the budget available for transport. As such, two versions of the final economic evaluation will be presented to ensure for consistency with both the appraisal and current guidance.

Evaluation of Indirect Tax Revenue Impact

4.47. Whilst the outturn indirect tax revenues could be calculated, it is not considered possible to calculate them in a way that would allow for a like-for-like comparison with the scheme appraisal. As such, the PVC calculation will use the forecast indirect tax revenue impact of £5.394m (2002 values, 2002 prices) when considered as a cost.

Vehicle Operating Costs

4.48. Vehicle Operating Costs and indirect tax impacts are very closely linked to changes in fuel consumption, which can be affected by factors such as changes in speed. If there is increased fuel consumption, VOC will increase as drivers pay more for fuel (i.e. a dis-benefit to the driver), but this would result in increased indirect tax being collected by the Treasury (i.e. a benefit to the Treasury). Non-fuel VOC for non-business trips depends only on the distance travelled; as distance increases, so does the costs. For example, the scheme appraisal forecast a car-other dis-benefit in non-fuel VOC. This is explained by vehicles in this user class choosing longer distance routes to make use of the reduced travel time provided by the scheme.

4.49. Given that VOC is closely linked to indirect tax, for the reasons listed above, it is not considered possible to calculate them in a way that would allow for a like-for-like comparison with the scheme appraisal. As such, the PVC calculation will use the forecast VOC costs of £15.3m (2002 values, 2002 prices).

Carbon Impact

4.50. At appraisal, the TUBA model was used to calculate the monetary value for change in change emissions, based on a price per tonne, for BBMM1 and BBMM2 combined. In the opening year, there was expected to be a decrease of 417 tonnes of carbon across the West Midlands, and a reduction of 20,179 tonnes of carbon over the 60-year appraisal period, giving a small monetary benefit.

4.51. A proxy for the change in carbon emissions in the post opening period has been calculated using the forecast and observed journey times and traffic flows along the scheme section presented earlier in this report. The impact of the scheme on greenhouse gases (change in carbon outputs) is considered in detail in **Chapter 5** of this report.

4.52. This analysis shows that the scheme has had an as expected impact on greenhouse gases, therefore the outturn evaluation of the monetised impact has assumed the same value as that forecast.

Scheme Costs

4.53. This section compares the forecast costs of the scheme at the start of the construction period, with the actual spent at the time of writing this report. Scheme costs supplied by Highways England are for BBMM1 and BBMM2 combined, which is consistent with the appraisal.

4.54. Ideally, scheme costs for BBMM2 would be presented in isolation, but unfortunately this is not possible based on the information provided. Therefore, in line with the methodology adopted at OYA, the scheme costs for BBMM1 and BBMM2 have been included as a combined value.

4.55. The scheme costs were provided in 2007 prices. The scheme cost included an inflation element that has been removed to allow for comparison to outturn. These, along with the outturn costs, have been re-based to 2002 prices and are presented in **Table 4-11.**

Table 4-11 Forecast and Outturn Investment Costs

2002 prices	Cost (£m)
Forecast Cost	£116.0m
Outturn Cost	£117.3m

4.56. **Table 4-11** shows that the outturn scheme costs are slightly higher (approximately 1%) than the forecast scheme costs.

Present Value Costs

4.57. **Table 4-12** presents a summary of the forecast and observed present value costs. A 60-year cost is presented here, including operational costs. However, at this stage there is no outturn reassessment of the long term operational costs, instead the forecast operational costs have been maintained in the outturn evaluation of the total cost.

Table 4-12 – Summary of Forecast and Observed Present Value Costs

2002 prices and values	Forecast	Outturn
Operational Costs	£9.1m	
Investment Costs	£90.6m	£111.8m
Indirect Tax Revenue Impact	£5.4m	
Total PVC	**£105.1m**	**£126.3m**

*2002 prices and values

4.58. It can be seen from the table above that the outturn PVC is approximately 20% higher than forecast, unlike the similar values for the undiscounted investment costs shown in **Table 4-11**. Part of the difference can be explained by a difference in the assumed spend profiles, which can explain approximately 1% of the difference. The scale of difference between the discounted investment costs (23%) suggests that the scheme appraisal did not convert the forecast scheme costs into market prices using the standard conversion factor at the time of 1.209. Whilst this explanation is just an assumption, there is no data available to suggest an alternative explanation.

4.59. The values presented in **Table 4-12,** shown as present costs, will be used to calculate the BCR on a like-for-like basis with the benefits. For the purposes of evaluating the BCR, the forecast and outturn costs have been discounted to 2002 using the standard discount rate of 3.5% and converted to market prices.

Benefit Cost Ratio (BCR)

4.60. The Benefit Cost Ratio (BCR) is used as an indicator of the overall value for money of the scheme. It is the comparison of the benefits (PVB) and costs (PVC) expressed in terms of present value.

4.61. Projects with a BCR greater than one have greater benefits than costs; hence they have positive net benefits. The higher the ratio, the greater the benefits relative to the costs.

4.62. **Table 4–13** compares the predicted and outturn costs and benefits.

Table 4–13 – 60 Year BCR summary

		Forecast	Outturn Reforecast
Costs	**PVC (including Indirect Tax impact)**	**£105.1m**	**£126.3m**
Benefits	Journey time benefits	£346.0m	£217.9m
	Safety Benefits	£16.6m	-£83.8m
	Vehicle Operating Costs	£15.3m	
	Carbon benefits	£0.62m	
	User Charge	-£0.2m	
	PVB subtotal	**£378.4m**	**£149.8m**
	Indirect Tax Revenue	£5.4m	
Summary	PVC without Indirect Tax Revenue	£99.7m	£120.9
	PVB with Indirect Tax Revenue	**£383.7m**	**£155.2m**
	BCR (with indirect tax in PVC)	3.6	1.2
	BCR (with indirect tax in PVB)	**3.8**	**1.3**

4.63. It can be seen from **Table 4–13** that the BCR is lower than forecast due to lower than expected journey time benefits, a higher than forecast scheme cost, but mostly due to the outturn dis-benefit to safety. A BCR of 1.3 means that there is a return on investment of 30% for the project, or that for every pound spent, there is a return of 30 pence over and above the pound that has been spent. This is considered to represent low value for money according to DfT criteria.

4.64. It should be noted that the BCR does not include non-monetised impacts. According to the guidance in the Transport Business Case[25], the impact on wider objectives must be assessed but are not monetised.

Wider Economic Impacts

4.65. It is difficult to isolate wider economic impacts which could be attributed to a highway scheme. However, it is important to understand the socio-economic context in which the scheme opened, and how the scheme has assisted in local and regional socio-economic aspirations.

Forecast

4.66. An appraisal was completed for the wider economic impacts of the scheme. This was comprised of welfare benefits and GDP impacts, but only the GDP impacts were included in the overall economic appraisal. The impact of wider economic impacts has not been included in the BCR, in line with what was presented in the scheme appraisal.

4.67. The appraisal found that the welfare benefits amounted to approximately 14% of total user benefits, for both BBMM1 and BBMM2. The biggest component of these are agglomeration benefits, generated from the improved journey times. It was stated that with increased accessibility in the West Midlands region, firms are able to be more productive compared to without the scheme.

[25] https://www.gov.uk/government/publications/transport-business-case

Five Years After Opening Evaluation

4.68. The scheme appraisal conducted a detailed analysis of the impact of the scheme on the wider West Midlands economy. Whilst it is not possible to replicate this methodology for the purposes of this evaluation, this section discusses the extent to which the outturn has fulfilled the expectation of the forecasts.

4.69. Analysis presented earlier in this report shows that the weekday travel time benefits were lower than forecast, especially for vehicles travelling southbound. However, these are still considerable journey time savings. Journey time reliability has also improved which has benefits for all vehicles which use the scheme section, especially during peak periods.

4.70. Analysis has also shown that the scheme is being utilised for a larger proportion of the day than initially forecast. This is particularly evident during the Inter Peak periods, which is used when there were previously free-flow conditions, reducing speeds and increasing corresponding journey times in comparison to pre-scheme.

4.71. To conclude, based on the analysis presented in this report, it is considered that the scheme has contributed to the growth aspirations of the West Midlands region through the provision of additional capacity and improved journey times and reliability on a key strategic route through the region. It is considered that at outturn this is to the same extent as forecast. Although as the journey time benefits are lower than forecast, it is likely that if quantified this would be lower than forecast.

Key Points – Economy

Present Value Benefits (PVB)

- The outturn PVB is £149.8m compared to a forecast of £378.4m. The lower benefit in the outturn is primarily as a result of the safety dis-benefit. There was an observed increase in the annual number of PICs across the study area, in comparison to the without scheme (counterfactual) scenario based on pre-scheme data taking into account the background trend of collision reduction. This monetisation of the safety impact does not take into account the observed reduction in severity of the collisions.
- The journey time benefits are also lower than forecast, due to the lower than forecast saving/increase in the AM peak southbound and PM peak northbound. Despite an enforced reduction in speed limit when the scheme is operational, there are still substantial journey time benefits and improvements to reliability across the scheme section.
- Furthermore, as the scheme is often utilised during the Inter Peak, this lowers the speed limit to 60mph which has occasionally increased journey times outside of peak hours.

Costs

- The outturn PVC (£124.9m) is approximately 20% higher than that forecast (£105.1m), whereas the undiscounted investment costs are relatively similar (£116.0m forecast, £117.3m observed). This difference can be explained by a difference in assumed spend profiles. The scale of this difference suggests that the scheme appraisal did not convert the forecast scheme costs into market prices. This is just an assumption as no data is available to suggest an alternative explanation.
- After discounting, outturn investment costs were higher (23%) than forecast at £111.8m.

Benefit Cost Ratio (BCR)

- The forecast BCR was 3.58 and the outturn BCR is 1.3. The outturn BCR is lower than that forecast due to the higher than forecast PVC and lower than forecast PVB. This represents low value for money according to DfT criteria.

Wider Scheme Costs

- The scheme has contributed to the growth aspirations of the growth aspirations of the West Midlands region by providing additional capacity on the main strategic highways through the region.

5. Environment

Introduction

5.1. Following the successful trial of the first Active Traffic Management (ATM) pilot project on the M42 between junction 3A and junction 7, the (former) Highways Agency (HA) extended the ATM application to other motorway links around the Birmingham Box area. The Birmingham Box ATM[26] (BBATM) Phases 1 and 2 project includes sites on the M40, M42, and M6, and was undertaken in two phases.

- The first phase covered the sites on the M40 (J16 to M42 J3A Northbound), M42 (J7 to J9) and the M6 (J4 to J5); and
- The second phase covered the M6 section between J8 and J10a.

5.2. This chapter documents the evaluation of the environmental sub-objectives concerning the second phase, and focusses on those aspects that were either not fully evaluated at the One Year After (OYA) stage, or where suggestions were made for further study. Any issues that have arisen since the OYA evaluation are also evaluated here.

5.3. An Environmental Assessment Report (EAR) for Phases 1 and 2 of the ATM Rollout was produced for Highways England (formerly Highways Agency) in 2008, where the environmental objective of the scheme was stated as to have a globally neutral impact.

5.4. The EAR recommended that the overall environmental impact associated with the ATM Rollout scheme would not create the need for statutory Environmental Impact Assessment leading to the production of an Environmental Statement.

5.5. To build on the EAR and to understand the impacts on other aspects highlighted within the New Approach To Appraisal (NATA), roll out forecasting was revised and reported in 2009 by the BBATM Phases 1 and 2 – Modelling of the Impact of Rollout report (hereafter referred to as the BBATM 2009 report), whose objectives included the production of a full Appraisal Summary Table (hereafter referred to as the 2009 AST) and analysis of environmental objectives. The BBATM 2009 report concluded that the scheme was expected to have the following positive outcomes for environment:

- Modest improvements in air quality and carbon emissions; and
- Large benefits in terms of journey ambience, particularly in terms of reducing stress and unpredictability of journeys.

5.6. The majority of information required for the 2009 AST and worksheets under the Environment sub-objective of the BBATM 2009 report was sourced from the EAR, and the revised scoring of environmental impacts within the 2009 AST is consistent with the levels of impact implied by the recommendation of the EAR.

5.7. POPE is not aware of any significant environmental effects associated with design changes made to the scheme since the EAR or the BBATM 2009 report.

5.8. The following environmental sub-objectives were appraised in the 2009 AST according to NATA guidance at that time:

- Noise;
- Local Air Quality;
- Greenhouse Gases;
- Heritage;
- Landscape/ Townscape;

[26] Phases 1 and 2 of the roll out of ATM around the Birmingham Box are now referred to as Birmingham Box Managed Motorway (BBMM) Phases 1 and 2. However, to maintain consistency of terminology with the original reports, the term ATM will be used within this Chapter.

- Biodiversity;
- Water Environment;
- Physical fitness; and
- Journey Ambience.

5.9. For each of these environmental sub-objectives, the evaluation in this section assesses the environmental impacts predicted in the 2009 AST against those observed five years after opening.

5.10. In the context of the findings from the OYA evaluation and using new evidence collected five years after opening, this section presents:

- An evaluation of the ongoing effectiveness of the mitigation measures implemented as part of the scheme;
- An updated summary of key impacts against the nine environment WebTAG sub-objectives, with particular focus on the assessment of sub-objectives where it was too early for conclusions to be drawn at the OYA evaluation stage; and
- Additional analysis relevant to close out issues/ areas for further study identified at the OYA stage for consideration at the FYA stage.

Methodology

5.11. Although the detail of the OYA evaluation is not repeated here, reference is made to the OYA evaluation where required, and key points are incorporated into this FYA report to provide contextual understanding where appropriate.

5.12. No new modelling or survey work has been undertaken for this FYA environmental evaluation.

Data Collection

5.13. The following documents/ data have been used for the FYA evaluation of the M6 junction 8-10a Scheme:

- Productivity TIF27 Birmingham Box Active Traffic Management Phase 1 & 2 Environmental Assessment Report, Volume 1 Revision C, April 2008;
- Birmingham Box Active Traffic Management Phases 1 and 2 - Modelling of the Impact of Roll Out, March 2009, incorporating Appraisal Summary Table;
- Birmingham Box Managed Motorway Phases 1 and 2 - Modelling of the Impact of Roll Out, November 2009;
- M6 Junction 8-10a Managed Motorway One Year After Opening Study, April 2014;
- Sandwell Metropolitan Borough Council 2014 Air Quality Annual Status Report, July 2014;
- Walsall Council 2016 Air Quality Annual Status Report, January 2017;
- M6 J8-10a Phase 2b Planting Schedule, Undated; and
- As Built drawings (Earthworks, fencing, drainage, engineering, and infrastructure).

Site Visit

5.14. As part of the FYA evaluation, a site visit was undertaken in mid-May 2017. This included a review of the physical aspects of the scheme and inspection from publicly accessible locations (i.e. from footpaths, over bridges, subways etc.).

5.15. No viewpoint locations were noted in the landscape and visual assessment chapter of the EAR. Where possible, viewpoint locations noted in the OYA report were visited and photographs taken from the same locations to provide comparison with material produced at

[27] Transport Innovation Fund – The M6 J8-10a Scheme was initially developed as part of a bid for funding from the Productivity Transport Innovation Fund, which focused on schemes of national importance that would increase productivity through a reduction in congestion.

FYA; the photographs taken at both the OYA and FYA stages are included in this chapter and are noted as such.

Consultation

5.16. Statutory environmental organisations (Natural England and the Environment Agency), Walsall Metropolitan Borough Council, Sandwell Metropolitan Borough Council, and South Staffordshire Council were contacted as part of the FYA evaluation regarding their views on the impacts they perceive the scheme has had on the environment.

5.17. The OYA report noted that Historic England (formerly English Heritage) were not consulted, as the scheme was undertaken within the highway boundary and as far as POPE was aware, there had been no impact on archaeology. Historic England were not contacted as part of this evaluation, as the OYA report considered that no further evaluation of the heritage sub-objective was necessary at FYA.

5.18. The responses to consultation are as shown in **Table 5-1**.

Table 5–1 – Summary of Environmental Consultation Responses

Organisation	Field of Interest	Comments at OYA	Comments at FYA
Environment Agency	Water	No response	Did not respond to the invitation to provide feedback.
Natural England	Landscape and Ecology	No response	Had no comments to make.
Walsall Metropolitan Borough Council	General and Emissions	Noise complaints received during construction. Air quality monitoring information available. Consider it too soon to attempt a meaningful evaluation of the scheme given that the tranche of motorway is invariably influenced by other phases of on-going “ATM” (smart motorways) to the south and north. Traffic patterns not settled into an established pattern and considered unrepresentative due to other works.	Did not respond to the invitation to provide feedback.
Sandwell Metropolitan Borough Council	General and Emissions	Limited air quality information available, provided monitoring data and commentary. Unable to comment on noise as Sandwell does not routinely monitor noise.	Did not respond to the invitation to provide feedback.
South Staffordshire Council	Emissions	No response	Did not respond to the invitation to provide feedback.

5.19. The Area 9 Asset Support Contractor has also been contacted with regard to animal mortality figures, but no information has been provided.

Traffic Forecast Evaluation

5.20. Three of the environmental sub-objectives (noise, local air quality and greenhouse gases) are directly related to traffic flows. No new noise or air quality surveys are undertaken for Post-Opening Project Evaluation (POPE), and an assumption is made that the level of traffic and the level of traffic noise and local air quality are related.

5.21. The EAR outlined the need for the scheme and provided Annual Average Daily Totals (AADT). It also described the main features of the scheme, as previously described in **Chapter 1** of this report. It was assumed that the scheme would be in operation in 2010, with the 15th (design) year being 2025.

5.22. The OYA report noted that the traffic appraisal assumed that when the scheme was active (i.e. when HSR was in use) the increase in capacity would be 14%. The comparison of observed peak hour pre- and post-scheme traffic flows at OYA indicated that this assumption was broadly consistent with the increase in capacity observed in the outturn data.

5.23. The OYA report also highlighted that the traffic appraisal had assumed that the scheme would only be operational during week day peak periods, but noted that the analysis of traffic data at OYA showed that the scheme was in use outside of these defined periods, and that such an assumption had been superseded in the appraisal of a managed motorway scheme by the development of the Initial and Full Responsive Intervention Investment Tool[28] (IFRIIT) spreadsheet.

5.24. The OYA evaluation stated that an inconsistency in the EAR forecast off-peak flows meant that it was not appropriate to consider them at the OYA stage – no impact was forecast in the off peak and this was verified in the outturn evaluation at that time. Rather than allow the inconsistency in forecast off-peak flows to impact on the OYA evaluation, the observed off-peak flow was used in the forecast AADT calculation. In light of this and in order for comparisons to be directly drawn with the OYA report, the same approach has been taken in this evaluation; data are presented in **Table 5-3,** below. The location of traffic data collection points is shown in **Figure 2-1** of the Traffic Data Evaluation Chapter of this report, where an explanation of the differences between pre-scheme and post-scheme flow is also provided.

[28] The economic assessment of Managed Motorways – All lanes running. DMRB Interim Advice Note 164/12 Revision 1. Highways Agency, August 2012.

Table 5–2 – Do-Something Forecast and Outturn Traffic Flows (AADT) at OYA and at FYA

Location	Forecast*	Outturn	% Diff. Actual vs. Forecast	Forecast*	Outturn	% Diff. Actual vs. Forecast
	OYA (2011/2012)			FYA (2017)		
J8-9						
NB	79,500	83,400	5%	79,500	83,000	4%
SB	83,400	84,300	1%	82,200	83,600	2%
Two Way	162,900	167,700	3%	161,700	166,600	3%
J9-10						
NB	79,300	80,200	1%	80,500	83,500	4%
SB	81,300	77,300	-5%	80,100	77,300	-3%
Two Way	160,600	157,500	-2%	160,600	160,800	0%
J10-10a						
NB	77,500	73,400	-5%	N/A	N/A	N/A
SB	76,700	67,600	-12%	75,500	68,100	-10%
Two Way	154,200	141,000	-8%	N/A	N/A	N/A

*Forecast traffic flows taken from 'Birmingham Box Active Traffic Management Phases 1 and 2: Modelling the Impact of Roll Out (March 2009)

5.25. It can be observed that traffic flows are:

- Higher than forecast between junction 8 and 9, and on the J9-10 northbound carriageway, by up to 4%; and
- Where data is available, are less than forecast by up to 10% across the remainder of the Scheme.

5.26. No comparisons with OYA traffic flows between J10-10a (northbound) have been possible due to technical limitations of the traffic counting at sites at this location at FYA.

Table 5–3 – Do-Something Forecast and Outturn Speeds (kph) at OYA and at FYA

Location	Forecast	Outturn	% Diff. Forecast vs. Actual	Forecast*	Outturn	% Diff. Forecast vs. Actual
	OYA (2011/2012)			FYA (2017)		
J8-9						
NB	76	74	-2	73	89	+16
SB	61	75	+14	59	90	+31
J9-10						
NB	67	81	+14	61	98	+37
SB	71	68	-4	73	80	+7
J10-10a						
NB	71	88	+17	N/A	N/A	N/A
SB	83	79	-4	82	96	+14

*Forecast traffic flows taken from 'Birmingham Box Active Traffic Management Phases 1 and 2: Modelling the Impact of Roll Out' (March 2009) and forecast speeds taken from 'Productivity TIF Phase I and II Impact on the Economy' (September 2007) and interpolated between the provided values for 2011 and 2021 to predict 2017 speeds.

5.27. It can be seen that observed traffic speeds are greater than forecast by between 7 and 37kph throughout the Scheme.

5.28. No comparisons with OYA traffic speeds between junction 10 to 10a (northbound) have been possible due to technical limitations of the traffic counting at sites at this location at FYA.

5.29. Although POPE methodology would also normally take HGV data into account for evaluating the effects of the Scheme on noise, local air quality and greenhouse gases, technical limitations of the traffic counting at sites throughout the Scheme precluded any comparisons between HGV data to be made.

Five Years After Environmental Assessment

5.30. Included in this section is a brief summary of statements from the EAR, the BBATM 2009 report (including the updated 2009 AST) and the OYA evaluations, including close out/ key issues identified at OYA for further reporting at the FYA stage, which have been included (in chronological order) to provide the context for the FYA evaluation.

Noise

5.31. The EAR stated that the total number of buildings identified within a 300-metre corridor along the M6 between junctions 8-10a were 3,845 residential, 60 commercial, 33 industrial and 25 community, and noted that that increases in noise levels of less than 3 dB(A) could be regarded as slight. However, the EAR stated that for the 'do-something' scenario, the increase in noise levels of 1- <3 dB(A), although slight, would affect about 50% of all the residential buildings in the area and for 1 residential building, an increase of 3-<5 dB(A) was expected – a moderate impact. The EAR traffic model also indicated that over the 15-year period, traffic would increase by about 5-10% more with the scheme than without, and concluded that the overall impact of the scheme was **Slight**, albeit fairly widespread.

5.32. The BBATM 2009 report forecasted that only in the AM Peak period in 2016 was there a change in average noise emission levels (0.1dB). Elsewhere, the change in population annoyed was calculated as zero, an indicative value stated as showing that the change in population annoyed was very small.

5.33. The 2009 AST stated that the overall assessment of the impact of the Scheme on the noise climate was **Neutral** as around 3% of the network links would experience increases in traffic levels sufficient to trigger potential noise impacts. Only 3% of the exposed populations were estimated to suffer noise annoyance (2016 AM Peak only), and there would be no change in the number of people annoyed in the 15th year (after opening).

5.34. The OYA noise evaluation concluded that although the lower enforced speed limit when Hard Shoulder Running (HSR) was in operation would appear to have reduced traffic noise at some locations and at certain time periods, it was considered too soon for a full evaluation to be made. Although the impact of the Scheme on noise was stated as likely to be Neutral, the evaluation suggested that noise be reconsidered at the FYA stage when traffic patterns had settled.

FYA Consultation

5.35. No responses to consultation requests were received.

FYA Evaluation

5.36. The OYA evaluation did not confirm the Road Surface Index (RSI) value of the resurfaced carriageways; no high-speed RSI values were made available for the FYA study and as such, any noise reduction properties of the installed surfacing remain unconfirmed.

5.37. The OYA evaluation also confirmed that existing environmental barriers had been retained where possible, and that new/replacement barriers had been provided as necessary. Although it did not confirm the performance specification of the new noise barriers; it noted that the scheme specification stated that the height of all proposed environmental barriers should match that of the existing barriers and that they were to be acoustic deflective, 10kg per square metre, with galvanized steel universal beam posts. No performance specification was made available for the FYA study and as such, any noise reduction properties of the new/ replacement barriers remain unconfirmed.

5.38. The OYA noise evaluation noted that the BBMM Phase 1 & 2 Monitoring and Evaluation Milestone 3: Phase 2 After Construction Noise Data Analysis Report (March 2012) concluded that the scheme had "*… resulted in the reduction in road traffic noise primarily through the reduction of traffic speed. The magnitude of the reductions at the northern end of the scheme extents are likely to be just perceptible in the short-term whereas at the southern end reductions are larger and likely to be readily perceptible. This reduction in noise relative to baseline has come about despite a corresponding increase in traffic demand and throughput*".

5.39. An assumption is made by POPE methodology that noise levels will be as expected if observed traffic flows are within 25% more or 20% less than predicted; as can be seen by the comparison of both the predicted and observed OYA/FYA AADT[29] flows in **Table 5-2** above, the data indicates that the observed AADT Traffic Flows are between 4% more and 10% less than predicted at all locations and as such, all are within the tolerances prescribed by POPE.

5.40. However, an assumption is also made by POPE methodology that noise levels will be as expected if average speeds are within 10kph more or 10kph less than predicted; as can be seen by the comparison of both the predicted and observed OYA speeds in and **Table 5-3**, above, the data indicates that:

- Observed speeds are 7kph more than predicted between junction 9 and 10 (southbound); this speed is within the tolerances prescribed by POPE and as such, is considered to have an effect on the noise climate that is as expected.
- Observed speeds are between 14kph and 37kph more throughout the rest of the Scheme; these speeds exceed the tolerances prescribed by POPE and as such, are considered to have an effect on the noise climate that is worse than expected.

5.41. Although POPE methodology would normally take HGV data into account when evaluating noise, no comparisons between HGV data have been made due to technical limitations of the traffic counting at sites through the scheme.

5.42. Although the AADT and flows are within the tolerances prescribed by POPE methodology, based on traffic speed data, it is considered likely that the noise climate as a result of the Scheme is generally worse than expected, although the junction 9 to 10 (southbound) is likely to be as expected.

[29] AADT: Annual Average Daily Traffic, the average 24-hour traffic, seven days a week, for all days within the year

Table 5–4 – Evaluation Summary: Noise

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Noise	Around 3% of network links experience increases in traffic levels sufficient to trigger potential noise impacts. Only 3% of exposed populations are estimated to suffer noise annoyance (2016 AM Peak only). No change in number of people annoyed in 15th year. **Neutral.**	The lower enforced speed limit when HSR is in operation would appear to have reduced noise due to traffic for some locations and at certain time periods. Walsall Metropolitan Borough Council (MBC) considers that traffic patterns have not established yet and have been influenced by other phases of Managed Motorways (MM) and that it is too early to evaluate the impacts. Noise should be considered further at FYA when traffic patterns have settled. **Likely to be neutral, but too soon to evaluate at OYA.**	Observed AADT Flows are between 4% more and 10% less than predicted at all locations, and are within the tolerances prescribed by POPE for the noise climate to be considered as expected. Observed traffic speeds are also within the tolerances for the noise climate to be considered as expected between J9-10 SB, but at all other locations, traffic speeds exceed these tolerances and the impact of the Scheme on the noise climate is considered worse than expected.	**Generally worse than expected, but as expected between J9-10 SB.**

Local Air Quality

5.43. The EAR stated that a detailed air quality assessment was warranted, as Air Quality Management Areas (AQMAs) had been designated in the vicinity of the proposed scheme. AQMAs are declared by local authorities when pollutant concentrations exceed the objectives of the Air Quality Strategy (AQS) objectives. Under these circumstances the local authority is charged with developing an action plan to improve air quality, and to bring these concentrations within the objectives.

5.44. The EAR stated that the total emissions calculations showed that within the area of the M6, emissions were estimated to increase with the introduction of the smart motorway by 2% for oxides of nitrogen (NO_X) and particulate matter (PM), and by 5% for carbon dioxide (CO_2). These changes in emissions were said to directly reflect a combination of changes in traffic flows, plus a smoothing of driving characteristics estimated with the introduction of the smart motorway. Overall the changes in emissions associated with the scheme were considered by the EAR to be relatively small, particularly when compared to changes in emissions associated with the process of vehicle fleet turnover. The resulting impacts of the scheme on air pollutant concentrations were considered to be negligible for both NO_2 and PM_{10} with no exceedances of the AQMS objectives.

Update since EAR

5.45. The BBATM 2009 report stated that local air quality assessment using the revised traffic forecasts for the WebTAG assessment indicated that the levels of change in exposure were relatively small – the scheme was not predicted to have a considerable impact on air quality for any individual motorway sections (measured as a change of >2 µg/m^3 in NO_2 or >1 µg/m^3 in PM_{10}). This low level of change in exposure was said to be consistent with that forecast in the EAR. The regional air quality assessment showed a reduction in NO_X of 810 tonnes/year (-2.1%) and a reduction in PM_{10} of 44 tonnes/year (-5%) in 2016 as a result of the scheme.

5.46. The report also stated that the scheme was expected to contribute to improving 10-year plan targets of air quality, and expected Walsall and Sandwell AQMA to be slightly improved by the scheme.

5.47. The 2009 AST stated that the scheme was not predicted to have a significant impact on air quality for any links; no overall assessment of the degree of any adverse or beneficial impacts of the Scheme on Air Quality was given, although it was stated that 3,853 properties would experience an improvement in Air Quality.

5.48. The OYA evaluation stated that based on the air quality monitoring data available, air quality was likely to be as expected (i.e. with no significant change as a result of the scheme). It was, however, suggested that air quality be reconsidered at FYA when traffic flows had established, and when air quality monitoring data should be available for a longer period, which would enable any trends in pollution concentrations to be determined.

FYA Consultation

5.49. No responses to consultation requests were received.

FYA Evaluation

5.50. With the exception of the (approximate) 1.7km northern extents of the scheme and J8, the entire Scheme, from the Vernon Way overbridge to Walsall Road (to the south), is contained within an area designated as Walsall AQMA 2006 in relation to NO_2 only. The Walsall Council 2016 Air Quality Annual Status Report (ASR) outlined the strategies employed by Walsall Council to improve Air Quality and progress that had been made.

5.51. The ASR stated that monitoring was carried out at 9 locations, three of which were monitoring for NO_2 within 500m of the Scheme. The results of the annual mean NO_2 monitoring are shown below in **Table 5–5.**

- Bloxwich Lane (within approx. 250m northeast of M6 junction 10);
- Alumwell (within 500m to the southeast of M6 junction 10); and
- M6 Junction 9.

Table 5–5 –Annual Mean NO_2 Monitoring Results in Walsall 2012 - 2016

Location	Site type	2010	2011	2012	2013	2014	2015*	2016	2017
Bloxwich Lane	Roadside	-	-	**53.3**	**43.6**	**40.7**	**44.1**	**41.1**	-
Alumwell	Urban background	26.7	-	30.9	32.8	-	30.9	29.5	-
M6 Junction 9	Roadside	**52.5 (43.9)**	**65.4 (49.8)**	**52.0** (**44.3**)	**47.7** (**40.3**)	**52.8** (**42.4**)	**49.2** (**40.4**)	**47.5** (37.5)	-

NB. Distance adjusted concentrations to nearest relevant receptor is shown in brackets, NO_2 exceedances of 40 µg/m^3 are shown in bold red.

5.52. It can be seen that despite fluctuations, there is an overall downward trend in annual mean NO_2 roadside concentrations. At the urban background site, there has been little change since 2012.

5.53. Junction 8 of the M6 is located within Sandwell Metropolitan Borough Council. Sandwell's 2014 Air Quality Progress Report (AQPR) stated that whole borough had been designated as an AQMA in 2005 due to exceedances of the annual mean NO2 objective, and that the Council

had undertaken 12 months of continuous monitoring at 5 locations during the period 1st January 2013 to 31st December 2013, including one site on Wilderness Lane, Great Barr (within 100m to the north of the M6 junction 8) along with an extensive programme of diffusion tube monitoring.

5.54. While POPE is not aware of any more recent data, the results for 2013 were stated by Sandwell's 2014 AQPR to be comparable to those recorded in 2012, and had shown no evidence of a strong downward trend in NO_2 concentrations throughout the previous 5 years. Monitoring data for 2013, was stated as confirming ongoing exceedances of the annual mean NO_2 objective in the areas to the north M6 J8 (Wilderness Lane and Birmingham Road, Great Barr) and to the south of the M6 J8 (including Longleat Close, Ragley Drive and Himley Close, Great Barr).

5.55. An assumption is made by POPE methodology that local air quality will be as expected if observed 2-way traffic flows (i.e. the sum of the directional flows) are within +/-1000 of those predicted. As can be seen by the comparison of both the predicted and observed AADT flows in **Table 5-2,** above, the data indicates that:

- J8-9: Observed AADT is higher than forecast by 4,900 vehicles, indicating that pollutant concentrations are likely to be higher (i.e. worse) than expected;
- J9-10: Observed AADT is higher than forecast by 200 vehicles, indicating that pollutant concentrations are likely to be as expected.
- J10-10a: While the lack of data available for the northbound carriageway means that confirmation is required, the observed AADT on the southbound carriageway is lower than forecast by 7,400 vehicles, indicating that pollutant concentrations may be less (i.e. better) than expected.

5.56. An assumption is also made by POPE methodology that local air quality will be as expected if observed average speeds are within 10kph more or 10kph less than predicted. However, it should be noted that the relationship between speed and emissions is not always straightforward. Emissions tend to be lowest during free-flow conditions, typically between 30 and 50 km/hr, and highest at low speeds during congested conditions, and at high speeds, such as on motorways. As can be seen by the comparison of both the predicted and observed speeds in **Table 5-3** above, the data indicates that in all cases observed speeds are higher than forecast. This indicates that emissions are likely to be higher than forecast, although if this is as a result of the reduction in congestion then there is still a likelihood that emissions are lower than they would have been in congested conditions. A large change in traffic flow would however, typically outweigh the effect in air quality from a change in speed.

5.57. The significance of the compared predicted and observed values of the assumptions made by the POPE methodology are summarised in **Table 5-6.**

Table 5–6 – Assumptions made by POPE methodology - Summary of the significance of the differences between predicted and observed values.

Location	% Diff. AADT (Forecast vs. Actual)	Absolute No. of Vehicles (Forecast vs. Actual)	% Diff Speed (Forecast vs. Actual)
	FYA (2017)		
J8-9			
NB	4%	***4,900***	***+16***
SB	2%		***+31***
J9-10			
NB	4%	200	***+37***
SB	3%		+7
J10-10a			
NB	-	-	-
SB	-10%	**-7,400**	***+14***

Green (bold) (significant, better than expected)
Orange (italics) (insignificant, as expected)
Red (bold italics) (significant, worse than expected)

5.58. Although POPE methodology would normally also take HGV data into account when evaluating local air quality, no comparisons between HGV data have been made due to technical limitations of the traffic counting at sites through the scheme.

Summary

5.59. Despite fluctuations, the overall trend in annual mean NO_2 roadside concentrations in the vicinity of the Scheme for Walsall shows a decrease in recent years.

5.60. Monitoring data for Sandwell in 2013 confirmed ongoing exceedances of the annual mean NO_2 AQS objective in the areas to the north and south of M6 J8. No more recent data is available.

5.61. It is considered that between Junction 8 and 9, local air quality as a result of the Scheme is likely to be worse than expected based on both the AADT and traffic speed data for this link. Between Junction 9 and 10, air quality is likely to be as expected based on the AADT data, while on the southbound link between junction 10 and 10a, air quality may be better than expected, based on the AADT data.

Table 5–7 – Evaluation Summary: Air Quality

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Local Air Quality	The scheme is not predicted to have a significant impact on air quality for any links (measured as a change of >2 µg/m^3 in NO_2 or >1 µg/m^3 in PM_{10}) Annual change (2016) in tonnes of: - NO_x: -810 - PM_{10}: -44 **Net total assessment (2016):** **NO_2 -396** **PM_{10} -99** **3,853 properties improved**	Based on the air quality monitoring data available it is likely that the scheme has not resulted in significant changes to local air quality. Walsall MBC considers that traffic patterns have not established yet and have been influenced by other phases of MM and that it is too early to evaluate the impacts. Air Quality should be considered further at FYA when traffic patterns have settled and a longer period of air quality monitoring data would be available. **Likely to be as expected – no significant change**	Despite the overall downward trend in NO_2 exceedance values within the Walsall AQMA 2006, both AADT flow and speed data for the junction 8-9 link indicate that pollutant concentrations are likely to be worse than expected. Based on the AADT data it is considered likely that pollutant concentrations along the junction 9-10 link are as expected, and better than expected along the junction 10-10a link.	**Worse than expected between junction 8 and 9.** **As expected between junction 9 and 10.** **Better than expected between junction 10 and 10a.**

Greenhouse Gases

5.62. The assessment of the impacts of transport schemes on emissions of greenhouse gases is one of the environment sub-objectives. WebTAG notes that carbon dioxide (CO_2) is considered the most important greenhouse gas for transport, which is therefore used as the key indicator for the purposes of assessing the impacts of transport options on climate change. Changes in CO_2 levels are expressed in terms of equivalent tonnes of carbon released as a result of the scheme.

Forecast

5.63. At appraisal, the TUBA model was used to calculate the monetary value for change in change emissions, based on a price per tonne, for BBMM1 and BBMM2 combined. The study area for this appraisal was a model of the wider West Midlands network, which includes rerouting. In the opening year, there was expected to be a decrease of 417 tonnes of carbon across the West Midlands, and a reduction of 20,179 across the 60-year appraisal period.

Evaluation

5.64. The evaluation has used the forecast and outturn figures for traffic flows and speeds to create carbon re-forecasts at outturn along the scheme, by section. This allows a comparison to be made between re=forecast and outturn data. This is only calculated for the scheme section, not the wider modelled area as forecast.

5.65. The evaluation has been carried out using the DMRB Air Quality Modelling Spreadsheet to calculate the change in greenhouse gases on the M6 scheme section alone. The model used to calculate the forecast used a TUBA model of the wider West Midlands network, which allowed for re-routeing. Previous analysis has demonstrated that there has been traffic growth

on the M6 scheme section, which will result in more carbon emissions in both the re-forecast and observed results shown in **Table 5–8.**

Table 5–8 – Change in Greenhouse Gases on M6 Scheme Section (tonnes of carbon/year) (2011)[30]

	Re - Forecast		Observed
Do Minimum	39,969	Pre-Scheme	37,970
Do Something	40,176	Post-Scheme	38,545
Difference	207 (+0.5%)	Difference	575 (1.5%)

5.66. **Table 5–8** shows that along the length of the scheme the outturn carbon impact has been greater than was forecast. However, in terms of the percentage change, the increase is 1% higher than expected from the re-forecast traffic flows and speeds.

5.67. Therefore, taking into consideration the accuracy of the methodology used to calculate these values, it can be considered that the impact on greenhouse gases is as expected.

Table 5–9 – Summary of Greenhouse Gases

Sub-Objective	AST Score	FYA Evaluation
Greenhouse Gases	Overall change in carbon emissions across the West Midlands network is -0.01%. Change in tonnes of carbon expected: - Opening Year -417 - Appraisal Period -20,179	Along the M6 corridor the scheme has had an **as expected impact** on greenhouse gases,

Landscape and Townscape

5.68. The EAR stated that the key landscape impacts would primarily comprise new visual intrusion associated with local vegetation loss within the existing soft estate and would be derived from any '*new views*' of gantries/ structures. Mitigation was stated to focus on addressing particular local sensitivities e.g. residential areas or other publicly accessible areas. The EAR also noted that the "*various cantilever gantries, portal gantries, signals, CCTV masts and, barrier works being of necessity highly visible to road users, can only rarely give rise to any beneficial landscape or visual impact. At best, the installation of the signals and CCTV results in 'no change' or a 'neutral effect' on the landscape.*" The EAR did not deal with townscape as a separate issue, although it described the urban forms alongside the motorway as part of its landscape assessment.

5.69. The EAR concluded that in general, the majority of structures could be incorporated into the surrounding landscape pattern with **negligible** residual impact, and noted that the existing tree and shrub belts within the highway estate would be supplemented by new planting with the aim of integrating the motorway improvement scheme into the local landscape, and expected mitigation to include planting of individual trees and shrubs, and the management of existing areas of vegetation.

[30] Calculated using the DMRB Regional Impact Assessment Spreadsheet, assuming a year of 2011 to create a 'counter-factual' scenario to ensure a like-for-like comparison between pre- and post-scheme, without taking into account background traffic growth.

5.70. The BBATM 2009 report noted that much of the landscape in the area comprised "*ordinary quality land*" with medium to low sensitivity to change, and that the landscape was on the urban fringe or had been subject to encroachment by development and mining works leading to some deterioration of land quality. It considered the key impacts on landscape to arise from the new Emergency Refuge Areas (ERAs), and the key impacts on visual amenity to arise from new electronic displays, either free-standing or on new or existing gantries. Mitigation planting was expected to include individual trees and shrubs and the management of existing areas. New planting would, wherever possible, use native species appropriate to the location and to match the existing planting, and was expected to reinstate screening 10-15 years after construction.

5.71. The 2009 AST (Landscape) stated that the majority of structures could be incorporated into the surrounding landscape pattern with negligible residual impact. The retention of as much of the soft estate as possible would seek to achieve the development within the existing landscape framework where possible whilst enabling the development of a comprehensive set of additional complementary planting proposals to contribute to the scheme's integration into the local landscape. Mitigation planting would include individual trees and shrubs and management of existing areas. The overall AST score for Landscape was **Neutral.**

5.72. The BBATM 2009 report considered that additional infrastructure in the form of signal gantries and ERAs would have little material impact on existing townscapes, given that the works would be accommodated within the existing disturbed motorway corridor. Townscape impacts were expected to be limited to townscape views, and the additional visual intrusion generated by the additional infrastructure.

5.73. The 2009 AST (Townscape) stated that additional infrastructure in the form of signal gantries and Emergency Refuge Areas (ERAs) would have little impact on existing townscapes given that the works would be accommodated within the existing disturbed motorway corridor. The majority of structures could be incorporated into the surrounding townscape pattern with negligible residual impact. The retention of as much of the soft estate as possible would seek to achieve the development within the existing townscape framework where possible whilst enabling the development of a comprehensive set of additional complementary planting proposals to minimise the long term impact of the scheme on townscape appearance and views. The overall AST score for Townscape was **Slight Adverse.**

5.74. The OYA evaluation stated that in terms of landscape, the existing screen planting had been retained which allowed the scheme to be generally implemented within the established landscape framework, although there had been some additional urbanisation of the motorway corridor; overall, the impact of the Scheme was stated to be **Neutral, as expected,** but it was noted that very little post-opening information had been available for evaluation at OYA, and that Landscape should be reconsidered at FYA.

5.75. The OYA evaluation stated that in terms of Townscape, the impacts had been limited by the existing highway vegetation, although there would have been some additional visual intrusion generated by the additional infrastructure; the overall assessment of the impact of the Scheme on Townscape was stated to be **Slight Adverse, as expected.**

FYA Consultation

5.76. Natural England responded that they had no comments to make.

FYA Evaluation

5.77. Where landscape and townscape impacts of the proposals were identified in the EAR, mitigation measures, including the retention of existing vegetation and the reinstatement of planting where vegetation was not able to be retained, were incorporated into the scheme to avoid, minimise, or reduce potentially adverse impacts.

5.78. In terms of the retention of existing vegetation, the OYA evaluation confirmed that existing vegetation had been retained, and that this vegetation continued to provide a landscape framework for the motorway corridor. The FYA site visit observed that the retained vegetation

was continuing to perform the screening function noted by the OYA report, and had developed since the time of the OYA evaluation; this is illustrated below by **Figure 5-1** to **Figure 5-3.**

Figure 5-1 Bloxwich Lane, view of gantry

The new signal gantry is clearly visible from the footpath adjacent to Bloxwich Lane, both at OYA (April 2014, left) and at FYA (May 2017, right), but is not out of keeping with the existing motorway infrastructure. It can also be seen that the retained vegetation continues to provide a landscape framework for the motorway corridor, and has developed since the OYA evaluation.

Figure 5-2 Southey Close, view of gantry

The new gantry adjacent to Southey Close at OYA (April 2014, left), and at FYA May 2017, (right). It can be seen that the retained vegetation continues to perform a screening function for the gantry and limits townscape impacts, and has developed since the time of the OYA evaluation.

Figure 5-3 Oregon Drive

Since the OYA evaluation (April 2014, left), the retained vegetation has developed and continues to screen the M6 and limit townscape impacts on Oregon Drive at FYA (May 2017, right).

5.79. In terms of the reinstatement of planting where vegetation was not able to be retained, the (Undated) M6 J8-10a Phase 2b Planting Schedule stated that proposed planting was to comprise native trees and shrubs in small groups along the motorway corridor.

5.80. POPE has been unable to confirm as to whether planting has been undertaken in accordance with the M6 J8-10a Phase 2 Planting Schedule or to fully evaluate the condition or degree of establishment of any such reinstatement planting, as the majority of the planting plots noted in the planting schedule were unable to be observed from the publicly accessible locations visited by POPE as part of the FYA evaluation, and no further information regarding planting has been received since the OYA evaluation.

5.81. A single planting plot near Lichfield Road was observed by the FYA site visit; the development of this plot since the OYA evaluation is illustrated by **Figure 5-4** below, where it can be seen that the new planting on the batter has established and developed as would reasonably be expected at this stage.

5.82. In terms of species composition of the planting plot at Lichfield Road, while hazel and acer species were identified by the FYA site visit as components, the species composition of the planting plot as a whole, and the condition of the individual plants with respect to pest and diseases, was unable to be ascertained as the plot was unable to be accessed directly.

Figure 5-4 Planting Plot at Lichfield Road

The planting plot at Lichfield Road at OYA (April 2014, left), and at as observed by the site visit at FYA (May 2017, right) where it can be seen that establishment appears to be broadly as would be expected.

5.83. In terms of maintenance of the planting plot at Lichfield Road, **Figure 5-5** (below) illustrates that plant protectors in the form of spiral guards remain intact (highlighted), and the height of the underlying sward suggests that maintenance operations, in the form of cutting, have been undertaken during the previous growing season (2016).

Figure 5-5 Planting Plot at Lichfield Road (FYA)

5.84. No records of maintenance operations or any specific issues arising during the Aftercare Period have been made available for this evaluation.

5.85. Despite the increased urbanisation of the motorway corridor, the OYA evaluation concluded that this urbanisation was generally limited to the motorway corridor itself and the townscape character areas adjacent to the motorway had not changed significantly as a result of the scheme, and this was confirmed during the FYA site visit; no further evaluation regarding Townscape was undertaken, as there were no unresolved issues from the OYA evaluation, and no further issues were identified during the FYA site visit.

Summary

5.86. Whilst there has been some urbanisation of the motorway corridor, the coverage and condition of the retained vegetation continues to perform a screening function, and has developed since the time of the OYA evaluation to further integrate the scheme within the established landscape framework and limit both landscape and townscape impacts.

5.87. While POPE has been unable to confirm as to whether reinstatement planting has been undertaken in full accordance with the M6 J8-10a Phase 2 Planting Schedule or to fully evaluate the condition or degree of establishment of any such planting, plant establishment and development within the single planting plot able to be observed during the FYA site visit is as would reasonably be expected at this stage, and evidence of previous maintenance operations, comprising grass cutting, was apparent.

5.88. Based on the available evidence, it is concluded that the overall landscape effects of the scheme are likely to be neutral and broadly **as expected,** although further information is required to fully evaluate the success or otherwise of the reinstatement planting.

5.89. There is no reason to suggest that townscape impacts are anything other than as concluded at OYA, and are **slight adverse, as expected.**

Table 5–10 – Evaluation Summary: Landscape

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Landscape	The majority of structures can be incorporated into the surrounding landscape pattern with negligible residual impact. The retention of as much of the soft estate as possible would seek to achieve the development within the existing landscape framework where possible whilst enabling the development of a comprehensive set of additional complementary planting proposals to contribute to the scheme's integration into the local landscape. Mitigation planting will include individual trees and shrubs and management of existing areas. **Neutral.**	Existing screen planting has been retained which has allowed the scheme to be generally implemented within the established landscape framework. There has been some additional urbanisation of the motorway corridor. Very little post opening information has been available at OYA and landscape should be reconsidered at FYA. **Neutral, as expected.**	The coverage and condition of the retained vegetation continues to perform a screening function and integrate the scheme within the established landscape framework. Plant establishment and development within the single planting plot able to be observed during the FYA site visit is as would reasonably be expected, and evidence of previous maintenance operations was apparent.	**Likely to be broadly as expected, although further information is required to confirm the extent and success or otherwise of the reinstatement planting.**

Table 5–11 – Evaluation Summary: Townscape

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Townscape	Additional infrastructure in the form of signal gantries and Emergency Refuge Areas will have little impact on existing townscapes given that the works will be accommodated within the existing disturbed motorway corridor. The majority of structures can be incorporated into the surrounding townscape pattern with negligible residual impact. The retention of as much of the soft estate as possible would seek to achieve the development within the existing townscape framework where possible whilst enabling the development of a comprehensive set of additional complementary planting proposals to minimise the long term impact of the scheme on townscape appearance and views. **Slight Adverse.**	As expected, the impacts on townscape have been limited by the existing highway vegetation. There will have been some additional visual intrusion generated by the additional infrastructure. **Slight adverse, as expected.**	In line with the OYA findings, the scheme has resulted in some increased urbanisation that is generally limited to the motorway corridor. The Townscape character areas that are adjacent to the motorway have not changed significantly as a result of the scheme. **Slight Adverse.**	**As expected.**

Cultural Heritage & Archaeology

5.90. The EAR stated that the scale of the works, undertaken entirely within the (former) HA boundary, would not have a significant detrimental impact upon any '*known assets*' of archaeological or cultural heritage importance. Furthermore, it was anticipated that the scheme would not have a significant adverse visual impact on the setting of any Conservation Area along the route corridor.

5.91. The BBATM 2009 report stated that from a review of available information, it could be concluded that the proposed works, undertaken entirely within the HA boundary, would not have a direct significant detrimental impact upon any '*known assets*' of archaeological or cultural heritage importance[31]. The retention of established tree and shrub cover within the

[31] The BBATM 2009 report (including the 2009 AST) also stated that there remained a potential slight adverse impact on the setting of remains of a Motte and Bailey scheduled monument (a large conical or pyramidal mound of soil or stone - the motte - surrounded by, or adjacent to, one or more embanked enclosures - the bailey) adjacent to the M6 at J5. This site was noted as having limited amenity having been mostly destroyed during construction of the M6, and with limited public access. However, while relevant to the Phase 1 scheme (i.e. the M40 J16 to M42 J3A Northbound, M42 J7-9, and the M6 J4-5), the monument is not relevant to the Phase 2 scheme and as such, the evaluation of any impact on this monument does not lie within the scope of this study.

(former) HA boundary and mitigation planting was expected to reduce any potential adverse effects. Mitigation measures, in the form of the retention of existing vegetation or new/ replacement planting, was expected to minimise any potential adverse impacts on the settings of heritage features.

5.92. The 2009 AST stated that there were considered to be no impacts on most heritage resources, noting that while there would be some temporary and short term impacts relating to construction and removal of vegetation, these impacts would be remediated through replacement planting. Overall, the effects of the Scheme were predicted to be Neutral.

5.93. The OYA evaluation stated that it was unaware of any impact on archaeology, **as expected,** and that no further evaluation of the heritage sub-objective was necessary at FYA.

FYA Consultation

5.94. No requests for consultation were made.

FYA Evaluation

5.95. POPE methodology assumes that by the FYA evaluation, all archaeological reports should have been published and deposited in the agreed archive for future reference.

5.96. The EAR stated that in the unlikely event of the identification of significant archaeological features within the existing highway boundary during the construction process and any watching brief, contingency plans (including excavation with a view to obtaining a full record of any archaeological remains prior to construction and producing of a report on the findings) would be activated.

5.97. POPE is unaware of any archaeological reports relating to the scheme being produced.

5.98. The OYA report considered that there had been no long-term impacts to the setting of the Grade II listed James Bridge Aqueduct on the Walsall canal (which passes under the M6 (about 200 metres away to right of view) and although not as a result of the scheme under evaluation here, a comparison of the photographs taken during the OYA and FYA site visits (respectively **Figure 5-6**, below) show that the setting of the Grade II listed James Bridge Aqueduct on the Walsall canal has been improved since publication of the OYA report.

Figure 5-6 James Bridge Aqueduct

Although not as a result of the scheme, it can be seen that at FYA (May 2017, right), the setting of the Grade II listed James Bridge Aqueduct on the Walsall canal has been improved since evaluation at OYA (April 2014, left).

5.99. No further evaluation has been undertaken, as no changes regarding Cultural Heritage as a result of the scheme since the OYA evaluation were identified during the FYA evaluation.

5.100. Based on the evidence presented, it is considered that the effects of the scheme are as expected.

Table 5–12 – Evaluation Summary: Heritage

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Heritage	There are considered to be no impacts on most heritage resources. There will be some temporary and short term impacts relating to construction and removal of vegetation although these will be remediated through replacement planting. *(Refer also to Footnote 5, above).* **Neutral**.	POPE is not aware that there have been any impacts on archaeology. The setting of the Grade II Listed James Bridge aqueduct is not considered to have been adversely affected by the scheme. **Neutral, as expected.**	No changes regarding Cultural Heritage as a result of the scheme were identified during the FYA evaluation.	**As expected.**

Biodiversity

5.101. Both the EAR and the BBATM 2009 report stated that:

- Implementation of the scheme would cause minor site-specific permanent loss of habitat within the highway boundary only, which was assessed as being of intrinsic biodiversity value and as such, of negligible nature conservation value. Nevertheless, this habitat was stated to support ecologically sensitive and / or legally protected species such as amphibians and reptiles, badgers and nesting birds, and so any loss or disturbance to this habitat was to be negated through appropriate mitigation. With the exception of the Great Crested Newt (GCN) for which residual impacts were noted as uncertain[32] (although likely to be of relatively low impact magnitude and relatively easy to mitigate), the predicted residual impacts of the scheme on species were not expected to be significant.
- The immediate offsite habitats include sensitive designated sites, such as Sites of Special Scientific Interest (SSSI's), Sites of Important Nature Conservation (SINC's), Local Nature Reserves (LNR's), and important habitats such as running water and semi-natural ancient woodland likely to support species such as otter, water vole, bats, white-clawed crayfish, and bullhead (a type of freshwater fish). During construction, the potential to significantly affect any sensitive site, habitat, or species, either on or offsite, through direct or indirect temporary degradation or disturbance was expected to be mitigated for, and residual impacts were not expected to be significant.
- A licence from Natural England would be required for works affecting badger and potentially for GCN.
- It was expected that the future habitat potential of the works corridor would be enhanced by the increased use of native species in planting, and by the creation of more structured habitat types to improve habitat connectivity; although this enhancement was not thought to warrant a significant positive impact, it was expected to make some contribution to the (former) HA and national biodiversity objectives. It was suggested that some hibernacula could also be built on site as an enhancement measure in line with the (former) HA Reptile and GCN Biodiversity Action Plan (BAP).

5.102. The 2009 AST stated that there would be no significant impact on designated sites or established habitats. The works to be undertaken were not anticipated to damage, disturb, or prevent species dispersal from or to breeding sites, although potential nesting, hibernation, or foraging sites might be subject to these potential effects. There was also potential for direct

[32] Due to the absence of detailed field survey information.

loss of terrestrial habitat that may be used for shelter, although such potential habitat loss was expected to be minor and not significant in total. Overall the effects of the scheme on biodiversity were expected to be **Slight Adverse.**

5.103. The OYA evaluation stated that although the Scheme was not expected to result in any significant adverse impacts on biodiversity (as it would be constructed within the existing highway boundary), there was the potential for reptiles, GCNs, badgers, and breeding birds to be affected. While the OYA report considered that impacts on these species were likely to be as expected, it was noted that insufficient information had been made available to confirm this at OYA, and that Biodiversity should be reconsidered at FYA.

FYA Consultation

5.104. Natural England responded that they had no comments to make.

FYA Evaluation: Species

5.105. In terms of impacts of the scheme on species, the OYA evaluation noted that:

- It was unaware of any evidence of white clawed crayfish, freshwater fish, otter, or water vole in the vicinity of the scheme;
- No information relating to the impact of the scheme on reptiles, badgers, other UK Priority Biodiversity Action Plan (BAP) species, or the status of GCN within the (former) HA soft estate had been provided for the OYA evaluation; and that
- It was not aware if there had been any impacts on bats as a result of the scheme.

5.106. No further information or evidence has been made available to POPE at FYA for the purposes of evaluation and while there is no reason to suspect that impact of the scheme on the species noted above is likely to be anything other than as concluded by the OYA evaluation (i.e. as expected), further information would be required to confirm this.

5.107. No information or evidence has been made available to for the purposes of this evaluation regarding the impact or otherwise of the scheme on bullhead.

5.108. In terms of the impact of the scheme on breeding birds, the OYA evaluation confirmed that habitat loss, i.e. loss of nesting sites, had been mitigated by minimising the removal of existing vegetation. As noted in the landscape sub-objective, above, the retained vegetation has developed since the time of the OYA evaluation and as such, potential nesting sites for breeding birds continue to be provided.

5.109. No animal mortality data has been made available for the purposes of this study; as such, no conclusions can be drawn regarding the effects of the scheme on this aspect of the biodiversity sub-objective.

Evaluation: Habitat

5.110. In terms of impacts of the scheme on habitat, the OYA evaluation noted that it was unaware of any impact on any designated sites or on the local water environment.

5.111. As discussed above, the coverage and condition of the retained vegetation continues to provide habitat within the soft estate, and has developed further since the time of the OYA evaluation.

5.112. No hibernacula were observed from the publicly accessible locations visited by POPE as part of the FYA evaluation.

5.113. No further information or evidence has been made available to POPE at FYA for the purposes of evaluation and while there is no reason to suspect that impact of the scheme on habitat is likely to be anything other than as concluded by the OYA evaluation (i.e. as expected), further information would be required to confirm this.

Evaluation Summary

5.114. While there is no reason to suspect that impact of the scheme on species is likely to be anything other than as concluded by the OYA evaluation (i.e. as expected), further information would be required to confirm this.

5.115. In terms of habitat, while the coverage and condition of the retained vegetation continues to provide habitat, the establishment and performance of the majority of new planting plots and the presence of new hibernacula have not been able to be confirmed at this stage.

5.116. It is therefore concluded that the effects of the scheme on Biodiversity are likely to be broadly as expected, but confirmation is required.

Table 5–13 – Evaluation Summary: Biodiversity

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Biodiversity	No significant impact on designated sites or established habitats. The works undertaken are not anticipated to damage, disturb, or prevent dispersal from or to breeding sites, although potential nesting, hibernation, or foraging sites may be subject to these potential affects. There is also potential for direct loss of terrestrial habitat that may be used for shelter, although such potential habitat loss is expected to be minor and not significant in total. **Slight Adverse.**	Insufficient information has been made available to POPE to fully evaluate the impacts of the scheme on biodiversity. **Likely to be as expected, but further data would be required to confirm this**.	Species While there is no reason to suspect that impact of the scheme on species is likely to be anything other than as expected, further information is required to confirm. Habitat While the coverage and condition of the retained vegetation continues to provide habitat, the establishment and performance of the majority of new planting plots and the presence of new hibernacula have not been able to be confirmed.	**Likely to be as expected, but confirmation is required.**

Water Quality and Drainage

5.117. The EAR stated that the most serious potential for any impacts on water quality and drainage would occur during the construction phase, but would be minimised by close control (by the contractor) and adherence to a comprehensive Construction Environmental Management Plan (CEMP). The EAR indicated that there were generally no new significant incursions into the water table or surrounding flood plains, or any significant direct impacts on rivers, standing water, or other water bodies. No change was expected in the rate of discharge at any of the existing outfalls, all of which were to be maintained in their existing position and condition, and no impacts on groundwater, aquifers or on any source protection zones were expected. The application of the mitigation principles, specifically the use of catch pits and cut off valves (able be operated in response to any accidental pollution incident), was expected to offer a significant operational benefit over the existing water quality control and management of the network. Overall, the impacts associated with the proposals were considered to be **Neutral.**

5.118. The BBATM 2009 report reiterated the findings of the EAR, although the impacts associated with the proposals were considered negligible to minor adverse, rather than neutral.

5.119. The 2009 AST stated that there would be no new significant incursions into the water table, surrounding flood plains, or any significant direct impacts on rivers, standing water, or other water bodies, and there would be no change in the rate of discharge at any of the existing outfalls, which would all be maintained in their existing position and condition. There would be no impacts on groundwater, aquifers, or on any source protection zones. The greatest potential for any impacts on water quality and drainage were predicted to occur during the construction phase, but it was stated that these could be minimised by close control (by the contractor) and adherence to a comprehensive CEMP. Overall, the effects of the scheme on the water environment were expected by the 2009 AST to be **Neutral to Slight Adverse.**

5.120. The OYA evaluation confirmed that drainage had been designed to tie into the existing network which has been retained/ refurbished/ upgraded as required, and that new drainage and pollution control measures had been provided at the ERAs with a kerb and gulley positive drainage system, in combination with a system of pipes, chambers, throttle pipes and penstock arrangements to contain drainage and any accidental spillage event locally. No pollution incidents, either during the construction phase or operational phase were reported, and the predicted overall impact of the scheme was considered to be neutral during operation as expected (by the EAR). However, it was noted that the water quality and drainage sub-objective should be reconsidered at FYA.

FYA Consultation

5.121. No responses to consultation requests were received.

FYA Evaluation

5.122. The OYA evaluation confirmed that, based on the As Built drawings, drainage had been designed to tie into the existing network which has been retained/ refurbished/ upgraded as required, new drainage and pollution control measures had been provided at the ERAs, and the existing drainage network / outfalls had been retained.

5.123. No water quality monitoring data / information has been made available to POPE for this evaluation, and no information has been received at FYA to indicate whether any incidents had occurred that may have affected the drainage system.

5.124. No further evaluation has been undertaken, as no changes regarding drainage and the water environment since the OYA evaluation were identified during the FYA evaluation, and no drainage measures were able to be observed from publicly accessible locations by the FYA site visit.

Summary

5.125. Operational mitigation measures have been incorporated into the scheme, as expected, and no information has been provided to POPE which would indicate that drainage is performing other than as expected; it is therefore concluded that while there is no evidence to suggest that the effects of the scheme on the water environment anything other than **as expected** by the 2009 AST (i.e. Neutral to Slight Adverse), further information is required to confirm.

Table 5–14 – Evaluation Summary: Water Quality and Drainage

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Water	No new significant incursions into the water table, surrounding flood plains or any significant direct impacts on rivers, standing water, or other water bodies. No change in the rate of discharge at any of the existing outfalls which will all be maintained in their existing position and condition. No impacts on groundwater, aquifers or on any source protection zones. The greatest potential for any impacts on water quality and drainage would occur during the construction phase, but can be minimised by close control by the contractor and adherence to a comprehensive CEMP. **Neutral to Slight Adverse.**	Mitigation measures have been incorporated into the scheme and the existing drainage network / outfalls retained. No information has been provided which would indicate that drainage is performing other than as expected. **Neutral during operation, as expected.**	No information has been provided which would indicate that drainage is performing other than as expected.	**Likely to be as expected, although confirmation is required.**

Physical Fitness

5.126. The EAR stated that as the works would be undertaken entirely within the existing highway land and that no direct or indirect impacts on pedestrians, cyclists, equestrians, or communities were anticipated, assessment of these types of sensitive receptors was not considered applicable.

5.127. The BBATM 2009 report stated that the impact of the Scheme on Physical Fitness would be neutral in terms of the directly affected motorway links. However, analysis of traffic volume changes on the approach to motorway junctions within the area of the scheme was detailed under the Severance sub-objective, which anticipated there to be a limited increase in traffic on these approach roads.

5.128. The 2009 AST stated that the scheme would have no direct impacts on pedestrian and cyclist activity, as these road users are prohibited from the motorway. Secondary impacts on the propensity to walk or cycle for more than 30 minutes resulting from changes in traffic volumes on roads surrounding the motorway junctions within the scheme area were considered minimal; overall, the impacts of the Scheme were assessed as **Neutral.**

5.129. The OYA evaluation considered that there were no operational impacts of Scheme regarding physical fitness, and that the predicted AST score of neutral was accurate and therefore **as**

expected; it was also noted that further evaluation of this sub-objective was not proposed at FYA.

FYA Consultation

5.130. No consultation requests were made.

FYA Evaluation

5.131. POPE is unaware of any Non-Motorised User (NMU) audits or Vulnerable User studies undertaken for this scheme.

5.132. All footpaths and cycleways adjacent to the scheme that were viewed during the FYA site visit appeared to be maintained and capable of performing as expected, and pedestrians were observed using footpaths.

5.133. No further evaluation has been undertaken, as no changes regarding physical fitness since the OYA evaluation were identified during the FYA evaluation.

Summary

5.134. There were no unresolved issues from the OYA report, and no changes regarding physical fitness since the OYA evaluation were identified during the FYA site visit; it is therefore concluded that the effects of the scheme on physical fitness remain neutral, **as expected.**

Table 5–15 – Evaluation Summary: Physical Fitness

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Physical Fitness	The scheme has no direct impacts on pedestrian and cyclist activity as these road users are prohibited from the motorway. Secondary impacts on the propensity to walk or cycle for more than 30 minutes resulting from changes in traffic volumes on roads surrounding the motorway junctions within the scheme area are considered to be minimal. **Neutral.**	As expected, the scheme has had no direct impact on pedestrians and cyclists. **Neutral, as expected.**	All footpaths and cycleways adjacent to the scheme that were viewed during the FYA site visit appeared to be maintained and capable of performing as expected.	**As expected.**

Journey Ambience

5.135. The journey ambience sub-objective considers traveller care (facilities and information), traveller views, and traveller stress (frustration, fear of potential accidents, and route uncertainty).

5.136. The EAR assessed the effects of the Scheme on drivers and their passengers under two areas, namely Views from the Road (i.e. Traveller Views) and Driver (i.e. Traveller) Stress:

- *Views from the Road:* The EAR expected that there would undoubtedly be an increase in the urbanisation of the motorway corridor due to the number and density of new structures, although it was noted that the significance of the degree of change would not be uniformly perceived due to the varying degrees of existing urbanisation

(in the form of adjacent development, existing lighting, and visual clutter) associated with the motorway corridor; and
- *Driver Stress*: The EAR stated that it was difficult to draw any firm conclusions on the overall potential for changes in driver stress based on a limited amount of data, and on the application of an assessment methodology that was not specifically set up to assess a dynamically managed motorway network.

5.137. The BBATM 2009 report stated that in terms of:

- *Traveller care* - this referred specifically to the provision of emergency refuge areas (ERA's) and general travel information, such as messages relating to accidents or roadworks elsewhere on the network. There would be no change in the provision of service areas as part of this scheme;
- *Traveller views* - while the Scheme had relatively few distinctive features or attributes upon which the road user would focus, or recognise, as having special or particularly valued landscape characteristics, there would undoubtedly be an increase in the urbanisation of the motorway corridor due to the number and density of new structures; and
- *Traveller stress* - the Scheme would improve traffic flow (leading to a reduction in frustration), provide support for additional speed enforcement measures (leading to a reduction in the fear of accidents), and provide route / network information (leading to a reduction in route uncertainty).

5.138. The 2009 AST stated the new ERA's and electronic information signs would improve perceptions of safety and confidence in use of the motorway, and that variable speed limits and HSR were expected to reduce congestion related frustration by improving the flow of traffic. Additional gantries were expected to have a minor detrimental impact on views, although mainly in rural areas; overall, a **Large Beneficial** impact was predicted for Journey Ambience.

5.139. In terms of Traveller Care, the OYA stated that the Scheme had resulted in a beneficial impact as:

- Emergency refuge areas had been provided as a replacement to the hard shoulder during periods when HSR is in operation; and
- Gantries provide Advance Motorway Indicators (AMI) and MS4 Message Signs in addition to fixed directional sign plates (signal gantries), and sign plates alone (sign gantries). The AMIs were considered to provide information on availability and maximum speed limits for each lane across the carriageway, while the MS4 signs provided instructions to drivers (e.g. *Use hard shoulder for J9*) and detailed pictorial and textual information regarding general traffic conditions.

5.140. In terms of Traveller Views, the OYA considered that there had been an adverse impact due to an increase in the urbanisation of the motorway corridor due to the number and density of new structures.

5.141. In terms of Traveller Stress, the OYA stated that the Scheme resulted in beneficial impacts as:

- There had been an improvement in journey times southbound towards Birmingham, and a slight increase in journey times northbound on the M6. Although the improvement in journey times had been slightly lower than forecast, this was balanced by the fact that the scheme has been utilised far more than had been assumed in the scheme appraisal. Journey time reliability had improved, which supports the Schemes objective to reduce congestion. It was considered likely that freer flowing traffic would have improved driver stress;
- Accident rates had improved since the scheme was built, and fear of accidents should have decreased as a result; ERAs had been provided; and

- Gantries and signage had been implemented as expected, thereby decreasing route uncertainty.

5.142. Overall, the OYA stated that the impact of the Scheme on Journey Ambience was beneficial and **as expected.**

FYA Consultation

5.143. No responses to consultation requests were received.

FYA: Traveller Care

5.144. The FYA site visit observed the route to be well signed, with junctions providing safe access and egress points to and from the M6 and Emergency Refuge Areas (ERA's) clearly marked. HSR was observed to be in operation during the FYA site visit (as illustrated in **Figure 5-7**, below), and AMI's were observed to be providing information on availability and maximum speed limits for each lane across the carriageway; detailed pictorial and textual information was provided by MS4 signs.

Figure 5-7 Hard Shoulder Running (HSR) in operation

Hard shoulder running in operation at the time of the FYA site visit (May 2017). The ERA is clearly signed (just left of centre), and the AMI's and MS4 are providing detailed information to travellers.

5.145. As noted above, the site visit observed that ERA's had been provided; in terms of ERA provision and frequency, the DMRB Interim Managed Motorways All Lanes Running Advice Note (IAN) 161/ 12 states that refuge areas must be provided such that a driver is never more than 2.5km from a refuge, and the Smart Motorways IAN 161/ 15 states that the distance between refuge areas shall not exceed 2.5km - POPE is not aware of any relaxation or Departures from standards that have been issued for this Scheme.

5.146. No further evaluation regarding Traveller Care was undertaken, as no other issues were identified during the FYA site visit and there were no unresolved issues from the OYA evaluation.

FYA Evaluation: Traveller Views

5.147. At the time of the FYA site visit, verges were found to be generally tidy and litter free where able to be observed.

5.148. As discussed in the landscape sub-objective, above, the OYA evaluation confirmed that existing vegetation had been retained wherever possible, and that the retained vegetation has continued to provide a landscape framework for the motorway corridor.

5.149. As noted at OYA, the perception of urbanisation along the motorway corridor has undoubtedly increased as a result of the number and density of new structures along the motorway corridor; while it is considered that signing is a part of the expected traveller experience and that the adverse effects of any increase in highway 'clutter' on Traveller Views are not significant in isolation, the cumulative effect of additional infrastructure has increased the visual presence of signage throughout the route.

5.150. No further evaluation regarding Traveller Views was undertaken, as no other issues were identified during the FYA site visit and there were no unresolved issues from the OYA evaluation.

FYA Evaluation: Traveller Stress

5.151. It is considered that the increased capacity of the M6 when HSR is in operation is likely to provide more opportunities for the safe overtaking of slower vehicles and a greater likelihood of free-flowing traffic; consequently, the scheme is considered likely to have resulted in a reduction in the degree of driver frustration, and therefore driver stress.

5.152. The provision of clearly signed ERA's and clear, informative signage is considered to have had a beneficial effect on perceived safety and as such, the fear of accidents is likely to have been reduced. However, and as discussed in the Safety chapter, above, while the observed safety impact of the scheme shows that between pre- and post-scheme, there has been an increase in the collision rate, there has been a decrease in the severity of collisions along the length of the scheme, indicating that the scheme is partly fulfilling its objective to reduce the impact of collisions.

5.153. The provision of clear, informative signage is also considered to have had a beneficial effect on route uncertainty.

5.154. The considerable improvement in journey time reliability that has been observed northbound and southbound in all time periods is discussed in detail within the Traffic Analysis and Journey Times chapters of this report, and is considered to have had a beneficial impact of Traveller stress.

5.155. No further evaluation regarding Traveller Stress was undertaken, as no other issues were identified during the FYA evaluation and there were no unresolved issues from the OYA report.

FYA Evaluation Summary

5.156. It is considered that the overall effects of the scheme on Traveller Care and Traveller Views are beneficial, as expected.

5.157. **Table 5–16**, summarises the evaluation of the scheme's impact on Journey Ambience.

Table 5–16 – Evaluation Summary: Journey Ambience

Sub Objective	2009 AST (Forecast)	OYA Evaluation (April 2014)	FYA Evaluation (May 2017)	
			Summary	Assessment
Journey Ambience	New emergency refuge areas and electronic information signs will improve perceptions of safety and confidence in use of motorway through treated sections. Variable speed limits and HSR reduce frustration caused by congestion by improving flow of traffic. Additional gantries may have some minor detrimental impact on views in mainly rural areas. 110,000 daily motorway users benefit in terms of improved journey quality. **Large Beneficial.**	Impacts on journey ambience are as expected. Reduction in congestion and improved traffic flows will have reduced driver stress and improved journey times. Collision rates are unchanged as a result of the scheme. ERA's have been provided to replace the hard shoulder, and electronic information relieves route uncertainty. Slight additional urbanisation of the motorway corridor due to additional signs and gantries. **Beneficial, as expected.**	<u>Traveller Care</u> ERA's are clearly signed, and electronically provided information on the availability and maximum speed limits for each lane across the carriageway, along with detailed pictorial and text information, is clear. <u>Traveller Views</u> Retained vegetation has continued to provide a landscape framework for the motorway corridor. The adverse effects of any increase in highway 'clutter' and perceived urbanisation of the route corridor on Traveller Views are not considered significant in isolation. <u>Traveller Stress</u> The increased capacity of the M6 when HSR is in operation is likely to provide more opportunities for the safe overtaking of slower vehicles and a greater likelihood of free-flowing traffic. Journey time reliability has also significant improved. The provision of clearly signed ERA's and clear, informative signage is considered to have had a beneficial effect on perceived safety and on route uncertainty. There has been a decrease in the severity of collisions along the length of the scheme, indicating that the scheme is partly fulfilling its objective to reduce the impact of collisions.	**As expected.**

Key Points – Environment

Noise

- Traffic speed data suggests that it is likely that the noise climate as a result of the Scheme is generally worse than expected, although the junction 9 to 10 southbound link is likely to be as expected.

Local air quality

- It is considered that between Junction 8 and 9, local air quality as a result of the Scheme is likely to be worse than expected based on both the AADT and traffic speed data for this link. Between Junction 9 and 10, air quality is likely to be as expected based on the AADT data, while on the southbound link between junction 10 and 10a, air quality may be better than expected, based on the AADT data.

Greenhouse gases

- The outturn carbon impact is 1% higher than forecast, which is likely to be due to the scheme being switched on during the Inter Peak when this was not originally forecast to be the case. Taking into consideration that accuracy of the methodology used to calculate these values, it is considered that the impact on greenhouse gases is as expected.

Landscape

- Mitigation measures, including the retention of existing vegetation and the reinstatement of planting where vegetation was not able to be retained, were incorporated into the scheme to avoid, minimise, or reduce potentially adverse impacts.
- The coverage and condition of the retained vegetation continues to perform a screening function and integrate the scheme within the established landscape framework. Plant establishment and development within the single planting plot able to be observed during the FYA site visit is as would reasonably be expected, and evidence of historic maintenance operations was apparent.
- No records of maintenance operations or any specific issues arising during the Aftercare Period have been made available for this evaluation.

Townscape

- In line with the OYA findings, the scheme has resulted in some increased urbanisation that is generally limited to the motorway corridor. The Townscape character of the areas adjacent to the motorway have not changed significantly as a result of the scheme.

Biodiversity

- While there is no reason to suspect that impact of the scheme on species is likely to be anything other than as expected, further information is required to confirm this.
- While the coverage and condition of the retained vegetation continues to provide habitat, the establishment and performance of the majority of new planting plots and the presence of new hibernacula has not been able to be confirmed.

Heritage

- There is no evidence to suggest that the effects of the scheme on Cultural Heritage are anything other than as expected.

Water

- There is no evidence to suggest that the overall effect of the scheme on water quality and drainage is anything other than what would be expected at this time.

Physical Fitness

- The effects of the scheme on physical fitness are considered to be neutral and as expected, as there are no unresolved issues from the OYA report and no changes since the OYA evaluation were identified during the FYA site survey.

Journey Ambience

- Traveller Care - ERA's are clearly signed, and electronically provided information on the availability and maximum speed limits for each lane across the carriageway, along with detailed pictorial and text information, is clear.
- Traveller Views - Retained vegetation has continued to provide a landscape framework for the motorway corridor, and the adverse effects of any increase in highway 'clutter' and perceived urbanisation of the route corridor on Traveller Views are not considered significant in isolation.
- Traveller Stress - The increased capacity of the M6 when HSR is in operation is likely to provide more opportunities for the safe overtaking of slower vehicles and a greater likelihood of free-flowing traffic. The significant improvement in journey time reliability will also contributed to reduced traveller stress. The provision of clearly signed ERA's and clear, informative signage is considered to have had a beneficial effect of perceived safety and on route uncertainty. There has been a decrease in the severity of collisions along the length of the scheme, indicating that the scheme is partly fulfilling its objective to reduce the impact of collisions.

6. Accessibility and Integration

Introduction

6.1. This chapter evaluates the impact of the scheme in terms of accessibility and integration sub-objectives.

6.2. The accessibility objective is primarily concerned with how the scheme has affected the ability of people in different locations to travel to a range of destinations using any mode of transport. It consists of three sub-objectives:

- Option Values;
- Severance; and
- Access to the Transport System.

The integration objective considers how the scheme assists different modes of transport in working together and the ease of people moving between them to choose to use sustainable transport modes. It consists of three sub-objectives:

- Transport Interchange;
- Land-Use Policy; and
- Other Government Policies.

6.3. The AST for this scheme presents the combined impact for both BBMM1 and BBMM2. The assessment presented in the AST is applicable to both schemes, and as such this evaluation does not distinguish between the impacts of the two schemes, with the exception of 'Land Use Policy'. This evaluation is based on a desk based study and observations from a site visit conducted in May 2017.

Accessibility

Option Values

Forecast

6.4. Option Values, as defined in WebTAG, relate to measures which will substantially change the availability of transport services within the study area.

6.5. The AST states that the scheme '*does not provide any new transport infrastructure or route options'.* As such, the AST forecasted a score of **neutral.**

Evaluation

6.6. As stated in the AST, the scheme has not provided any new transport infrastructure. It is considered that detailed evaluation of this sub-objective would not reveal any further changes to option values as a result of implementing this scheme. Therefore, the forecast scoring of **neutral** is upheld at outturn.

Severance

Forecast

6.7. The severance sub-objective primarily relates to the impact of the scheme on non-motorised users. WebTAG states that severance is only an issue where '*vehicle flows are significant enough to impede pedestrian movement or where infrastructure presents a physical barrier to movement'.*

6.8. The AST forecast that the scheme would not generate sufficient change to traffic levels on the local highway network and motorway junctions within the scheme area, and therefore that the

scheme would not generate any severance impacts. As such, the AST forecast a score of **neutral.**

Evaluation

6.9. This outturn evaluation supports that the scheme has not resulted in a significant change to traffic levels on the local highway network and motorway junctions within the scheme area. The scheme has not provided any new infrastructure that presents a physical barrier to pedestrian movement. Therefore, the forecast scoring of **neutral** is upheld at outturn.

Access to the Transport System

Forecast

6.10. WebTAG states that access to the transport system is strongly influenced by access to a private vehicle and proximity to public transport services.

6.11. The AST states that this scheme does not change the supply of transport infrastructure or public transport provision, nor provide new access points onto the local highway network for residents. Therefore, the AST forecast a score of **neutral.**

Evaluation

6.12. As stated in the AST, the scheme has not changed the supply of transport infrastructure of access to public transport services. Therefore, the forecast scoring of **neutral** is upheld at outturn.

Integration

Transport Interchange

Forecast

6.13. This sub-objective considers the extent to which to the scheme improves the ability of different modes of transport to work together and the ease of people moving between these modes to choose to travel sustainably.

6.14. The AST states that the scheme '*does not provide any new transport interchange facilities'.* As such, the AST forecast a score of **neutral.**

Evaluation

6.15. As stated in the AST, the scheme has not provided any new transport interchange facilities. Therefore, the forecast scoring of **neutral** is upheld at outturn.

Land Use and Other Government Policies

Forecast

6.16. This sub-objective considers how the scheme relates to national, regional and local level policies, as well as current local land use and wider government objectives.

The AST provides a range of impact of the scheme in relation to this sub-objective for both BBMM1 and BBMM2. These are shown in **Table 6-1.** Those which are applicable for BBMM2 will be considered in this evaluation.

Table 6-1 Land Use and Government Policy Qualitative Impacts by Scheme

Qualitative Impact	Scheme
LAND USE POLICIES	
Beneficial to local and national business development, especially development of key employment centres such as NEC, Birmingham Airport and Land Rover.	BBMM1
Enhances access to, and improves competitiveness of regional and major investment sites and regeneration zones	BBMM1 BBMM2
Contributes to the development of strategic park and ride, and forms first stage of consideration of policy towards motorway widening.	BBMM1 BBMM2
Increased pressure for inappropriate development in green belt areas.	BBMM1 BBMM2
GOVERNMENT POLICIES	
Improving the economic competitiveness of the Birmingham city region by facilitating efficient movement of goods and people in and out of the region.	BBMM1 BBMM2
Contributes to enhancing competitiveness of other UK regions where movement between regions is dependent on the West Midlands motorway network	BBMM1 BBMM2
Marginal contribution towards expanding employment opportunities, but improved reliability of access to employment may assist in encouraging greater take-up of jobs at these locations	BBMM1 BBMM2

Evaluation

6.17. From the above points, the policies relating to park and ride and development in green belt areas have not yet come to fruition. The scheme has increased the competitiveness of the region, by increasing capacity on the M6 and improving journey time reliability and variability. The measures of journey time reliability and variability are important for business users and freight, to ensure that goods deliveries are made on time and individuals have more certainty in the time it will take to complete their journey. In addition, the scheme has also directly facilitated the provision of two additional adjacent managed motorway schemes: M6 junction 5 to 8 (BBMM3) and M6 junction 8 to 10a. The provision of these three schemes will help to enhance the local competitiveness of the region, and as well as the competitiveness of other UK regions where movement of dependent on this section of the West Midlands motorway network. This is considered as an improvement, as the M6 is a known bottleneck for both local and regional traffic movements.

6.18. There are a number of retail parks and large employment sites located along the length of the scheme, most notably at junction 9 and 10. In early 2017, a new distribution centre for large supermarket chain, Lidl, opened in Wednesbury, which will benefit from excellent links to the M6 and wider motorway network from junction 9. At junction 9, the Gallagher Retail Park has also undergone re-development, with new retailers occupying outlets on the park, creating approximately 150 new jobs.

6.19. The West Midlands Integrated Transport Authority has produced The West Midlands Local Transport Plan (LTP) (2011 – 2026). There are several aspects of this document which are directly of relevance to the scheme:

- To underpin private sector led growth and economic regeneration in the West Midlands Metropolitan Area.
- To make best use of existing transport assets and capacity.
- To provide improvements to existing strategic and local highways networks to improve traffic flow and reliability.
- Encourage people to move away from car use.

6.20. Of the strategy elements detailed above, it is considered that the scheme directly facilitates the first three aspects. As detailed earlier in this report, the scheme has increased traffic levels along the scheme section, above the levels which can be explained by background growth through the provision of an additional lane and consequent increases to capacity. It has also improved journey time reliability. These factors can encourage economic growth and regeneration whilst making best use of the existing transport assets and capacity. However, it is not considered that the scheme helps to meet the fourth aspect of the LTP described above. The improvement in highway conditions may encourage car use, rather than encourage people to move away.

6.21. Taking into consideration the points made above, the forecast scoring of **beneficial** has been upheld at this outturn evaluation.

Key Points – Accessibility and Integration

Accessibility

- It is considered that the AST rating of neutral for option values, severance and access to the transport system sub-objectives is appropriate given the outturn impact of the scheme.

Integration

- The scheme has not impacted the provision of public transport interchange, so the forecast rating of neutral has been upheld.
- The scheme integrates well with the objectives set out in the regional policies and contributes to improving the reliability of the transport system in the region. Therefore, the outturn assessment is scored in line with forecast, as beneficial.

7. Appraisal Summary Table and Evaluation Summary Table

Appraisal Summary Table (AST)

7.1. The AST is a summary of the main economic, safety, environmental and social impacts of a highway scheme. **Table 7-1** presents the AST for this scheme.

7.2. In particular, the AST presents a brief description of the scheme, a statement detailing the problems that the scheme planned to address, and makes an assessment of the schemes predicted qualitative and quantitative impacts against the following objectives:

- **Environment** – an estimate of the impact of the scheme on factors such as noise, local air quality, landscape, biodiversity and water.
- **Safety** – measured reduction in the number and severity of collisions and qualitative assessment of impacts on security.
- **Economy** – Estimated impact of the scheme upon journey times, vehicle operating costs, scheme costs, journey time reliability and wider economic impact.
- **Accessibility** – A review of scheme impact upon access to the public transport network, community severance, and non-motorised user impact.
- **Integration** – A description of how a scheme is integrated with wider local planning, regional and national policy objectives**.**

Evaluation Summary Table (EST)

7.3. The EST was devised for the POPE process to record a summary of the outturn impacts against the objectives, compared to the predictions in the AST.

7.4. Drawing on the results presented in this report, **Table 7-2** presents the EST for the scheme. An assessment of each of the objectives at the FYA stage is given. Where possible, the format of the EST mirrors the appearance and process of the AST to enable direct comparison between the two.

Table 7-1 – Appraisal Summary Table (March 2009)

Scheme:	Description:	Problems:	Present Value Cost £m:
Birmingham Motorway Box Active Traffic Management Phase 1&2	**Implementation of Active Traffic Management including variable speed limits and HSR on a number of sections of the Birmingham motorway box**	**Significant congestion on sections of the M6 and M42 especially at peak times and during major events**	**£105.2m**

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Environment	**Noise**	Around 3% of network links experience increases in traffic levels sufficient to trigger potential noise impacts. Only 3% of exposed populations are estimated to suffer noise annoyance (2016 AM Peak only)	No change in number of people annoyed in 15th year	Neutral
	Local Air Quality	The scheme is not predicted to have a significant impact on air quality for any links (measured as a change of >2 µg/m3 in NO2 or >1 µg/m3 in PM10)	Annual change (2016) in tonnes of: - NOx: -810 - PM10: -44	Net total assessment (2016): NO2 -396 PM10 -99 3,853 properties improved
	Greenhouse Gases	Overall change in carbon emissions across the West Midlands network is -0.01%	Change in tonnes of carbon emitted: - Opening year: -417 - Appraisal period: -20,179	PVB £0.62m
	Landscape	The majority of structures can be incorporated into the surrounding landscape pattern with negligible residual impact. The retention of as much of the soft estate as possible would seek to achieve the development within the existing landscape framework where possible whilst enabling the development of a comprehensive set of additional complementary planting proposals to contribute to the scheme's integration into the local landscape. Mitigation planting will include individual trees and shrubs and management of existing areas.		Neutral
	Townscape	Additional infrastructure in the form of signal gantries and Emergency Refuge Areas will have little impact on existing townscapes given that the works will be accommodated within the existing disturbed motorway corridor. The majority of structures can be incorporated into the surrounding townscape pattern with negligible residual impact. The retention of as much of the soft estate as possible would seek to achieve the development within the existing townscape framework where possible whilst enabling the development of a comprehensive set of additional complementary planting proposals to minimise the long term impact of the scheme on townscape appearance and views.		Slight Adverse
	Heritage of Historic Resources	There are considered to be no impacts on most heritage resources. There will be some temporary and short term impacts relating to construction and removal or vegetation although these will be remediated through replacement planting. There will be some visual impacts on the motte and bailey at Castle Bromwich, although this site was predominantly destroyed when the M6 was constructed.		Neutral
	Biodiversity	No significant impact on designated sites or established habitats. The works undertaken are not anticipated to damage, disturb or prevent dispersal from or to breeding sites, although potential nesting, hibernation or foraging sites may be subject to these potential affects. There is also potential for direct loss of terrestrial habitat that may be used for shelter, although such potential habitat loss is expected to be minor and not significant in total.		Slight Adverse
	Water Environment	No new significant incursions into the water table, surrounding flood plains or any significant direct impacts on rivers, standing water or other water bodies. No change in the rate of discharge at any of the existing outfalls which will all be maintained in their existing position and condition. No impacts on groundwater, aquifers or on any source protection zones. The greatest potential for any impacts on water quality and drainage would occur during the construction phase, but can be minimised by close control by the contractor and adherence to a comprehensive CEMP.		Neutral to Slight Adverse
	Physical Fitness	The scheme has no direct impacts on pedestrian and cyclist activity as these road users are prohibited from the motorway. Secondary impacts on the propensity to walk or cycle for more than 30 minutes resulting from changes in traffic volumes on roads surrounding the motorway junctions within the scheme area are considered to be minimal.		Neutral
	Journey Ambience	New emergency refuge areas and electronic information signs will improve perceptions of safety and confidence in use of motorway through treated sections. Variable speed limits and HSR reduce frustration caused by congestion by improving flow of traffic. Additional gantries may have some minor detrimental impact on views in mainly rural areas.	110,000 daily motorway users benefit in terms of improved journey quality	Large Beneficial
Safety	**Accidents**	Evidence from the ATM pilot suggests accident rates have reduced from 5.1 per month to 2.9 per month, although this is based on a limited 'after' data set. Total accident savings may be greater than estimated if the trial data is fully representative of the impact of HSR and VMSLs.	Change in number of PICs: -404.5	PVB £16.6m

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
			Change in number of casualties: - Fatal -5.5 - Serious -42.5 - Slight -529.6	
	Security	New CCTV combined with direct emergency call to operators at each ERA. CCTV also monitors hard shoulder during HSR periods and operators can shut down hard shoulder to traffic where necessary. Users perceive better personal safety in ERAs than on conventional hard shoulder. While interval of emergency call facilities may be unchanged, their location is more formalised and clearer to drivers. Currently lighting is provided at regular intervals along the motorway, whereas the ERAs will be provided with additional lighting specific to their location. Some removal of vegetation required to build ERAs will improve sight lines.	New facilities will improve personal security for an estimated 12 daily vehicle breakdowns on the motorway	Slight Beneficial
Economy	**Public Accounts**	All scheme implementation and maintenance costs incurred by central government (HA)	Central Govt PVC £105.2m Local Govt PVC £0.0m	PVC £105.2m
	TEE: Business Users & Transport Providers	A small loss in revenue for public transport operators. No developer contributions.	Users PVB £220.5m Transport Providers PVB -£2.3m Other PVB £0.0m	PVB £218.3m
	TEE Consumers		Users PVB £141m	PVB £141m
	Reliability	Reliability benefits equate to £0.16 per £1 of journey time saving benefit.	First order benefits: 0.45p/km Second order benefits: 0.09p/km	PVB £50.3m
	Wider Economic Impacts	Welfare benefits contribute to overall economic appraisal whereas GDP impacts do not. Some benefits are counted as both Welfare and GDP benefits. Welfare benefits amount to 14% of total user benefits.	Wider benefits: - Welfare £52.5m - GDP £53.2m	Welfare PVB £52.5m
Accessibility	**Options Values**	The scheme does not provide any new transport infrastructure or route options.		Neutral
	Severance	No severance impacts relating to provision of infrastructure. Change in traffic levels on local highway network around motorway junctions within the Phase 1 & 2 scheme area is generally insufficient to generate any severance impacts.		Neutral
	Access to the Transport System	The scheme does not involve any change in the supply of transport infrastructure or services. The scheme does not involve provision of any new access points onto the highway network for local residents, nor any change public transport provision.		Neutral
Integration	**Transport Interchange**	No new transport interchange facilities are provided as part of the scheme.		Neutral
	Land-Use Policy	Beneficial to local and national business development, especially development of key employment centres such and NEC, Birmingham Airport and Land Rover. The scheme enhances access to, and improves competitiveness of regional and major investment sites, and regeneration zones. Can contribute to development of strategic park and ride and forms first stage of consideration of policy towards motorway widening. Scheme may, however, increase pressure for inappropriate development in green belt areas.		Beneficial
	Other Government Policies	The scheme contributes to improving the economic competitiveness of the Birmingham city region by facilitating more efficient movement of goods and people into and out of the city region. It also contributes to enhancing competitiveness of other UK regions where movement between regions is dependent on the West Midlands motorway network. Contribution towards expanding employment opportunity are likely to be marginal but improving reliability of access to employment locations may assist in encouraging greater take-up of jobs at these locations.		Beneficial

Table 7-2 – Evaluation Summary Table

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Environment	**Noise**	The lower enforced speed limit when HSR is in operation would appear to have reduced noise due to traffic for some locations and at certain time periods. Based on both the AADT and traffic speed data, it is considered likely that the noise climate as a result of the Scheme is generally worse than expected, although the junction 9 to 10 southbound link is likely to be as expected.		Generally worse than expected (neutral), junction 9 to 10 southbound likely to be as expected.
	Local Air Quality	AADT flow and speed data for the junction 8-9 link indicate that pollutant concentrations are likely to be worse than expected. Based on the AADT data it is considered likely that pollutant concentrations along the junction 9-10 link are as expected, and better than expected along the junction 10-10a link.		Worse than expected between junction 8 and 9. As expected between junction 9 and 10. Better than expected between junction 10 and 10a.
	Greenhouse Gases	Along M6 corridor, the scheme has had the expected impact on greenhouse gases. It is not practicable to translate this into a network wide impact.	Reforecast carbon emissions predicted an increase to 40,176 tonnes (0.5% increase). Observed increase is lower that 38,545 (1.5% increase)	As expected.
	Landscape	Existing screen planting has been retained which has allowed the scheme to be generally implemented within the established landscape framework. Very little post opening information has been available at FYA.		Likely to be as expected (neutral) but further data would be required to confirm this
	Townscape	As expected the impacts on townscape have been limited by the existing highway vegetation, there will have been some additional visual intrusion generated by the additional infrastructure. Some increased urbanisation on the scheme corridor.		Slight adverse as expected
	Heritage of Historic Resources	POPE is not aware that there have been any impacts on archaeology. The setting of the Grade II Listed James Bridge aqueduct is not considered to have been adversely affected by the scheme.		Neutral as expected
	Biodiversity	Insufficient information has been made available to POPE to fully evaluate the impacts of the scheme on biodiversity.		Likely to be as expected (slight adverse) but further data would be required to confirm this
	Water Environment	Mitigation measures have been incorporated into the scheme and the existing drainage network / outfalls retained. No information has been provided which would indicate that drainage is performing other than as expected.		Likely to be as expected (neutral to slight adverse), although further information would be required to confirm this
	Physical Fitness	As expected the scheme has had no direct impact on pedestrians and cyclists.		Neutral as expected
	Journey Ambience	Impacts on journey ambience are as expected. Reduction in congestion and improved journey time reliability will have reduced driver stress and improved journey times. Emergency Refuge Areas (ERAs)have been provided to replace the hard shoulder and electronic information relieves route uncertainty. Slight additional urbanisation of the motorway corridor in rural areas due to additional signs and gantries.		Beneficial as expected
Safety	**Accidents**	There has been an increase in collision rates as a result of the scheme; however the severity of collisions has reduced.	Increase in collisions of 12.2 collisions per year	Worse than expected
	Security	The impact on personal security is slight beneficial as expected due to improved journey time reliability and the provision of CCTV at the ERAs.	N/A	As expected (Slight Beneficial)

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Economy	**Public Accounts**	The forecast and outturn scheme investment costs are consistent. It seems likely that the forecast PVC may have excluded conversion to market prices.	Forecast PVC (including indirect tax) - £105.1m Reforecast PVC (including indirect tax) - £124.9m	As expected
	Transport Economic Efficiency	The scheme's impact on journey times is not exactly as expected. Northbound, journey times have not increased as much as forecast. Southbound in the AM peak there has not been as big of a journey time saving as expected. Southbound in the PM peak the journey time saving exceeds the forecasts. Furthermore, the utilisation of the scheme, especially during Inter Peak periods has affected the journey time benefits across an average week.	Outturn journey time saving in excess of £200m.	Lower than expected
	Reliability	Analysis of the distribution of speeds indicates that the scheme has reduced journey time variability in all directions and time periods. There is also an indication that the impact maybe greater than forecast though it has not been possible to quantify this precisely to give a rating other than 'as expected'.	Flow Weighted PTI reduced by approximately 23% in both directions	As expected
	Wider Economic Impacts	The scheme has contributed to the growth and transport aims of the West Midlands by providing additional capacity at peak times and improving journey time reliability on the M6 corridor. It is likely that given the increase in journey times in some sections and time periods that if able to quantify that this would be lower than expected.	N/A	As expected
Accessibility	**Options Values**	The scheme has not changed the availability of transport services in the vicinity of the scheme.	N/A	As expected (Neutral)
	Severance	The scheme has not affected the provision of infrastructure.	N/A	As expected (Neutral)
	Access to the Transport System	No direct change in public transport provision as a result of the scheme.	N/A	As expected (Neutral)
Integration	**Transport Interchange**	The scheme has not had an impact on the provision of transport interchange facilities.	N/A	As expected (Beneficial)
	Land-Use Policy	The scheme integrates well with the regional and national policy. The scheme makes best use of existing infrastructure and contributes to the competitive of the West Midlands corridor.	N/A	As expected (Beneficial)

8. Conclusions

Introduction

8.1. This section of the report concludes the report and summarises how the scheme is meeting scheme specific objectives.

Scheme Specific Objectives

8.2. **Table 8-1** presents an evaluation of the scheme's objective using the evidence presented in this report.

Table 8-1 Appraisal against Scheme Objectives

Objective	Has the scheme objective been achieved?	
Reduce congestion, thereby increasing the mobility of people and goods	**Yes** – there has been a marked improvement in journey times, despite not being to the level forecast. This is balanced by analysis presented in this report that has demonstrated that the HSR is in operation more than expected, for example during the Inter Peak period. The utilisation of the scheme enforces a speed limit of 60mph, which may reduce speeds and journey times.	✓
Reduce the impact of collisions	**No** – analysis has shown that between pre- and post-scheme the collision rate has increased, which may increase the impact on traffic flow. However, there has been a significant improvement in the severity of collisions and fatality weighted index.	X
Have a globally neutral environmental impact	**Yes** – Although there has been an increase in traffic, there has been minimal changes in greenhouse gases. There has been no discernible change in environmental indicators for the scheme, and so it is considered that the scheme contributes to an almost neutral impact. No further consideration has been given to this objective.	✓
Improve driver comfort	**Yes** – there has been a clear reduction in congestion (indicated by improved speeds on a number of scheme sections). Journey time reliability has improved considerably, having a beneficial impact on driver stress. The severity of collisions has reduced as there is better information provided for drivers, all of which contributes towards improved driver comfort on the scheme section.	✓

8.3. **Table 8-1** shows that the scheme has successfully achieved all of the objectives, apart from that to reduce the impact of collisions for the reasons outlined in the table.

Appendices

Appendix A. Glossary

Table A.1 – Glossary

Term	Meaning
AADT	**Annual Average Daily Traffic.** Average of 24 hour flows, seven days a week, for all days within the year.
AAWT	**Annual Average Weekday Traffic**. As AADT but for five days, (Monday to Friday) only.
Accessibility	Accessibility can be defined as 'ease of reaching'. The accessibility objective is concerned with increasing the ability with which people in different locations, and with differing availability of transport, can reach different types of facility.
AMCB	**Analysis of Monetised Costs and Benefits**
AQMA	**Air Quality Management Area**
AQS	**Air Quality Strategy**
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
ATC	**Automatic Traffic Counter**
ATM	**Active Traffic Management,** a method of increasing peak capacity and smoothing traffic flows on busy major highways. Techniques include variable speed limits, hard-shoulder running and ramp-metering controlled by overhead variable message signs. The M42 pilot was called Active Traffic Management – all schemes after this were referred to as managed motorways, or more recently as smart motorways.
AWT	**Average Weekday Traffic**. Average of Monday to Friday 24 hour flows.
BAP	**Biodiversity Action Plan**
BBMM	**Birmingham Box Managed Motorway**
BBATM	**Birmingham Box Active Traffic Management**
BCR	**Benefit Cost Ratio.** This is the ratio of benefits to costs when both are expressed in terms of present value i.e. PVB divided by PVC
CCTV	**Closed-circuit television**
CEMP	**Construction Environment Management Plan**
CM	**Controlled Motorways** is used where only variable speed limits are used.
CO2	**Carbon Dioxide,** for transport, this is the main greenhouse gas
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 unless it is being used in Accident-only mode.
DfT	**Department for Transport**
Discount Rate	The percentage rate applied to cash flows to enable comparisons to be made between payments made at different times. The rate quantifies the extent to which a sum of money is worth more to the Government today than the same amount in a year's time.
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**
Do Minimum	In scheme modelling, this is the scenario which comprises the existing road network plus improvement schemes that have already been committed.
Do Something	In scheme modelling, this is the scenario detailing the planned scheme plus improvement schemes that have already been committed

Term	Meaning
EAR	**Economic Assessment Report**
EA	**Environment Agency**
ERA	**Emergency Refuge Area,** An area provided for the vehicle at breakdown or emergency
ES	**Environmental Summary**
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.
FWI FWI/bvkm	**Fatalities & Weighted Injuries.** This figure is a combined measure of casualties based on the numbers of fatal, serious and slight casualties. It is weighted by severity of injuries, with fatalities having the highest weighting. It can be expressed as a ratio per accident, per year or based on the amount of travel (bvkm, billion vehicle kilometres).
FYA	**Five Years After**
GCN	**Great Crested Newts**
GDP	**Gross Domestic Product,** is the market value of all officially recognized final goods and services produced within a country
Grade separated junction	A junction which is constructed, by the use of bridges or underpasses so that the flow of two or more roads crossing does not interrupt the flow of traffic on the major road.
Halogen	Data from the overhead gantries e.g. whether the hard shoulder is open and the Variable Mandatory Speed Limit in operation
Highways England	Responsible for operating, maintaining and improving the strategic road network in England.
HEMP	**Handover Environmental Management Plan**
HGV	**Heavy Goods Vehicle.** In the context of this report, the precise definition of the term is dependent 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'.
HSR	**Hard Shoulder Running,** usage of the hard shoulder is known as hard shoulder running
KSI	**Killed or Seriously Injured.** KSI is the proportion of casualties who are killed or seriously injured and is used as a measure of accident severity
IFRIIT	**Initial and Full Responsive Intervention Investment Tool** - This tool calculates annualisation factors for forecast years to determine how much an HSR scheme would be used.
ITA	**Integrated Transport Authority,** A statutory body coordinating the provision and development of public transport
LEAP	**Landscape and Ecology After plan**
LNR	**Local Nature Reserve**
LTP	**Local Transport Plan**
MAC	**Managing Agent Contractor**. An organisation normally contracted in 5-year terms for undertaking the management of the road network within a HA area.
MACSEM	A spreadsheet application used for appraisal
MIDAS	**Motorway Incident Detection and Automatic Signalling**. This is a system installed on motorway and trunk roads which detracts queues of incidents so that variable message signs can be set to warn approaching traffic.
MM	**Managed Motorway** (now referred to as "smart" motorways) - a motorway which uses technology to vary speed limits in response to driving conditions. These smart motorways make the hard shoulder available to traffic. This could be permanently or at particularly busy times of the day.
MS4	**Messaging Sign.** LED variable design messaging sign which can display an almost infinite range of pictograms, aspects and legends.
NATA	**New Approach To Appraisal** is a multi-criteria decision framework used to appraise transport projects and proposals.

Term	Meaning
NEC	**National Exhibition Centre** is an exhibition centre in Birmingham
NE	**Natural England**
Neutral month	A month used for traffic analysis that is considered to be unaffected by seasonal trends in traffic.
NMU	**Non-Motorised User.** A generic term covering pedestrians, cyclists and equestrians
NO2	**Nitrogen Dioxide**
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. At the time this scheme was appraised, the most recent one was NRTF97, i.e. dating from 1997.
OYA	**One Year After**
PIC	**Personal Injury Collision**. A road traffic accident in which at least one person required medical treatment.
POPE	**Post Opening Project Evaluation**, before & after monitoring of all major highway schemes in England.
PM10	**Particulate Matter** measuring less than 10µm. This is the generally accepted measure of particulate material in the atmosphere likely to be inhaled by humans
Present Value	Present Value is the value today of an amount of money in the future. In cost-benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value.
PRISM	The West Midlands strategic traffic model.
PVB	**Present Value Benefits**. Value of a stream of Benefits accruing over the appraisal period of a scheme expressed in the value of a Present Value
PVC	**Present Value Cost.** As for PVB but for a stream of costs associated with a project
Queue Protection	It is the algorithm/parameter used to control queue formation downstream of high speed platoons
RSS	**Regional Spatial Strategy**
Smart Motorway	Referred to previously as “managed motorways”: A motorway which uses technology to vary speed limits in response to driving conditions. These smart motorways make the hard shoulder available to traffic. This could be permanently or at particularly busy times of the day.
SNCI	**Site of Nature Conservation Importance**
SSSI	**Site of Special Scientific Interest**
STATS19	A database of injury accident statistics recorded by police officers attending accidents
TEE	**Transport Economic Efficiency**
TJR	**Through Junction Running** - Motorists travelling will be able to drive along the motorway hard shoulder between junction slip roads - ‘through-junction running’
TPO	**Tree Protection Order**
TUBA	**Transport Users Benefit Analysis.** A computer system issued and maintained by the DfT. The program calculates the costs and benefits that would accrue to users of a transport system, companies, national and local government as a result of making improvements to a transport network.
VISSIM	a microscopic multi-modal traffic flow simulation software package
VMSL	**Variable Mandatory Speed Limit** a mechanism that uses electronic signs on the gantries above the carriageways to display the variable speed limits
vpd	**Vehicles Per Day**
VOC	**Vehicle Operating Costs.** For highway schemes these are costs to the user of the fuel and maintaining the vehicle.
web TAG	Department for Transport’s website for guidance on the conduct of transport studies at http://www.webtag.org.uk/

Term	Meaning
webTRIS	Database holding information on traffic flows on the strategic network.
West Midlands ITA	**West Midlands Integrated Transport Authority**, promotes and develops public transport across the region

Appendix B. Local Schemes

B.1. Table of Schemes

	Scheme	Description/Impact on Traffic	Start of Construction	Scheme Opening
1	M6 Junction 9 Traffic Signal Upgrade (Pinch Point Programme)	Implementation of MOVA traffic signals at the roundabout of M6 junction 9.	April 2013	June 2013
2	BBMM3 (M6 junction 5 to 8)	Smart Motorway implemented between junction 5 to 9, including M5 link roads.	January 2012	April 2014
3	M6 Junction 10a to 13	Smart Motorway implemented between junctions 10a and 13, with dedicated slip roads on interchanges with M54 and M6 toll.	October 2013	February 2016
4	M6 Walsall Canal Bridge Southbound re-surfacing (Junction 9-10)	Phase 1 of this work replaced joined and re-waterproofed the deck of Walsall canal bridge between junctions 9 and 10.	April 2014	July 2014
5	Improvement scheme at M6 Junction 6 (Salford Circus Roundabout)	Widening of roundabout at Junction 6 and new traffic signals installed.	June 2014	July 2016
6	M6 Northbound Junction 7 to 10 Carriageway re-surfacing and bridge expansion	The carriageway was re-surfaced between junction 7 and 10 (northbound) to improve safety and road conditions. There were overnight closures of the M6 northbound between junction 7 and 10.	February 2015	April 2015
7	M6 8 to M5 Link Southbound re-surfacing (waterproofing)	The bridges on the link road between the southbound M6 to the M5 require re-surfacing. Traffic management was in place throughout the construction period, with single lane running. There were some overnight closures in January 2017 to complete the works.	January 2015	January 2017
8	M6 Junction 4 northbound and southbound entry slip roadworks	Roadworks planned	June 2016	
9	M6 / A38(M) Gravely Hill Interchange Waterproofing Scheme and Replacement of Lighting Columns	Waterproofing of bridges on link road between southbound M6 to the M5 (Western Arm), including Ray Hall Viaduct, River Tam Bridge and Wigmore Viaduct. The M6 junction 9 on-slip was closed for the duration of the works, and a single lane was in operation on the M5 western arm (southbound). There were some overnight closures with a 50mph speed limit enforced throughout. Lighting columns were also replaced, work on which was carried out at night with some overnight closures (February 2017)	May 2016	December 2016
10	M6 Bromford and Witton Viaduct Concrete Repairs (near Junction 5)	Structural maintenance work was carried out at these two locations, as well as concrete repairs to the	October 2014	June 2016

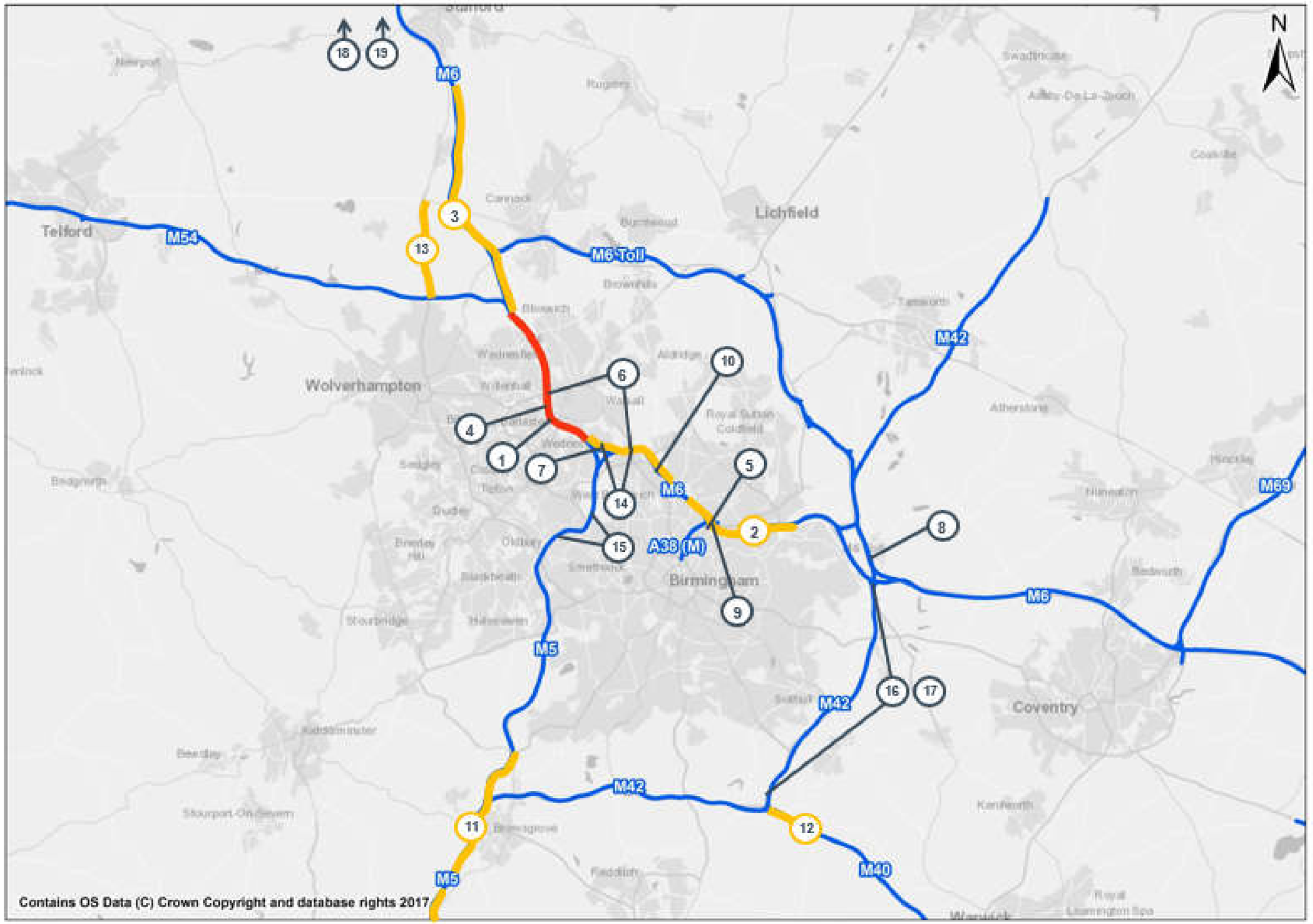
	Scheme	Description/Impact on Traffic	Start of Construction	Scheme Opening
		structure over the Junction 5 southbound on-slip. This is to improve the safety of the structures. Junction 5 southbound on-slip had a full closure from January 2016. Diversion routes were in place and signposted.		
11	M5 Junction 4A to 6 Smart Motorway	Upgrading to a smart motorway with all lanes running with four lanes for use by traffic. Overnight closures of M5 between Junctions 4A and 6 in both directions throughout construction period. 50mph speed limit enforced.	January 2016	Scheduled Spring 2017
12	M40 Junction 16 to M42 Junction 3a Safety Improvement	Maintenance work to improve safety and reduce queuing on the M40 northbound between Junction 16 and M42 Junction 3a. Overnight closure of this stretch of road for 5 weeks	February 2017	March 2017
13	A449 Improvements	Resurfacing of the carriageway on the A449 from A449/A5 Gailey Roundabout to the M54 junction. The safety barriers will also be upgraded. A fully signposted diversion route will be in place using M6 Junction 11/12	January 2017	Scheduled June 2017
14	M6 northbound (Junction 7 and 8)	Structural repairs to damaged concrete and waterproofing on northbound carriageway. Work taking place in hard shoulder and lane one to minimise disruption. Overnight and weekend closures of slip roads and main carriageway. Enforced stepped speed limit from 70mph, to 50mph and 40mph through the work area, with fully signposted diversions between Junction 7 and 8.	February 2017	Scheduled April 2017
15	M5 Junction 1 to 2 Oldbury Viaduct	Preparation work for major concrete work and waterproofing in advance of main scheme which started in April/May 2017. This was carried out using overnight lane closures and weekend overnight full closures of slip roads and the main carriageway.	January 2017	Scheduled Autumn 2018
16	M42 re-surfacing	Re-surfacing M42 junction 6 to 7 northbound, M42 junction 6 to 7 southbound, M6 4A to M42 southbound junction 7 and northbound junction 8 link road. Full road closures will be in place overnight with full signposted diversions with no traffic management in place during the day.	March 2017	Scheduled May 2017
17	M42 Junction 3a to 7 Radar Renewal	Renewal of traffic technology between Junction 3a and 7 on the M42 northbound. Some overnight closures were used with full diversions in place.	January 2017	March 2017
18	M6 Whitgreave Lane overbridge maintenance	Essential maintenance was carried out on the bridge, resulting in full	February 2017	March 2017

	Scheme	Description/Impact on Traffic	Start of Construction	Scheme Opening
		closure of the bridge overnight. Diverted through Junction 14.		
19	M6 Lymes Road Parapets	Replacement of parts of the concrete structure underbridge which carried the M6. Traffic diverted from Junction 15 and 16.	October 2016	April 2017

B.2. Map of Schemes

Numbers to reference schemes are shown in

Table 1-3 of the main report.



Appendix C. Environment

C.1. Sources

Table 1. Standard list of information required to evaluate the environmental sub-objective.

Environment Specific Requirements	OYA Response	FYA Response
Environment Statement (ES) or Stage 3 Scheme Assessment Report (SAR) or Environmental Assessment Report (EAR) including Environmental Masterplan (EMP) drawings.	Productivity TIF Birmingham Box Active Traffic Management (ATM) Phase 1 & 2 Environmental Assessment Report Volume 1 Revision C 17/04/08 and Volumes 2 and 3 Revision B 03/04/08 Final Draft (EAR);	Received at OYA.
AST.	AST (July 2009) AST (March 2009)	Received at OYA.
Any amendments / updates, additional surveys or reports since the ES / SAR / EAR. Have there been any changes to the scheme since the ES / SAR / EAR e.g. to lighting and signs, retention of material on site in earthworks in the form of landscape bunds or other, or to proposed mitigation measures.	BBMM ATM Phases 1 and 2 Modelling of the Impact of Roll Out March 2009	No additional information received at FYA.
As built drawings for landscape/ biodiversity/ environmental mitigation measures/ drainage/ fencing/ earthworks etc.	As Built drawings provided for earthworks, fencing, drainage, engineering, infrastructure works M6 J8-10a Phase 2b Planting Schedule	No additional information received at FYA.
Construction Environment Management Plan (CEMP), Landscape and Ecology Aftercare Plan (LEAP), Landscape Management Plan (LMP) or Handover Environmental Management Plan (HEMP).	Not provided	Not received.
Health and Safety File – Environment sections (to include all environment As-Built reports).	Not provided	Not received.
Relevant Contact Names for consultation.	Provided and sourced by POPE team	As noted at OYA.
Archaeological Reports (popular and academic).	N/A.	N/A.
The Road Surface Influence (RSI) value of any low noise surface installed.	Not provided	Not received.
The insulation performance properties of any noise barriers installed (The BS EN 1794-2 result provided by the noise barrier manufacturer).	Some information provided in the specification Appendix	As noted at OYA.
List of properties eligible for noise insulation.	N/A	N/A
Employers Requirements Works Information - Environment sections.	Series 3000 and 2500 specification Appendix 1_9V1 relating to construction noise	No additional information received at FYA.
Reports for any pre/ post opening survey and monitoring work e.g. for noise, biodiversity, water quality).	Ecological Survey Record Note for 20/10/10	No additional information received at FYA.

	Milestone 3: Phase 2 After Construction Noise Data Analysis Report March 2012	
Animal mortality data.	Provided.	No additional information received at FYA.
Pre or Post opening Non-motorised User (NMU) Audits or Vulnerable User Surveys.	N/A.	N/A
Information may be available regarding environmental enhancements to streetscape/ townscape for bypassed settlements	-	None received.
Scheme Newsletters / publicity material/ Award information for the scheme.	None provided	None received.

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