Post Opening Project Evaluation

M1 Junction 39 to Junction 42 Smart Motorway All Lane Running – One Year After

August 2017

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 M1 J39 to 42 section of the motorway was upgraded to permanently remove the hard shoulder and converting it into an additional driving lane. Before the scheme, customers experienced high levels of congestion, particularly between J41 to 42. Heavy Goods Vehicles (HGV) found the gradient in this area challenging, which combined with the high volumes of traffic resulted in slow moving vehicles.

The M1 J39 to 42 is a key north-south transport route, and the improvements were proposed to support and enhance this role. The scheme was designed to make customer journeys **more reliable**; applying speed restrictions to **better manage the flow of traffic**. It aimed to **maintain safety performance** of the road and **improve quality of information provided to customers**.

This report indicates how the scheme was performing within its first year of operation. This initial assessment forms part of a longer-term evaluation which reviews performance over five years. The one year after study is not intended to provide conclusive evidence about scheme benefits but gives an early indication about whether a scheme is heading in the right direction. This helps us identify areas where we can focus effort to optimise the benefits of the scheme.

Since adding the additional motorway capacity the evaluation findings indicate that journey times have reduced in both directions, most significantly for customers travelling northbound in the morning and southbound in the evening peak period. Journey times have also become more reliable, particularly for those travelling at the busiest times.

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 result of the scheme. Whilst the findings from this study are not conclusive, we have been reviewing them carefully and will continue to monitor the safety of this scheme as part of our programme of monitoring and evaluation.

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 M1 Junction 39 (J39) to Junction 42 (J42) scheme was a Highways England major scheme to improve 7 miles (11km) of the M1 by providing additional capacity between J39-J42 to the west of Wakefield through the implementation of a smart motorway. The scheme was completed in two stages, J39 -J41 opening in December 2015 and J41 -J42 opening in January 2016.

The key smart motorway features in the scheme were the following in both directions:

- Conversion of the hard shoulder for use as a permanent traffic lane.
- Introduction of enhanced on-road technology, including variable mandatory speed limits (VMSL) to manage traffic flow.

Scheme Objectives

Objective (stated in Client Scheme Requirements)	Objective Achieved?
To support and enhance the role of the current M1 as a major national and interurban regional transport artery.	✓
To deliver the scheme in a way which supports the delivery of the Government's transport policy objectives.	✓
To achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.	Too early to conclude
The scheme should improve journey time reliability, by improving and better managing traffic flow conditions.	✓
The scheme should aim to improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway.	✓
To minimise the detrimental environmental effects of the scheme and offset by mitigation measures where technically feasible and economic to do so, taking account of costs, availability of funding and statutory obligations.	✓

Key findings

- Congestion has reduced in the peak periods.
- Journey time reliability along the scheme section has improved.
- Initial results suggest safety in the wider area has improved but severity of collisions has increased on the M1 scheme section.
- Environmental impacts are broadly in line with expectations with most impacts either being scored as neutral or slightly adverse.

Summary of Scheme Impacts

Traffic

Traffic Volumes

- Post scheme opening, traffic flows have increased on the scheme between 2% to 8%. The highest growth of 8% is seen on the northbound link between J41-J42 a five-lane section which was previously three lanes.
- Increases in traffic volumes post opening on the neighbouring M62 range between 8% and 12%.
- On local roads traffic flowing towards the scheme grew by 5% and traffic flowing away from the scheme grew by 6%.
- All roads studied as part of this evaluation saw an increase in flow from pre-scheme to post-scheme.

- Forecasts predicted much higher levels of traffic both pre-scheme and post-scheme and generally predicted more growth. However, traffic growths were consistent when considering those traveling north in the AM peak and those travelling south in the PM peak.

Journey Times

- The periods of highest traffic volumes on the scheme section are at the times when people have travelled north in the AM peak and south in the PM peak. In these periods journey times have reduced by as much as 100 seconds with speed increases of around 12mph.
- In other less busy time periods the impact on journey times post opening is minimal.
- Forecasts for the scheme assumed journey time saving across all time periods. Observed journey time savings in the peak periods are lower than forecast. This is partly due to modelling forecasting much slower speeds for the without scheme scenario than seen in the pre-scheme observed data.

Operation of the Smart Motorway

- VMSL are only in operation for approximately 10% of the time in the northbound direction across all time periods.
- VMSL are in operation for slightly longer (15% of the time) on the southbound carriageway, mainly in the PM peak between J40- J41 and J41- J42. This is to be expected as this is the busiest time period in the southbound direction. The VMSL is most commonly set at 60mph.

Reliability

- Post opening, large improvements in reliability of journey times are seen in the AM peak (northbound) and the PM peak (southbound) indicating that the scheme has been beneficial in the busiest time periods.
- In both directions, the less congested time periods show little change in reliability with the scheme.
- The planning time index further indicates that journey time reliability has improved in both directions. In the northbound direction the planning time index has reduced from 1.59 to 1.43 and in the southbound direction the planning time index has reduced from 1.53 to 1.43.

Safety

- In the wider modelled area the number of collisions has reduced by 1% from an average of 750 to 744 collisions per year although at the one year after stage this change is not statistically significant.
- On the scheme section of the M1 (between J39-J42), the annual average number of collisions has increased from 15 to 20. Collisions are random in nature, and a minimum of three full years of post opening data is normally required to identify emerging trends, so the results should be treated with some caution.
- When the change in collision numbers is combined with increases in traffic flows, these have also increased from 0.035 collisions per million vehicle kilometres to 0.048.
- Overall, the severity of collisions across the wider area has increased by 2%. On the M1 scheme section between J39-J42, 25% of collisions post opening are either fatal or serious collisions, an increase from 9% for the same section pre scheme.
- The fatal weighted injuries metric (FWI/bvkm) has decreased from 2.9 to 2.6 post opening, indicating that the severity of casualties has decreased when considering the number of vehicles traversing the route.
- Observed savings for the wider modelled area are slightly higher than forecast. The scheme appraisal forecast no change in the number of collisions on the scheme itself post opening.
- These safety findings reported here are not statistically significant, and therefore it cannot be confidently considered that any of these changes are directly as a result of the scheme with only one year of post scheme data available.

Environment

- As expected, the use of the hard shoulder as a permanent running lane has moved traffic closer to sensitive receptors for noise. Based on available information, traffic flows are lower than forecast, although within the ‘as expected’ parameters apart from J41-J42 southbound (21% lower) with the potential for noise from traffic to be marginally better than forecast at this location.
- Increases in traffic post opening has been lower than predicted and based on traffic flows there is potential for local air quality to be better than expected.
- Greenhouse gases were re-forecast to be 14% higher, whereas the observed data has shown that greenhouse gases are only 2% higher and as such is better than expected.

- The scheme has introduced additional infrastructure along an established motorway corridor, which was an existing dominant feature within the local landscape and has not significantly altered the overall local landscape character.
- Retained highway planting helps to filter views to the new large scale gantries and signs, however there are open views from some locations and it will take time for mitigation planting to mature sufficiently to provide any additional screening. There have been no impacts on townscape.
- Based on the information available as part of this evaluation, it would appear that habitat loss has been localised and protected species have not been affected by the works. Mitigation planting will, in time, replace habitat suitable for breeding birds that was lost as a result of the scheme.
- The scheme has been constructed within the existing motorway corridor and there have been no direct impacts on buried archaeology or cultural heritage features and the impacts are considered to be as expected.
- POPE is not aware of any pollution incidents, however, no information has been made available which would indicate that the effects of the scheme are other than neutral as expected, although further information would be required to confirm.
- The scheme has been carried out within the motorway boundary, and the impact on journey ambience is likely to be as expected, with improved route clarity through signing.

Summary of Scheme Economic Performance

All monetary values in £ million 2010 market prices, discounted		Forecast	Outturn re-forecast
Present Value Benefits	Journey Times	419.3	350.9
	Vehicle Operating Costs (VOC)	-22.5	58.2
	Construction and future maintenance delay	-57.7	-57.7
	Safety	9.6	*
	Carbon	-50.5	-8.3
	Noise	-3.4	-3.4
	Air Quality	-2.2	-2.2
	Indirect Tax	12.5	-28.3
	Total	305.0	309.2
Present Value Costs (including operational costs)		142.5	145.3
Benefit Cost Ratio (BCR)		2.1	2.1

*Safety benefits not included as not statistically significant at this stage
N.B. Numbers in this table are rounded to one decimal place.

- Benefits from journey time savings were forecast to be large and provide the majority of the monetised benefits. Outturn journey time benefits in the opening year are lower, with subsequently results in a lower forecast for the scheme benefits over the 60 year scheme period. These lower journey time benefits result from the lower than forecast traffic flows. It is also due (to a lesser extent) to lower than forecast increases in speed post opening.
- Despite the reduction in collisions being slightly higher than forecast for the wider modelled area, this has not been included in the total benefits at this stage as the result is not statistically significant.
- Vehicle Operating Costs (VOC) was forecast to be a dis-benefit for road users and Indirect tax revenue impact was expected to be a benefit for the Government. However, VOC is now a benefit and indirect tax revenue is a dis-benefit due to lower than forecast flows and speed increases.
- Reliability benefits from the reduction in incident related delay were large in the appraisal. Based on the information at the one year after stage journey time variability has improved, and a rerun of the model suggests the outturn reliability monetary benefits could be slightly lower than forecast due to lower than forecast traffic volumes.
- The investment cost of building the scheme was £114.9 million (2010 prices not discounted), which was 1% higher than forecast.
- The present value costs in discounted 2010 prices are £145.3million (£120.3 million investment cost and £25.0 million operating costs)
- The outturn BCR of 2.1 is the same as the forecast BCR of 2.1. This is considered to be high value for money. Despite the higher than forecast costs, there are higher outturn benefits in some areas.

1. Introduction

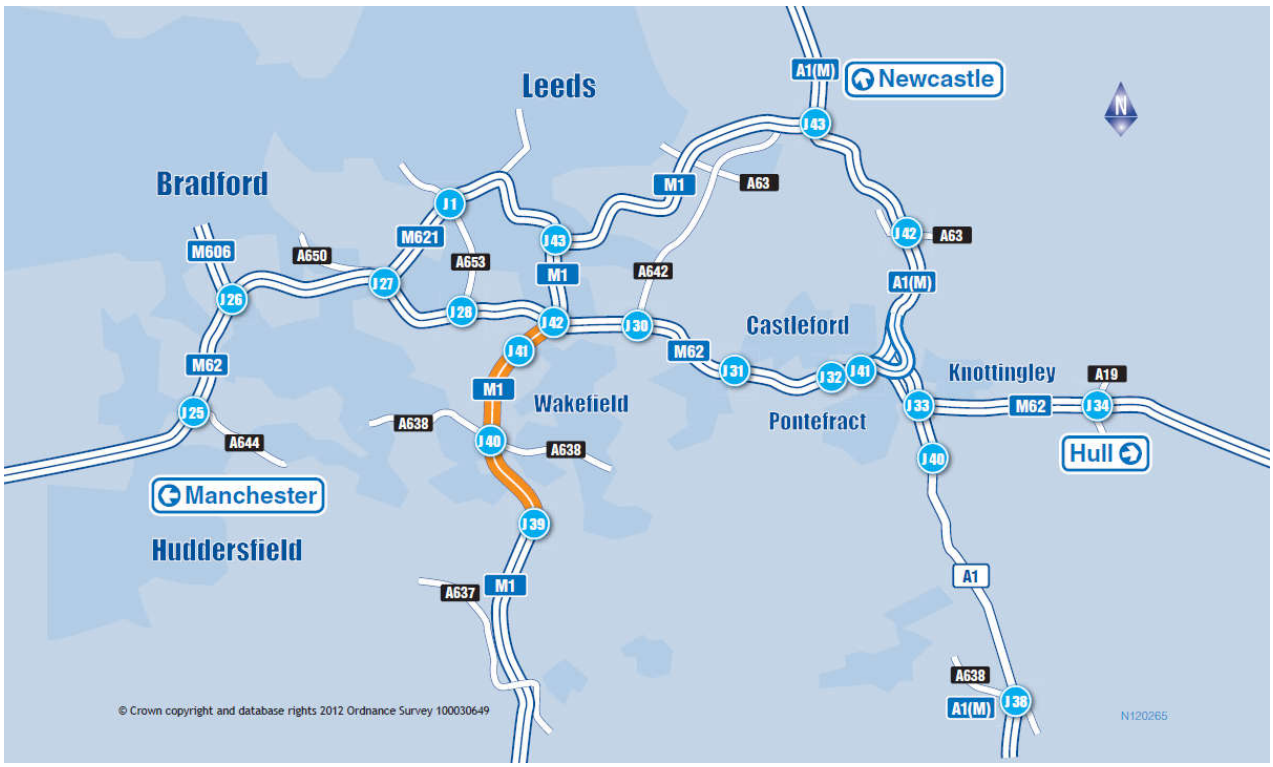
1.1. M1 J39-J42 Smart Motorway is a Highways England[1] major scheme improving a 7-mile (11km) section of motorway which was completed in two stages, J39 -J41 opening in December 2015 and J41-J42 opening in January 2016.

1.2. This report presents a One Year After (OYA) opening evaluation of the scheme J39-J42 and has been prepared as part of the Highways England Post Opening Project Evaluation (POPE) programme. The purpose of this report is to present the initial impacts of the scheme in the one year after opening.

Scheme Location

1.3. The section of the M1 between J39-J42 lies to the west of Wakefield and south of Leeds. ***Figure 1-1*** shows the location of this scheme.

Figure 1-1 Location of the M1 J39-J42 Scheme



Scheme Context

1.4. The M1 is a strategic route used by local, regional and international traffic and provides a direct route that connects the North to the South. The M1 is also part of the Trans European Road Network (TERN).

1.5. M1 J39 -J42, is a key section of the M1, with J39 situated to the South-West of Wakefield and J42 is the interchange with the M62. Prior to the scheme, congestion on this part of the network was a frequent problem with the M1 carrying Annual Average Daily Traffic (AADT) in excess of 109,000 vehicles between J39-J42.

1.6. The strategic case for providing additional capacity on this section of the M1 was examined in the early part of the last decade. The South and West Yorkshire Multi-Modal Study (SWYMMS) reported in 2002 that the motorway should be widened to 4 lanes and that this capacity improvement should be protected by use of Active Traffic Management and physical demand management measures to control traffic flows. These initial proposals were rejected on cost grounds. In July 2008, the Secretary of State tasked the Highways Agency (HA, at the time) to

[1] Formerly known as the Highways Agency (HA), however for the purposes of this report Highways England will be used.

investigate the means to increase capacity using the existing infrastructure which was already in place.

1.7. After a successful pilot of Hard Shoulder Running (HSR) at congested periods on the M42 to the east of Birmingham, a feasibility study conducted by the HA reported in March 2008 concluded that the M1 J39-J42 scheme, amongst others, would see benefits in the short and medium term if a HSR scheme was to be implemented.

1.8. In January 2009, the Department for Transport (DfT) announced that Hard Shoulder Running (HSR) should be pursued on the M1 J39-J42. HSR, now known as Smart Motorway, makes use of the existing hard shoulder to provide additional lane capacity during times of heavy congestion or during incident management. Gantry mounted signals and variable message signs are installed to provide dynamic control of the use of the hard shoulder as a running lane together with emergency refuge areas (ERAs) for stopped vehicles. As a result of the development in the scheme plans and developments in smart motorway guidelines, the proposed scheme was altered to make this a 4-lane section through the permanent conversion of the hard shoulder to a running lane under the Controlled Motorway system apart from Northbound between J41-J42, which has been widened to become a 5-lane section. This is now termed an All Lane Running (ALR) scheme.

Transport Problems

1.9. The transport problems which necessitated the scheme, as outlined in the Client Scheme Requirements (December 2014) were:

- Daily traffic flows between J39-J42 averaged 109,038 vehicles a day during 2008 with a peak flow of 141,386 vehicles a day between J41-J42.
- The route is considered one of the most congested trunk roads in the north of England with levels of congestion in the top twenty percent nationally.
- Congestion is a particular problem between J41-J42 both northbound and southbound.
- The route contains two-lane slip road layouts, with ghost island merges and diverges at each junction between J39-J42.
- The worst northbound journey times between J39-J42 are approximately one and a half minutes longer than the reference journey times of four minutes and forty-five seconds during the morning and evening peaks.
- The worst southbound journey times between J39-J42 are approximately one minute twenty seconds longer than the reference journey times of five minutes forty seconds during the morning and evening peaks.
- Heavy Goods Vehicles (HGV) make up on average 14% of vehicles using this stretch of motorway, which is in line with national averages. However, the scheme links the M1 and M62, which is a strategic national corridor for freight movements which carries 20% HGV traffic.
- HGV traffic combined with a challenging vertical alignment, including gradients approaching 3%, can give rise to slow moving vehicles.

Scheme Description

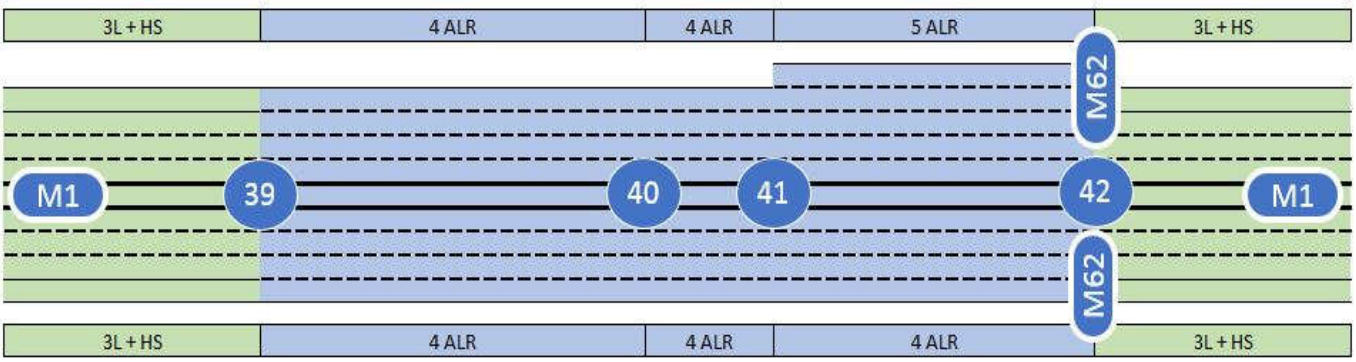
1.10. SM-ALR is a controlled four lane carriageway with no hard shoulder. This is supported by technology in the form of Motorway Incident Detection and Automatic Signalling (MIDAS) traffic detection and traffic control. The signs and signals can be controlled by operators and by automatic algorithms for Congestion Management (CM) and Queue Protection (QP). ERAs are available for broken down vehicles.

1.11. It should be noted that the M1 J39 -J42 SM-ALR scheme was opened in two stages, J39 -J41 opening in December 2015 and J41 -J42 opening in January 2016.

1.12. A schematic diagram of the scheme is shown in Figure 1-2. The scheme involved:

- Conversion of the hard shoulder for use as a permanent traffic lane.
- Introduction of enhanced on-road technology to manage traffic flow.
- Widening of the northbound section between J41-J42 to incorporate 5 lanes.

Figure 1-2 Schematic of the Key Features of Scheme



Scheme Objectives

1.13. The key objectives of the scheme, as summarised from the Client Scheme Requirements (December 2014) which can be found in Appendix E, were:

- To support and enhance the role of the current M1 as a major national and interurban regional transport artery.
- To deliver the scheme in a way which supports the delivery of the Government's transport policy objectives.
- To achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.
- The scheme should improve journey time reliability, by improving and better managing traffic flow conditions.
- The scheme should aim to improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway.
- To minimise the detrimental environmental effects of the scheme and offset by mitigation measures where technically feasible and economic to do so, taking account of costs, availability of funding and statutory obligations.

History

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

Table 1-1 Timeline of M1 J39-J42 improvement

Date	Summary
2002	SWYMMS reports that M1 J39-J42 should be widened to four lanes and improvements should incorporate active traffic management. Initially declined on cost grounds.
2008	HA feasibility study reports that M1 J39-J42 would see benefits in the short and medium term from a HSR scheme.
2009	DFT announces that HSR scheme should be pursued on M1 J39-J42
2011	Two viable solutions considered at SGAR (Stage Gate Assessment Review) Stage 1, both ALR rather than HSR.
2012	Scheme identified as ALR with through junction running in accordance with IAN 161/12 'Managed Motorway Requirements – All Lane Running'.
Nov 2013	M1 J39-J42 construction starts
Dec 2015	M1 J39-J41 section opens.
Jan 2016	Full ALR scheme open to traffic.

1.15. The evaluation in this report takes into account this timeline to ensure that the analysis compares the changes between before and after the Smart Motorway was built, excluding the impact of its construction period.

Nearby Schemes

1.16. ***Table 1-2*** below details a number of Highways England schemes that have been implemented in the vicinity of the scheme and may have had effects that we may need to consider as we progress through this evaluation.

Table 1-2 List of nearby schemes

	Location	Details	Status
1	M1 J39 LMNS Signalisation	Part signalisation of roundabout	Completed 2012
2	M62 J25 -J30	Smart Motorway	Completed 2013
3	M1 J40 Pinchpoint	Widening SB exit slip and circulatory carriageway	Completed 2014
4	M1 J41 Pinchpoint	Widening of approaches and circulatory carriageway	Completed 2015

Overview of POPE

1.17. Highways England are 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.

1.18. When submitting a proposal for a major transport scheme, the DfT specifies that an Appraisal Summary Table (AST) is produced which records the degree to which the Government objectives for Transport grouped under the categories, Economy, Environmental, Social and Public Accounts have been achieved.

1.19. 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 presented in Appendix A of this report.

1.20. POPE studies are carried out for all Major Schemes to evaluate the strengths and weaknesses in the techniques used for appraising schemes. This is so that improvements can be made in the future. For POPE, this is achieved by comparing information collected before and after the opening of the scheme, against predictions made during the planning process. The outturn impacts of a scheme are summarised in an Evaluation Summary Table (EST) which summarises 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.

Contents of this Report

1.21. Following this introduction, the report is divided into six 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 – Conclusions
- Appendix A – Appraisal Summary Table (AST) and Evaluation Summary Table (EST)
- Appendix B – Environment Documents
- Appendix C – Traffic growth on Adjacent and Local Roads
- Appendix D – EnAR /Scoping Report existing views and OYA Comparison photographs
- Appendix E – Client Scheme Requirements Objectives
- Appendix F – Tables and Figures in this Report
- Appendix G – Glossary

2. Traffic Impact Evaluation

Introduction

2.1. In order to evaluate the traffic flow, journey time and reliability impacts of the scheme, the following section reports on:

- Sources
- Summary of the traffic modelling approach and forecast assumptions
- Background traffic changes
- Observed traffic volume changes
- Traffic Flow forecasting accuracy
- Journey time changes on the M1
- Journey time changes forecasting accuracy
- Operation of the Smart Motorway
- Reliability impacts

Sources

2.2. The analysis of traffic in this section of the report is based on data collected from the following sources.

- Operation of the Smart Motorway
  - Highways England's HALOGEN (Highways England Logging Environment) data[2]. This is a record of the signs displayed on the overhead gantries for the smart motorway. The data can be used to determine the different speed limits in place as part of the variable speed limit (queue protection) used in Smart Motorways.
- Traffic volumes and classifications
  - Highways England's TRADS (Traffic Flow Data System) database for motorway locations and adjacent A roads
  - Radar data for the M1 J39-J42 sourced from MIDAS
  - DfT data on national and regional traffic levels
  - Count data commissioned on adjacent roads
- Traffic speeds and journey times
  - Highways England's MIDAS data[3]
  - Journey time data was obtained from sat-nav[4] data from vehicles using the M1 along the full length of the scheme in the year before start of construction and year following completion.

2.3. Documents which have been sourced for the background to the traffic modelling and forecast traffic impacts are:

- M1 J39 -J42 Traffic Forecasting Report – (November 2012), (TFR)
- Incident Cost Benefit Appraisal – (December 2012), (INCA)
- Client Scheme Requirements – (December 2014),

2.4. The report has been prepared to be read in conjunction with the SM-ALR M1 J39-J42 Twelve Month Evaluation Report.

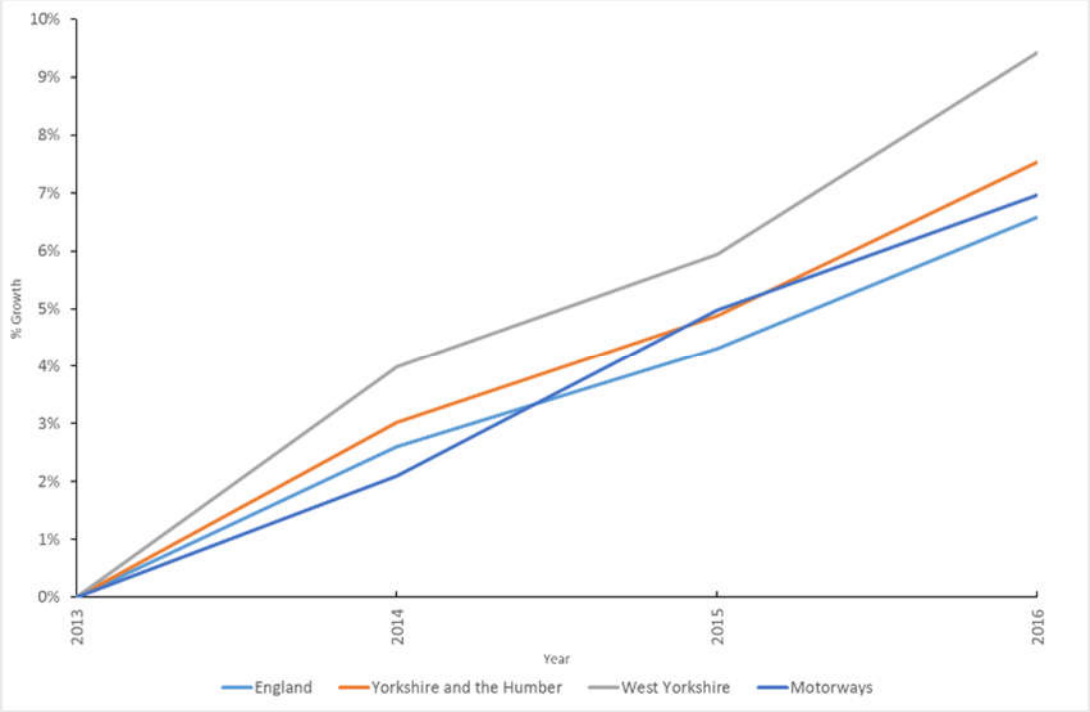
[2] Halogen data is available from Highways England and includes the data displayed on overhead gantries forming part of a smart motorway scheme. The data can be used to determine when, and for how long, the hard shoulder was open for traffic and the different speed limits in place as part of the variable speed limit (queue protection) used in Smart Motorways.
[3] MIDAS data available from Highways England provides lane by lane traffic flows and speeds. MIDAS technology forms part of the Smart Motorway operation, but records of lane by lane speeds and flows, together with the settings from the overhead gantries from Halogen data (i.e. whether the hard shoulder is open and what speed the Variable Mandatory Speed Limit is operating at) can provide additional insight into the operation of the Smart Motorway. As this data forms part of the Smart Motorway, it is not possible to perform a pre and post analysis.
[4] Drivers who use satellite navigation devices have the option to voluntarily allow anonymous data about their journeys to be collected and used to provide a range of services, including the analysis of historic journey times along specific routes.

Background Changes National, Regional Traffic Trends

2.5. Traffic volumes are increasing over time nationwide. POPE studies have taken a considered approach in order to assess changes in the vicinity of the scheme, within the context of national, regional and locally observed background changes in traffic.

2.6. The best measure of the wider trends in overall traffic levels both regionally and nationally is provided by DfT's annual statistics for total distance travelled (million vehicle kilometres). ***Figure 2-1*** shows the changes by year in the period from 2013 through to 2016 (the latest available) for all roads in the region in which it lies, and all motorways managed by Highways England, and for England as a whole.

Figure 2-1 National and Regional Trends in Traffic Levels[5]



2.7. The key points regarding the wider trends in recent years are:

- From 2013 (when the pre-scheme data was observed) up to 2016, West Yorkshire showed higher levels of growth than national levels and growth on motorways.
- Growth in traffic on motorways was roughly in line with the area of Yorkshire and the Humber and England as a whole.

2.8. The observed traffic flows used in the traffic analysis within this chapter are presented as observed in the before construction and post opening periods and have not been adjusted for the background trend of net growth of traffic seen regionally on all roads and nationally on motorways. However, actual traffic growth over the period of 2013 to 2016 was around 7%, so this should be considered when interpreting results later in this section.

Traffic Volumes before and after scheme construction

2.9. Weekdays traffic flows have been analysed for the M1 through the scheme, for the M62 and selected 'A' roads surrounding the scheme. On the motorway sections the pre-scheme data is from April 2013 and the post-scheme data is April 2016. The local traffic data is from a range of months due to limited availability, with most counts taking place in 2013 and 2016 for pre- and post-scheme respectively. The Average Weekday Traffic (AWT) flows on the links are presented in ***Figure 2-2.***

2.10. The key points shown by the AWT flows on the M1 and adjacent roads are:

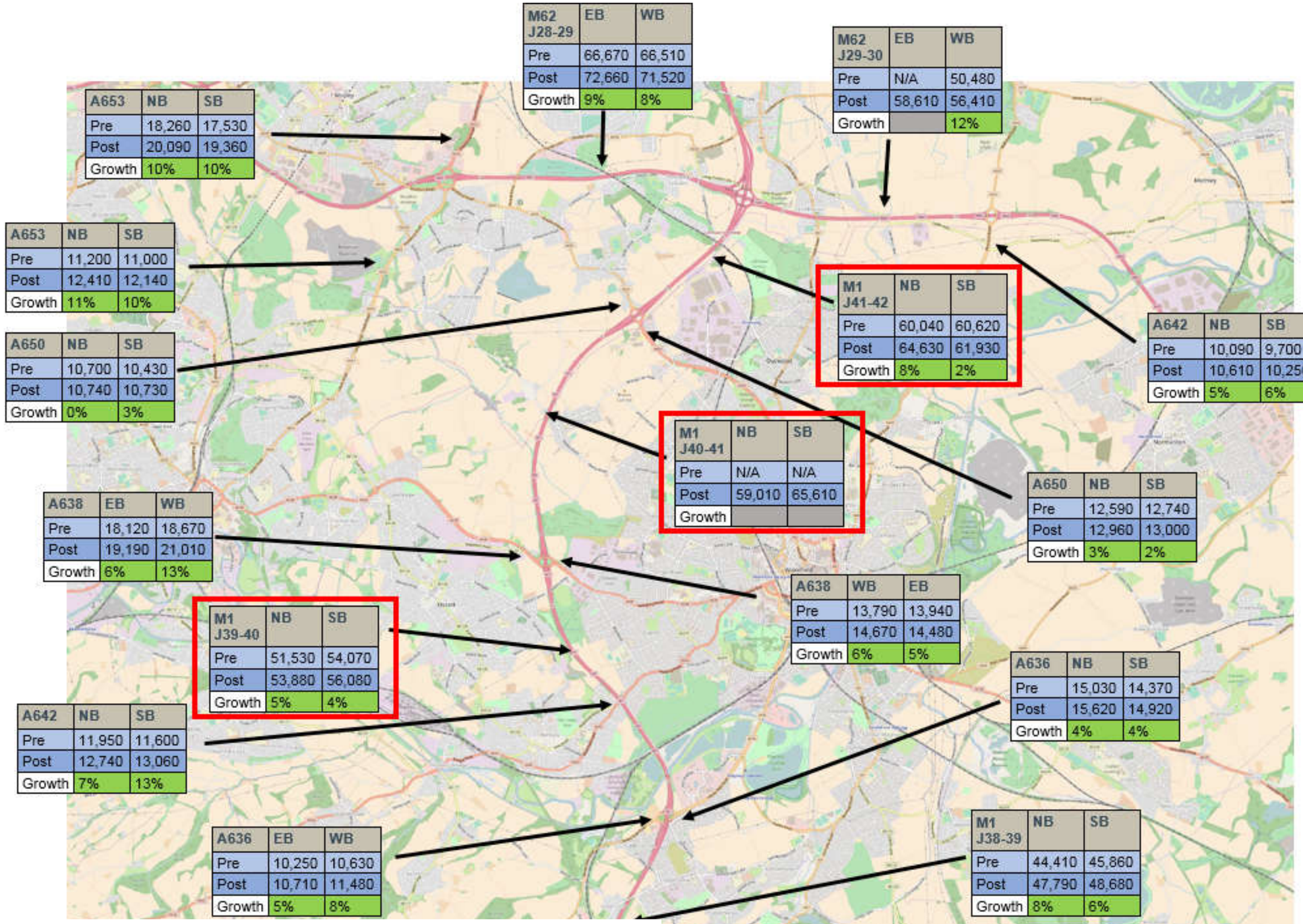
- On the Smart Motorway sections of the M1, growth of traffic is seen to vary between 2% and 8% for both directions. Due to the reliability of the pre-scheme data on the section between J40-J41 we are unable to show the growth in this section. The 8% growth was

[5] Graph based on data in DfT tables TRA8904 and TRA4112

seen on the northbound section between J41-J42 which has now become a five-lane section.

- On the section of the M1 to the south of the scheme the growth in traffic has been larger, in both directions, than the growth seen between J39-J40.
- Traffic growth on the M62 has been higher than the national average of motorway growth of 6-7%.
- Traffic growth for A roads in the vicinity of the scheme has been on average 5% with a slightly higher growth of 6% for traffic travelling away from the scheme. Whilst traffic growth to the west of the scheme has been on average higher than traffic growth to the east of the scheme.
- All the roads that we have observed have seen a growth in traffic flows from pre-scheme to post-scheme which is to be expected when considering the trends seen in ***Figure 2-1.***

Figure 2-2 Average Weekday Traffic (AWT) flows on M1 and other adjacent links before (2013) and one year after (2016)



Note: Traffic flows not adjusted for the background trend of net growth of traffic (around 7%)

HGV traffic flows

2.11. Analysis of HGV levels is undertaken through vehicle classification by length, in which a HGV is classed as a vehicle over 6.6m in length. The Client Scheme Requirements states that 'HGV traffic combined with a challenging vertical alignment, including gradients approaching 3%, can give rise to slow moving vehicles'. In ***Table 2-1*** below HGV as a percentage of total traffic in both directions is presented below for two sections of the scheme.

Table 2-1 Percentage of HGV Traffic on Scheme

Link	% Pre-Scheme	% Post Scheme
J39-J40	12	11
J41-J42	10	15

2.12. The results suggest that HGVs as a percentage of overall traffic has fallen between J39-J40 and grown between J41-J42.

Scheme Modelling and Forecast Assumptions

2.13. The scheme modelling used the Wakefield Area Motorway Model developed in SATURN. A full variable demand modelling (VDM) approach was used in developing the future year matrices in the highway model of this scheme.

2.14. The traffic modelling had a base year of 2010 with June used as the neutral month, and there were three forecast years: 2015 (opening year), 2025 (Interim Year) and 2030 (15 years after opening).

2.15. The time periods modelled were three AM peak hours (07:00-08:00, 08:00-09:00, 09:00-10:00), an average inter peak hour (10:00-16:00) and three PM peak hours (16:00-17:00, 17:00-18:00, 18:00-19:00).

2.16. The traffic model was developed using NTEM (National Trip End Model) 6.2 central dataset (July 2011 definitive version) for car and public transport demands. The economic parameters were derived from WebTAG 3.5.6 released in April 2011. Growth in traffic levels for goods vehicles (LGV and HGV) was derived from NTM11.

2.17. Additional sensitivity tests were undertaken to account for future uncertainty in line with guidance in WEBTAG 3.15.2 and 3.15.5. High and low growth scenarios used central forecasts of ±2.5% for forecasts one year ahead rising with the square root of the number of years. The results of these scenarios were that links exhibited a logical pattern of low and high growth in every time period whilst not altering the overall behaviour of the scheme.

2.18. The modelled area in SATURN included detailed modelling within 5km of the scheme and for most of West Yorkshire and South Yorkshire. Adjacent authorities and the rest of the country was a mixture of detailed and buffer (less detailed) network coverage.

Model Forecast Scenarios

2.19. As noted above, the Forecast Model Core Scenario (Central Demand) was constructed in line with WebTAG guidance (WebTAG Unit 3.15.2). This accounts for national economic uncertainty by applying a range of ±2.5% around the Central Demand (i.e. the most likely forecast scenario) for one year ahead, rising with the square root of the number of years. Therefore, the forecast DM matrices had a variance from the core scenario as follows:

- Low Demand Growth Forecast:
  - 2013: -4.3% (-2.5%*√3)
- High Demand Growth Forecast:
  - 2013: +4.3% (+2.5%*√3)

Traffic Flow forecasting accuracy

2.20. Justification for the scheme was based on detailed forecasting of the traffic impacts. This section compares the observed traffic impacts with those forecast. As noted earlier, the final detailed traffic flow forecasts were modelled for the central growth option only using TEMPRO and NTEM 6.2 and for opening year of 2015.

2.21. As the modelled opening year was 2015 for the Do Minimum (DM) and Do Something (DS) scenarios, for comparisons with observed traffic data from the pre-construction period in 2013 and

post construction in 2016, proxy forecasts were created for 2013 and 2016 data to compare against the observed data in those years. The adjustment for 2013 was made by assuming linear growth between the 2010 base year and the 2015 DM forecasts. Where base model flows were not provided for local roads, the adjustment was made using factors from TEMPRO 7.2 for the Yorkshire and Humber region, working backwards from the 2015 DM flows. The adjustment to create 2016 DS forecasts was made by assuming a linear growth between the DS forecasts for 2015 and 2030 DS scenarios.

2.22. ***Table 2-2*** shows the accuracy of the traffic forecasts before and after construction for the northbound section of the scheme and ***Table 2-2*** shows the accuracy of modelling for the southbound section of the scheme. Forecast flows are the average hourly flows for the modelled time period in June and observed flows are the same for April. AM here is the largest hourly flow from 7:00 to 10:00, IP is an average hourly flow from 10:00 to 16:00 and PM is the largest hourly flow from 16:00 to 19:00.

2.23. As indicated in ***Table 2-2*** and ***Table 2-3***, the difference between the DM forecast (2013) and DM observed (2013) hourly flows along the scheme section range between -2% and -14%. This suggests that the Central Demand Forecasts have over-estimated hourly flows. However, the difference between the majority of DM forecast and DM Observed hourly flows is close to or within the 2013 Core Scenario (Low Demand) range (-4.3%) which suggests that the forecast Low Demand projections for GDP and fuel price were more aligned with the observed hourly flows than the Central Demand scenario.

Table 2-2 Average Hourly Traffic flows on M1 Northbound: Forecast and Observed

		Pre - Scheme 2013			Post - Scheme 2016			Increase with Scheme	
Time Period	Location	Forecast DM	Observed Before	% Diff	Forecast DS	Observed After	% Diff	Forecast	Observed
AM	J39-J40	5,040	4,810	-5%	5,600	5,630	0%	11%	17%
	J40-J41	5,670	N/A	N/A	6,540	6,410	-2%	15%	N/A
	J41-J42	6,020	5,890	-2%	7,360	6,830	-7%	22%	16%
IP	J39-J40	3,200	3,040	-5%	3,490	2,950	-15%	9%	-3%
	J40-J41	3,590	N/A	N/A	4,010	3,220	-20%	12%	N/A
	J41-J42	3,880	3,520	-9%	4,350	3,600	-17%	12%	2%
PM	J39-J40	3,940	3,810	-3%	4,140	3,840	-7%	5%	1%
	J40-J41	4,410	N/A	N/A	4,800	4,240	-12%	9%	N/A
	J41-J42	4,620	4,450	-4%	4,970	4,770	-4%	8%	7%

Table 2-3 Average Hourly Traffic flows on M1 Southbound: Forecast and Observed

		Pre - Scheme 2013			Post - Scheme 2016			Increase with Scheme	
Time Period	Location	Forecast DM	Observed Before	% Diff	Forecast DS	Observed After	% Diff	Forecast	Observed
AM	J39-J40	4,440	3,800	-14%	4,420	3,870	-12%	0%	2%
	J40-J41	4,480	N/A	N/A	4,890	4,740	-3%	9%	N/A
	J41-J42	4,690	4,520	-4%	5,450	4,360	-20%	16%	-3%
IP	J39-J40	3,810	3,410	-11%	3,940	3,340	-15%	3%	-2%
	J40-J41	3,870	N/A	N/A	4,220	3,890	-8%	9%	N/A
	J41-J42	4,090	3,810	-7%	4,720	3,790	-20%	15%	-1%
PM	J39-J40	5,430	5,350	-2%	5,830	5,910	1%	7%	11%
	J40-J41	5,720	N/A	N/A	6,520	6,930	6%	14%	N/A
	J41-J42	5,740	5,550	-3%	6,830	6,130	-10%	19%	11%

2.24. Key points to note regarding the accuracy of the forecasts for the scheme M1 sections as shown in ***Table 2-2*** and ***Table 2-3*** are:

- All pre-scheme observed data shows lower levels of traffic than was forecast in the DM scenario. This is also true in most cases for the DS scenario when compared against post-scheme observed data. Although this is not the case for the J39-J40 heading northbound in the AM peak, and between J39-J40 and J40-J41 heading southbound in the PM peak.
- In some cases the variation from forecasts is beyond the -4.3% variance for the low growth scenario in both directions.
- Both the observed data and the forecast data show higher levels of growth in the AM peak heading Northbound and the PM peak heading Southbound. However, the forecast data generally predicted higher levels of growth than was seen between J41-J42.
- Forecast data predicted higher levels of growth in the Inter peak period than was observed, where either fairly flat or even a decrease in traffic was observed.
- Due to the reliability of data we are unable to make comparisons between forecasting and observed data for the section between J40-J41.

2.25. The accuracy of the traffic flow forecasts for adjacent sections of motorway and 'A' roads has also been considered and the detailed tables are shown for the modelled time periods in Appendix C.

2.26. The key points regarding the accuracy of the forecasts for the adjacent motorways and 'A' roads are:

- As noted previously for the motorway traffic flows, generally, observed flows are lower than forecast values both pre-scheme and post-scheme.
- On the section of the M1 directly to the south of the scheme, a similar pattern is seen whereby traffic growth in the AM peak periods heading northbound is higher than forecast and in the PM peak heading southbound traffic growth is higher than forecast.
- The M62 has across all time periods seen increases in traffic in both directions that are generally higher than forecast.
- Traffic growth on local roads at M1 J40 is similar to or higher than was forecast across all time periods. This could be attributed to the Pinch Point scheme in this location.

Journey Time Analysis

2.27. This section considers the impact on journey times following the scheme's implementation. Pre-scheme journey times along the M1 are compared with post-opening journey times for both directions as recorded by sat-nav devices in vehicles using the route. Here we consider journey times extending to the south of the scheme, as far as J38, to assess if the scheme has had any wider effects.

2.28. The journey time analysis is split into three components:

- Analysis of pre and post-scheme journey time differences from J38 -J42.
- A comparison of forecast and outturn journey times along the scheme section.
- A comparison of journey time reliability pre-scheme and post-opening from J38 -J42.

Observed Journey Times before and after

2.29. Data was obtained for the pre and post-scheme periods in the AM, Inter-peak (IP) and PM peak periods as follows:

- Pre-scheme: April 2013
- Post-scheme: April 2016

2.30. The time periods examined are as follows:

AM Peak

- 07:00-08:00
- 08:00-09:00
- 09:00-10:00

Inter Peak

- 10:00-16:00

PM Peak

- 16:00-17:00
- 17:00-18:00
- 18:00-19:00

2.31. ***Figure 2-3*** and ***Figure 2-4*** show the mean of the times observed between the junctions in the above time periods and each direction through the scheme. Note that the journey times here are measured between the mid-points of the junctions on the mainline carriageway.

Figure 2-3 M1 J38-J42 Northbound Journey Time Comparison

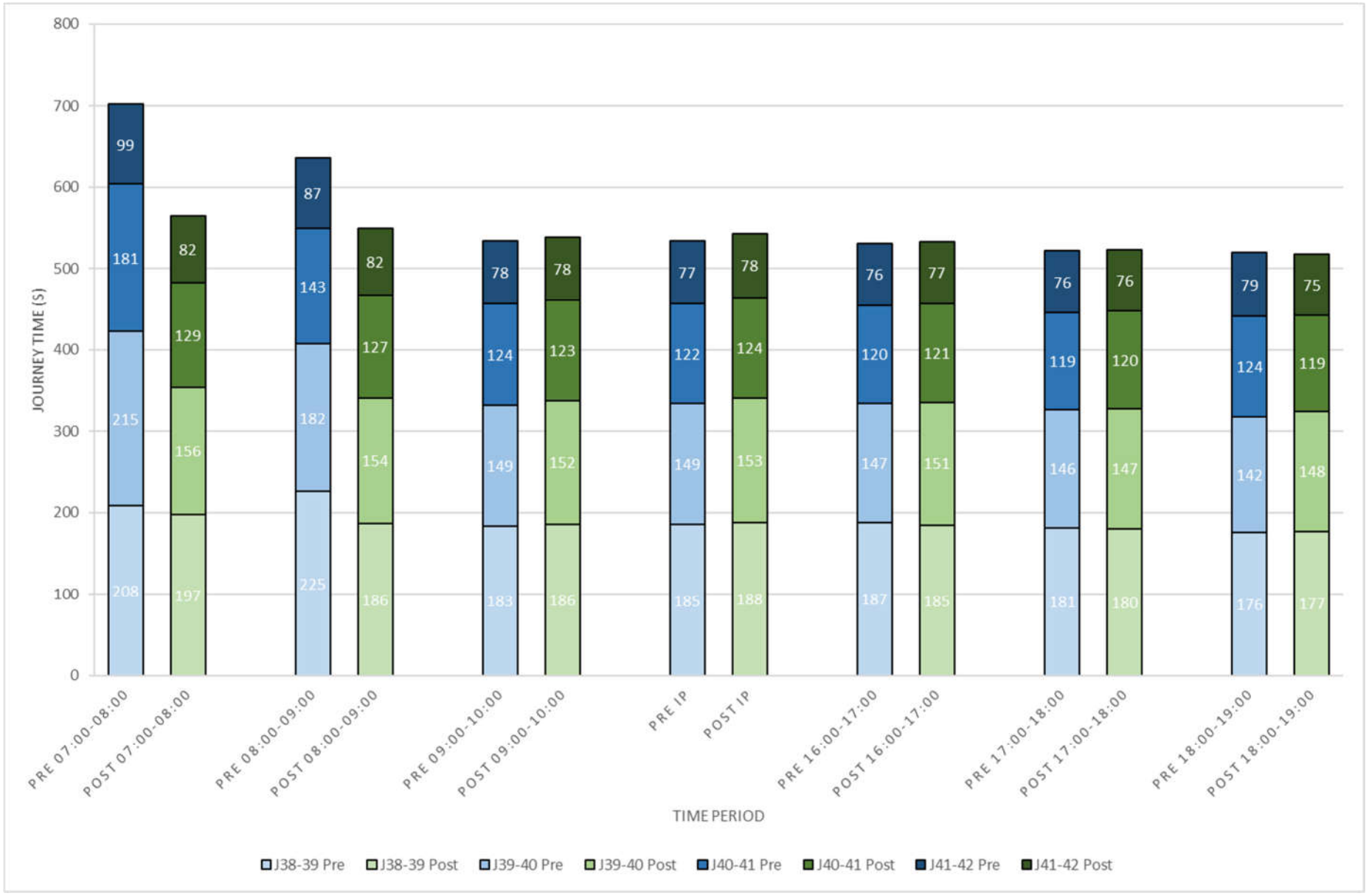
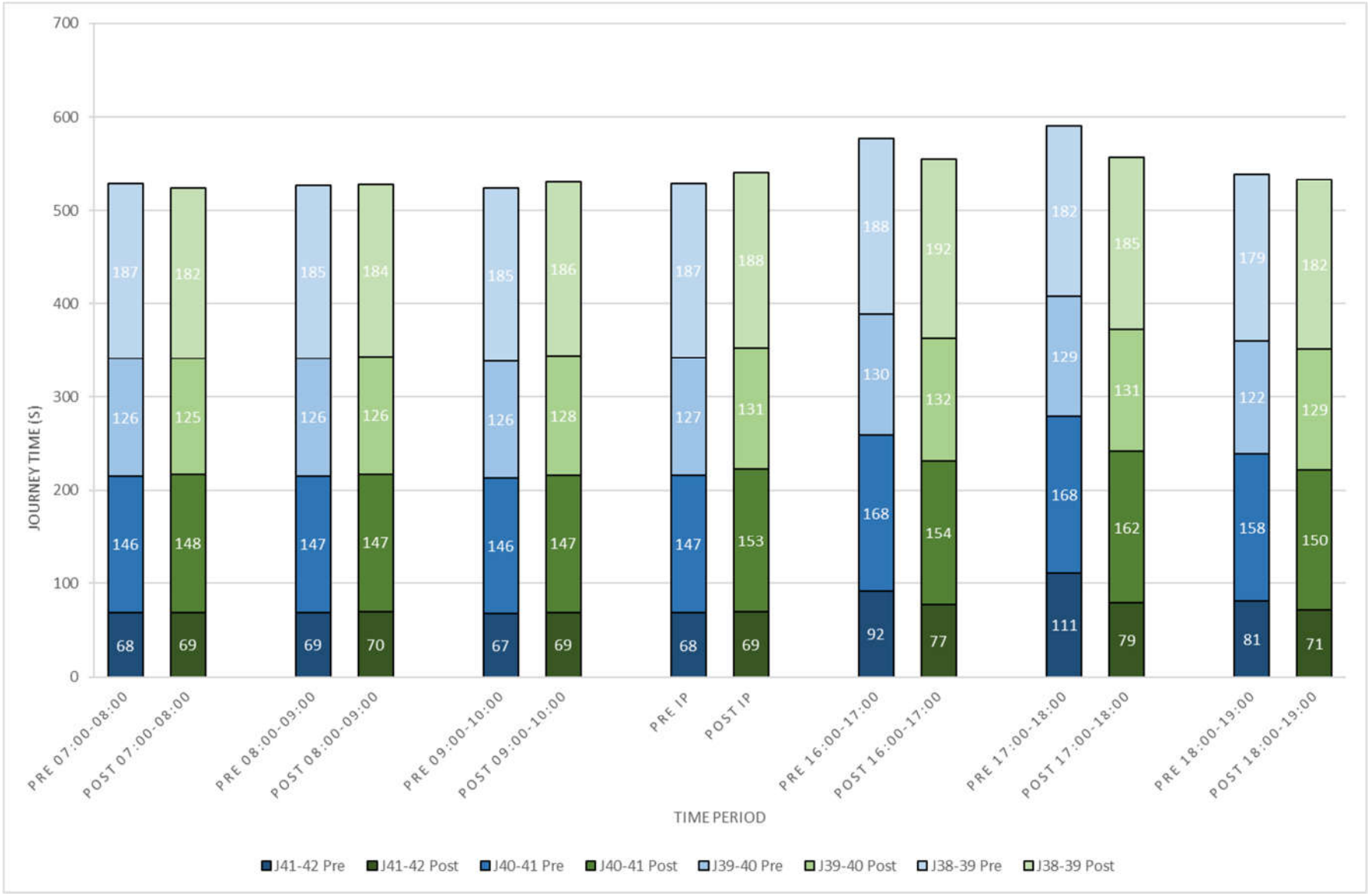


Figure 2-4 M1 J38-J42 Southbound Journey Time Comparison



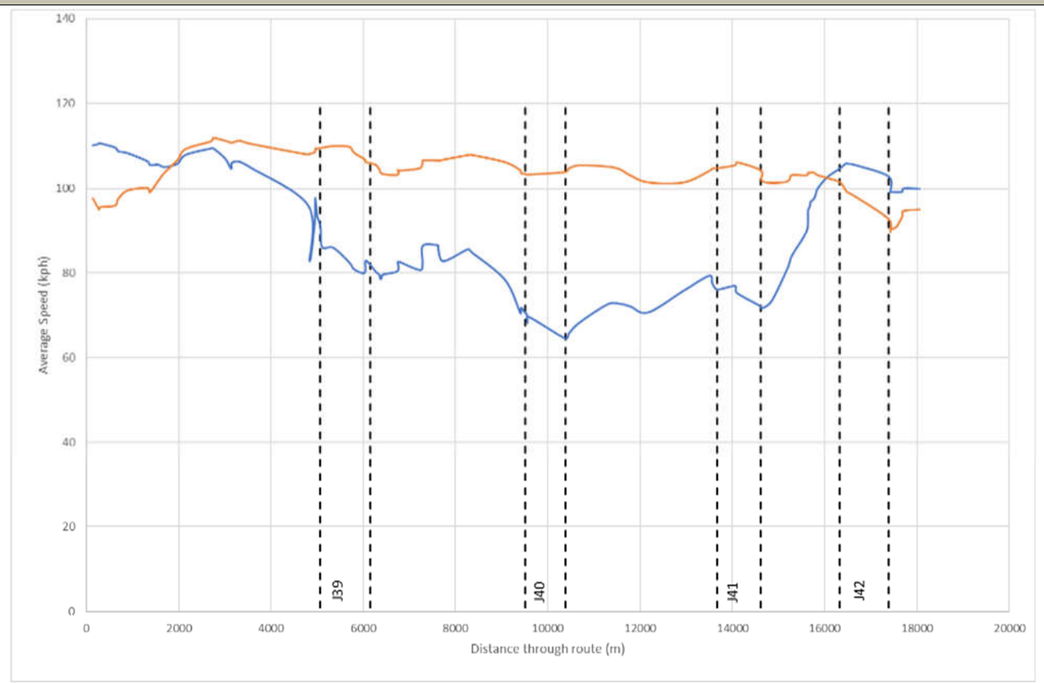
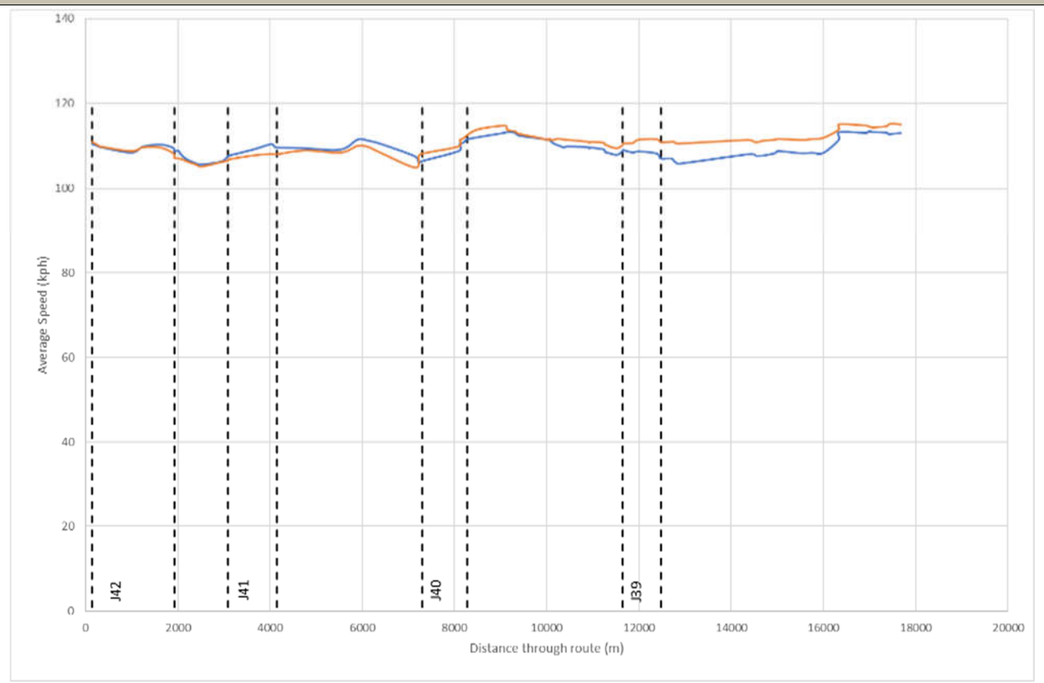
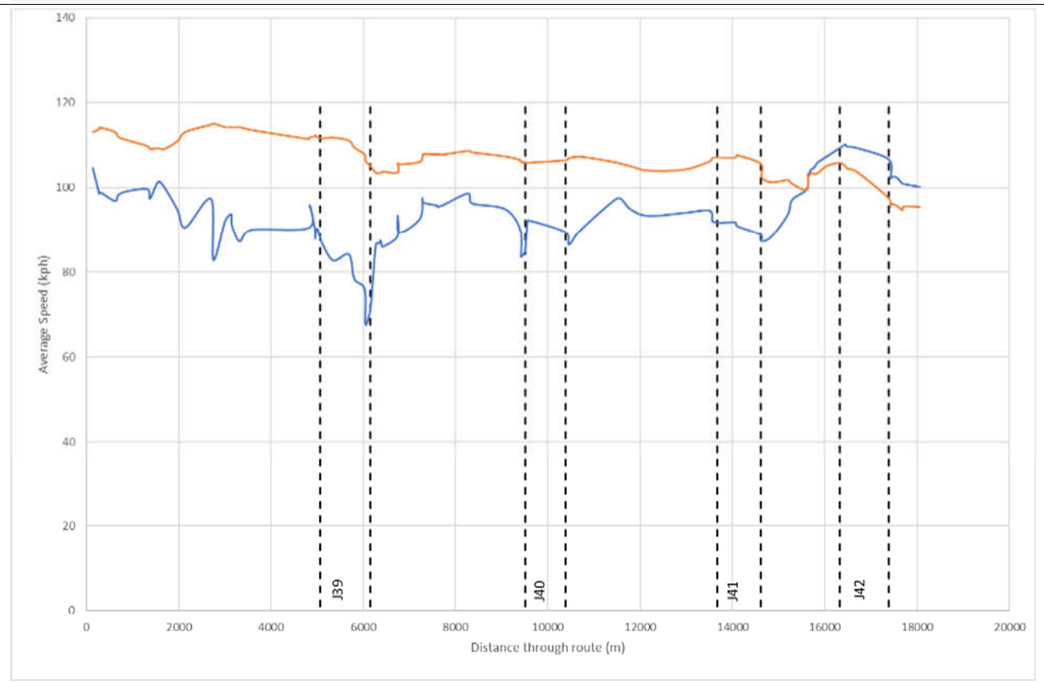
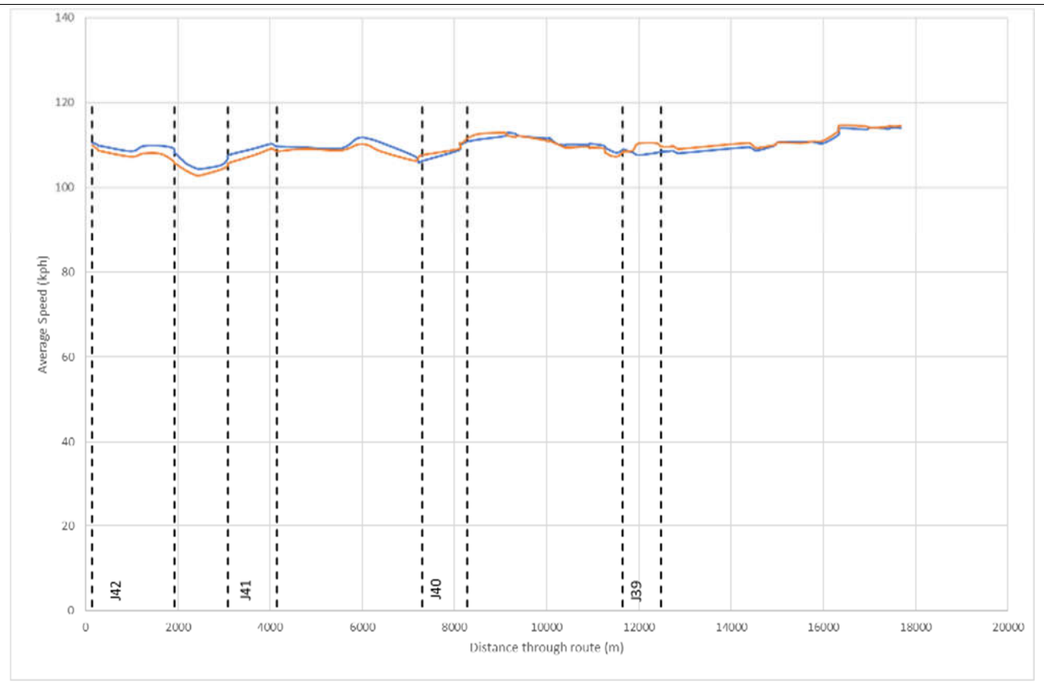
2.32. These results presented in ***Figure 2-3*** and ***Figure 2-4*** show that the scheme has had a positive effect on journey times, in periods of higher traffic flows. In the AM peak heading northbound large savings in journey times are observed, similarly the same can be seen in the PM peak heading southbound. These are the movements that see the larger traffic flows as seen earlier in the section. All other time periods show little or no change in the journey times.

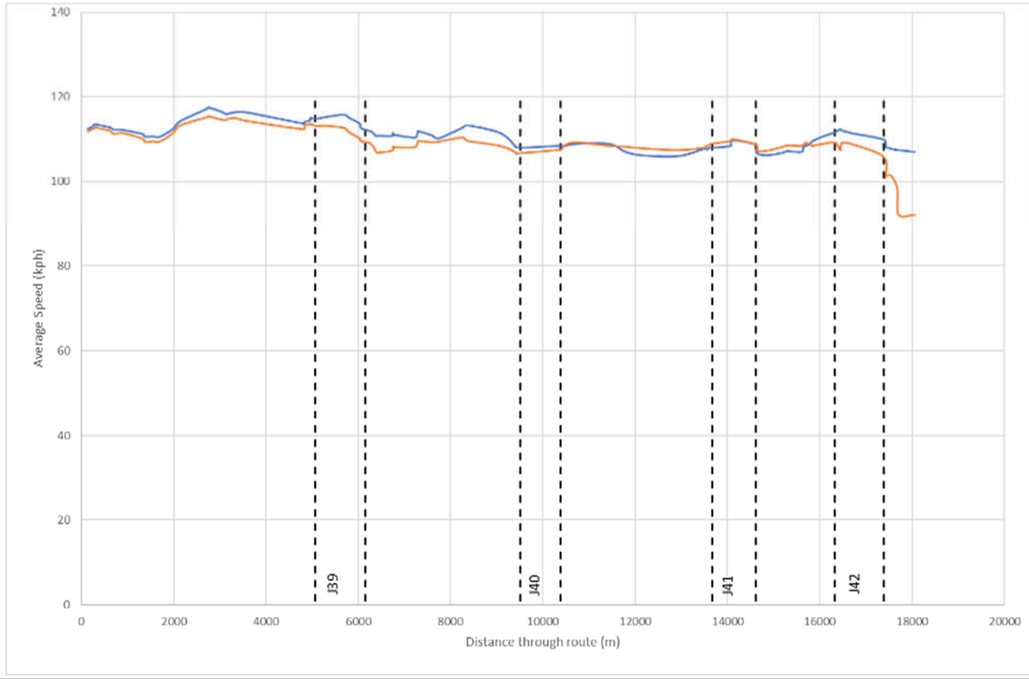
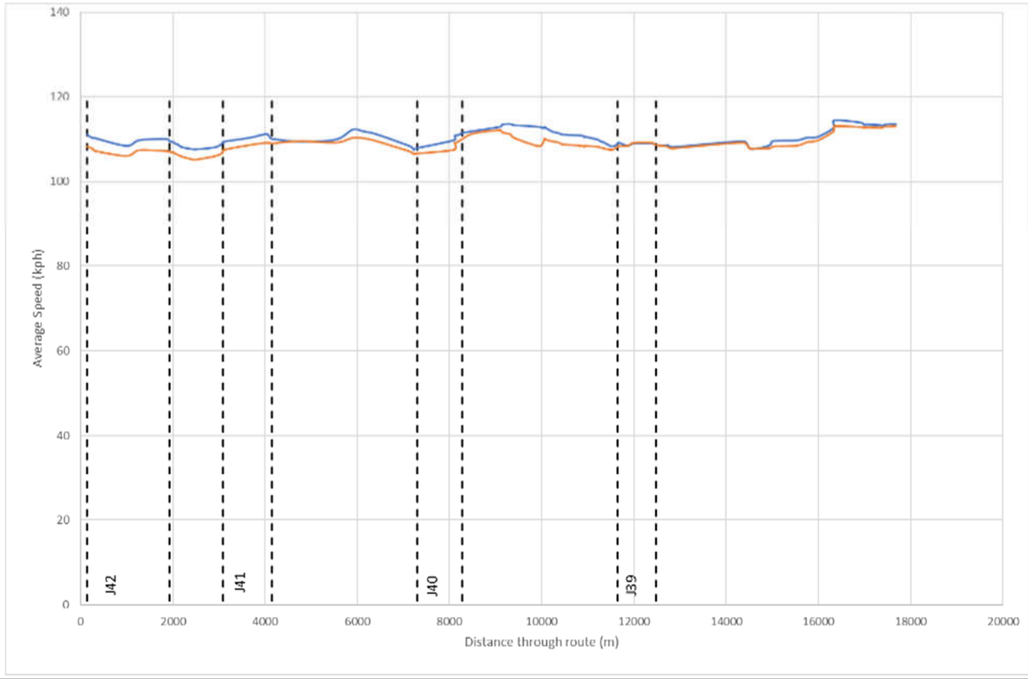
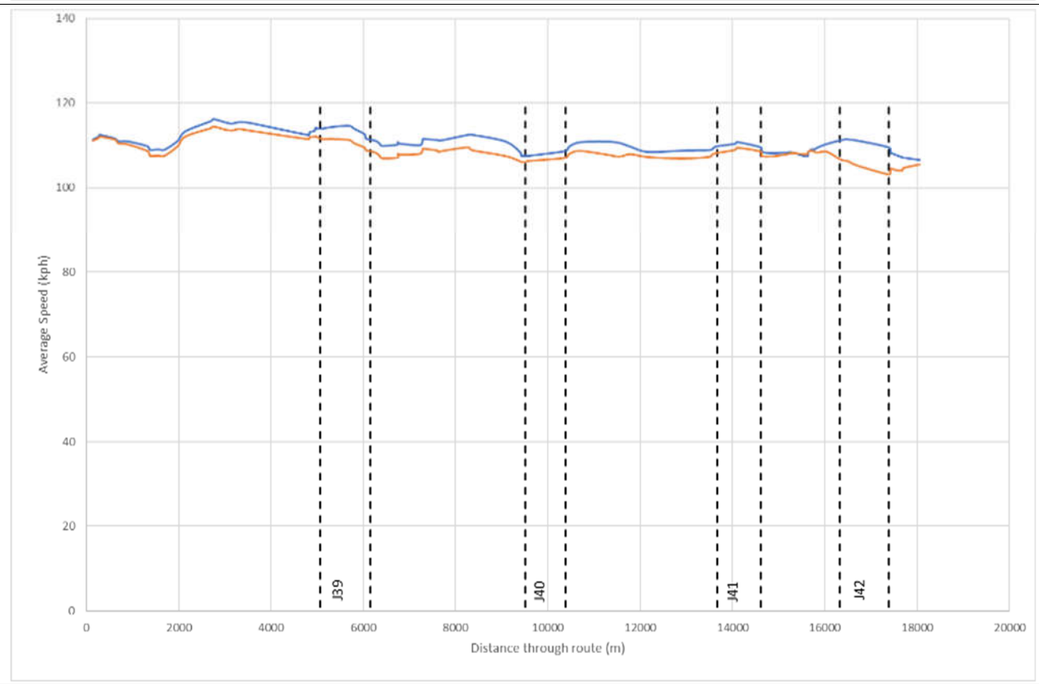
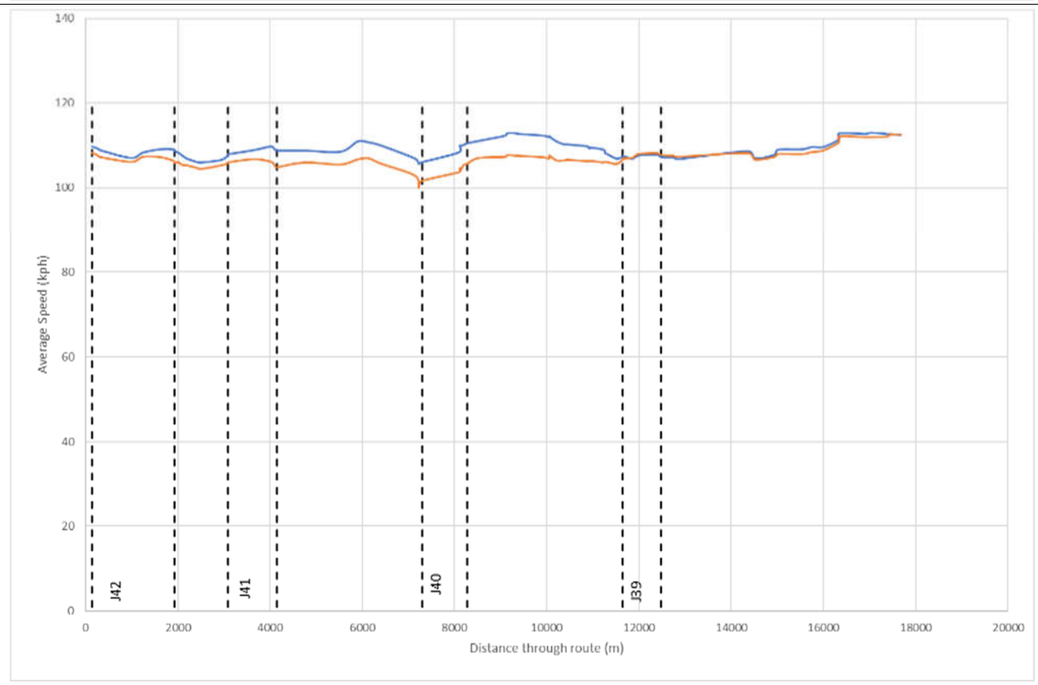
Speed by Distance Analysis

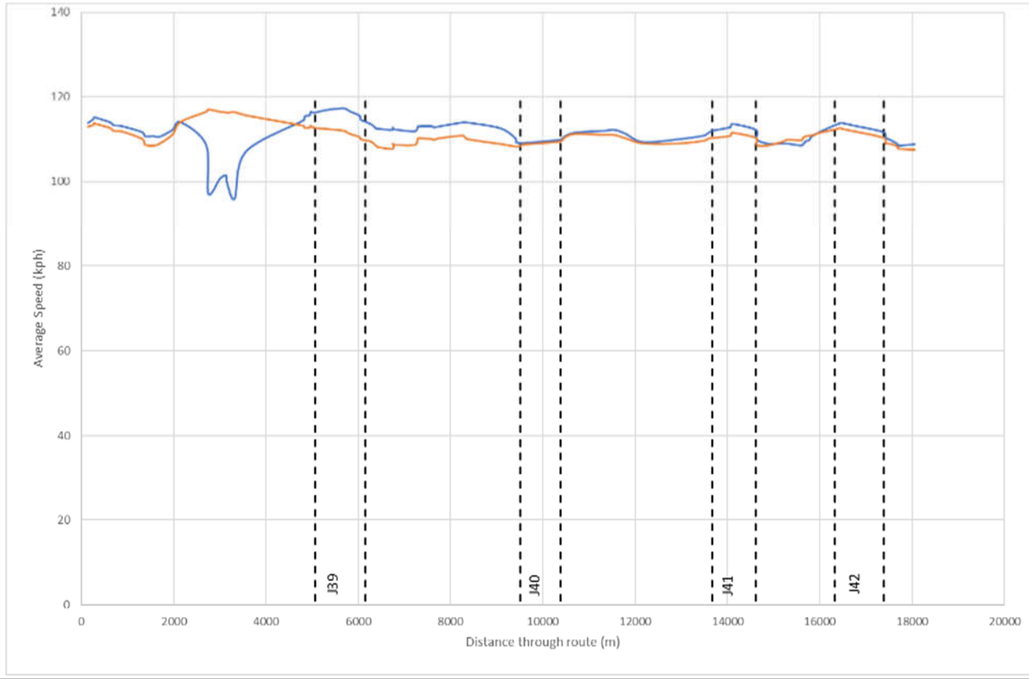
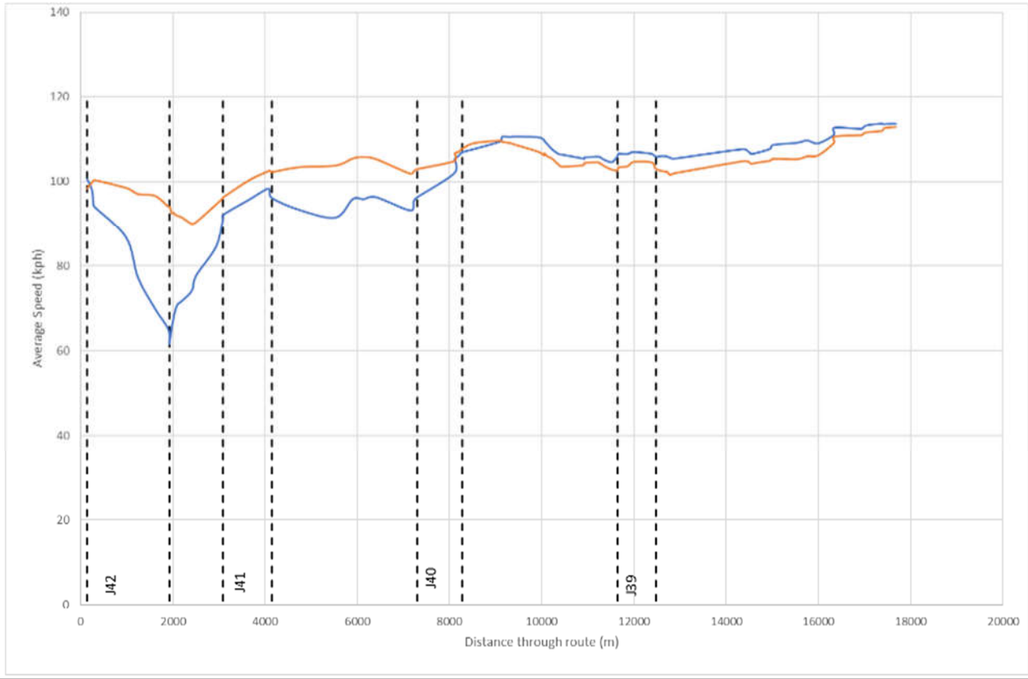
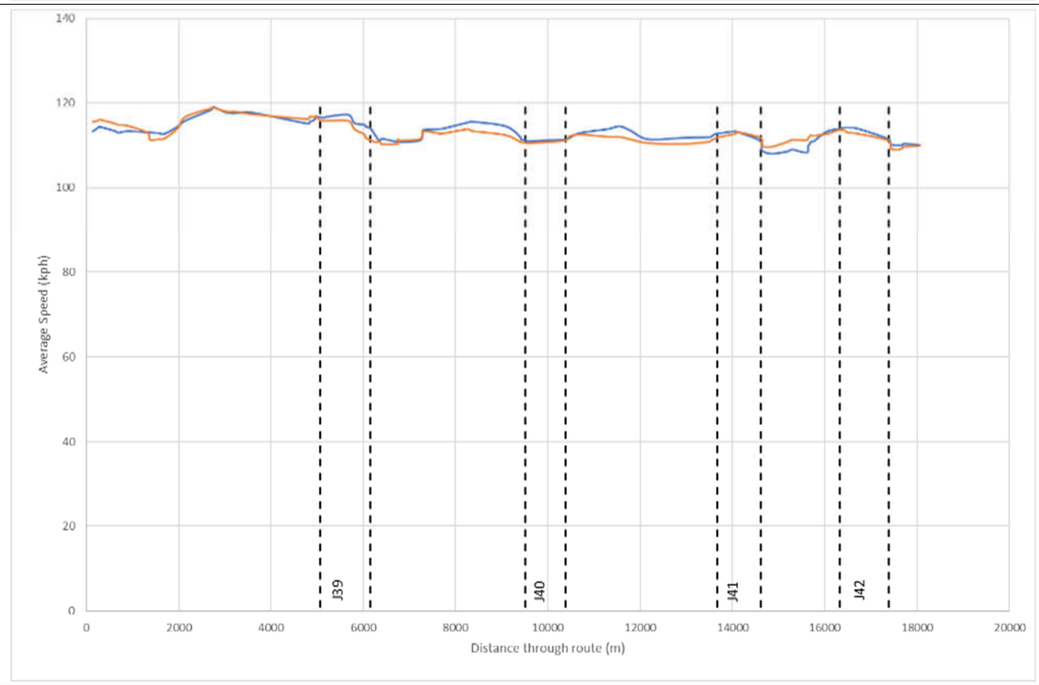
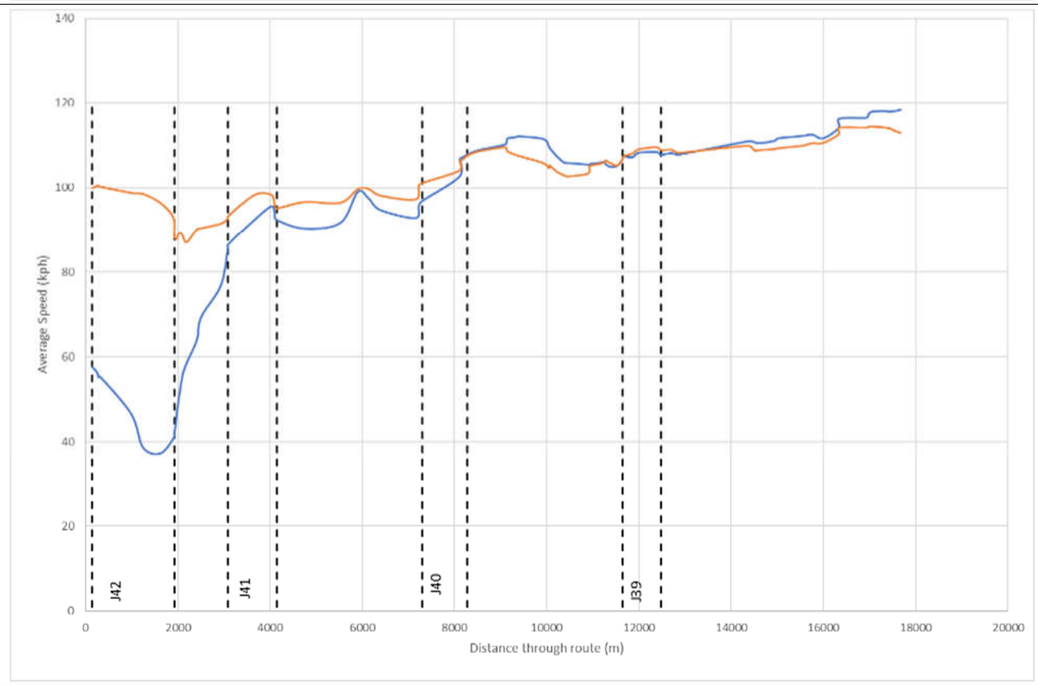
2.33. The average journey time impacts show journey time savings in the most heavily delayed periods in the before but much smaller impacts in all other time periods. In the inter-peak journey times have appeared to get a little bit worse. To understand where the journey times have improved, analysis of average speed along the scheme has been carried out using MIDAS data.

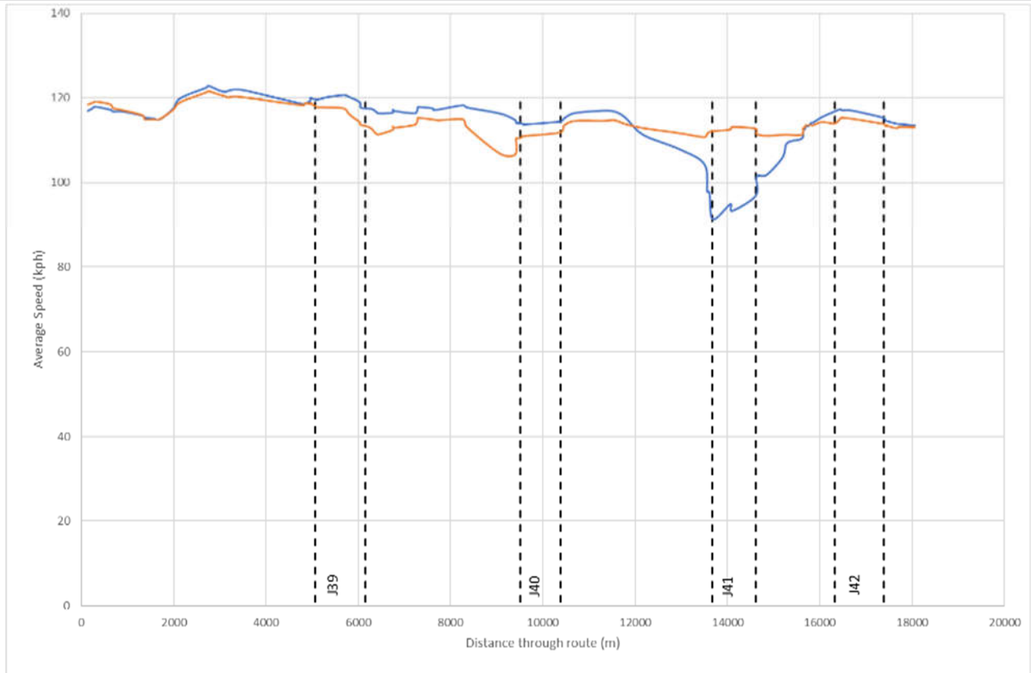
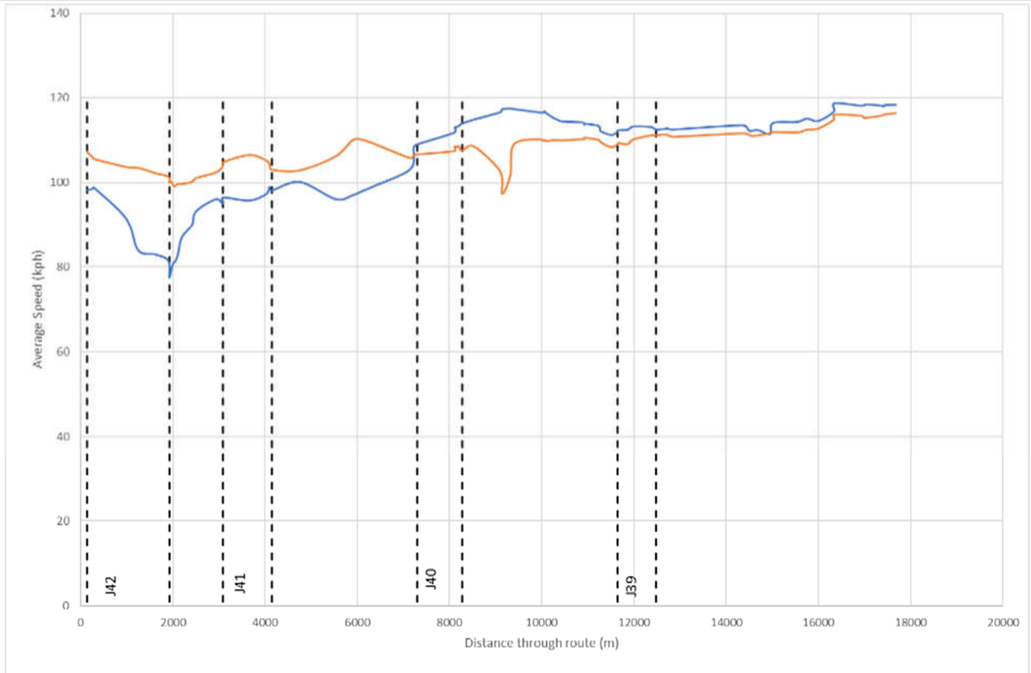
2.34. ***Table 2-4*** on the following page shows the average speed along the scheme by time period. Junction numbers are shown so it can be seen where journey time improvements have been made and whether they relate to on- or off slip locations. When the post-scheme line is above the pre-scheme line, journey time improvements are being shown. Here post-scheme is shown in orange and pre-scheme is shown in blue.

Table 2-4 Speed over Distance for pre-scheme and post-scheme on M1 J38-J42

Time Period	Northbound	Southbound
7-8		
8-9		

Time Period	Northbound	Southbound
9-10		
IP		

Time Period	Northbound	Southbound
16-17		
17-18		

Time Period	Northbound	Southbound
18-19		

2.35. The key findings shown by the weekday speeds over distance plots in ***Table 2-4*** **Northbound** are:

- In the time periods 07:00-08:00 and 08:00-09:00 the average speeds pre-scheme were 89kph and 94kph and post-scheme they are 104kph and 107kph respectively. Across the length of the scheme post-scheme clearly has higher average apart from in the section travelling through J42 where the scheme ends.
- In other time periods the differences between pre- and post-scheme average speeds are minimal, apart from before J39 in the time period 16:00-17:00 there is a dip in speeds pre-scheme and travelling through J41 in the time period 18:00-19:00 where the speeds increase by around 20 kph post-scheme.
- The differences in speeds in all other time periods are minimal.

2.36. The key findings for the speeds **Southbound** are:

- Average speeds have improved in the PM peak period from the northern end of the scheme until J40 with average speeds in this section increasing from 86 kph to 100 kph. After J40 the differences are either minimal or slightly worse.
- The differences in speeds in all other time periods are minimal.

2.37. The results show that improvements in average speed and therefore journey times between pre-scheme and the post-scheme are mainly in the peak period for that particular direction, as would be expected for this type of scheme.

2.38. Periods where no congestion was recorded exhibited minimal decreases in average speed. The reason for this may be that drivers who were previously driving above the speed limit may have reduced their speed due to VMSL.

2.39. The results also show that journey time reliability has improved in both directions in all time periods, as demonstrated by the consistency of the DS speeds for traffic travelling along the length of the scheme, i.e. mainly horizontal on the preceding graphs with fewer deviations for both direction and all time periods. Journey time reliability is considered further in later in this section and is monetised in Section 4.

Journey Time forecasting accuracy

2.40. The TFR included details of the forecast journey times along the whole scheme by time period for the modelled years in the DM and DS scenarios. The time periods are as discussed before.

2.41. It is noted that forecast periods are the same as the observed data. This was done for consistency and so that direct comparisons could be made between what was forecast and what was observed. Comparison here has been undertaken by calculating the journey time savings that were forecast and is shown below in ***Table 2-5*** where green is a positive impact, red is a negative impact and amber is neutral.

Table 2-5 Journey Time Forecasting accuracy M1 J39-J42: net saving (seconds)

Direction	Time Period	Forecast Journey Time Saving (Seconds)	Observed Journey Time Saving (Seconds)
NB	07:00-08:00	155	129
	08:00-09:00	112	52
	09:00-10:00	16	-7
	IP	9	-10
	16:00-17:00	16	-6
	17:00-18:00	16	-2
	18:00-19:00	5	2
SB	07:00-08:00	26	0
	08:00-09:00	32	-2
	09:00-10:00	8	-7
	IP	11	-12
	16:00-17:00	115	37
	17:00-18:00	102	105
	18:00-19:00	11	18

2.42. The key points on journey time forecasting accuracy shown in ***Table 2-5*** are:

- In the four instances that journey time savings were predicted to be over 100 seconds, these are the four time periods where the largest journey time savings were seen in the observed data. In two cases the saving is of a comparable size, namely northbound between 7:00 and 8:00 and southbound between 17:00 and 18:00.
- In most other time periods the forecasts predicted small journey time savings. The observed data shows small negative impacts in most of these instances.
- The forecast journey time savings were derived from modelling which was based on predictions of much higher volumes of traffic than those observed. However, these lower volumes apply to the before and after scenarios, so limited conclusions can be confidently inferred in relation to observed savings compared to forecast savings.

Operation of the Smart Motorway

2.43. This section presents a summary of how the smart motorway is operating based on data as recorded in HALOGEN data (Highways England's LOGging ENvironment).

HALOGEN Operation Data Analysis

2.44. This is a record of the smart motorway settings as installed by this scheme, and therefore there is no equivalent pre-scheme data shown here. Analysis of HALOGEN data has been used to determine how much, on average, different speed limits were in place during the peak periods.

2.45. The time periods used in this analysis were as used throughout this section. Again this was done for April 2016.

2.46. The smart motorway scheme includes capability to use variable mandatory speed limits (VMSL) along the full length of J39-J42. This means that when it is deemed necessary to reduce the speed limit below the national speed limit (70mph), when congestion is high or there has been an incident for example, the VMSL is activated and the gantries on the relevant part of the motorway show the speed limit setting. When 70mph applies, the gantries do not show the speed limit.

2.47. HALOGEN data has been analysed for several points though the scheme as the speed limits setting by the variable mandatory speed limits (VMSL) can vary along a section of carriageway.

2.48. The proportions of the time periods when any VMSL is active are summarised in ***Table 2-6.***

Table 2-6 Summary of VMSL use proportions by time period

% of time period that VMSL is set		AM Peak	Inter-Peak	PM Peak
NB	J39-J40	3%	3%	5%
	J40-J41	5%	2%	5%
	J41-J42	5%	4%	5%
SB	J39-J40	1%	5%	7%
	J40-J41	5%	7%	18%
	J41-J42	4%	3%	24%

2.49. ***Table 2-6*** shows that across these time periods VMSL was active less than 10% of the time in the northbound direction.

2.50. In the southbound direction the VMSL was active more than 15% of the time in the PM peak between J40-J41 and J41-J42. In these two instances, the majority of time the VMSL was active it has been set at 60mph. This is to be expected with this being the period and movement associated with the larger traffic flows as stated before.

Flows and Speeds by Lane

2.51. In addition to the traffic flow and journey time analysis, additional analysis has been undertaken using MIDAS data focusing on the main peak period flows, namely for the AM peak that spans from 07:00-10:00 in the northbound direction and the PM peak that spans 16:00-19:00 in the southbound direction. These two periods were chosen as this is where there were most changes to the journey times. Unlike the sat-nav data, MIDAS data provides a breakdown of the results by lane.

2.52. The graphs presented in the remainder of this section show the lane-by-lane traffic flows and speeds on the All Lane Running section between J39-J42.

2.53. The analysis here is for an average weekday in April 2016. This is the same month that has been used for post-opening traffic flow. In each figure, the different coloured lines represent the different lanes as shown in the key. The distance on the x-axis is the distance in metres from within J39 in the northbound direction and from within J42 for the southbound direction. In the northbound direction a lane G has been included, this lane represents the lane gain past J41 that joins up with the scheme to create the 5 lane section.

2.54. ***Table 2-7*** shows the flows and speeds in the AM peak on the busiest direction (northbound), and ***Table 2-8*** shows the southbound flow and speeds in the PM peak period.

Table 2-7 Flows and Speeds by Lane on J39 – J42: Weekday AM peak (7:00- 10:00) Northbound

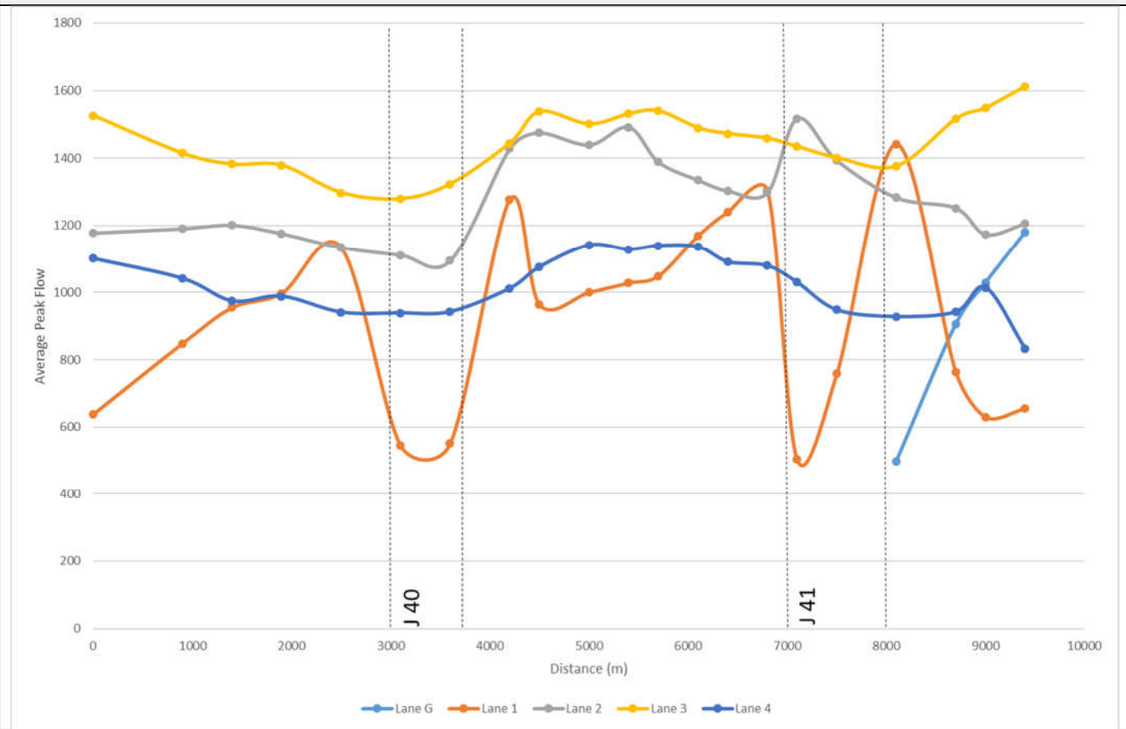
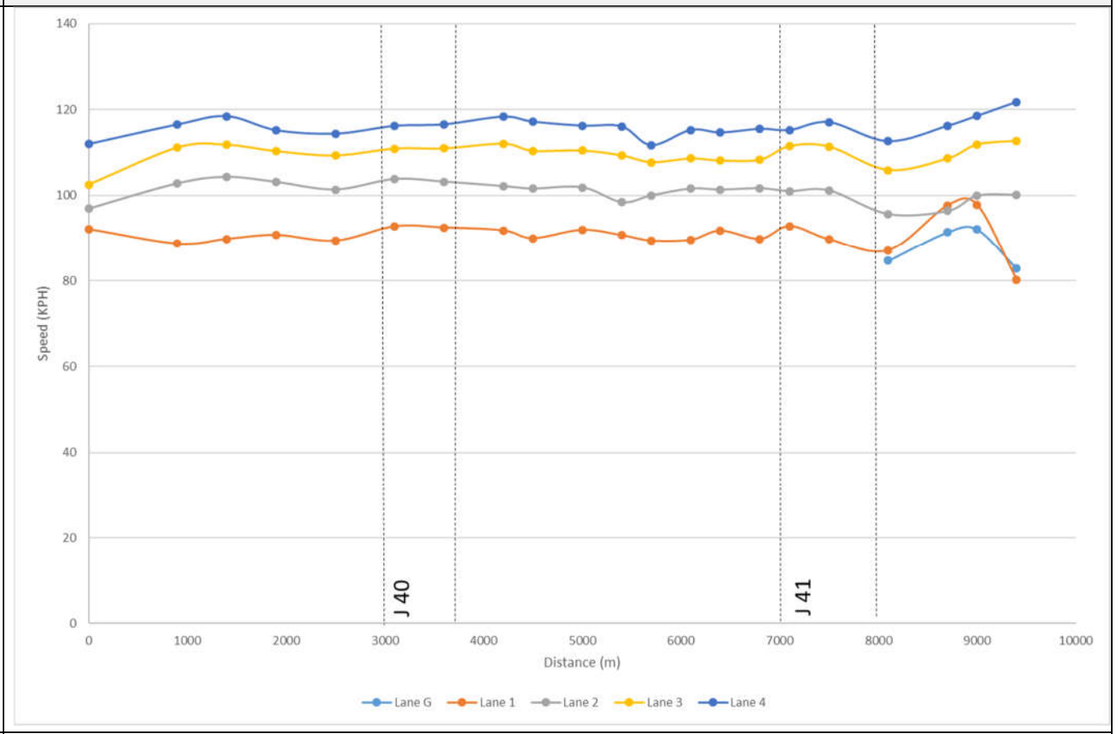
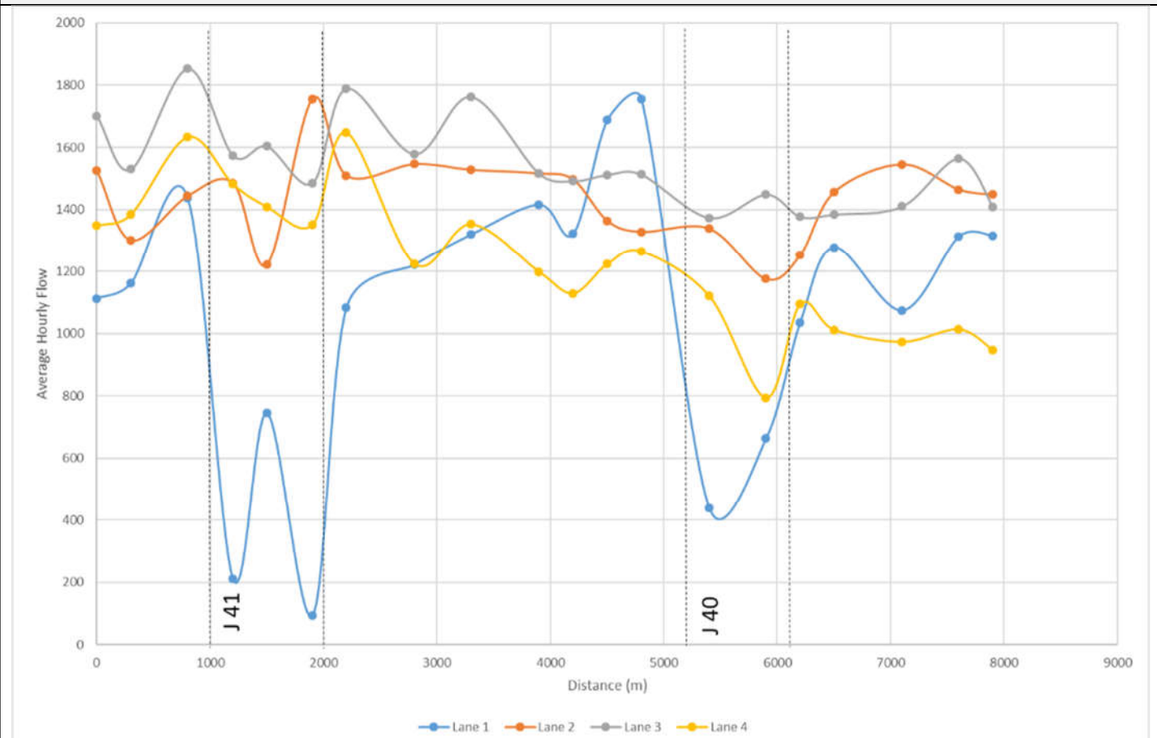
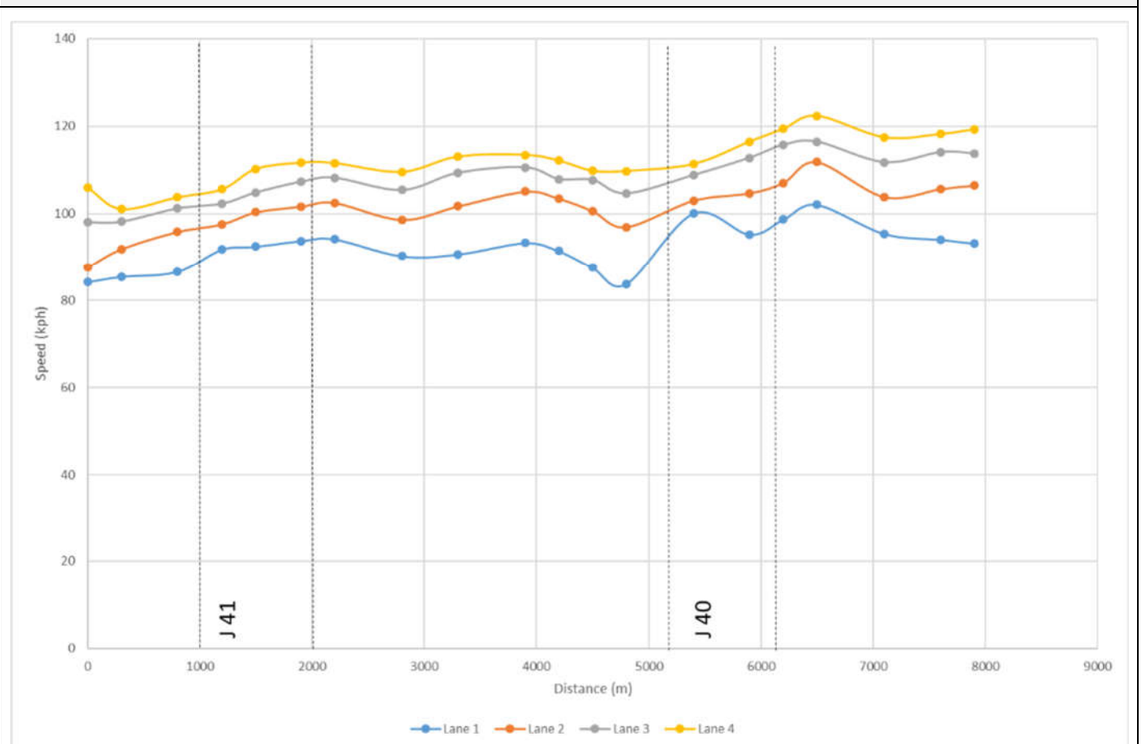
	Flows by Lane	Speeds by Lane
AM peak		
Comment	• Lane 1 shows dips in traffic through junctions where traffic has exited the motorway. Traffic then enters past the junction creating a peak in flow before drivers then move over into other lanes. There is also another peak in flows in lane 1 immediately before a junction as drivers have moved over in order to exit. • The usage of lane 2 increases after J40, this may be due to drivers making the move early to stay on the M1 past J42 as both lane 1 and the lane gain as it is labelled here become slip roads to exit for the M62 at J42. • We can see that past J41 the lane gain generally increases as drivers move over from the other 4 lanes. • Comparing the levels of usage of the lanes we see that between the junctions lane 3 and lane 2 have the highest use. Lane 1 has a similar level of use to lane 4 which implies that the extra capacity that has been provided is being used.	• Speeds for all lanes here show traffic is free-flowing along the length of the scheme, implying good reliability across all four lanes. This remains true except for an increase in speed in lane 1 when moving into the 5-lane section. This is due to the lane gain between J41-J42 and lane 1 actually becoming lane 2. • As you would expect to see speeds generally increase as you move from lanes 1 to 4.

Table 2-8 Flows and Speeds by Lane on J39 – J42: Weekday PM peak (16:00- 19:00) Southbound

	Flows by Lane	Speeds by Lane
PM peak		
Comment	• The comparison of flows here is very similar to that of the northbound direction in the AM peak. • Again the use of lane 1 is of a level similar if not higher than lane 4 and so the extra capacity is being utilised. • One very noticeable observation is the peak in traffic flow in lane 1 immediately before J40. This suggests that a high level of traffic wishes to exit the scheme at this point.	• Results are similar to the northbound direction in the AM peak with speed increasing as you move from lanes 1 to 4. • We do a see a slight dip in speed in lane 1 before J40 but we notice this corresponds with the high peak seen in flow in the same location.

Reliability

2.55. The reliability sub-objective of this scheme was appraised using the INCA which forecast a benefit over 60 years of £106.075m (2010 prices). This included high benefits for day-to-day travel time variability (TTV) but a small dis-benefit for delay reliability (due to collisions and incidents) arising from the impact of the loss of the hard shoulder.

2.56. It is not possible to evaluate reliability using data on observed incidents before and after the scheme was built because the nature of the Smart Motorway means that recording of even relatively minor incidents has much improved. Clearly a basic assessment of the data would show more incidents being recorded through the Smart Motorway technology than that recorded by more manual means before the scheme opened. Mainly the inclusion of CCTV cameras across the length of the scheme has enabled for more incidents to be detected.

2.57. Therefore an alternative approach to the evaluation of reliability impact is to study the impact that the scheme has had on the variability of journey times.

2.58. Variability is the extent to which journey times at a particular time and day vary from the expected average journey time for the same time and day. The distribution of journey times is considered to be a good indication of how much journey times vary.

2.59. The sat-nav data which was used to determine the average journey time along the route also provides the distribution of journey times by percentile ranges. ***Figure 2-5*** and ***Figure 2-6*** present the variability in journey times for the different peak periods. The analysis presented is for the route as a whole (J38 –J42). The nature of traffic flows and congestion issues vary by peak and direction depending on the section of the scheme so, in turn, the variability is greater for individual sections of the scheme.

2.60. Four metrics of the distribution of journey times through the scheme have been used:

- 5th Percentile – One in 20 vehicles are completing the journey faster than this value, so it is a good measure of the best time achievable.
- 25th Percentile – One in four vehicles are completing the journey faster than this value and it is known as the lower quartile. The further this value from 5th percentile the more variability in the fastest journeys, indicating that delays are experienced by a high proportion of all vehicles.
- 75th Percentile – Three quarters of vehicles complete the journey faster than this value and it is a good measure of general variability from day to day of in journey times.
- 95th Percentile – 95% of vehicles complete the journey faster than this value, the remaining journeys are likely to be affected by incidents or heavy congestion. The further the 95th percentile journey time is from the 75th percentile the more heavily congested a journey is, and is an indication of incident related variability.

2.61. These four metrics are shown below in ***Figure 2-5*** and ***Figure 2-6*** as box-and-whiskers diagrams for each time period, before and after. The 95th percentile and 5th percentile are labelled on the figures as well as the mean.

Figure 2-5 Northbound Journey Time Reliability Analysis

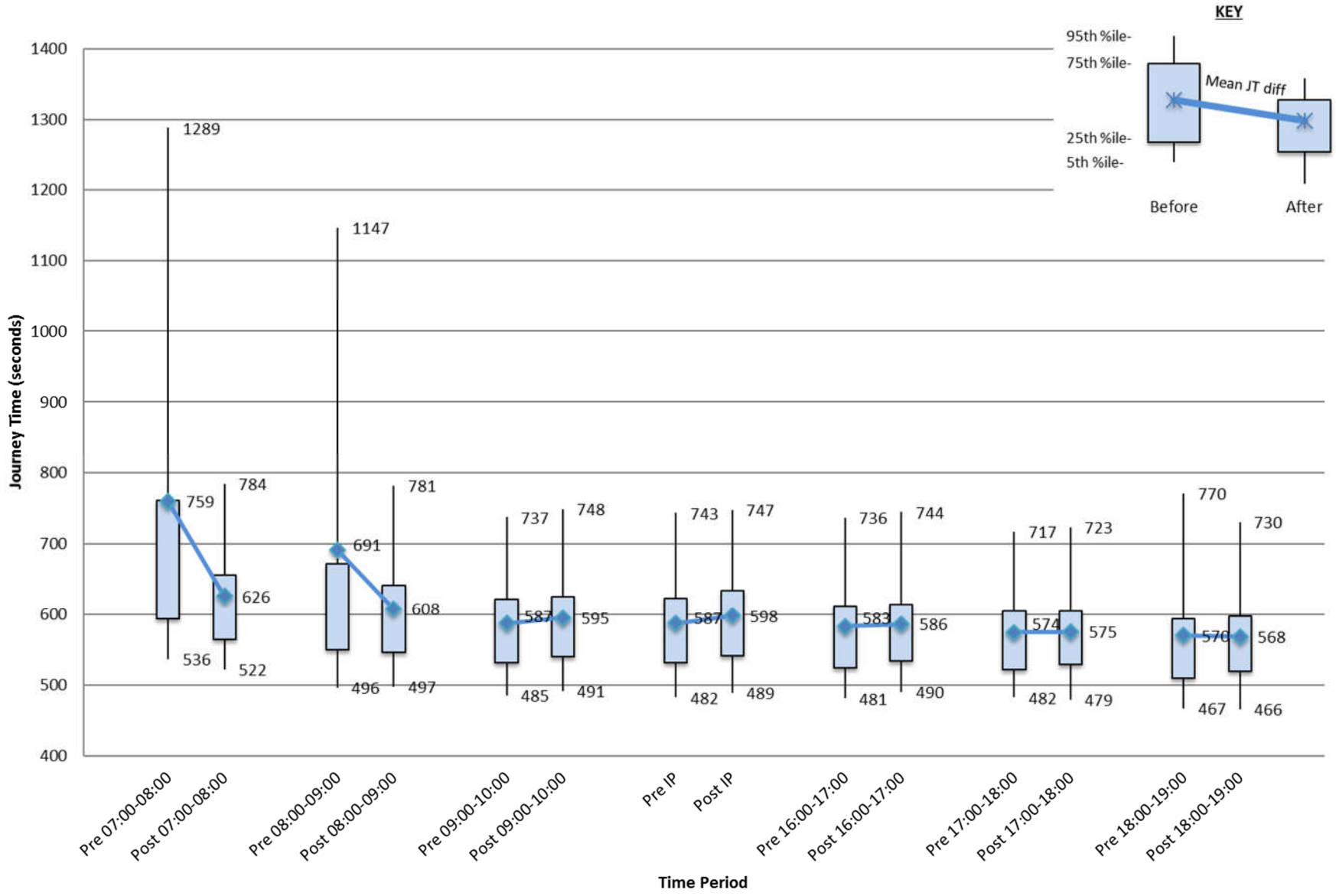
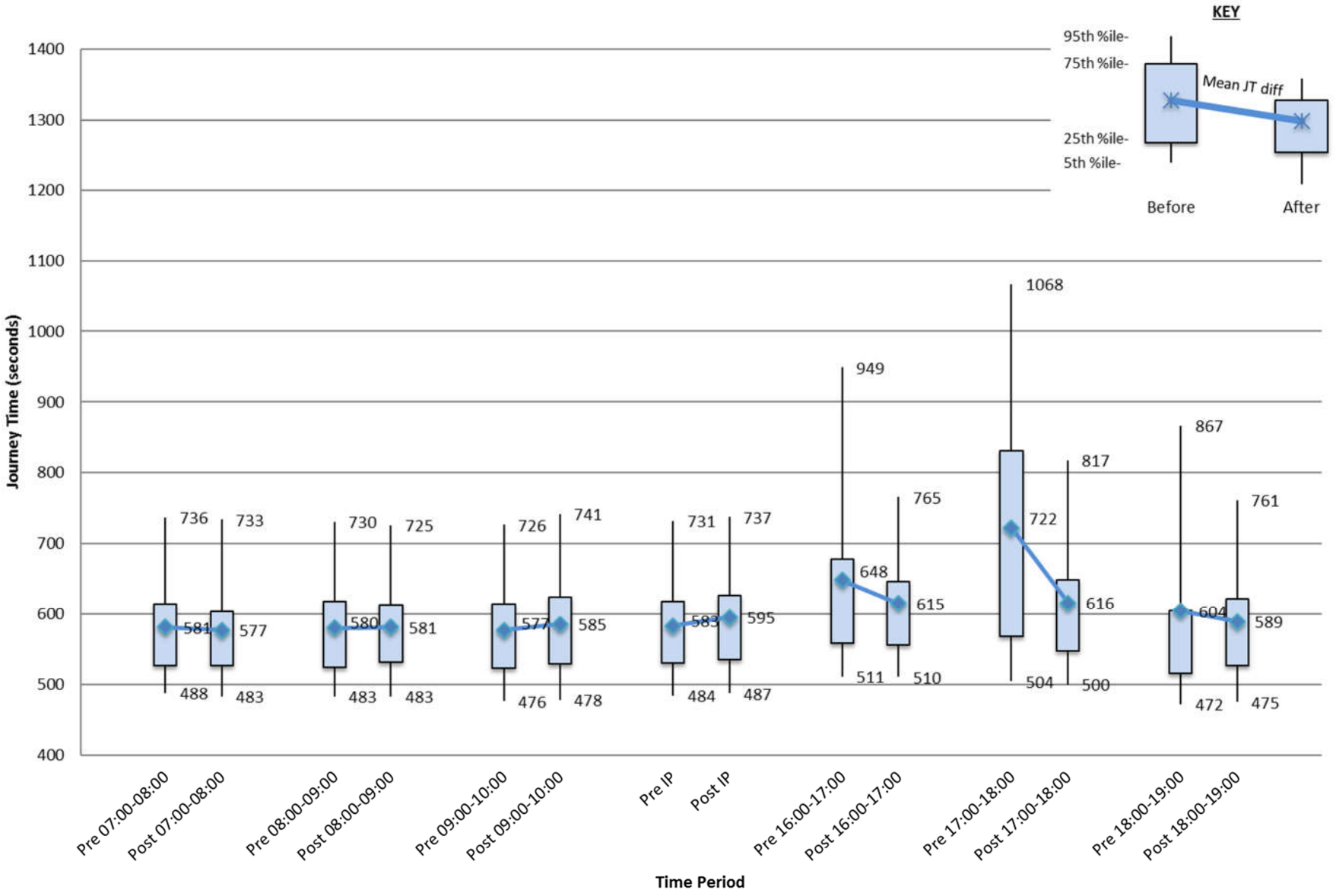


Figure 2-6 Southbound Journey Time Reliability Analysis



2.62. The most congested time periods (AM northbound and PM southbound) had the greatest spread of journey times before the scheme was implemented indicating journey times in these were more unreliable than in other periods. In the post-opening periods there have been noticeable reductions in variability in these periods, showing show that reliability has improved in congested time periods. Other time periods show negligible change.

2.63. Observations on northbound journey time reliability shown in ***Figure 2-5*** include:

- The most unreliable journey times were in the periods from 07:00-08:00 and 08:00-09:00 and this is where reliability has been seen to improve the most.
- The less congested time periods exhibit little change before and after.

2.64. Observations on southbound journey time reliability shown in ***Figure 2-6*** include:

- The most unreliable journey times were in the PM peak time periods and, as for the northbound journey times, it is in these periods the largest improvement in journey time reliability have been seen.
- The less congested time periods have similar results before and after.

2.65. Reliability is monetised in the Economy chapter later in this report but the INCA forecasts a benefit of £106.1 million.

Planning Time Index

2.66. The Planning Time Index (PTI) is a relatively new metric by which reliability is measured. As set out in Highways England's Operation Metrics Manual, this measure is designed to indicate how much additional time road users need to allow to ensure they arrive on time. It highlights roads where very slow journeys are encountered. This measure is the ratio of the 95 percentile journey time to the free-flow journey time, where free-flow time is the maximum of the journey time and 15 percentile journey time (i.e. that when taken at the 85 percentile speed) and the journey time taken at the 70mph motorway speed limit.

2.67. ***Table 2-9*** below shows the PTI for the before and after periods journeys through the full length of the scheme based on the sat-nav journey time data, weighted by flows in the individual time periods.

Table 2-9 Flow-weighted PTI

	Before	After
Northbound	1.59	1.43
Southbound	1.53	1.43

2.68. The PTI figures show that the reliability has improved in the post opening period in both directions, with the greatest improvement for northbound journeys.

Traffic Impacts – Key Points

Flows

- On the scheme sections of the motorway traffic growth was seen to vary from between 2% to 8%. The highest growth of 8% has been seen on the northbound link J41-J42 where the extra lane has also been added.
- Traffic growth on the M62 is higher than the national average for motorway growth which stands around 6-7%
- Traffic heading towards the scheme has grown by on average 5%, while traffic heading away from the scheme has grown by on average 6%.
- All roads observed have seen growth from pre-scheme to post-scheme.

Journey Times

- In periods of higher traffic flows the journey times are have improved. Those periods include the AM peaks for the northbound direction and the PM peaks for the southbound direction. This is also borne out in the increase in speeds during these periods also, with increases in speed of up to 20kph from pre- to post-scheme.
- In other time periods the differences in journey times are minimal with either no impact or a small negative impact.

Forecast vs. Outturn Flows and journey time impacts

- All pre-scheme flows were lower than those which were forecast with differences ranging from 2 to 14%. The lower than forecast flows for the pre-scheme period seems to suggest that growth from the base year was not as high as was anticipated.
- Post-scheme flows were also in general lower than forecast with differences of up to 20%.
- Growth was seen to be high in the periods of larger flows mentioned before but little change was seen in other periods. The forecast predicted consistently large growth at J41-J42 in both directions across all time periods whereas this was not seen in the observed data.
- The forecast predicted savings in journey times across all time periods whereas as stated earlier these were only seen in periods of larger flows. Where the forecast predicted lower journey time savings, the observed show little change.

Operation of Smart Motorway

- VMSL has been active less than 10% of the time in the northbound direction across all time periods.
- In the southbound direction, the VMSL has been active more than 15% of the time in the PM peak between J40-J41 and J41-J42. In these two instances, the majority of time the VMSL has been active it is set at 60mph. This is to be expected with these being the periods of larger traffic flows.

Reliability

- Reliability has improved in the period of larger traffic flows with other periods displaying similar results from pre- to post-scheme.
- The planning time index also shows that reliability has improved in both directions.

3. Safety Evaluation

Introduction

3.1. This section of the report considers the impact of the scheme in terms of the level of success in addressing the objective of reducing collisions.

3.2. The Client Scheme Requirements (CSR) document notes that one of the scheme objectives was:

> *To achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.*

3.3. In order to assess the impact of the scheme on collisions, personal injury collisions (PICs) occurring in the pre-construction period, and the available post-opening period have been analysed. Evaluation of the scheme's impact on personal security draws on observations made during a site visit.

3.4. This section of the study concerns the changes in collision numbers; the economic impact of the change in collisions is evaluated later in the Economy section of this report.

Sources

3.5. The sources used in this section are:

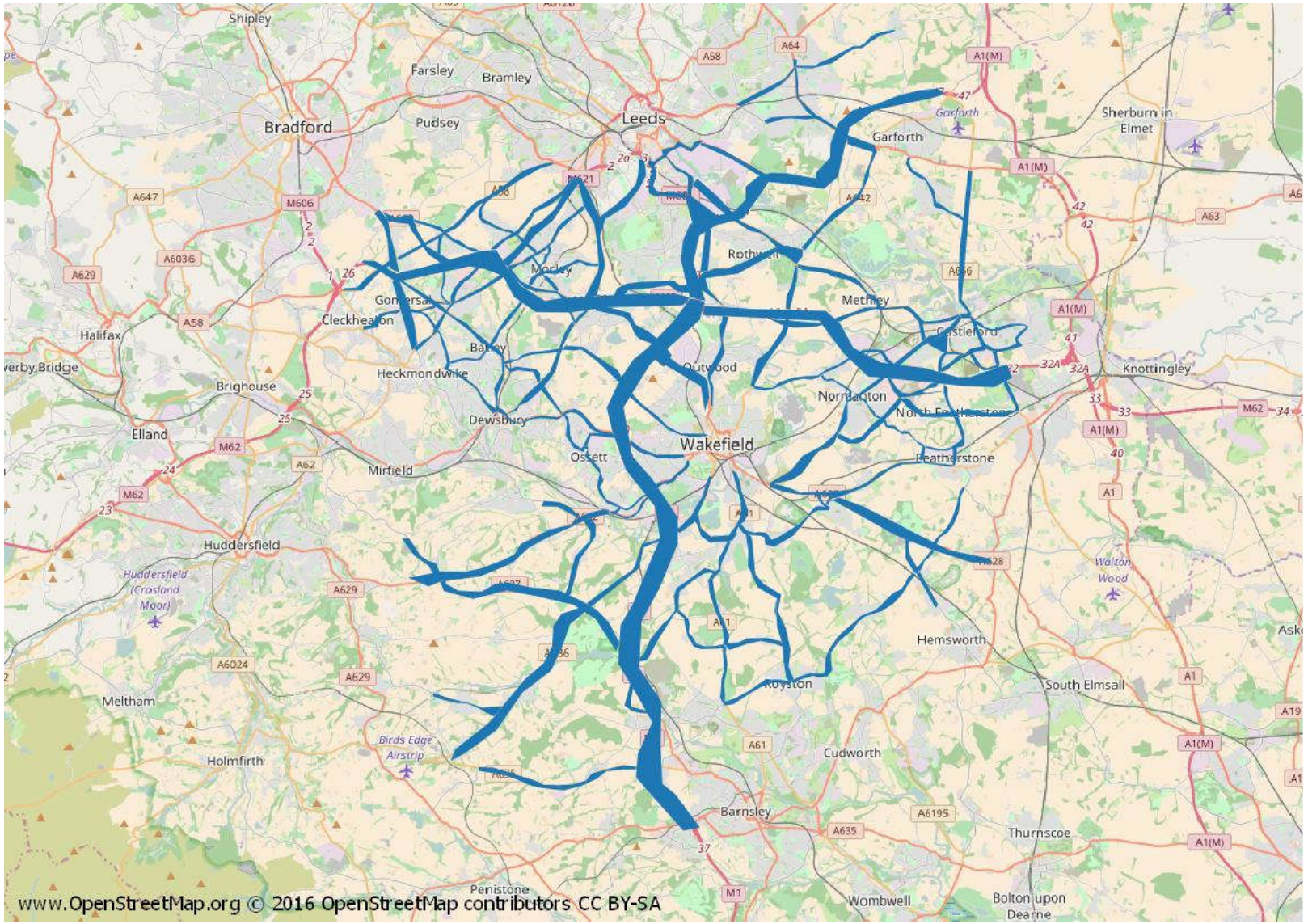
- AST
- Economic Appraisal Report
- Recorded collision data provided by Leeds City Council
- COBA (Cost Benefit Analysis) model

Forecast sources

3.6. The Economic Appraisal Report predicts that over the 60-year appraisal period a reduction of 133 collisions would occur giving rise to a benefit of £9.6m.

3.7. In order to ensure like-for-like comparison between the predicted and observed collision changes, the overall geographical area of analysis used for this study is the same area as shown in ***Figure 3-1***. It is also the same scope of just the motorways, 'A' roads and other key links.

Figure 3-1 Roads Modelled for collisions impact appraisal



Observed data sources

3.8. Collisions by their nature include a random element and are somewhat unpredictable events. To ensure that the scheme is the main change to the road network in the immediate area and the observed changes are likely to be linked to the scheme, the following approach has been taken.

3.9. Collision data has been obtained from Leeds City Council for the area shown in ***Figure 3-1*** covering the following time periods:

- Pre-Scheme: 1 November 2008 – 31 October 2013 (five years)
- Post Construction: 1 February 2016 – 31 January 2017 (1 year)

3.10. The collision data is based on the records of Personal Injury Collisions (PICs) that are recorded in the STATS19 database as collected by police when attending collisions. Collisions that do not result in injury are not included in this dataset, and are therefore not included in this evaluation.

3.11. Collision analysis is normally undertaken with a minimum of three full years of data, so the emerging trends identified in a one year POPE, should be treated with some caution.

Analysis of Collision Numbers

3.12. This section analyses the observed changes in PICs following the implementation of the scheme and includes an investigation into the changes in the number of collisions and associated casualties, as well as whether there has been any change in the relative severity of recorded collisions.

Background Collision Reduction

3.13. It is widely recognised that, over a decade, there has been a year-on-year reduction in the number of personal injury collisions on the roads, even against a trend of increasing traffic volumes over much of that period. The reasons for the reduction are considered to be wide-ranging and include improved safety measures in vehicles and reduced numbers of younger drivers. This background trend needs to be considered when looking at the changes in collision numbers in the scheme area in the before and after periods. Had the scheme not been built, collision numbers in the area are still likely to have been influenced by wider trends and fallen.

3.14. The best way to take this into account is to assume that, had the scheme not been built, the number of collisions on the roads in the modelled area here would have dropped at the same rate as they did nationally during the same time period. This gives what is known as a counterfactual 'without scheme' scenario which allows comparison on a like-for-like basis with the observed post-opening data which is the 'with scheme' scenario.

3.15. The difference between the numbers of collisions in these two scenarios can then be attributed to the scheme rather than the wider national trends and the result will inform the calculation of monetised safety benefits achieved by the scheme, as discussed in the economy chapter of this report.

Evaluation of Collision Numbers and Severity in the Scheme Modelled Area

3.16. The evaluation of the before and after collision numbers by year for the scheme modelled area (as shown in ***Figure 3-1***) and the counterfactual number of collisions which could have been expected in the opening year had the scheme not been built, is shown in ***Figure 3-2*** and ***Table 3-1***. The severity of a collision is defined by the most serious injury incurred.

Figure 3-2 Number of Collisions on Year by Year Basis for Scheme Modelled Area

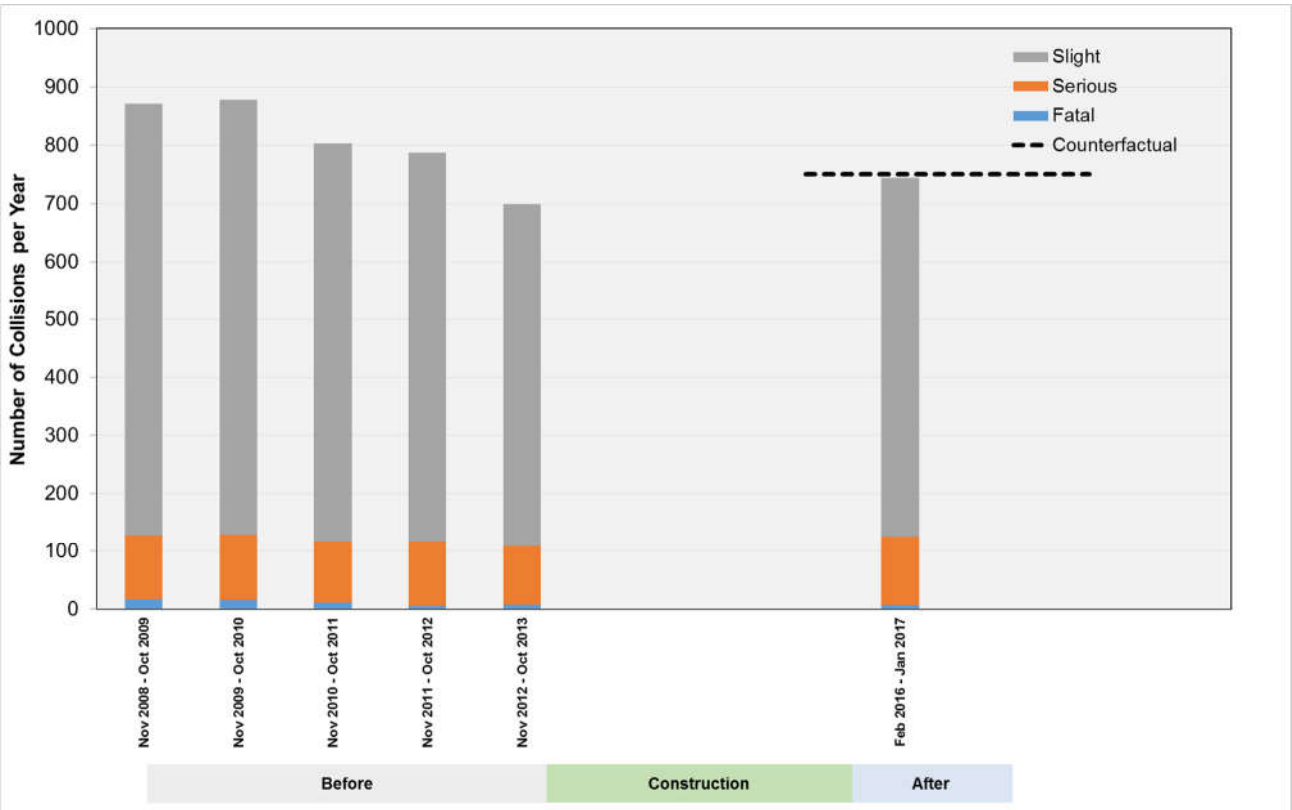


Table 3-1 Annual Average Number of Collisions by severity in Modelled Area

	Five years Before	One year After	Difference	% Difference
Fatal	11.2	6.0	-5.2	-46%
Serious	109.0	120	11.0	10%
Slight	687.4	618	-69.4	-10%
Total	807.6	744.0	-63.6	-8%
Total Adjusted counterfactual*	750.4		-6.4	-1%

*Adjusted figure is the counterfactual annual average i.e. the estimated annual average if collisions risk due to the road layout was the same as observed before construction, reduced by the background trend observed nationally.

3.17. Collison data shown here for the modelled area shows that at this stage there have been reductions in annual average collision numbers from the before and after periods, and a 1% decrease in total collisions when the post opening data is compared with expected number of collisions had the scheme not been built (the counterfactual scenario).

3.18. A statistical test[6] carried out on the change in collisions numbers shows that this 1% saving is not a statistically significant difference.

Evaluation of Collision Numbers and Severity on M1 J39-J42 through the scheme

3.19. This sub-section examines the numbers of collisions and rate occurring on the section of the M1 improved by the scheme. This data has been taken from the same source as for the full modelled area, however we only study accidents before from a three year period and a one year after period as before in order to maintain consistency with the SM-ALR M1 J39-J42 Twelve Month Evaluation. The three year period for the pre-scheme is from July 2010 through till June 2013. The results are shown below in ***Table 3-2***.

[6] Chi-square test with a 95% confidence interval.

Table 3-2 Annual Average Number of Collisions by severity for M1 J39-J42

	July 2010-June 2011	July 2011-June 2012	July 2012-June 2013	Three Years Before Average	One Year After	Difference	% Difference
Fatal	0	0	0	0.0	0	0.0	0%
Serious	2	0	2	1.3	5	3.7	287%
Slight	17	11	15	14.3	15	0.7	5%
Total	19	11	17	15.7	20	4.3	27%
Total Adjusted counterfactual*				14.9		5.1	34%

*Adjusted figure is the counterfactual annual average i.e. the estimated annual average if collisions risk due to the road layout was the same as observed before construction, reduced by the background trend observed nationally.

3.20. ***Table 3-2*** shows that collision numbers rose by 5.1 (34%) on J39-J42 of the M1 within the scheme in the counterfactual scenario.

3.21. The key thing to note is that the increase appears to be quite high however this was due to one of the pre-scheme years having a low number of collisions compared to all other years. This unusually low year for collisions brings the pre-scheme average down and hence makes for a large increase from pre- to post-scheme.

3.22. A statistical test similar to that performed on the whole modelled area for the change in collision numbers here shows that this increase is not statistically significant. Another way of examining the impact on safety is through the collision rates displayed in ***Table 3-3***.

Evaluation of Collision Rates on M1 through the scheme

3.23. The number of collisions along a length of road in conjunction with its AADT can be used to calculate a collision rate (calculated as the number of collisions per million vehicle kilometres travelled). By looking at these rates it is possible to identify the safety impact on the roads of interest whilst ignoring the impact of the change in traffic volumes.

3.24. These collision rates can also be compared against the expected rates used in the forecasts and is shown in the Economic Appraisal Report and COBA model. The forecast collision impact in the COBA model includes a predicted collision reduction over time. The POPE evaluation counterfactual rate as shown below is based on the observed national reduction in collisions on motorways from DfT national data between the before and after time periods.

Table 3-3 Collision rates on M1 J39 – J42

	Three years before		One Year after	Difference
	Observed	Counterfactual		
Personal Injury Collision per million vehicle kilometres (PIC/mvkm)	0.039	0.035	0.048	37%

3.25. The results show that the collision rate has increased to 0.048 PICs/mvkm, an increase of 37% when compared to the counterfactual rate. This collision increase is not statistically significant at this stage when only one year's post opening data is available for the scheme. Again, this is due to the low number of collisions recorded in one of the pre-scheme years.

Collison Severity

3.26. ***Table 3-4*** shows the comparison of results for the Severity Index which is calculated as the proportion of fatal and serious collisions of the total number of collisions. The results indicate an increase in the Severity Index in the modelled area and the M1 mainline scheme section. However, this is based on a small sample size and is not statistically significant (The same chi square test as previously stated), so no conclusions should be drawn at this stage.

Table 3-4 Severity Index of Collisions

Scope	Before	After
Modelled area	15%	17%
M1 mainline (scheme section only)	9%	25%

Forecast vs. Outturn Collision Numbers and Rates

3.27. Forecasting of the safety impact of this scheme was undertaken using the COBA modelling software. This gave forecasts of the changes to collision numbers which is examined here and the associated monetary benefit which is evaluated in the next section of this report.

3.28. The extent of the network of roads included in the COBA modelling was defined as the part of the SATURN network most affected by the scheme in terms of traffic flows shown in ***Figure 3-1.***

3.29. The COBA model included all motorways and trunk roads within the proximity of the scheme. Due to the ongoing works on the smart motorway scheme at M62 J25 to 30 a default national accident rate was applied to that section and this is also true of all other non-motorway and non-trunk roads that were in the forecasting model.

Forecast vs. Outturn Collision Rates

3.30. The Economic Appraisal Report states that the modelling of the collision rate on the M1 was based on observed data from the period 2007-2011. In line with the guidance for the modelling of Managed Motorways (as they were known at the time) there was forecast to be no change in the collision rate as a result of the scheme. Forecast and observed changes in collision rates are shown in ***Table 3-5***.

Table 3-5 Collision Rates on M1 J39-J42: Forecast and observed (PIC/mvkm)

Section	Forecast 2015			Observed		
	Do Minimum	Do Something (with scheme)	% diff	Before (with counterfactual adjustment)	After	Diff
J39-J40	0.035	0.035	0%	0.035	0.048	37%
J40-J41	0.035	0.035	0%			
J41-J42	0.095	0.095	0%			

3.31. The key points on collision rates shown here are:

- The observed increase in the collision rate of 37% (including adjustment for counterfactual) is higher than what was forecast with the collision rates remaining the same in forecasts.

Forecast vs. Outturn Collision Numbers

3.32. ***Table 3-6*** shows the forecast saving in terms of collision numbers which have been taken from the COBA model, and the numbers are compared with the observed data on savings from ***Table 3-1*** and ***Table 3-2***.

Table 3-6 Collision numbers: Forecast and Observed

Scope	Forecast		Observed	
	Saving	%	Saving	%
Modelled area	0.9	0%	6.4	1%
M1 J39 – J42	0	0%	-5.2	-35%

3.33. The key points on the number of collisions saving forecast are:

- Across the modelled area, the observed saving in terms of collisions is greater than that forecast.
- The Economic Appraisal Report states that there would be no saving between the do minimum and do something scenario on the scheme section of the M1 mainline. However, collisions have increased by 35% in the observed data.

Casualties and Fatal Weighted Injury (FWI)

3.34. Fatal and weighted injury (FWI) casualties and the rate of FWI casualties per billion vehicle kilometres per annum are metrics used in the objectives of the smart motorway as set out in the Interim Advice Note IAN 161[7]. ***Table 3-7*** shows the number of casualties and the FWI for the before and after periods. This is calculated based on the numbers of fatal, serious and slight casualties as weighted proportions, to adjust for the severity. Note that no adjustment has been made here for the background reduction in casualties as was made in the approach for the collision counterfactual assessment above.

3.35. FWI is defined as: (number of fatalities) + 0.1 x (number of serious casualties) + 0.01 x (number of slight casualties).

3.36. The FWI per billion vehicle kilometres (FWI / bvkm) allows comparison between road sections with different flows and lengths.

Table 3-7 Casualties and FWI

	FWI/accident	FWI/year	FWI/bvkm
Before	0.025	0.39	2.9
OYA	0.051	1.02	2.6

- ***Table 3-7*** shows that severity has increased but when considering the number of vehicles that travel along the route the fatality index has in fact decreased from pre-scheme to post-scheme.
- A larger data set is required for these findings to be deemed statistically significant so that confidence can be placed in them. The desirable period for analysis of collision data is three years.

Security

Forecast

3.37. The AST stated that this sub-objective was scored as neutral.

Evaluation

3.38. Smart Motorway schemes can be beneficial to security because they include permanent surveillance of the motorway with CCTV. In this case these were installed with the scheme, therefore the OYA assessment of the security impact is slight beneficial.

[7] FWI is defined as: (number of fatalities) + 0.1 x (number of serious casualties) + 0.01 x (number of slight casualties).

Safety Impact – Key Points

Collisions

- Collision analysis is normally undertaken with a minimum of three full years' of data, so the emerging trends identified in a one year POPE, should be treated with some caution.
- In the wider modelled area collisions were seen to fall by around 1%. Fatal collisions decreased by 46% but serious accidents increased by 10%.
- On the scheme itself collisions were seen to have risen by an average of 5 per year. Whilst the number seems to be quite high, one particularly low collision year pre-scheme has made the post-scheme look worse.
- Collision rates have also been seen to have increased from pre-scheme to post scheme on the scheme section of the M1 but this is due to the impact mentioned above.
- Collision severity as a proportion of all collisions has decreased over the wider modelled area but increased over the M1 mainline scheme section.
- Statistical tests at this stage show that changes in both the number of collisions and the severity of collisions are not significant and therefore we cannot state with confidence that the changes are due to the scheme.

Casualties

- The Fatal and Weighted Index (FWI) per billion million vehicle miles has decreased. The decrease shows that fatalities have reduced when taking into account the distance travelled. The index has increased though by accident which suggests more accidents are either fatal or serious.
- The after period (one year) is a relatively short period in which to collect sufficient data; a larger data set is required before FWI findings will become statistically significant.

Forecast vs. Outturn Collision Rate Savings

- Across the modelled area, the observed saving in terms of collisions is greater than that forecast.
- The forecast was that there would be no impact on collisions on the scheme section of the M1 whereas we have seen an increase in collisions.

Security

- The impact is scored as slight beneficial.

4. Economic Evaluation

Introduction

4.1. This section presents an evaluation of how the scheme is performing against the DfT's economy objective, which is defined in WebTAG as:

To support sustainable economic activity and achieve good value for money

4.2. The sub-objectives for economy are as follows:

- To achieve good value for money in relation to impacts on public accounts.
- Improve transport economic efficiency for business users and transport providers.
- Improve transport economic efficiency for consumer users.
- Improve reliability.
- Provide beneficial wider economic impacts.

4.3. When a scheme is appraised, an economic assessment is used to determine the scheme's value for money. This assessment is based on an estimation of costs and benefits from different sources:

- Transport Economic Efficiency (TEE) benefits (savings related to travel times, vehicle operating costs and user charges).
- Collision costs (savings related to numbers and severity level of collisions).
- Costs to users due to delays during construction and future maintenance periods.

4.4. This section provides a comparison between the outturn costs and benefits and the forecast economic impact, as well as evaluating reliability and the scheme's wider economic impacts.

Sources

4.5. The economic forecasts presented in this section are based upon:

- Benefits as presented in the M1 J39 – J42 Economic Appraisal Report S5, August 2013.
- Forecast costs of the scheme as in the September 2013 final estimate form;
- AST (May 2013).
- Economic model outputs from:
  - Transport Users Benefit Appraisal (TUBA): Transport Economic Efficiency, Indirect Tax Impact.
  - Incident Cost-benefit Analysis (INCA): Journey Time reliability (including incident related delay).
  - Cost Benefit Analysis (COBA): Safety impact.

4.6. The outturn results are based on the following sources:

- Costs from the Regional Finance Manager in July 2017.
- Benefits are based on the observed changes to the traffic and numbers of collisions as detailed in the preceding traffic and safety sections of this report monetised to create re-forecasts of the long term impacts.
- WebTAG guidance: Carbon impact, Fuel consumption.
- PAR 6.3 guidance[8].

4.7. The economic appraisal report provides forecasts of the benefits for a 60-year appraisal period. All costs presented in the Economic Appraisal Report and this chapter are in 2010 prices discounted to 2010 unless otherwise stated. This is in line with the price base as used in the EAR.

[8] Project Appraisal Report (PAR) is Highways England's standard approach to appraisal typically used for smaller schemes based on webTAG guidance on economic assessment. It provides a basis for POPE evaluations where is not appropriate to re-run full models.

Present Value Benefits

4.8. The appraisal considered the economic benefits of this scheme expressed in terms of present value (present value benefits – PVB) for the aspects set out in ***Table 4-1***. This table also sets out the approach taken in this post opening evaluation to the reforecasting of the benefits based on the observed data at this stage, and those which have not been evaluated and have been assumed as forecast. A 'yes' indicates that the element of benefits is considered as part of this evaluation. A 'no' indicates that the forecast impact from the appraisal will be used in place of a full evaluation at this stage.

Table 4-1 Economic Benefits of Scheme (2010 prices and values)

Benefits in £m 2010 market prices, discounted	Forecast £m (EAR)	Evaluate ?	Evaluation Approach
Journey Time (TEE business and consumer users)	419.270	Yes	Outturn journey time impacts in opening year can be calculated from observed data and forecasts.
Vehicle Operating Costs (VOC)	-22.536	Yes	Net change in fuel consumption used as a proxy of the outturn impact which is used to reforecast the value of VOC.
Construction period & Future maintenance periods: Journey time and VOC impacts	-57.690	No	Not known at this stage and not within the remit of POPE to evaluate.
Safety Benefits	9.584	Yes	Based on reduction in collision numbers, if this is statistically significant
Carbon Benefits	-50.539	Yes	Ratio between forecast and outturn opening year carbon impact used to calculate 60 year reforecast
Noise Benefits	-3.437	No	Small proportion of the overall scheme impacts.
Air Quality	-2.191	No	Small proportion of the overall scheme impacts.
Indirect tax impact as a benefit	12.549	Yes	Calculate outturn change in fuel consumption and use ratio against forecast change to reforecast 60 year benefit
Total PVB	304.997		
Reliability	106.100	Yes	Re-run INCA model with observed opening year traffic flow data
Total including Reliability	411.097		

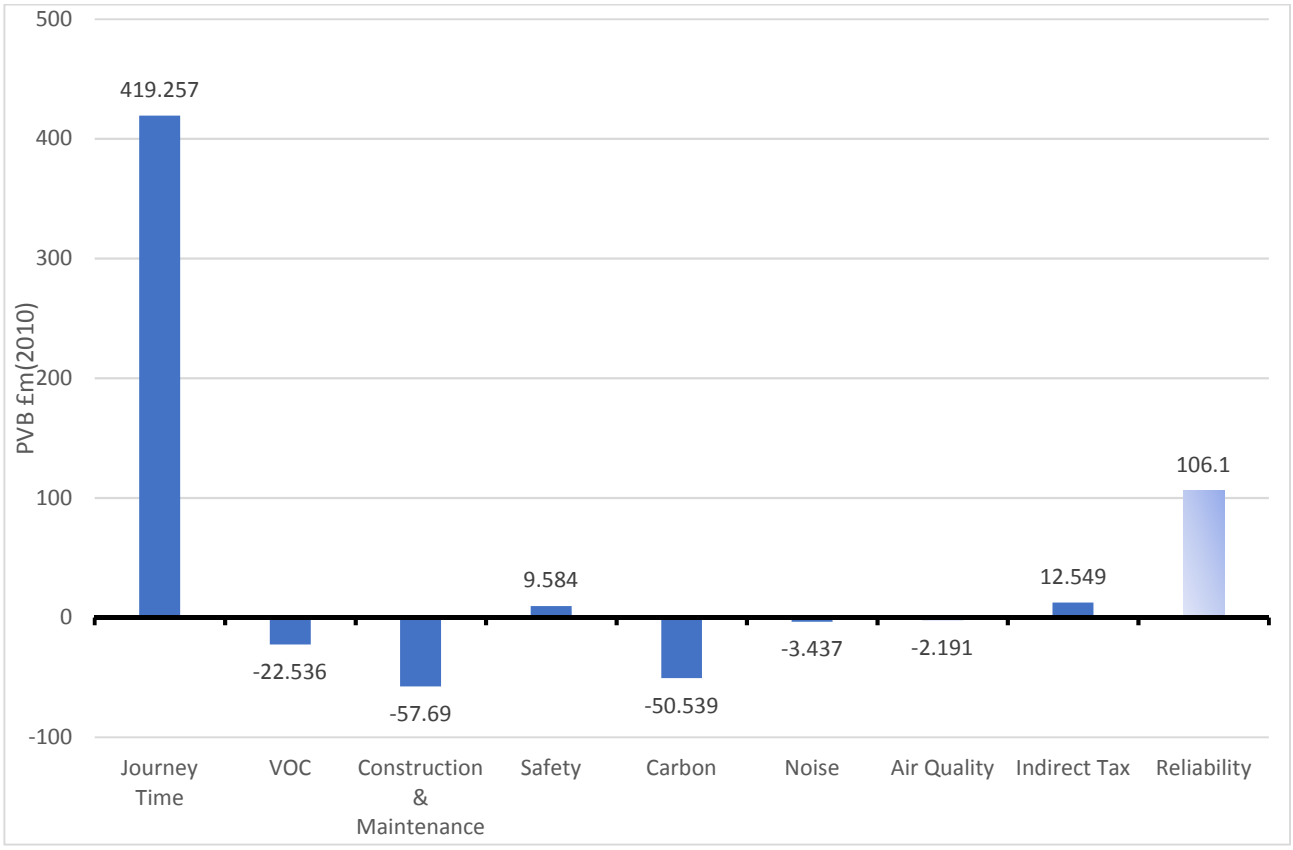
4.9. It is noted that although the reliability benefit was forecast in the EAR, it was not included in the overall benefits as set out in the Analysis of Monetised Costs and Benefits (AMCB) table in the EAR. This is because the WebTAG guidance states that the monetised reliability benefits should not be included in the overall AMCB.

4.10. Economic modelling was primarily for a core scenario, with low and high growth extrapolated in line with WebTAG guidance on Forecasting and Sensitivity (TAG Unit 3.15.3). The forecasts presented above are all from the core scenario, as are the results shown in the rest of this section.

How are the forecast benefits made up?

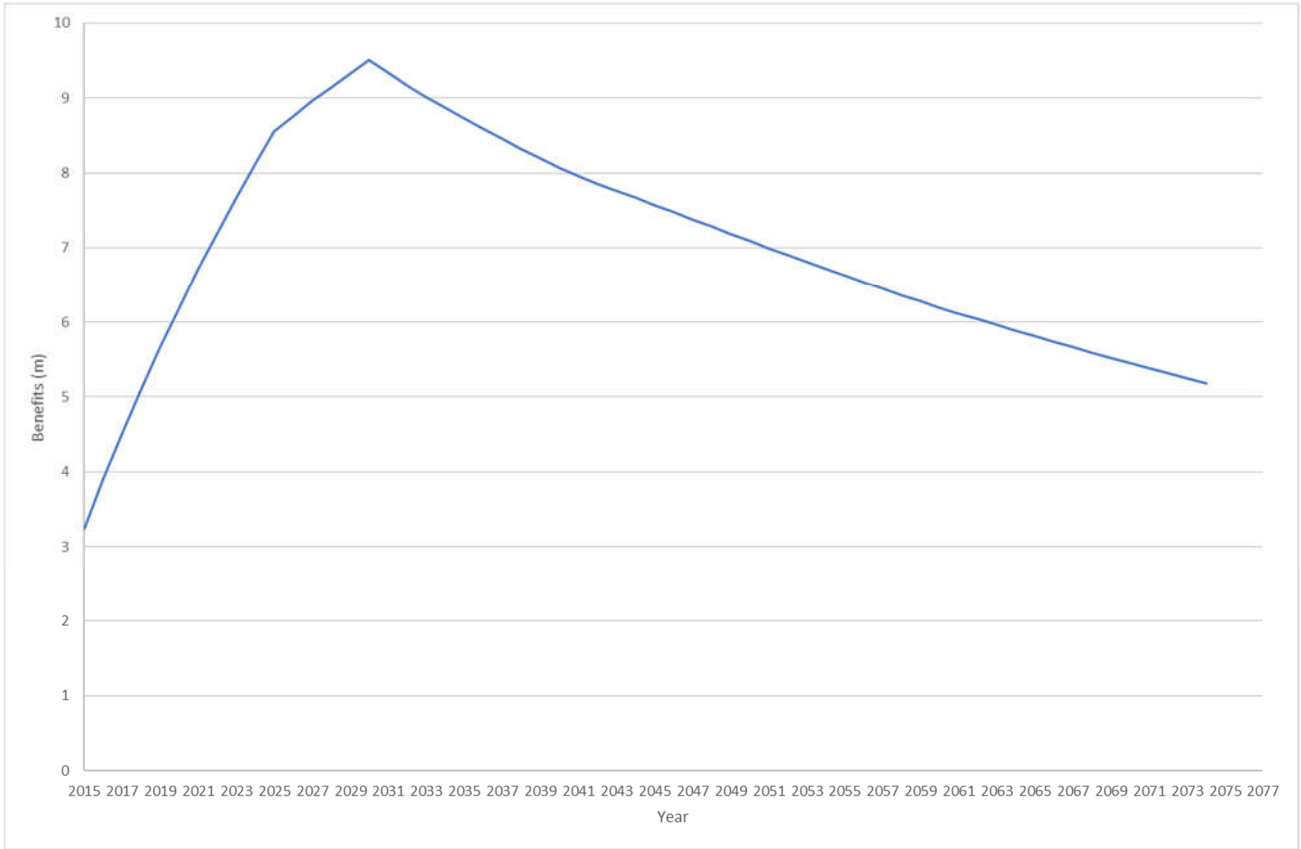
4.11. Benefits as listed in ***Table 4-1*** are shown graphically in ***Figure 4-1*** emphasizing the relative importance of the component parts.

Figure 4-1 Forecast 60 year Benefits by type



4.12. Supplementary analysis of the TUBA forecasts shows how journey time benefits are spread over the 60-year period detailed below in ***Figure 4-2.***

Figure 4-2 Forecast Journey Time Benefits spread over 60 years (£m)



4.13. The graphs of the spread of travel time benefits and analysis of the TUBA model output shows that benefits increase up until 2030 the design year. Beyond this point benefits slowly begin to decrease year on year as congestion increases beyond the optimum capacity.

Transport Economic Efficiency (TEE) benefits

4.14. TUBA was used to appraise the TEE benefits of the scheme compared to the do minimum scenario. The time periods used in the modelling were those on weekdays as shown in the traffic flow section of this report. The EAR states that weekends, bank holidays and night-times were specifically excluded to provide a conservative estimate of the scheme benefits.

4.15. TEE benefits assessed in TUBA include journey time benefits and vehicle operating costs (VOC), in addition to indirect tax revenue impact.

Evaluation of Journey Time Benefits

4.16. The standard POPE methodology for evaluating the economic value of benefits arising from journey time benefits is based upon comparing the observed vehicle hour savings in the opening year against a forecast of the savings. It is then assumed that the difference between these at OYA is indicative of the long-term trend, hence the 60-year outturn monetised benefits can be derived from the forecast 60 year benefits.

4.17. Due to the absence of reliable traffic flow information for the section of the scheme between J40-J41 as was discussed in the traffic section, a proxy has been created for the pre-scheme data based upon the traffic growth across the scheme in each time period.

4.18. Calculating the vehicle hour benefits in the first year attributable to the scheme is not a straightforward task. A number of logical assumptions were required and these are summarised below:

- The traffic already using the routes included in the assessment (in the before period) receives the full journey time benefit observed at this one year after stage;
- Any additional traffic receives half of the journey time benefits. This concept is known as the 'rule-of-a-half' and is the standard approach for dealing with extra traffic; and
- Off-peak periods are omitted as the appraisal did not include forecasts for these time periods as it was assumed that the motorway had spare capacity in these periods, even without the improvement.
- The ratio between the forecast opening year vehicle hour saving and observed opening year saving along the scheme section was applied to the forecast opening year monetised benefit from the TUBA appraisal. This assumes that the accuracy of journey time savings over the scheme section are representative of those in the wider modelled area.
- The profile method has been used to factor the observed opening year benefits to the full 60-year appraisal period. This method applies the absolute difference between the forecast and observed benefits in the opening year to the TUBA benefits profile for the remaining years of the appraisal period. It considers the difference between the observed and modelled benefits as an absolute difference rather than proportionally.

4.19. The journey time benefits are shown in ***Table 4–2***.

Table 4-2 Journey Time Benefits

	Vehicle Hours
Forecast annual vehicle hours saved on M1 J39-J42	336,600
Observed annual vehicle hours saved on M1 J39-J42	66,706
Ratio	19.8%

Forecast opening year benefit (Whole Area)	**Outturn opening year (Whole Area)**
£3.25m	£0.64m
Forecast 60 year benefit (Whole Area)	**Outturn 60 year (Whole Area)**
£419.3m	£350.9m

4.20. It can be seen from this assessment of the 60 year benefits, that the journey time benefits are lower at £350.9m. This is based on the assumptions outlined above, and based on analysis of only part of the scheme section. As such it is too early to be confident in the trends observed over only one year to be indicative of long term trends.

Vehicle Operating Costs (VOC)

4.21. WebTAG guidance states that the use of the road system by private cars and lorries gives rise to operating costs for the user. These are fuel and non-fuel costs, where fuel is usually the majority net impact of conventional highways schemes.

4.22. In the case of this scheme, the forecast VOC impact in the EAR was from the TUBA model. This forecast that VOC impact of the scheme would be a net dis-benefit. This dis-benefit would be mainly for consumer users, and this was largely due to the expected diversion of some consumer traffic from local roads onto the M1, which would have more capacity due to the ALR provided by the scheme. This would result in drivers travelling further to reach their destinations, but doing so in less time. As a result of the rerouting they were forecast to use more fuel (and non-fuel resources), thus increasing their operating costs. Business users see less impact as business traffic generally uses strategic roads and hence was forecast to only have a small dis-benefit VOC, due to the increase in speeds slightly increasing the fuel costs.

4.23. As with journey time benefits, the TUBA model cannot be rerun to evaluate the impact. The alternative approach adopted here is based on comparing estimated changes in fuel consumption between observed and forecast scenarios at OYA. This approach consists of the following steps:

- Estimating changes in fuel consumption one year after opening on the M1 between J39-J42 using observed data for flows and speeds by time period and based on VOC guidance on calculations given in webTAG.
- Using the ratio between these at OYA to proportion the forecast 60 year VOC, the 60-year outturn monetised benefits can be derived.

4.24. This evaluation approach is based on the assumptions:

- Changes to fuel consumption are the majority of the VOC impact.
- Changes on the key links J39 – J42 are indicative of the changes over the whole modelled area.
- The ratio between the changes in fuel consumption at OYA is indicative of the long term trend, hence the 60-year outturn monetised benefits can be derived from the forecast 60 year benefits.

4.25. The evaluation of the outturn impact based on the observations in the opening year is shown in **Table 4-3** compared with the forecast from the EAR.

Table 4-3 Vehicle Operating Costs (VOC)

		Net Change (litres)
Forecast total net change in fuel in opening year		1,684
Observed total net change in fuel in opening year		-3,797
Ratio		-2.26
	Forecast (whole area)	**Outturn reforecast (whole area)**
60-year impact £m	- £22.536m	£50.821m

4.26. This shows that the outturn assessment is a benefit rather than the dis-benefit that was forecast. This is in part due to the lower than forecast observed flows and less traffic growth between pre-scheme and post-scheme than was forecast. In the observed data, increases in speed were less dramatic than in the forecast, with the forecast having much lower speeds in the do minimum scenario than was actually observed pre-scheme. The result needs to be taken with caution with long term traffic trends difficult to predict at the one year after stage.

Monetised Safety benefits

4.27. As set out in the EAR and in the preceding safety section of this report, the safety benefits were forecast using the COBA modelling software. This also forecast the monetised value of the safety impact which was £9.6m over 60 years.

4.28. It was shown in the safety section of this report that changes in the numbers and rate of collisions between pre-scheme to post-scheme were found not to be statistically significant; as such we will not attempt to monetise the outturn safety impact here and therefore safety benefit is not included in the BCR.

Indirect Tax Revenue

4.29. Indirect tax revenue impact in the context of scheme appraisal means the changes to the revenue raised by central Government. For highway schemes, this primarily means the revenue from fuel duty for all users and, for consumers, from VAT which will both change if the scheme impacts the amount of fuel used by road users. Fuel usage changes are from the following:

- Changes in speeds which mean that vehicles are travelling at a greater or worse fuel efficiency;
- Changes to the amount of traffic; and
- Change to the journey lengths.

4.30. When this scheme was appraised, the impact of the scheme on net indirect tax revenue raised by central Government over the 60-year appraisal period was included as part of the benefits, rather than as part of the costs as had previously been the approach.

4.31. As the forecast indirect tax revenue for Government as a benefit is of similar magnitude, although in reverse, to the Vehicle Operating Costs (VOC) paid by users, the approach to evaluate the outturn impact is to use the ratio between the forecast and outturn VOC benefits to calculate the outturn reforecast of the 60 years Indirect Tax impact, as shown in **Table 4-4**.

Table 4-4 Indirect Tax Impact of scheme as a benefit (60 years, £million, 2010 prices and values)

	Forecast (whole area)	Outturn reforecast (whole area)
60-year impact	£12.5m	-£28.3m

4.32. This shows that the indirect tax was forecast to be a positive benefit of the scheme and that the outturn results is actually a dis-benefit, again due to lower traffic volumes than forecast, and less change in volumes after opening compared to forecasts. Increases in speed were also much higher in forecast than they were in the observed data.

Greenhouse Gas (Carbon) Benefits

4.33. The monetised Carbon impact of the scheme was undertaken in accordance with TAG Unit 3.3.5 with the value of carbon from Department for Energy and Climate Change (DECC) 'Valuation of Energy Usage and Greenhouse Gas Emissions for Appraisal and Evaluation" published in June 2010.

4.34. The forecast was a dis-benefit of -£50.4m, based on the core traffic growth scenario.

4.35. WebTAG states that for highway schemes, greenhouse gas emissions are assumed to be proportionate to the number of litres of fuel burnt. The evaluation of the fuel consumption undertaken in the VOC analysis showed that the total petrol and diesel consumption between J39-J42 had in fact decreased in the opening year, and outturn VOCs were in fact a benefit, mostly due to lower than forecast flows and lower than expected increases in speeds.

4.36. Therefore, the POPE outturn evaluation is based on calculating the opening year net carbon emissions, then using the ratio method to calculate the monetised impact. The evaluation of the carbon emissions is detailed later in the environmental section of this report.

4.37. ***Table 4-5*** summarises the evaluation of the monetary impact.

Table 4-5 Carbon Benefit (£m)

Carbon	Forecast (Core traffic growth)	Outturn
Net change in carbon tonnes within scheme links in 2015	14% increase	2% increase
Monetised impact	**Forecast (Core Traffic Growth)**	**Outturn**
60 years net change £m	-£50.4m	-£8.29m

4.38. The result of the evaluation of the carbon impact is a net increase in carbon emissions, but this is lower than forecast hence the level of the dis-benefits of proportionately lower at -£8.29m over 60 years.

Other benefits: Noise, Air Quality, Impact of Construction period and future maintenance

4.39. Noise and Air Quality impacts of this scheme are a very small proportion of the monetised benefits of this scheme respectively. Although the traffic flows have been lower than predicted (as shown in in the traffic flow section earlier), as the importance of the monetary impact is so low, the monetised impacts have assumed to be as forecast for both.

4.40. Dis-benefits were forecast during the construction period, largely due to delays caused to M1 journey times. The impact of future maintenance was also considered and the total net impact of these was -£57.7m.

4.41. It is not part of the POPE process to evaluate the impacts during the construction period and at this point, it can be assumed that the future maintenance of the scheme will be as expected, therefore the OYA assessment of the impact of the construction period and future maintenance is as forecast at -£57.7m.

Reliability Impact

4.42. The scheme appraisal estimated the reliability benefits for the scheme. The monetised reliability benefit was not included in the overall monetised benefits in the EAR. The reliability sub-objective includes the impact of the scheme on incidents and day-to-day journey time variability.

4.43. Benefits of delays and travel time variability costs relating to incidents were examined using INCA. The appraisal used INCA (INcident Cost Benefit Assessment) version 4.2 for estimating the benefits of reduced delay, and travel time variability (TTV) caused by unforeseen incidents that reduce capacity, such as collisions, breakdowns, debris on the carriageway and major disruptions such as fire, load shedding or spillage. The combined impact on delay and variability are known as reliability. The forecast INCA benefit was not however included in the overall benefits for the purpose of calculating the BCR. This is in line with the webTAG guidance which states that the monetised reliability benefits should not be included in the overall Analysis of Monetised Costs and Benefits (AMCB).

4.44. INCA modelling was based on two modelled years (2015 and 2030) from which the INCA software extrapolates the 60 year benefits. ***Table 4-6*** shows the forecasts as stated in the EAR and a rerun of the INCA model obtained for this study. The POPE outturn evaluation is based on calculating the opening year reliability using forecast and observed traffic flow data, then using the ratio method to calculate the monetised impact.

Table 4-6 Reliability Benefits from INCA (£m)

	Forecast (£m)	Outturn reforecast (£m)
Total Travel Time Variability Benefits Net Change over 60 years	96.2	94.6
Total Delay Benefits Net Change over 60 years	9.9	9.6
Ratio		98%
Total Reliability Benefits Net Change over 60 years	**106.1**	**104.2**

4.45. The re-forecast reliability impact is 2% lower. Reliability is a combination of delay benefits and variability benefits. The lower than forecast flows result in lower delay benefits. They also result in slightly lower variability benefits. The combination of these two changes result in lower total reliability benefits.

4.46. As most of the years in the re-forecast are still based on the original model from 2030 onwards there is still considerable uncertainty in terms of whether the scheme is likely to achieve the forecast monetary benefit for reliability.

4.47. It is further noted that the INCA assessment is based on the observed data on incidents on the motorway. Although this data does exist for the M1 before and after the scheme was built, the data cannot be compared on a like-for-like basis, as once a smart motorway is fully operational, the additional technology means that far more incidents are automatically being detected and hence recorded, than was the case with all manual recording before the scheme was in place. Therefore when we re-run our INCA assessment we do not change the incident rate assumptions.

Summary of Total Present Value Benefits

4.48. The total benefits as forecast and the outturn reforecast of the 60 year benefits are shown in ***Table 4-7***.

Table 4-7 Present Value Benefits summary (£m)

Costs in £m 2002 market prices, discounted	Forecast	Outturn
Journey Time	419.3	350.9
Vehicle Operating Costs (VOC)	-22.5	58.2
Construction period & Future maintenance periods: Journey time and VOC impacts	-57.7	-57.7
Safety Benefits	9.6	*
Carbon Benefits	-50.5	-8.3
Noise Benefits	-3.4	-3.4
Air Quality	-2.2	-2.2
Indirect tax impact as a benefit	12.5	-28.3
Total	305.0	309.2

*Safety benefits not included as not statistically significant at this stage

4.49. This summary of the total benefits shows that despite lower journey time benefits, the outturn total benefits are higher than forecast. The lower journey time benefits result from the lower than forecast vehicle hours saved which is mainly due to lower traffic flows than predicted and less dramatic increases in speed. However, because of this vehicle operating costs are now a benefit and carbon dis-benefits have been reduced. The effect of this means we have benefits that were higher than forecast.

Scheme costs

4.50. Costs of the scheme are also considered for the full appraisal period of 60 years such that they can be compared with the benefits over the same period. Investment costs are considered in terms of a common price base of 2010 for comparison with forecast. For comparison with the benefits, overall costs are expressed in terms of present value, termed Present Value Cost (PVC).

Present Value Costs (PVC)

4.51. 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.

4.52. Following current Treasury Green Book guidance, calculation of the present value entails the conversion to market prices, then discounting by year. This uses a rate of 3.5% for the first 30 years and 3% thereafter. Note that the base year used here is 2010, as used in the scheme forecasts.

4.53. Appraisal of this scheme included the following types of cost:

- Investment costs: before and during construction; and
- Operational costs of the smart motorway during the 60 years after opening.

4.54. Note that when this scheme was appraised, the impact on Indirect Tax revenues during the 60 years after opening was included as part of the benefits in accord with then current guidance, rather than as part of the costs. It has likewise been treated as a benefit in this report.

Investment Cost

4.55. The investment cost is the cost to Highways England of the following:

- Costs of construction;
- Land and property costs;
- Preparation and supervision costs; and
- Allowance for risk and optimism bias.

4.56. For the purpose of this evaluation, we have determined the forecast scheme cost based on data presented in the M1 J39-J42 Final Estimate form which was an update on the figures presented in the EAR. This gave a total cost for Highways England Major Projects of £142.5m.

4.57. For comparison with the outturn costs on an equivalent basis, the investment part of the PVC was calculated assuming the same spend profile by year as the forecast spend by milestone, and adjusted to 2010 prices (without discounting), as presented in ***Table 4–8***.

4.58. The outturn investment costs, as of July 2017, for building this scheme have been obtained from the Regional Finance Manager at Highways England covering the period 2010 – 2018. For the purpose of comparison between forecast and actual, and with other major schemes, prices have been converted to 2010 prices. This figure can then be compared with the forecast cost on a comparable basis. These figures are shown below in ***Table 4-8***.

Table 4-8 Investment Cost of Scheme (£million, 2010 prices, not discounted)

Forecast	Outturn	Difference
113.7	114.9	1.0%

4.59. This shows that the outturn cost was 1.0% higher than forecast.

Operational Costs

4.60. Operational costs of the scheme were assessed in the EAR in line with guidance in IAN 164/12. It covers expenditure relating to the following aspects of the smart motorway:

- Day-to-day running and operation of the smart motorway;
- Enforcement costs including police; and
- Capital costs of renewal. This is the costs over 60 years of the maintenance and renewal of the technology and associated infrastructure. Note that this is distinct from Vehicle Operating Costs (VOC) which is the impact on the costs to road users, and is considered as part of the benefits assessment above.

4.61. No outturn reassessment of the operating costs has been made as at this stage; the assumptions made in the appraisal are still considered to hold true.[9]

Summary of Present Value Cost (PVC)

4.62. ***Table 4-9*** shows the total of the costs expressed in terms of present value.

Table 4-9 Present Value Costs Summary (£m)

Costs in £m 2010 market prices, discounted	Forecast	Outturn
Investment cost	117.5	120.3
Operational costs	25.0	25.0
Total PVC	142.5	145.3

[9] It is understood the costs so far have been higher than expected, but no figure was available for the additional costs in the long term.

4.63. It should be noted that there are no Do minimum costs included in this summary. The EAR stated that the capital cost of regular maintenance (other than for the smart motorway) would be similar in Do minimum and Do something scenarios. Capital cost of the smart motorway technology renewal is covered within the operating costs[10].

4.64. With these costs expressed in Present Value on the same basis as the benefits (PVB), we can now assess the benefit cost ratio.

Benefit Cost Ratio

4.65. The benefit-cost ratio (BCR) is an indicator used in the cost-benefit analysis of a road scheme that attempts to summarize the overall value for money of a project or proposal. The BCR is the ratio of the benefits of a scheme or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs are expressed in present values as detailed in the above sub-sections.

4.66. ***Table 4-10*** shows the calculation of the BCR using the costs and benefits presented earlier in ***Table 4-9*** and ***Table 4-7***.

Table 4-10 Benefit Cost Ratio (£m)

Monetary values in £m 2002 market prices, discounted	Forecast	Outturn
Present Value Benefits (PVB)	305.0	309.2
Present Value Costs (PVC)	142.5	145.3
Benefit Cost Ratio (BCR)	2.1	2.1

4.67. The key points regarding the BCR assessments are:

- The original forecast was 2.1 meaning than over £2 of benefits were expected for every £1 spent.
- The outturn evaluation BCR is the same at 2.1, which is categorised as high Value for Money (VfM). Despite the higher costs, there are higher outturn benefits. Statistically insignificant safety benefits have not been included in the Outturn BCR.
- Uncertainty over predicting the long term trend of journey time saving based on only the first year for a scheme of this type means that the outturn BCR has the potential for a wide range of outcomes.

4.68. Reliability benefits (as shown in ***Table 4-6***) are not included in this BCR assessment, in line with the original appraisal. If they are included, then the forecast BCR rises to 2.9. For the outturn, the inclusion of the rerun reliability benefit (***Table 4-6***) then the outturn BCR at OYA is slightly lower at 2.8.

4.69. It should be noted that the BCR ignores non-monetised impacts. In the former NATA assessment and its replacement, the Transport Business Case, the impacts on wider objectives must be considered but are not monetised.

4.70. The evaluation of the environmental and social objectives is covered in the following chapters of this report.

Regeneration, Wider Economic Benefits

4.71. The AST stated that regeneration impacts and wider impacts were not included in the appraisal of the scheme and therefore there is no assessment of it in this report.

[10] In line with guidance in Interim Advice Note 164/12 – The economic assessment of Managed Motorways – All lanes running

Economic Impacts – Key Points

Benefits

- Benefits from journey time savings were forecast to be large and provide the majority of the monetised benefits. Outturn journey time benefits in the opening year were lower, hence the benefit has been reforecast to be lower over the 60 years.
- The lower journey time benefits result from the lower than forecast vehicle hours saved which is mainly due to lower traffic flows than predicted. It also is due to the lower than expected increase in speeds from pre to post scheme.
- Despite the reduction in collisions being higher than forecast for the wider modelled area, this has not been included in the total benefits at this stage as the result is not statistically significant.
- Dis-benefits from the delay during construction period and maintenance of the technology in future years were forecast to be £57.7 million; this has not been recalculated.
- The monetisation of the Carbon impact of the scheme was forecast to be a large dis-benefit (-£50.4million) due to the increase in emissions, but the outturn evaluation is less negative at -£8.3million.
- Vehicle Operating Costs (VOC) was forecast to be a dis-benefit for road users and Indirect tax revenue impact was expected to be a benefit for the Government. However VOC is now a benefit and indirect tax revenue is a dis-benefit due to lower than forecast flows and less dramatic changes in speed.
- Other monetised benefits are roughly as expected.
- Reliability benefits from the reduction in incident related delay were large in the appraisal. Based on the information currently available to POPE, journey time variability has improved, and a rerun of the model suggests the outturn reliability benefits could be slightly lower than forecast.

Cost

- The investment cost of building the scheme was £114.9 million (2010 prices not discounted), which was 1.0% higher than forecast.
- Long term costs of operating the smart motorway are assumed to be as forecast at £25.0million.
- The Present value costs in discounted 2010 prices are £145.3million (£120.3million investment cost and £25.0million operating costs)

Benefit Cost Ratio

- The outturn BCR of 2.1 is the same as the forecast BCR of 2.1. The outturn BCR of 2.1 is categorised as high Value for Money. Despite the higher than forecast costs, there are higher outturn benefits. Statistically insignificant safety benefits have not been included in the Outturn BCR.
- Forecast and outturn reliability benefits have not been included in the overall benefits for the purpose of calculating BCR, in line with webTAG guidance.

5. Environmental Evaluation

Introduction

5.1. This section documents the evaluation of the impacts of the scheme on the environmental sub-objectives.

5.2. The aim of the scheme was to increase capacity and reduce congestion by making use of the existing hard shoulder using managed motorway technology as an alternative to conventional motorway widening. More signs and gantries are needed than for standard 'non-managed' motorway sections, provided through a combination of verge mounted cantilever signs[11] and super-span gantries extending across both carriageways. As there would no longer be a hard shoulder, emergency refuge areas (ERAs) with emergency telephones would be provided at intervals in case of breakdown.

5.3. The overall project objectives relevant to environment were to:

- To reduce congestion and develop solutions to provide additional capacity, ensuring the safe and economic operation of the motorway and the slip roads;
- Make best use of existing infrastructure and provide additional capacity within the existing highway boundary and, where possible, within the existing paved area; and
- Outside of those works/infrastructure required for the effective operation of a managed motorway scheme, the project would only include the minimum improvements to the road superstructure (for example surfacing, vehicle restraint systems, environmental mitigation and drainage improvements) that would be required to achieve safe and legal operation of the scheme. The scheme was to be designed to suit the requirements of ongoing maintenance, the needs of Highways Agency (now Highways England) Network Operations, and, within the constraints of the design guidance, minimise whole life costs.

Scheme Overview

5.4. The M1 between J39-J42 links the major urban settlements of Leeds and Wakefield. The villages of Kirkhamgate and Crigglestone are located to the east of the M1 and the towns of Horbury and Ossett to the west.

5.5. At the southern end of the scheme, the motorway runs close to residential areas on the outskirts of Wakefield and crosses predominantly agricultural land towards the northern end of the scheme. The EnAR noted that the route corridor is located almost entirely within Green Belt and it was expected that the proposed works would be contained within the existing highway owned land.

Assessment

5.6. The findings of the non-statutory environmental assessment were reported in the EnAR for the scheme. The evaluation in this chapter considers the environmental impacts predicted in the Scheme's AST and the published EnAR against those observed one year after opening.

Data Collection

5.7. The following documents have been used in the environmental evaluation part of this study:

- AST, 2013;
- Environmental Assessment Report (EnAR) May 2013 (Volumes 1, 2 and 3);
- Environmental Scoping Report October 2011;
- Construction Environmental Management Plan (CEMP) Rev 02 24/09/2014
- Handover Environmental Management Plan (HEMP) February 2016;
- As Built detailed mitigation planting drawings; and
- Series 3000 Specification Appendices 30/1 – 30/12 Rev 03 August 2015.

5.8. A full list of the background information requested and received to help with the compilation of this report is included in Appendix D.

[11]Described in the EAR as MS4 (Motorway signal mark 4) Variable Message Sign (VMS)

Site Inspections

5.9. A site visit was undertaken at the end of May 2017, which included taking photographs for inclusion in this report. The Scoping Report and EnAR included a series of pre-scheme winter views; where possible these have been revisited at OYA – see Appendix D.

Consultations

5.10. ***Table 5-1*** lists the organisations contacted regarding their views on the impacts they perceive the road scheme has had on the environment, and whether they feel that the mitigation measures implemented have been effective.

Table 5-1 Summary of Environmental Consultation Responses

Organisation	Field of Interest	Comments
Environment Agency	Water Quality	No monitoring which would enable EA to comment on any changes as a result of the scheme, not aware of any pollution incidents and the overall waterbody classification status for the three rivers crossed by the scheme has remained at Moderate between 2013 and 2016
Natural England	Biodiversity	No response to the invitation to provide feedback
Historic England	Archaeology	Responded that it has no comments to make but suggested consulting with the Wakefield Council Conservation Team and West Yorkshire Archaeology Service
Wakefield MDC	General	Provided air quality data and also suggested consult with West Yorkshire Ecology and West Yorkshire Archaeology
Leeds MDC	General	No response to the invitation to provide feedback
Crigglestone PC	General	Commented on landscape, biodiversity, lighting, emissions. Issues relating to traffic and safety have been forwarded for inclusion within the Traffic and Safety sections of this report. The full response has been forward to Highways England.
West Yorkshire Archaeology	Archaeology	No response to the invitation to provide feedback
West Yorkshire Ecology	Biodiversity	Unable to provide feedback due to lack of information and considers that 'this type of poorly directed questionnaire is no substitute for undertaking proper follow-up ecological evaluation surveys'. Suggested one aspect POPE might consider is more detailed analysis of road lighting schemes at junctions, in particular whether the road lighting could be reduced for the benefit of biodiversity and to reduce the running costs of the road. The full WYE response has been forwarded to Highways England.

Animal Mortality

5.11. The Managing Agent Contractor (MAC) has been consulted with regard to animal mortality data and information for the period June 2013 to June 2017 has been provided and is discussed in the Biodiversity section.

Traffic Forecasts and Evaluation

5.12. Three of the environmental sub-objectives (noise, local air quality and greenhouse gases) are directly related to traffic flows. No new environmental surveys are undertaken for POPE and an assumption is made that if the observed level of traffic is in line with forecasts, then it is likely that local noise and air quality are as expected.

5.13. The M1 is a strategic route and the EnAR noted that it was carrying in excess of 153,000 vehicles a day. Congestion was a serious problem between J39-J42 and the extent and severity of congestion was expected to increase. Delays were experienced most weekdays during peak times, which severely affected journey time reliability. Vehicle numbers were predicted to rise by 19% by 2015 and 37% by 2025 from 2003 levels[12].

5.14. The EnAR 2010 baseline traffic data noted that average peak hour speeds were under 100km/hour in both directions and HGVs made up approximately 6.2% of traffic flow on the motorway between J39-J42[13]. Average traffic speed was predicted to be slightly higher and the percentage of HGVs was predicted to reduce in 2030 with the scheme in place. Post smart motorway changes average peak hour speeds are 104km/hour. HGV proportions have increased overall but are still in line with average numbers nationally on motorways.

5.15. The EnAR noise section states that traffic data provided by the project transport consultants was used for the baseline year of 2015 and future assessment year of 2030. In line with the traffic sections of this study, Table ***5-2*** below uses data from the Traffic Forecasting Report.

5.16. The traffic figures below show that observed traffic is lower than expected, however, this is considered to be as a result of lower than predicted overall traffic growth nationally i.e. not as a result of the scheme.

Table 5-2 With the Scheme (2016) AADT Traffic Flows: Observed vs Forecast

Location	Direction	2015 DS Forecast*	2016 Factored**	2016 Observed	% Difference (factored to observed)
J39-J40	NB	52,300	53,100	48,700	-8%
	SB	56,900	58,200	50,200	-14%
	Two -way	109,200	111,300	98,900	-11%
J40-J41	NB	60,500	61,400	53.200	-13%
	SB	62,300	63,700	58,300	-8%
	Two -way	122,800	125,100	111,600	-11%
J41-J42	NB	65,700	66,700	57,900	-13%
	SB	68,300	69,800	54,800	-21%
	Two -way	134,000	136,500	112,700	-17%

* 2015 Do Something (DS) Forecast from Traffic Forecasting Report

** 2015 DS Forecast factored to 2016, using a straight line method between the 2015 DS Forecast and the 2030 DS Forecast, to allow direct comparison with 2016 observed flows

[12] Source: National Transport Model – Road Transport Forecasts 2008
[13] EAR Section 10 Effects on all Travellers

One Year After Environmental Assessment

5.17. Included in this section is a brief summary of statements from the AST and EnAR evaluations which have been included to provide the context for the OYA evaluation.

5.18. The key environmental features discussed in this chapter are illustrated on the EnAR photo viewpoint Figures 6.3A and 6.3B reproduced in Appendix D.

Noise

Forecast

AST

5.19. The AST stated that changes at residential receptors would either be No Change or Negligible, with approximately a fifth being increases in noise. Similar changes would be experienced at non-residential receptors. Changes would be caused by changes in traffic flow plus use of the hard shoulder. Social and distributional impacts (SDI) showed adverse impacts on all social groups and for children and young people. The overall effect was assessed as **slight adverse**.

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5.20. The EnAR noted predictions of road traffic noise were undertaken for 5,860 residential dwellings and 32 other sensitive receptors[14] within the Calculation Area. The changes in noise would be due to changes in traffic flows and as a result of the traffic moving closer to receptors as the hard shoulder is utilised.

5.21. With the scheme, in the opening year (2015) the majority of dwellings, and other sensitive receptors, were predicted to experience an increase in noise rather than a decrease. For the majority of receptors, the predicted increase would be negligible, although a minor increase in noise (1 – 2.9 dB) was predicted for 631 dwellings and 6 other sensitive receptors[15].

5.22. In the Do something scenario, there were predicted to be more dwellings with an increase in traffic noise nuisance than a decrease. The assessment of airborne vibration nuisance indicated that the majority of dwellings within 40m of the M1 would not experience any change, however, seven dwellings were predicted to experience an increase with the introduction of the scheme.

5.23. In the longer term all the impacts were predicted to be negligible (increases and decreases) or no change. Due to the low magnitude of impacts it was not considered necessary to propose mitigation measures.

5.24. The EnAR also noted that Defra's[16] strategic-level noise maps of the road network indicated the immediate area along the route was subject to noise levels of above 75 dB(A) Lden (generally considered to be a high level of road traffic noise). Within the study area several noise action planning Important Areas (IAs) had been identified; five First Priority Locations along the M1 and one other IA where the noise source was jointly from the M1 and A642 Horbury Road (local authority controlled). At the time of the EnAR these areas were being investigated as part of the Highways Agency's (as was) noise action planning investigation process.

5.25. The EnAR also noted that due to predicted increases in road traffic as a result of an increase in planned employment at Stourton, Leeds, there were forecast to be moderate adverse increases in noise in the long term, independent of the M1 scheme, and therefore not considered as part of the EnAR.

Consultation

5.26. Crigglestone Parish Council considers that it is a little quieter in the Durkar Low Lane area (east of J39 off Denby Dale Road and the A636) and that noise seems to have been reduced, although it notes that this could be due to summer tree foliage deadening the noise. The PC would like more

[14] Sensitive receptors for a noise and vibration assessment are considered to include dwellings, hospitals, schools, community facilities, designated areas (e.g. National Parks, Sites of Special Scientific Interest, Scheduled Monuments), and public rights of way.
[15] HD213/11 provides classification for the magnitude of changes in road traffic noise. A change in road traffic noise of 1dB(A) in the short term (Do minimum to Do something in the baseline year) is the smallest that is considered perceptible. In the long term (Do minimum in the baseline year to Do something in the future assessment year) a 3dB(A) change is considered to be perceptible.
[16] Defra Department for Environment, Food and Rural Affairs

evergreen tree planting in combination with a noise barrier, without removing existing vegetation to accommodate a barrier. (Based on the before and after flow data included in the traffic sections of this report; between J39 and 40 there has been an increase in traffic growth of 4% SB and 5% NB, and also a 1% reduction in HGV numbers as a percentage of overall numbers – based on POPE methodology these changes would not trigger an improvement in local noise climate).

5.27. The PC also considers that 'the speed restriction could have extended up to the Cliffe Road bridge (south of J39) as this would have helped with noise and air quality for adjacent properties' – 'traffic accelerates up the hill as it emerges from the speed restrictions. Accelerating vehicles produce more noise and more CO_2 so this is not 'great planning' in an area designated as a priority for both noise and air quality'.

Evaluation

5.28. With regard to the Noise Important Areas, POPE has no further information.

5.29. The EnAR included the existing road surface in its assumptions for the baseline year of 2015[17] together with the assumed future year (2030) surfaces and corrections. It assumed that whether the scheme went ahead or not, that the M1 would be re-surfaced between 2015 and 2030 as a result of routine maintenance requirements. It was noted that, at the time, it was Highways Agency policy that all resurfacing works would provide a Low Noise Thin Surface. As such, a Low Noise Surface correction of -3.5dB (in relation to hot rolled asphalt) was factored in during noise calculations for the 2030 Do minimum and Do something scenarios.

5.30. POPE has no information relating to the Road Surface Influence (RSI) of the resurfacing undertaken as part of the scheme or subsequently.

5.31. As expected traffic has moved closer to properties and sensitive receptors due to the permanent use of the former hard shoulder as a running lane. With regard to traffic flows, 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 in Table 5-2 above, the data indicates that the observed flows are generally between 8% and 14% lower than forecast and as such, are within the tolerances prescribed by POPE. J41-J42 southbound flows are 21% lower than forecast. EnAR noise mapping plans indicated that sensitive receptors between J41-J42 would experience short term noise level changes ranging from a negligible increase in noise (+0.1 to +2.9 dB) in the vicinity of J41 to a negligible decrease and it is possible that the local noise climate is marginally better than forecast, although more detailed analysis including HGV data would be required to confirm.

5.32. Based on the available information, it is therefore concluded that the effects of the scheme on the local noise climate overall are likely to be **as expected**.

Table 5-3 Summary of Noise Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	198 properties exposed to levels above 68dB LAeq Est. Population Annoyed (Do-Min): 1,300 Est. Population Annoyed (Do-Something): 1,376 Net difference in est. population annoyed: 77	Slight adverse
EST	As expected the use of the hard shoulder as a permanent running lane has moved traffic closer to receptors. Based on available information, traffic flows are lower than forecast, although within the 'as expected' parameters apart from J41-J42 SB (21% lower) with the potential for noise from traffic to be marginally better than forecast at this location.	As expected

[17] EAR Table 9.1: Road Surface Correction Assumptions

Local Air Quality

Forecast

AST

5.33. The AST stated that there were three Air Quality Management Areas (AQMAs) within 200m of the proposed scheme: Wakefield City, Wakefield M1 and Barnsley No.1. The scheme would result in 4 new exceedances of the Air Quality Strategy (AQS) Objective, but the change in annual mean nitrogen dioxide (NO_2) concentrations was expected to be small at the majority of receptors (less than 2µg/m³). Based on EnAR Table 5.7: *Selected Annual Mean Nitrogen Dioxide Results* the new receptors are R113, 114 and 115 located on EnAR Appendices AQ Figure 5.9 (Lawns Lane south of J42) and R266 on Figure 5.14 (SB between J40 and 39 off Horbury Rd). In the opening year there would be a 21.4 tonnes increase in nitrogen oxides (NOx) emissions and 0.8 tonnes increase in particulate matter (PM_{10}) emissions.

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5.34. The EnAR air quality summary noted that within 200m of the scheme there were sensitive receptors and three AQMAs, but no designated ecosystems[18].

5.35. It also stated that the plan level TAG assessment suggested that overall air quality for NO_2 and PM_{10} would worsen and that the regional assessment also indicated an overall increase in emissions (e.g. NOx and PM_{10}).

5.36. The public exposure predictions at the identified sensitive receptors[19] along the scheme route and affected roads suggested that in 2015 air quality would meet annual average UK Government AQS and EU limit values in the majority of locations for NO_2 (158 receptors).

5.37. In those locations which, at the time of the EnAR, did not meet air quality objectives, it was predicted that changes in air quality would generally be small (i.e. less than 0.4 µg/m³) and these were unlikely to be observable within normal year to year variations in NO_2 concentrations. There were only six properties within the study area whose concentrations were not predicted to drop below pre-scheme levels within six years of the scheme opening (based on the long-term trend factors, at the time).

5.38. Air quality was expected to meet 1-hour NO_2, annual average PM_{10} and 24-hour PM_{10} air quality objectives at all receptors with or without the scheme.

5.39. Overall construction and operational air quality effects were considered not to be significant for the scheme.

Consultation

5.40. Wakefield MDC provided their latest air quality monitoring results which it notes are due to be published in its forthcoming Annual Status Report, pointing out that for the M1 AQMA results, following a gradual decline in results there has been an increase in 2016. Wakefield MDC notes that this increase has occurred for the vast majority of monitoring results so it is difficult to distinguish the impact of the smart motorway as yet.

5.41. Crigglestone Parish Council commented on speed restrictions (see noise section above) and considers that Pugneys Country Park may be subject to pollution through standing traffic along Denby Dale Road and Asdale Road.

5.42. The PC also states that Durkar is above the EU legal limit for pollution and it would like effective and transparent monitoring of air quality at Durkar and to know if the M1 locally is still being monitored as it was previously, noting that monitoring had previously indicated that air quality was poor. The PC notes that it is difficult to know whether the increase in NO_2 for the Wakefield MDC monitoring site on Denby Dale Road East is due to the completion of the M1 scheme or to traffic congestion on the A636 and at the Calder Park roundabout.

5.43. The PC's detailed air quality response has been forwarded to Highways England. With regard to the concerns raised about Pugneys Country Park located approximately 1km east of the M1 and congestion on the A636 Denby Dale Road / Calder Park roundabout – POPE has no traffic data

[18] e.g. SSSI, SPA, RAMSAR or SAC.
[19] Sensitive receptors are all locations where members of the public might be regularly exposed; these include the building façades of residential properties, schools, hospitals, care homes, etc

relating to Asdale Road. It is understood that there has been a 4% increase in traffic on Denby Dale Road (AWT both directions) however this is less than background traffic trends. The Calder Park roundabout (M1 J39) has been part signalised which may have contributed to congestion at certain times, however this is not connected to the smart motorway scheme being evaluated.

Evaluation

5.44. Based on the comments provided by Wakefield MDC to accompany its latest local air quality monitoring results, it is suggested that air quality should be considered further at FYA when a longer period of monitoring data should be available post-operation of the smart motorway technology.

5.45. POPE methodology states that if observed post-opening traffic flows identified by POPE vary by more than +/- 1000 AADT, or by +/- 200HDV AADT; or daily speed by 10kph; or peak hour speeds by 20kph from those predicted, it would be assumed that local air quality is likely to be either 'worse than' or 'better than' expected.

5.46. Based on the available data in Table 1.2 above**,** observed post-opening flows were lower than forecast for all links by over 10,000 AADT indicating that local air quality is likely to be better than expected in these locations.

Table 5-4 Summary of Air Quality Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	PM_{10} Improve/Worse - 2140/699 properties, PM_{10}/NO_2 No Change - 462/437 properties, NO_2 Improve/ Worse - 2168/696 properties Net Route Assessment (opening year) for PM_{10}: 71, Change in NOx emissions over 60-year appraisal period: 3,468 tonnes	Local AQ impacts not considered significant
EST	Traffic growth has been less than predicted and based on traffic flows there is potential for local air quality to be better than expected. Local air quality should re-visited at FYA with regard traffic flows and when a longer period of monitoring results should be available.	Better than expected due to lower traffic flows than forecast

Greenhouse Gases

5.47. The assessment of the impact of transport schemes upon the emission of greenhouse gases is one of the environment sub-objectives. WebTAG notes that carbon dioxide (CO2) is considered the most important greenhouse gas 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 considered in terms of equivalent tonnes of carbon released as a result of the scheme. Carbon emissions are therefore estimated for the DS and DM scenarios using forecast and observed OYA data.

Forecast

5.48. The M1 J39-J42 SM AST predicted an increase in carbon on emissions of 28,368 tonnes across the traffic model study area between the DM (with scheme) and DS (without scheme) scenarios. This can be explained by the forecast increase in traffic (regardless of the scheme being implemented) and the increase in speeds forecast due to the scheme as well.

Evaluation

5.49. Given the AST forecast covers a wide area, a re-forecast, of carbon emissions for the DM and DS scenarios only for the scheme links has been calculated using current DMRB guidance. Observed carbon emissions were calculated using the same methodology for the DM and DS scenarios, using flow and speed data collected for this study. WebTAG states that for highway schemes, greenhouse gas emissions are assumed to be proportionate to the number of litres of fuel burnt. The evaluation of the fuel consumption undertaken in the VOC analysis showed that the total petrol and diesel consumption between J39-J42 had in fact decreased in the opening year, and outturn

VOCs were in fact a benefit, mostly due to lower than forecast flows and lower than expected increases in speeds.

5.50. Therefore, the POPE outturn evaluation is based on calculating the opening year net carbon emissions, then using the ratio method to calculate the monetised impact. Table 5-5 presents the results of this exercise.

Table 5-5 Reforecast and outturn carbon emissions (carbon tonnes/year)

	Reforecast	Observed
DM/Counterfactual (based on before)	18,429	19,120
DS/Post-Opening	20,938	19,548
Net Difference	2,509 (14%)	428 (2%)

5.51. Table 5-5 shows that observed carbon emissions have seen a little change between the DM and DS scenarios, equivalent to 428 tonnes of carbon, where as in the reforecast the carbon emissions showed an increase between DM and DS scenarios of 14%, equivalent to 2,509 carbon tonnes. The forecast carbon emissions are much higher than the observed due to higher forecast flows and higher travel speeds. Observed traffic flows, whilst increasing, have not seen the increase forecast and, as shown in the traffic chapter, speeds have not increased by as much as expected. Therefore, traffic is travelling at a more fuel efficient speed compared with reforecast scenarios.

5.52. It should be noted that this calculation only considers the impact of the mainline M1 and does not take into account any reassignment of traffic from other routed, which would possibly mean increased distances for rerouting traffic and higher speeds on alternative routes.

Landscape and Townscape

Forecast

AST

5.53. The AST noted that there would be no change to the existing urban fringe/ agricultural landscape character considered to be of low sensitivity. Proposed gantries would have an adverse visual impact on nearby residential receptors. Overall, the landscape impact was predicted to be **slight adverse**.

5.54. There were not expected to be any townscape impacts as the surrounding area was urban fringe or agricultural landscape. The townscape impact was assessed as **neutral**.

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5.55. Townscape was not expected to be affected by the scheme and where appropriate is included within the landscape and visual impact chapter of the EnAR.

Landscape Character

5.56. The EnAR stated that the scheme runs through two Local Landscape Character Areas (LLCA) and to the east of another;

- West Wakefield Urban Fringe LLCA 13 between J39-J40 – the scheme would introduce new structures on the River Calder section of motorway and it was expected that some of these would be concealed within existing cuttings or by established roadside planting such as at J39;
- Leeds / Wakefield Arable Urban Fringe LLCA 14 between J40-J42 – the scheme would introduce new structures across the shallow valley landscape to the north and south of Kirkhamgate, some of which is on embankment and would slightly increase the motorway's impact on the existing rural local landscape character; and
- East Ardsley Residential Wooded Ridgetops LLCA 15 is 0.5km to the west of the motorway near J42 - the motorway was noted to be an existing dominant feature running close to this character area. The scheme would generally blend in with the characteristic features and elements and enable a sense of place to be restored.

5.57. With regard to landscape / townscape designations,

- the motorway corridor runs through the Greenbelt;
- West Ardsley Special Landscape Area is located to the west of the M1 near J41 (south of East Ardsley and east of West Ardsley); and
- Pugneys Country Park lies 1km to the east of the motorway and south of Wakefield, on the right hand bank of the River Calder.

5.58. The EnAR concluded that the scheme would have a negligible to slight adverse effect on landscape character based on the implementation of minor modifications along an established motorway corridor, which was already an existing feature and part of the local landscape fabric.

Mitigation Measures

5.59. The EnAR noted that the MS4 VMS signs would be approximately 8m high and the gantries extend up to 14.5m [including signs] and would have a potential impact on landscape and views. Landscape mitigation measures would include the retention of existing vegetation where possible and restoration of areas used temporarily including replanting trees, hedgerows, shrubs and grass. Localised adjustments to the location of new features such as gantry signs and verge mounted signs (small scale variations in location of a few tens of metres) would be considered during the design process. New planting within the highway boundary would include the use of native plants to reflect the distinctive local character. Dense native tree and shrub planting on and adjacent to highway embankments would be used as appropriate to break up the scale, to screen structures and to help integrate the scheme into the existing landscape fabric.

Visual Impact

5.60. The visual assessment concluded that the construction and operation of the scheme would have a variety of temporary and longer-term impacts on the views from receptors. The construction of the signs, gantries and Emergency Refuge Areas (ERAs) would result in temporary alterations to the existing roadside verges with the loss of established vegetation in certain locations and changes to the profile of cuttings and embankments most notably where the ERAs would be located.

5.61. The mitigation proposals included for the reinstatement of vegetation lost or damaged during construction, which was expected to reduce the landscape / visual impacts as the vegetation matured. As a result, the assessment concluded that although there would be nine locations where moderate or large adverse impacts were anticipated, at scheme opening there would only be one location - houses at the northern end of the terrace at the junction of Lawns Lane and Lingwell Gate between J41-J42 - that would still experience any adverse effect (reduced to slight) after 15 years.

Night time Motorway Character and Lighting

5.62. The EnAR noted that the motorway corridor took on its own character at night, passing through contrasting urban and more rural settings, with varying views from those looking directly along the motorway dominated by the stream of vehicle lights to views where the motorway sat within a well-lit night time panorama of housing, factories and general urban glow as the built-up nature of West Yorkshire was highlighted at night.

5.63. The EnAR noted that there was no lighting between J39-J40, but it was existing between J40-J42; most of which would need to be taken down to construct the scheme. It would only be replaced along the short J41-J42 link.

5.64. The VMS and gantry signs would be illuminated and visible at night from receptors with views of the front face of the signs. The motorway between J41-J42 was already lit with high lighting columns and it was therefore considered that the impact of illuminated signs on visual receptors would be much less than where the motorway was not lit.

5.65. Between J40-J41, the existing lighting columns were to be removed so this section would become darker. Whilst the new illuminated signs would be clearly apparent, the overall light levels in this section would significantly decrease.

5.66. It was noted that the reflected glare from externally illuminated directional signs can be significant. The receptors on the south side of signs for the northbound carriageway and on the north side of signs for the southbound carriageway might experience night time visual effects even at some distance from the sign. It was expected that the proposed mitigation planting would reduce these effects over time. In particular, the EnAR noted that, although existing woodland partially screened

the view, signs on the gantry near Lawns Lane would be facing north so there could be significant night time impacts for the northernmost properties in the row of housing at Lawns lane. It was expected that the proposed mitigation would help reduce this impact over time.

Consultation

5.67. Crigglestone Parish Council considers that the loss of trees southbound between J40 – J39 has not been good for the houses on Horbury Road.

5.68. It also notes that there has been some lopping of existing trees southbound south of J39 making the new signs very visible. The PC considers that the new planting undertaken a few years ago does not seem to have grown much.

5.69. NB: with regard to this comment and following further clarification with the PC, the comment relates to removal of existing vegetation on the embankment slopes to facilitate access steps which appears to have opened up some views to the VMS, and a concern that replacement planting does not appear to be thriving. Establishment of planting in this location (in vicinity M/P 289/4 SB) should be revisited at FYA.

Evaluation

Landscape Character

5.70. As expected the scheme has introduced additional infrastructure along an established motorway corridor, which was already a dominant feature and part of the local landscape fabric and has not significantly altered overall local landscape character.

5.71. The EnAR predicted that the **West Wakefield Urban Fringe LLCA** would be able to accommodate several of the new structures as they would be located in cutting or well screened by existing planting and in these locations this is the case (see ***Figure 5-1***). As expected where the gantry signs and VMS are located where the motorway is on embankment e.g. across the Calder Valley they have slightly altered the existing character locally (see ***Figure 5-2***).

Figure 5-1 View south from Snapethorpe footbridge, pedestrian route between Horbury and Lupset. M1 in cutting with existing vegetation along highway boundary.

Figure 5-2 View west from public footpath alongside the River Calder; new gantry signs prominent with M1 on embankment and river crossing.

5.72. New structures and ERAs have been introduced to the shallow valley rural landscape of the **Leeds Wakefield Arable Urban Fringe LLCA** north and south of Kirkhamgate between J40-J41, and where the route is on embankment the influence of the motorway has slightly increased within the local landscape as expected (see ***Figure 5-3***).

Figure 5-3 View north from Park Mill Lane overbridge with M1 a dominant feature within the rural landscape. East Ardsley on horizon centre, Kirkhamgate to extreme right of view.

Figure 5-4 View looking east to gantry signs - M1 on embankment within open landscape

5.73. The **East Ardsley Residential Wooded Ridgetops** LLCA is 0.5km to the west of the motorway, which was an existing dominant feature running close to this character area; as expected the new infrastructure slightly detracts from the sense of place but due to distance, it generally blends in with the existing motorway features and does not significantly alter the local landscape. (see ***Figure 5-5*** below).

Figure 5-5 View east across open farmland from edge of East Ardsley landscape character area towards M1 in middle distance

5.74. The **West Ardsley Special Landscape Area (SLA)** lies to the west of J41 and at its closest, near Kirkhamgate, the boundary of the designated area is approximately 100 m from the motorway in cutting which conceals the VMS from the wider landscape (see ***Figure 5-6*** below). More open views are available from the SLA where new gantry and VMS signs are evident and seen in the context of the existing motorway corridor. Mitigation planting has been implemented which in time should help integrate the signs into the local landscape. (see ***Figure 5-7*** and ***Figure 5-8*** below).

Figure 5-6 Looking north from Batley Road overbridge illustrating VMS within cutting and screened from SLA by mature highway planting (SLA is at its closest point to the M1 immediately beyond planting to left of view)

Figure 5-7 Looking north east towards M1 from Woodhouse Lane at the edge of SLA with open views to gantry and filtered views to top of VMS (centre left)

Figure 5-8 Close up of gantry from Woodhouse Lane illustrating mitigation planting in place on embankment slope around a gantry location.

Permanent Visual Effects

5.75. It was expected that the retained existing mature highway planting would continue to provide good screening of the scheme in many locations, although this would be reduced during winter months. Based on the OYA site visit and as built plans it is considered that this is generally the case; existing highway planting has been retained where possible and continues to provide a framework to the road corridor, although there are instances where gantries and VMS are visible above the tree canopy. (See Figure 5-9 below and photo comparisons in Appendix D).

Figure 5-9 View towards M1 J39 from Durkar Lane with VMS partially visible above existing vegetation.

5.76. As expected new planting has been undertaken at various locations along the route to infill gaps and replace vegetation lost to the scheme. The As Built plans include plant numbers and species on a plot by plot basis; species include Alder, Birch, Blackthorn, Hawthorn, and Oak. OYA plants were generally establishing satisfactorily (see para 5.76 below for more detail), although some failed plants were evident and it will take time before new planting is mature enough to help screen new structures.

5.77. Table 5-6 below summarises the adverse visual effects of the scheme predicted by the EnAR and the evaluation at OYA. By the summer of year 15 (design year) and with the exception of a slight adverse impact on houses at the northern end of the terrace at the junction of Lawns Lane and

Lingwell Gate, it was expected in the EnAR that there would be no permanent visual effects as the mitigation planting would have matured to provide screening. It is suggested that ongoing establishment of planting with regards to meeting the longer term landscape objectives should be reconsidered at FYA.

Table 5-6 Summary of Visual Impacts

Location	Summary of Predicted Effects: Winter Year 1	Evaluation OYA
J39 – J40	Moderate adverse effects would occur for: Cyclists and walkers on National Cycle Route 69 and public footpaths parallel to the River Calder and the railway line; Residents of Horbury south of A642 and users of playing fields and public footpaths.	As expected. PRoW routes pass below the M1 on embankment and new ganties / VMS are clearly visible. Horbury (0.5km west of M1) is on gently rising land, some properties and PRoWs have views over the flat playing fields and allotments to the motorway on embankment including new infrastructure. Existing planting helps filter views in summer and new planting has been implemented.
	Slight adverse effects would occur for: Houses in Lupset around Lennox Avenue and Airedale Heights; Offices on Bennett Avenue; Houses facing north in Hall Cliffe area of Horbury; Houses in Ossett Spa on Spa Street and Spring End; Haggs Hill and Holiday Inn Hotel on Queen's Drive. Other locations were considered to be neutral	As expected. Lupset and Bennet Avenue- existing highway planting and garden planting helps screen properties, some filtered views to signs/VMS. Users of PROWs within open fields on rising ground east of M1 near Lupset have open views to M1. Hall Cliffe, Ossett Spa and Haggs Hill - elevated distant views to M1 rising up to J40, intervening vegetation and highway planting helps filter some views to VMS. Generally as expected although some properties in Crigglestone, Durkar and Calder Grove experience open/filtered views e.g. to top of VMS above vegetation or where vegetation has been removed for ancillary works.
J40 – J41:	Moderate adverse effects would occur for: Walkers on footpath leading off Park Mill Lane overbridge and other footpaths west and east of motorway; Lodge Hill Farm, Lower Park Farm and New Park Grange; House at Golden Elders.	As expected. Relatively open landscape and users of PRoWs including where cross over and under M1 have views to gantries/signs seen in context of the existing motorway. Individual farms and properties located within open landscape and views to M1 on embankment and new infrastructure. Golden Elders has open views south along M1 Existing planting helps filter some views in summer and new planting has been implemented.
	Slight adverse effects would occur for: Park Mill Farm and Low Laithes Farm; Houses along Batley Road in Kirkhamgate facing south west and off Brandy Carr Road facing north west; Houses on Woodhouse Lane; Houses on Brandy Carr Lane;	As expected. Individual farms, Brandy Carr lane and Melbourne- have filtered views of M1 crossing valley Some properties on Batley Road have open views south across the valley to M1, on Brandy Carr Road views are filtered by vegetation.

Location	Summary of Predicted Effects: Winter Year 1	Evaluation OYA
	Properties at Melbourne Mews and offices at Melbourne House.	Woodhouse Lane – views from properties on rising ground to M1 in middle distance with some intervening vegetation. Existing planting helps filter some views in summer and new planting has been implemented but will take time to establish
J41- J42:	Large adverse effects would occur for: The houses at the northern end of the terrace at the junction of Lawns Lane and Lingwell Gate.	As expected. Properties close to the M1 which was an existing dominant feature, some views to new SB gantry / signs, traffic has moved nearer due to all lane running. At OYA Standard tree planting to supplement existing vegetation did not appear to be establishing and many trees seem to have failed[20]and will require replacement if screening objectives are to be realised.
	Moderate adverse effects would occur for: Walkers on footpaths east of East Ardsley.	As expected. Views over open farmland towards M1 and further eastward, filtered during summer by intervening vegetation, new infrastructure viewed in context of existing motorway
	Slight adverse effects would occur for: Houses on the eastern edge of East Ardsley, along Cave Lane and in The Fall.	As expected. Partial views from rising ground over fields with intervening vegetation filtering views
	Other locations were considered to be neutral	As expected.

Permanent Visual Effects

5.78. Lighting has been replaced between J41-J42; moved from the former central reserve (due to the installation of the VCB) to the verge and it is likely that illumination from the new signs is seen in the overall context of the road lighting within this section as expected. Lighting has not been replaced between J40-J41 and although illumination from the signs will be evident, overall light levels are less than before the scheme changes.

5.79. It was expected in the EnAR that existing planting and the new mitigation planting would, over time, help reduce any effects of illumination / glare from signs. A night time assessment has not been carried out at OYA and this could be considered at FYA taking ongoing establishment of vegetation into consideration e.g. for properties at Lawns Lane.

HEMP

5.80. The HEMP notes that advance works prior to construction involved vegetation removal and installation of cable ducts and that the main environmental works would include 'topsoiling and seeding areas, planting of saplings for screening purposes, grass cutting and tree maintenance'. The Landscape Specification (included in the HEMP) identifies the aftercare operations to be undertaken for planting and seeded areas.

5.81. The HEMP confirms that planting and seeding were completed in January 2016 with a 36 month maintenance period for planting and 12 months for seeded areas. The key maintenance tasks were identified as;

- Replacement of failed plants;
- General upkeep of planting plots;
- Grass cut to 500mm either side of the new walkways, access steps, technology cabinets etc. to extend to the back of the safety barrier where practicable; and

[20] Based on OYA site visit drive through.

- Grass cut sight lines to signs and visibility splays (ERA's and slip roads) to ensure they are not obstructed.

5.82. The HEMP also notes that in addition to standard environmental maintenance activities the following would need to be considered;

- Hydroseeded areas – steep grassed slopes have been hydro-seeded over reinforced mesh, which should not be punctured or damaged or the stability of the slope may be compromised. Therefore any natural regeneration of large trees should be removed. It was not proposed that the grass on these slopes would be cut. Any seeded areas that fail to establish would be reinstated using the hydro-seeding method;
- Grass seeded paving - the seeding within the reinforced concrete paving provided to the maintenance access platforms would require regular cutting to ensure sward density and lessen the chance of invasion by weeds. It was recommended that these areas are cut at least once a month (in the growing season) combined with the relevant swathe cut of the verges. The application of a non-translocated herbicide was recommended to control weed growth as necessary;
- Trees and grassed areas – should be maintained in accordance with the current standards adopted for the remainder of the network;
- Retaining structures – gabion baskets have been provided as retaining walls throughout the scheme. It was recommended that self-sown seedlings of large trees are removed. No maintenance was proposed for any areas where excavation as part of the works left the natural rock exposed;
- Removal of tree guards – depending on plant growth tree guards would need to be removed at year 5.

5.83. Based on the OYA site visit, planting was generally establishing, however some dead plants were noted and the avenue of Standard Trees near the properties on Lawns Lane did not appear to be thriving (***Figure 5-10***). Replacement of failed plants is included within the landscape specification and it would appear that this may not have happened during the winter 2016/17 season.

Figure 5-10 Standard tree avenue at rear of verge and in front of existing mature hedge

5.84. There was evidence of individual weed free circles generally being in place, some weed growth was present within plots. Ongoing aftercare should be reconsidered at FYA. (***Figure 5-11*** and ***Figure 5-12***).

5.85. The landscape specification for the works indicates that Inspection Reports should be provided to the overseeing organisation identifying the level of work activities undertaken for planting and seeding maintenance during the aftercare period. POPE has not received any of the Inspection Reports which would confirm the aftercare undertaken and it is suggested that these are made available for the FYA evaluation.

Figure 5-11 Example of planting plot illustrating typical plant growth, occasional failed plants and weed free circles in place

Figure 5-12 Weed growth evident within small planting plot on embankment slope at Lawns Lane with M1 on overbridge

5.86. It is too soon to evaluate the establishment of new planting in filtering views and integrating the scheme into the local landscape. Replacement of any failed plants and ongoing aftercare will be necessary to ensure the planting reaches its landscape objectives. Landscape should be reconsidered at FYA.

Table 5-7 Summary of Landscape and Visual Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	No change to existing urban fringe/ agricultural landscape character of low sensitivity. Proposed gantries will have adverse visual impact on nearby residential receptors.	Slight adverse
EST	The scheme has introduced additional infrastructure along an established motorway corridor, an existing dominant feature within the local landscape and has not significantly altered the overall local landscape character. Retained highway planting helps filter views to the new large scale gantries and signs, however there are open views from some locations and it will take time for mitigation planting to mature sufficiently to provide any additional screening. Ongoing establishment should be reconsidered at FYA.	Likely to be as expected in the longer term subject to ongoing successful establishment of landscape mitigation.

Table 5-8 Summary of Townscape Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	No townscape impacts as surrounding area is urban fringe or agricultural landscape	Neutral
EST	There have been no direct impacts on townscape.	As expected

Biodiversity

Forecast

AST

5.87. The AST stated that there would be very minor loss of habitats of local value within the soft estate and no adverse impacts on designated species, i.e. great crested newts and breeding birds. The overall impact was assessed as **neutral.**

Environmental Assessment Report

Designated Sites

5.88. The EnAR noted that there was one statutory designated site within 10km of the study area and four non-statutory sites located within 500m of the scheme - designated at a local level as Wakefield Nature Areas (WNA);

- Denby Grange Ponds SAC21 located 4km west of the scheme, primarily designated due to the presence of Great Crested Newts (GCNs);
- Horbury Lagoons WNA 47 - wetland features associated with the River Calder and located adjacent to the soft estate on both sides of the M1 north of J39;
- Lupset Golf Course Ponds WNA 38 - located between the southbound carriageway and the railway line, and southwest of Wakefield;
- Roundwood WNA 43 - an area of grassland, scrub and bracken located adjacent to the soft estate south of J40; and
- Lofthouse Colliery WNA 35 - an area of wetlands, grassland and heathland located about 180m east of J42.

5.89. All potential construction and operation effects to designated sites were predicted as neutral as there would be no direct impacts, with any potential indirect impacts from operational run-off, dust and noise considered minor and not significant.

[21] Special Area of Conservation

Habitats

5.90. The habitat types identified within the soft estate were plantation woodland, dense scrub, semi-improved neutral grassland, bare earth with ephemeral vegetation and running water.

5.91. It was expected that habitat loss would be relatively minor (estimated total residual habitat loss approximately 0.4ha), with negative, direct and permanent impacts predicted to scrub, plantation woodland habitats and semi-improved neutral grassland habitat. The effects of temporary loss of habitat were considered neutral following restoration of habitats after the works were completed; the minor overall loss of habitat was considered neutral, due to the minor area and existing low value of the habitat affected.

5.92. The EnAR stated that re-instatement of semi-improved grassland would involve the use of a native seed mix, such as British Seed Houses WFG4 Neutral Soils on the road verges, which was considered appropriate considering the nature of the soil and the pre-existing vegetation composition (in some locations a seed-mix such as WFG5 Calcareous Soils was suggested as being appropriate). Where the re-seeding was adjacent to existing scrub and woodland a shade-tolerant grassland species mix would be appropriate (e.g. British Seed Houses WFG8 Shaded Areas).

Species

5.93. Species identified as potentially impacted were breeding birds, great crested newts (GCN) and reptiles. No evidence of badger activity was recorded within or adjacent to the site. There was low / negligible potential for bats and limited foraging habitat present. It was noted that otters may use ditches and the River Calder for movement and foraging, although habitat close to the motorway was considered unsuitable for holt building. None of the watercourses close to the motorway were considered suitable for water vole.

5.94. Badgers - Although no badger setts were recorded during the surveys, as a precaution, a badger pre-construction survey would be undertaken along the soft estate and within 30m of the working area to ensure that no new setts had been built within the working areas.

5.95. Breeding Birds - The habitats within the scheme were shown to be of negligible value for breeding birds and following the implementation of mitigation measures in accordance with legal requirements e.g. works undertaken outside the bird breeding season the construction and operation effects were considered neutral.

5.96. GCN - No ponds would be directly lost through the scheme. There would be permanent and temporary losses of habitat within the verges with the potential to support GCN (primarily grassland, scrub and woodland). This potential habitat was connected to two ponds with known GCN populations. However, it was considered that the loss of habitat was highly unlikely to affect GCN populations in the local area due to the small population sizes recorded, the presence of abundant alternative habitat close to the ponds, the extent of the works (the loss of potential GCN terrestrial habitat within the soft estate would be small) and the location of proposed ground works. Following the implementation of mitigation measures in accordance with legal requirements the construction and operation effects on GCNs were considered neutral.

5.97. Reptiles - Despite negative results for reptiles during the surveys, it was noted that grass snake could be present in low numbers within survey areas 1,2,3 and 7 and it was recommended that a precautionary clearance of these areas should be undertaken in advance of works.

CEMP

5.98. Significant effects to other species, were not predicted. However, to ensure that impacts were minimised, it was expected that construction would be undertaken in accordance with procedures detailed in the Construction Environmental Management Plan (CEMP), which would include measures to prevent damage to designated sites, protected species and valuable habitats.

Consultation

5.99. Wakefield MDC suggested that POPE consult with West Yorkshire Ecology (WYE). WYE confirmed that it could not comment on biodiversity impacts as it has no data, no means of acquiring any, and that ‘this type of poorly directed questionnaire is no substitute for you undertaking proper follow-up ecological evaluation surveys’. WYE suggested the scheme should collate any data collected e.g. on road-kill species, botanical surveys for woodland and grassland creation and management in a report and present recommendations for ways in which the biodiversity could be further enhanced.

5.100. WYE also suggested more detailed analysis of road lighting schemes at junctions, in particular whether the road lighting could be reduced for the benefit of biodiversity and to reduce the running costs of the road. WYE's full response has been provided to Highways England.

5.101. Crigglestone Parish Council commented on the loss of wildlife habitat near J39 due to development in Calder Park[22].

Evaluation

Species

5.102. Within the HEMP the Scheme Register of Environmental Actions and Commitments confirms;

- Badger - the precautionary badger survey was undertaken and no badgers were found;
- Breeding Birds – vegetation was removed where possible outside the bird breeding season (November to February). Duck nests were found near the works and these were cordoned off so that works avoided the area and the nests monitored to ensure that they were not disturbed;
- Reptiles – a precautionary method of working included dismantling any piles of rubble, debris, log piles etc. by hand under the supervision of the ecologist and the incidental creation of reptile refuges, e.g. piles of cut vegetation was avoided. POPE is not aware whether any reptiles were found during the works; and
- GCN – a precautionary method of working was completed for an area north of J39 under the supervision of an ecologist. No GCNs were found.

5.103. The MAC has provided animal mortality data for the period June 2013 (pre-scheme) to June 2017. Incidents appear to have increased slightly since 2014 although data over a longer time fame would be required to draw any firm conclusions i.e. whether the use of a solid central reserve barrier and bringing running traffic nearer to the soft estate has had any effect on animal mortality. It is suggested that this aspect is reconsidered at FYA.

Table 5-9 Available Animal Mortality Data June 2013 to June 2-17

	Fox	Cat	Dog	Badger
2013 (from June)	1	-	-	-
2014	2	1	-	-
2015	-	4	1	
2016 (scheme opened spring)	4	-	-	-
2017 (to June)	3	2	-	1

Habitats

5.104. The HEMP notes that no ecological habitats were created as part of the scheme which would require any particular maintenance measures. With regard to the areas of wildflower grassland provided, the HEMP states that 'no specific maintenance would be required as wildflower grassland is left to mature over time however these areas should be monitored to ensure the correct health and safety standards are met for the network'.

5.105. The EnAR expected a range of species-rich grass mixes to be used for reinstatement of areas disturbed during the works (e.g. the installation of the ERAs, areas around the new signs / gantries and cabinets, and verge areas disturbed due to cable ducting). The HEMP notes in the Register of Environmental Actions and Commitments that reinstatement of semi-improved grassland 'would involve the use of a native seed mix, such as British Seed Houses WFG4 Neutral Soils on the road verges'. However, the landscape specification appendices for the scheme only identifies one grass mix – a Low Maintenance Motorway and Verge Mix (a mix of fescues and bent grass) and this is not considered by POPE to be species rich.

[22] NB: with regard to this consultation comment it should be noted that the development referred to is not related to the M1 smart motorway upgrade scheme.

5.106. The HEMP notes that 'areas of wildflower grassland have been provided' and the As Built planting plans also indicate that the soil nailed slopes have been hydro-seeded with a standard wildflower mix (with, in some locations, hawthorn and blackthorn seed added). POPE has no information which would confirm the seed mixes used. The soil nailed slopes viewed at OYA were beginning to 'green up' but it will take time for any diverse sward to become apparent (***Figure 5-13***).

Figure 5-13 Example of soil nailed hydro-seeded slope

5.107. During the OYA site visit oxeye daisy was evident in extensive swathes throughout the route corridor; however, based on Google images, oxeye daisy was present prior to the scheme. (***Figure 5-14***).

Figure 5-14 View north from Snapethorpe footbridge with new southbound ERA southbound and backdrop of oxeye daisy. Ossett Spa middle distance to left of view

5.108. As part of the scheme upgrade a vertical concrete barrier (VCB) has been provided in the central reserve and former grassed areas have been replaced by what appears to be a low fertility substrate – at OYA this was being colonised by vegetation but it is presumed there was no intention for this to become species rich. (see Figure 5-15).

Figure 5-15 View west from informal area of open space east of M1, illustrating VCB and vegetation colonisation within central reserve. VMS, CCTV and cabinets located northbound centre view.

5.109. Based on the information available it is likely that Biodiversity impacts are as expected; the works have been completed within the existing highway boundary and the HEMP indicates no unforeseen impacts on species. With regards to habitats; replacement planting and seeding have been undertaken, however, no information has been made available to POPE which would confirm the composition of any species rich / wildflower grass seed mixes used and therefore whether the aspiration of ecological enhancement[23], as noted in the CEMP, have been achieved. It is suggested that this aspect could be reconsidered at FYA when further information might be available confirming the wildflower mix.

Table 5-10 Summary of Biodiversity Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	Very minor loss of habitats of local value within soft estate. No adverse impacts on designated species, i.e. great crested newts and breeding birds.	Neutral
EST	Based on the information available it would appear that habitat loss has been localised and protected species have not been affected by the works. Mitigation planting will in time replace habitat suitable for breeding birds.	As expected

Cultural Heritage and Archaeology

Forecast

AST

5.110. The AST stated that the scheme would be within the existing motorway corridor and there would be no effects on buried archaeology. The setting of designated built heritage receptors of regional value was already changed by the M1 corridor and modern housing developments and it was considered that the gantries would not mark further appreciable changes. The overall impact was assessed as **neutral**.

[23] CEMP section 11.G.2 Ecological enhancement. 'Local nature groups have been consulted to ascertain ways in which local species / habitats can be improved. • Leave a positive legacy – options are being discussed'

Environment Assessment Report

5.111. As part of the scoping exercise it was concluded that provided no land-take or construction works were required beyond the existing highway boundary, there would be no impact on buried archaeological assets. It also concluded that although there would be no direct impacts on scheduled monuments, listed buildings, or conservation areas the visual impacts on the settings of such designated heritage assets should be assessed under the Landscape section and therefore cultural heritage as a topic was scoped out of the EnAR.

5.112. With regard to the historic landscape the EnAR landscape section noted that there were no designated historic landscapes within the study area and only four historic listed buildings/artefacts within 500m of the motorway;

- Milestone Lock marker stone. Circa 1838 (date of Calder and Hebble Navigation Horbury Cut). Stone post with rounded top;
- Grade II listed Durkar Hall Farm Barn and attached stable located to the east of J39. Mid C16 and late C17;
- Grade II Denby Dale Road Farmhouse Late C17 or early C18; and
- Woodhouse Lane Gate Lodge Mid C19.

5.113. It was considered that the various other listed buildings and their settings, at a greater distance from the motorway, would not be impacted by the proposals due to distance;

- Grade 11* listed Lupset Hall (now the clubhouse for the City of Wakefield Golf Course);
- Grade 11* listed East Ardsley Old Hall (private residence);
- The derelict Grade 11 listed Carr Lodge in Horbury; and
- Grade 11 listed Melbourne House (an office building).

5.114. Two conservation areas in Horbury and Ossett, over 1km to the west of the motorway between J39 and J40 were outside the ZVI[24] and were not expected to be impacted.

5.115. The EnAR noted that there had been considerable urban expansion locally in the last 150 years and much of the local landscape had changed significantly. Despite this, in areas that have remained agricultural, much of the field patterns remained as shown on 1850 maps, with some consolidation of fields and loss of boundaries. However, it was considered that there was little of value in terms of historic landscape features within the study area.

Effects on Historic Landscapes

5.116. The EnAR stated that as the works would be entirely within the existing motorway boundaries they would have no direct impact on any historic features. The local landscape within the study area was noted to be generally of low historic value which, it was concluded, would not be affected by the scheme and it was expected that there would be minimal impact on the setting of listed buildings and conservation areas.

Consultation

5.117. Historic England responded that it had no comments to make and suggested POPE consult with the local authority Conservation Team at Wakefield Council and West Yorkshire Archaeology Service.

5.118. No response has been received from the Wakefield Conservation Team or West Yorkshire Archaeology.

Evaluation

5.119. As expected the works have been implemented within the existing motorway boundaries and it is understood that no buried archaeological or cultural heritage features were found within the scheme extents. The M1 was already a dominant feature of the local landscape which was said to be generally of low historic value and although the scheme has slightly increased the visual influence of the road corridor in some locations, any effects on the setting of listed buildings or conservation areas is minimal.

[24] **Zone of Visual Influence** (ZVI) – area within which a proposed development may have an influence or impact.

Table 5-11 Summary of Cultural Heritage Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	Scheme is within existing motorway corridor so no effects on buried archaeology. Setting of designated built heritage receptors of regional value already changed by the M1 corridor and modern housing developments. The gantries will not mark further appreciable changes	Neutral
EST	The scheme has been constructed within the existing motorway corridor and there have been no direct impacts on buried archaeology or cultural heritage features. The M1 was a dominant feature within the local landscape and the additional infrastructure has increased the visual influence of the road although any impacts on the setting of built heritage is considered minimal	As expected

Water Quality and Drainage

Forecast

AST

5.120. The AST stated that the water environment was locally important and of mostly medium/low quality. There would be minimal change from small areas of increased impermeable surfaces and it was assumed that the existing drainage system was adequate. The overall impact was assessed as **neutral**.

Environment Assessment Report

5.121. The ERA notes that the scoping exercise concluded that in accordance with IAN 161/12, assessment of discharge rates, water quality and flood risk were not normally required. There would be minimal change to impermeable surface area and any increase in run-off would be offset by attenuation to maintain the existing discharge rates and therefore Road Drainage and the Water Environment were scoped out of the EnAR.

5.122. The highway drainage would need to be modified, mostly in the central reserve to collect runoff where the camber was to be modified on bends and also new paved areas such as the ERAs. However, it was expected that the design would be such that the rate of discharge would not change from the existing situation, with additional storage capacity provided within the highway land by underground chambers and over-sized piping. There would be no change to the existing outfalls as a result of the scheme.

Consultation

5.123. The EA responded that it does not carry out monitoring of the local river ecosystems in this area, so has no information as to changes in the watercourses in this area, and that the scheme would need to have done a before and after study to compare against a baseline collected before works took place, and compare to current situation to be able to assess impacts.

5.124. The EA confirmed that the M1 between J39 and J42 crosses three waterbodies.[25] The overall waterbody classification status for all three has remained at Moderate between 2013 and 2016 classifications – this covers assessment data from 2010 to end of 2015. The 2016 classification is the latest available.

5.125. It also notes that their Groundwater and Contaminated Land Team do not collect data from monitoring points that would identify impacts of the scheme and that EA has not been informed of any incidents that would have impacted on groundwater, or resulted in land contamination.

5.126. There have been no environmental incidents reported to them as a result of the smart motorway scheme. EA does not sample outfalls etc. therefore is not in a position to comment on run off discharges from the scheme and overall is not aware of a beneficial or detrimental impact on water

[25] Calder from River Colne to River Chald, River Chald from Source to River Calder and Oulton Beck from Source to River Aire

quality. EA also points out that as their sites are also a fair distance from the motorways, excluding a large incident, it is unlikely that any change would be detected from their data.

Evaluation

5.127. No As Built drainage details have been provided to POPE at this OYA stage, however the HEMP confirms that drainage works were required as part of the scheme, replacing existing pipes with new 600m diameter oversize pipes for attenuation of increased run-off from the increase in hard surface area, and that modifications to existing outfall manholes to add flow control devices or build new outfall manholes with flow control devices was carried out. POPE is not aware whether any pollution incidents have occurred. No information has been made available to POPE which would indicate that the effects of the scheme are other than as expected, although more detailed information would be required to confirm this. It is suggested that water quality and drainage could be reconsidered at FYA.

Table 5-12 Summary of Water Quality and Drainage Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	Locally important water environment of mostly medium/low quality. Minimal change from small areas of increased impermeable surfaces. It is assumed that the existing drainage system is adequate.	Neutral
EST	Flow attenuation provided and POPE is not aware of any pollution incidents, however, further information would be required to confirm the effects of the scheme	Likely to be as expected

Physical Fitness

Forecast

AST

5.128. The AST Physical Activity entry stated that the scheme would be entirely within the motorway boundary and so no non-motorised users (NMU) would be directly affected. The overall impact would be **neutral.**

Environmental Assessment Report

5.129. The EnAR noted that the only potential impacts on the non-motorised user network would be in terms of visual amenity and temporary changes during construction. Visual impacts would be assessed under the Landscape topic.

Consultation

5.130. No responses to consultation have been received.

Evaluation

5.131. No further evaluation has been undertaken for POPE, as expected there have been no permanent changes to the NMU network. The visual effects of the scheme on users of PRoWs have been considered in the landscape section above, and as illustrated in ***Figure 5-16*** and ***Figure 5-17***.

Figure 5-16 and Figure 5-17 looking east from PRoW alongside the River Calder to M1 on embankment crossing the Calder Valley illustrating open views to VMS and gantry signs increasing the urban influence of the motorway corridor in this rural section of the route. (See also Figure 5-2 in landscape section).

Table 5-13 Summary of Physical Fitness Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	The scheme would be entirely within the motorway boundary, so no non-motorised users would be directly affected	Neutral
EST	Non-motorised users have not been directly affected by the scheme.	As expected

Journey Ambience

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

Forecast

AST

5.133. The AST Journey Quality entry stated that variable message signs provide clear and unambiguous information and this would serve to reduce driver stress. Traveller Views were influenced by the existing motorway corridor and would not be substantially changed. The overall impact was predicted to be **Large Beneficial**.

Environmental Assessment Report

Traveller Views

5.134. Potential effects due to changes in amenity for traveller views were included within the landscape section of the EnAR which noted that between J39 and 42 there were a range of views from the motorway which were similar when travelling northbound or southbound on the M1, as the key views were sideways from the motorway rather than along it.

5.135. Immediately north of J39 the motorway is on a high embankment and vehicle travellers have views to the east and west over the valley of the River Calder. To the east, the view was said to be attractive, well wooded with large waterbodies. However, the skyline is dominated by the residential development of Horbury. The business park to the east is not particularly attractive however the wider view of the wooded skyline and the golf course is positive. As the motorway approaches the bridge over the A642 there is dense woodland planting on the embankment verges which limit the views of the suburban housing. North of this the motorway goes into cutting with mature planting restricting wider views other than a glimpsed view of grazing fields with Hall Cliffe on the horizon. At Ossett Spa the motorway is cut into slope allowing views to the west of trees and suburban housing. The slope to the east precludes any extensive views. As travellers approach J40 the motorway goes into cutting.

5.136. North of J40 and Park Mill Lane views open up with expansive attractive views east and west of rolling farmland. At Kirkhamgate the road goes briefly into a wooded cutting beyond which views open out again with attractive farmland and isolated farmsteads.

5.137. At the approach to J41 an electricity transmission line crosses the motorway and then turns north to run parallel - the pylons were noted as a dominant part of the view. The road goes into cutting at the junction.

5.138. Between J41-J42 the road is at grade. The major industrial units to the east are screened by dense woodland; however the farmland to the east is attractive. As travellers approach J42 the road is on embankment but views are screened by verge woodland.

5.139. Overall it was expected that the visual experience of vehicle travellers would not be significantly affected by the works. The major visual elements of the scheme were expected to be limited to the new signs, gantries and loss of existing roadside vegetation in some locations. The key impact would be the new gantries which would increase the visual presence of motorway infrastructure. However, it was not expected that they would impact significantly on the existing views from the road as they would not interrupt existing sideways views of the surrounding landscape.

Driver Stress

5.140. The EnAR noted that the M1 was a strategic route for local, regional and international traffic, carrying in excess of 153,000 vehicles a day. Congestion was already a serious problem and was expected to increase significantly. Delays were experienced most weekdays during peak times affecting journey time reliability. In addition, the short weaving lane between J41-J42 posed difficulties for drivers getting into the appropriate lane, especially during peak periods. Existing driver stress was considered to be high.

5.141. The scheme design was expected to help reduce driver stress by;

- satisfying design standards;
- the new gantries would manage traffic flows;
- the use of the hard shoulder would provide additional carrying capacity; and
- the dedicated merge and diverge lane between J41-42 would ease traffic flow on this short section of the motorway and reduce the need for lane weaving.

5.142. Traffic data forecasts showed that with the scheme in place, traffic flows per lane were expected to be lower in 2030 compared to the existing conditions and the 2030 Do minimum (use of the hard shoulder as a running lane would spread the traffic over 4 rather than 3 lanes). Average traffic speed was predicted to be slightly higher for the 2030 Do something compared with the 2030 Do minimum. This was expected to result in slight reductions in driver stress. The percentage of HGVs was also predicted to reduce in 2030 with the Proposed Scheme in place resulting in slight beneficial significance of effects on fear of accidents.

5.143. In addition, the improved directional signs, new gantry and cantilever message signs, and the dedicated merge-diverge lane between J41-J42 northbound, together with a reduction in the percentage of HGVs by 2030 would help to alleviate congestion, improve certainty of route and improve driver comfort.

5.144. As a result, the overall impact on driver stress (incorporating frustration, fear of accidents and route uncertainty) resulting from the scheme was anticipated to be slight beneficial.

Traveller Care

5.145. The EnAR did not assess traveller care as there would be no changes as a result of the scheme.

Consultation

5.146. With regard to the overhead lighting reduced as part of the scheme Crigglestone Parish Council considers that the lights were an aid to safety in times of darkness particularly during shorter days in the winter months.

5.147. Also with regard to safety – the PC is concerned about the lack of a hard shoulder and considers that the emergency refuge areas (ERAs) seem to be few and far between; the PC thought ERAs had to be every one and a half miles[26] but says they seem further apart than this and questions how many there are on this new section of M1 Smart Motorway.

[26] 1 mile = 2.4km (approx.)

5.148. The PC notes that the motorway is much better now in terms of traffic flow but also comments on traffic congestion on the Wakefield to M1 dual carriageway (A636) noting standing traffic for long periods and difficulties for local traffic joining the A636 at the Denby Dale Road East junction. (NB: based on available traffic data it is thought likely that congestion could be related to part signalling of the Calder Park roundabout at J39 and is not related to the smart motorway currently being evaluated).

Evaluation

Traveller Views

5.149. The visual experience of vehicle travellers was not expected to be significantly affected by the works as the introduction of new gantries/VMS would not interrupt sideway views of the surrounding landscape. It was expected that the gantries in particular would increase the visual presence of motorway infrastructure; this together with the new central reserve vertical concrete barriers has added to the feeling of urbanisation within the route corridor and this is considered to be the case. (see ***Figure 5-18***).

Figure 5-18 Example of new super-span gantry and signs northbound approaching J42

Driver Stress

5.150. Frustration – congestion and journey reliability have generally improved – most notably when the motorway is at its busiest i.e. peak periods (a.m. northbound and p.m. southbound). At other times it is understood to have remained similar to before the smart motorway changes. The scheme would appear to have improved journey times when most needed and, as a result, driver frustration. (see traffic sections of this study for details).

5.151. Fear of accidents – based on information within the safety section of this study it would appear that the number of vehicle collisions has increased slightly – from 22.8 to 26 per year. The severity of accidents has also gone up from 14% to 23%, with 6 serious compared to 2.6 before scheme changes, although the number of fatal accidents has gone down to 0. However, as these figures are based on one year's data, there is insufficient evidence to suggest that the changes are as a result of the scheme or to come to any firm conclusions and this topic should be considered in more detail at FYA.

5.152. With regard to the concerns raised by Crigglestone PC, the EnAR states that as there would be no hard shoulder along the carriageways, ERAs with emergency telephones would be provided at about 2.5km spacing in accordance with IAN 161/12. ERAs would be provided within each link in both directions between J39 and J41. However, due to the short distance between J41-J42 there would be no ERAs in this link although an additional emergency telephone would be located adjacent to the J42 northbound exit slip. 2 ERAs have been provided Northbound and Southbound at an average of 2.1km away from each junction between J39 and J41.

5.153. Route uncertainty – it is likely that the improved directional signs, new gantry and cantilever message signs will have improved route certainty for drivers as expected.

5.154. Based on observed data after opening the average peak hourly flow in 2016 is 1116 vehicles per lane with an average speed of 109 km/hr on the northbound carriageway and 1128 vehicles per lane with an average speed of 105 km/hr on the southbound carriageway (***Table 5-1***). These flows and average speeds would result in low levels of driver stress[27] compared to the 2010 baseline high levels of driver stress[28].

5.155. The EnAR expected that a reduction in the number of HGVs long term would also help reduce driver stress with slight beneficial significance of effects on fear of accidents – POPE has no post opening HGV data on which to base any comparison at this OYA stage.

Table 5-14 Driver Stress / frustration based on 2016 traffic data

Direction	Flow per lane	Average Speed (km/h)	Stress Level
Northbound	1,116	109	Low
Southbound	1,128	105	Low

Table 5-15 Summary of Journey Ambience Evaluation

Origin of Assessment	Summary of Predicted Effects	Assessment
AST	Variable message signs provide clear and unambiguous information and would serve to reduce driver stress. Traveller Views were influenced by the existing motorway corridor and would not be substantially changed	Large Beneficial
EST	Traveller Views - The motorway was an existing feature and views from the road have not been interrupted as expected. The new gantries increase the visual presence of motorway infrastructure; together with the new central reserve vertical concrete barriers add to the feeling of urbanisation within the route corridor as expected. Traveller Stress –The scheme has improved journey times when most needed i.e. at peak times and as a result driver frustration is likely to have benefitted. The number of collisions and severity of accidents has increased but there is insufficient data at OYA to come to any firm conclusion as to whether this is as a result of scheme changes. New and improved signage is likely to have improved route certainty. Based on post opening average vehicle and speed data driver stress is evaluated as low.	As expected

[27] Based on the methodology in EAR Section 10 Effects on All Travellers Table 10.1: Driver Stress/Frustration Categories
[28] EAR Section 10 Effects on All Travellers Table 10.3 Base Year 2010 Traffic Data

Environmental Impacts – Key Points

Noise

- As expected the use of the hard shoulder as a permanent running lane has moved traffic closer to receptors. Based on available information, traffic flows are lower than forecast, although within the 'as expected' parameters apart from J41-42 SB (21% lower) with the potential for noise from traffic to be marginally better than forecast at this location.

Local Air Quality

- Traffic growth has been less than predicted and based on traffic flows there is potential for local air quality to be better than expected.
- Local air quality should revisited at FYA with regard traffic flows and when a longer period of monitoring results should be available.

Greenhouse Gases

- Greenhouse gases were re-forecast to be 14% higher, whereas the observed data has shown that greenhouse gases are only 2% higher and as such is better than expected.

Landscape and Townscape

- The scheme has introduced additional infrastructure along an established motorway corridor, which was an existing dominant feature within the local landscape and has not significantly altered the overall local landscape character.
- Retained highway planting helps filter views to the new large scale gantries and signs, however there are open views from some locations and it will take time for mitigation plating to mature sufficiently to provide any additional screening. Ongoing establishment should be reconsidered at FYA.
- There have been no impacts on townscape.

Biodiversity

- Based on the information available it would appear that habitat loss has been localised and protected species have not been affected by the works. Mitigation planting will in time replace habitat suitable for breeding birds.
- No information has been made available to POPE which would confirm the composition of any species rich / wildflower grass seed mixes used and therefore whether the aspiration of ecological enhancement as noted in the CEMP, have been achieved.

Cultural Heritage

- The scheme has been constructed within the existing motorway corridor and no information has been made available to POPE which would indicate that there have been any direct impacts on buried archaeology or cultural heritage features. The M1 was a dominant feature within the local landscape and the additional infrastructure has increased the visual influence of the road although any impacts on the setting of built heritage are considered minimal.

Water

- Flow attenuation provided and POPE is not aware of any pollution incidents, however, further information would be required to confirm the effects of the scheme which were expected to be neutral.

Physical Fitness

- The scheme has been carried out within the motorway boundary, no non-motorised users have been directly affected No further evaluation has been undertaken and effects are considered to be neutral.

Journey Ambience

- Traveller Views - Views from the road have not been interrupted as expected. The new gantries increase the visual presence of motorway infrastructure; together with the new central reserve vertical concrete barriers add to the feeling of urbanisation within the route corridor as expected.

- Traveller Stress –The scheme has improved journey times when most needed i.e. at peak times and as a result driver frustration is likely to have benefitted. The number of collisions and severity of accidents has increased but there is insufficient data at OYA to come to any firm conclusion as to whether this is as a result of scheme changes. New and improved signage is likely to have improved route certainty.

- Based on post opening average vehicle and speed data driver stress is evaluated as low.

6. Social Impacts Evaluation

Introduction

6.1. WebTAG guidance current when the scheme was appraised described Social impacts as covering the human experience of the transport system and its impact on social factors, not considered as part of economic or environmental impacts. This covered the following impacts:

- Accidents
- Physical Activity
- Security
- Severance
- Journey Quality
- Option and Non-Use Values
- Accessibility
- Personal Affordability

6.2. Accidents (collisions) and security were considered in section 3 of this report, and Physical Fitness and Journey Ambience in the environment chapter, this section here covers the remaining social impacts.

Sources

6.3. Sources of the forecast social impacts of this scheme are from the AST.

Physical Activity

6.4. See environment section, page 86 section 5.127 onwards.

Journey Quality

6.5. See environment section, page 87 section 5.131 onwards.

Affordability, Access to Services, Severance and Option Values

6.6. The AST stated that these sub-objectives were not relevant to this scheme thus they were not appraised. There has been no change to the scheme as built which would alter impacts on these, thus they have likewise not been evaluated in this OYA.

7. Conclusions

7.1. To conclude this report, this section summarises how the scheme is meeting its specified objectives.

7.2. ***Table 7-1*** presents an evaluation of the scheme's objectives using the evidence presented in this study.

Table 7-1 Summary of Success of Scheme Objectives at OYA

Objective	Has the objective been achieved?	
To support and enhance the role of the current M1 as a major national and interurban regional transport artery.	Journey times have improved with savings of up to 100 seconds along the scheme despite increases in traffic flows. The two additional lanes of capacity delivered on the link between J41-J42 has also improved the connectivity to the M62 which is part of the strategic national corridor for Freight movements.	✓
To deliver the scheme in a way which supports the delivery of the Government's transport policy objectives.	The scheme has delivered additional capacity to help ease congestion in future years. The scheme has improved journey times in the peak periods and has reduced driver stress. Reliability has improved along the scheme and vehicle operating costs have reduced.	✓
To achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.	Despite the increase in number of the collisions on the scheme, the wider modelled area has seen a fall in the number of collisions. However, these results are not statistically significant at this stage. Severity has increased on both the modelled area and the scheme but the results are also not statistically significant at this stage.	Too early to conclude.
The scheme should improve journey time reliability, by improving and better managing traffic flow conditions.	In peak periods of large traffic flow reliability has improved and there has been minimal impact in other time periods.	✓
The scheme should aim to improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway.	Gantries provided by the scheme have improved driver information.	✓
To minimise the detrimental environmental effects of the scheme and offset by mitigation measures where technically feasible and economic to do so, taking account of costs, availability of funding and statutory obligations.	The scheme performed as expected with regards to the environmental effect it had and in some cases better than expected due to lower than forecast traffic flows. Mitigation measures have been put in place. Some effects will need to be revisited at the five year after stage.	✓

Appendix A. Appraisal Summary Table & Evaluation Summary Table

Appraisal Summary Table

7.3. The AST is a brief summary of the main economic, safety, environmental and social impacts of a highway scheme. ***Table 7-1*** presents the AST for the M1 J39-42 Smart Motorway All Lane Running scheme.

7.4. The AST presents a brief description of the scheme, a statement detailing the problems that the scheme planned to address, and assesses the scheme's predicted qualitative and quantitative impacts against the following objectives:

- **Economy** – Estimated impact of the scheme upon journey times, vehicle operating costs, journey time reliability, regeneration and wider impacts.
- **Environmental** – an estimate of the impact of the scheme on factors such as noise, air quality, greenhouse gases, landscape, townscape, heritage, biodiversity and water.
- **Social** – a review of scheme impact upon commuting and other users, physical activity, journey quality, collisions, security, access to services, affordability, severance and option values.
- **Public accounts** – estimated impact upon cost to broad transport budget and indirect tax revenues.

Evaluation Summary Table

7.5. 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.

7.6. 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 OYA 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 7-2 Appraisal Summary Table

IMPACTS		SUMMARY OF KEY IMPACTS	ASSESSMENT				
			QUANTITATIVE			QUALITATIVE	MONETARY (NPV)	DISTRIBUTIONAL 7-PT SCALE/ VULNERABLE GRP
Economy	**Business users & transport providers**	This scheme provides significant levels of business user benefits	**Value of journey time changes (£)** £218.087 **Net journey time changes (£)** 0 to 2 min: £151.772m; 2 to 5 min: £52.447m; > 5 min: £13.874m			-	£188.758	-
	Reliability impact on Business users	This scheme provides a significant journey time reliability benefit, through reduced Travel Time Variability and Incident Delay. (Note that Reliability monetary impacts are derived across all user groups, then split into Business / Commuting & Other based on the proportion split of TEE benefits)	-			-	£59.402	-
	Regeneration	Regeneration impacts not included within the appraisal of this scheme.	-			-	-	-
	Wider Impacts	Wider impacts not included within the appraisal of this scheme.	-			-	-	-
Environment	**Noise**	Changes at residential receptors are either No Change or Negligible, approximately a fifth are increases in noise. Similar changes experienced at non-residential receptors. Changes are caused by changes in traffic flow plus use of the hard shoulder. 198 properties exposed to levels above 68dB LAeq. SDI shows adverse impacts on all social groups and for children and young people	Est. Population Annoyed (Do-Min): 1,300 Est. Population Annoyed (Do-Something): 1,376 Net difference in est. population annoyed: 77			Slight Adverse	-£3.436m	Income Quintile 2, 4 & 5 = Slight Adverse, 1 = Moderate Adverse, 3 = Large Adverse
	Air Quality	3 Air Quality Management Areas (AQMAs) within 200m of proposed scheme: Wakefield City, Wakefield M1 and Barnsley No.1. The scheme results in 4 new exceedances of the AQS Objective, but the change in annual mean NO2 concentrations is small at the majority of receptors (less than 2µg/m³). PM10 Improve/Worse - 2140/699 properties, PM10/NO2 No Change - 462/437 properties, NO2 Improve/ Worse - 2168/696 properties. In opening year 21.4 tonnes increase in NOx emissions and 0.8 tonnes increase in PM10 emissions.	Net Route Assessment (opening year) for PM10: 71, Change in Nox emissions over 60-year appraisal period: 3,468 tonnes			Local AQ impacts not considered significant	-£2.191m	Income Quintile 1, 3 & 4 = Moderate Beneficial, 2 = Large Adverse, 5 = Large Beneficial
	Greenhouse gases	There is an increase in CO2 of 28,638 tonnes in the opening year as a result of the scheme.	Change in non-traded carbon over 60y (CO2e). 1043939 tonnes Change in traded carbon over 60y (CO2e).			-	-£50.539m	-
	Landscape	No change to existing urban fringe/ agricultural landscape character of low sensitivity. Proposed gantries will have adverse visual impact on nearby residential receptors.	-			Slight adverse	-	-
	Townscape	No townscape impacts as surrounding area is urban fringe or agricultural landscape	-			Neutral	-	-
	Heritage of Historic resources	Scheme is within existing motorway corridor so no effects on buried archaeology. Setting of designated built heritage receptors of regional value already changed by the M1 corridor and modern housing developments. The gantries will not mark further appreciable changes.	-			Neutral	-	-
	Biodiversity	Very minor loss of habitats of local value within soft estate. No adverse impacts on designated species, i.e. great crested newts and breeding birds.	-			Neutral	-	-
	Water Environment	Locally important water environment of mostly medium/low quality. Minimal change from small areas of increased impermeable surfaces. It is assumed that the existing drainage system is adequate.	-			Neutral	-	-

IMPACTS		SUMMARY OF KEY IMPACTS	ASSESSMENT				
			QUANTITATIVE			QUALITATIVE	MONETARY (NPV)	DISTRIBUTIONAL 7-PT SCALE/ VULNERABLE GRP
Social	**Commuting and Other Users**	This scheme provides significant levels of Commuting and Other user benefits. The most deprived income quintile receives a slight beneficial impact, whilst the least deprived income quintile receives a large beneficial impact. All other income quintiles receive a moderate beneficial impact.	**Value of journey time changes (£)** £201.170m **Net journey time changes (£)** 0 to 2 min: £138.756m; 2 to 5 min: £54.835m; > 5 min: £7.588m			-	£150.273m	Income Quintile 1 = Slight Beneficial, 2,3 & 4 = Moderate Beneficial, 5 = Large Beneficial
	Reliability impact on Commuting and Other users	This scheme provides a significant journey time reliability benefit, through reduced Travel Time Variability and Incident Delay. (Note that Reliability monetary impacts are derived across all user groups, then split into Business / Commuting & Other based on the proportion split of TEE benefits)	-			-	£46.673m	-
	Physical activity	The scheme is entirely within motorway boundary, so no non-motorised users would be directly affected.	-			-	Neutral	-
	Journey quality	Variable message signs provide clear and unambiguous information - this would serve to reduce driver stress. Traveller Views are influenced by the existing motorway corridor and will not be substantially changed.	-			-	Large Beneficial	-
	Accidents	Accident savings provided across the wider road network. No links meet the minimum number of accidents threshold required to enable the proportion (high, medium or low) of vulnerable group casualties to be determined. Assessment score is neutral.	Accidents: 133 Fatal Casualties: 1 Serious Casualties: 23 Slight Casualties: 113			-	£9.584m	Income quintile 1,2,3,4 & 5 = N/A
	Security	MM ALR reduces availability of hard shoulder, provision of ERAs and higher levels of monitoring should improve security for road users.	-			-	Neutral	-
	Access to services	The scheme does not affect the provision or location of transport facilities and hence access to transport is unaffected.	-			-	Neutral	-
	Affordability	This scheme does not impact upon User Charges, therefore no Affordability assessment has been undertaken.	-			-	Neutral	-
	Severance	Between junctions, people can only cross the M1 using grade separated facilities that are unaffected by MM operation. The local road network may experience some changes in traffic flows which may affect pedestrians crossing these roads.	-			-	Neutral	-
	Option values	Transport availability is unaffected by the scheme.	-			-	Neutral	-
Public Accounts	**Cost to Broad Transport Budget**	This scheme will be funded through central government funds	The impact would be on Central Government only. There would be no impact on Local Government, developer contributions or on revenues/fares.			-	£128.025m	
	Indirect Tax Revenues	There would be an increase in indirect tax revenue paid to the exchequer	The Indirect Tax Revenue is treated as a benefit to the scheme.			-	£12.549m	

Table 7-3 Evaluation Summary Table

IMPACTS		SUMMARY OF KEY IMPACTS	ASSESSMENT			
			QUANTITATIVE	QUALITATIVE	MONETARY	DISTRIBUTIONAL 7-PT SCALE/ VULNERABLE GRP
Economy	**Business users & transport providers**	This scheme provides benefits to users in terms of journey times. With particular improvements in the AM peak heading northbound and the PM peak heading southbound. Speeds have increased by as much as 30km/h.	-	-	£401.7m	-
	Reliability impact on Business users	This scheme provides a journey time reliability benefit, through reduced Travel Time Variability and Incident Delay. Again, particular improvements are seen in the AM Peak heading northbound and the PM Peak heading southbound.	-	-	£104.2m	-
	Regeneration	Regeneration impacts not included within the appraisal of this scheme.	-	-	-	-
	Wider Impacts	Wider impacts not included within the appraisal of this scheme.	-	-	-	-
Environment	**Noise**	As expected the use of the hard shoulder as a permanent running lane has moved traffic closer to receptors. Based on available information, traffic flows are lower than forecast, although within the 'as expected' parameters apart from J41-42 SB (21% lower) with the potential for noise from traffic to be marginally better than forecast at this location.	-	Slight Adverse	-£3.436m	-
	Air Quality	Traffic growth has been less than predicted and based on traffic flows there is potential for local air quality to be better than expected. Local air quality should re-visited at FYA with regard traffic flows and when a longer period of monitoring results should be available.	-	-	-£2.191m	-
	Greenhouse gases	The scheme forecast an increase in Carbon of 14% from pre to post scheme the observed increase was in fact 2%.	Change in non-traded carbon over 60y (CO2e). Change in traded carbon over 60y (CO2e).	428 tonnes (2% increase)	-	-£8.29m	-
	Landscape	The scheme has introduced additional infrastructure along an established motorway corridor, an existing dominant feature within the local landscape and has not significantly altered the overall local landscape character. Retained highway planting helps filter views to the new large scale gantries and signs, however there are open views from some locations and it will take time for mitigation plating to mature sufficiently to provide any additional screening. Ongoing establishment should be reconsidered at FYA.	-		Slight adverse	-	-
	Townscape	There have been no direct impacts on townscape.	-		Neutral	-	-
	Heritage of Historic resources	The scheme has been constructed within the existing motorway corridor and no information has been made available to POPE which would indicate that there have been any direct impacts on buried archaeology or cultural heritage features. The M1 was a dominant feature within the local landscape and the additional infrastructure has increased the visual influence of the road although any impacts on the setting of built heritage is considered minimal	-		Neutral	-	-
	Biodiversity	Based on the information available it would appear that habitat loss has been localised and protected species have not been affected by the works. Mitigation planting will in time replace habitat suitable for breeding birds.	-		Neutral	-	-
	Water Environment	Flow attenuation provided and POPE is not aware of any pollution incidents, however, further information would be required to confirm the effects of the scheme	-		Neutral	-	-
Social	**Commuting and Other Users**	See Business Impact	-		-	-	-

IMPACTS		SUMMARY OF KEY IMPACTS	ASSESSMENT			
			QUANTITATIVE	QUALITATIVE	MONETARY	DISTRIBUTIONAL 7-PT SCALE/ VULNERABLE GRP
	Reliability impact on Commuting and Other users	See Business Impact	-	-	-	-
	Physical activity	Non-motorised users have not been directly affected by the scheme.	-	-	Neutral	-
	Journey quality	Traveller Views - The motorway was an existing feature and views from the road have not been interrupted as expected. The new gantries increase the visual presence of motorway infrastructure; together with the new central reserve vertical concrete barriers add to the feeling of urbanisation within the route corridor as expected. Traveller Stress –The scheme has improved journey times when most needed i.e. at peak times and as a result driver frustration is likely to have benefitted. The number of collisions and severity of accidents has increased but there is insufficient data at OYA to come to any firm conclusion as to whether this is as a result of scheme changes. New and improved signage is likely to have improved route certainty. Based on post opening average vehicle and speed data driver stress is evaluated as low.	-	-	Large Beneficial	-
	Accidents	In the wider modelled area collisions have decreased by 1%. Fatal collisions have decreased but serious collisions have increased resulting in a higher severity ratio. On the scheme itself collisions have increased.	-	At this stage the results are not significant and so this has not been included in the benefits.	-	
	Security	The inclusion of CCTV monitoring where it was not previously means that security has been scored as slight beneficial.	-	-	Slight Beneficial	-
	Access to services	The scheme does not affect the provision or location of transport facilities and hence access to transport is unaffected.	-	-	Neutral	-
	Affordability	This scheme does not impact upon User Charges, therefore no Affordability assessment has been undertaken.	-	-	Neutral	-
	Severance	Between junctions, people can only cross the M1 using grade separated facilities that are unaffected by MM operation.	-	-	Neutral	-
	Option values	Transport availability is unaffected by the scheme.	-	-	Neutral	-
Public Accounts	**Cost to Broad Transport Budget**	This scheme will be funded through central government funds	The impact would be on Central Government only. There would be no impact on Local Government, developer contributions or on revenues/fares.	-	£145.3m	
	Indirect Tax Revenues	There has been a decrease	The Indirect Tax Revenue is treated as a benefit to the scheme.	-	£-28.3m	

Appendix B. Information requested for Environmental Evaluation

Table 7-4 Environment Information Requested

Requested Information	Response
Environmental Statement / Environment Assessment Report	EnAR Final Version 8/5/2013 Volume 1: Main Report, Volume 2: Figures and Volume 3:Appendices
AST	Dated 5/2/2013
Any amendments/ updates/addendums etc to the ES or any further studies or reports relevant to environmental issues. Have there been any significant changes to the scheme since the ES.	None
'As Built' drawings for landscape, ecological mitigation measures, drainage, fencing, earthworks etc. Preferably electronically or on CD.	Received landscape mitigation 'As Built' Drawings
Copies of the Landscape/Ecology Management Plan or Handover Environmental Management Plans	Received HEMP
Contact names for consultation	Provided by Highways England and sourced by POPE
Archaeology - were there any finds etc. Have any Archaeological reports been written either popular or academic and if so are these available?	Scoped out of EnAR
Have any properties been eligible for noise insulation?	No information received
Has any post opening survey or monitoring been carried out e.g. for ecology/biodiversity or water quality and if so would copies of the reports be available?	No information provided – POPE is not aware whether any has been undertaken
Animal Mortality Data	Provided by the MAC
Pre-scheme Non -Motorised User (NMU) Audit or Vulnerable User Survey	N/A
Employers Requirements Works Information - Environment sections	Not received
Health and Safety File – Environment sections	H&S File Volume 6 - Environment
Construction Environment Management Plan (CEMP)	Received
The Road Surface Influence (RSI) value of any low noise surface installed	No information received

Appendix C. Accuracy of impact on traffic flows for adjacent roads

Table 7-5 Time Period: 7:00-08:00

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-39 NB	4478	4185	-7%	4865	4918	1%	9%	18%
M1 J38-39 SB	3811	3262	-14%	3977	3472	-13%	4%	6%
M62 J28-J29 EB	4976	4612	-7%	5113	5345	5%	3%	16%
M62 J28-J29 WB	5965	5204	-13%	6667	5725	-14%	12%	10%
M62 J29-J30 EB	3634	N/A	N/A	3841	4158	8%	6%	N/A
M62 J29-J30 WB	4930	4602	-7%	5114	4853	-5%	4%	5%
A636 SW of J39 NB	1039	1118	8%	1109	1105	0%	7%	-1%
A636 SW of J39 SB	585	393	-33%	607	477	-21%	4%	22%
A636 NE of J39 NB	1068	1228	15%	990	1283	30%	-7%	4%
A636 NE of J39 SB	818	682	-17%	810	789	-3%	-1%	16%
A638 W of J40 EB	1595	1385	-13%	1754	1479	-16%	10%	7%
A638 W of J40 WB	1511	1273	-16%	1500	1599	7%	-1%	26%
A638 E of J40 EB	512	722	41%	531	882	66%	4%	22%
A638 E of J40 WB	882	1189	35%	938	1168	25%	6%	-2%
A650 NW of J41 NB	859	743	-13%	693	720	4%	-19%	-3%
A650 NW of J41 SB	559	884	58%	537	1001	87%	-4%	13%
A650 SE of J41 NB	853	1181	39%	1007	1133	12%	18%	-4%
A650 SE of J41 SB	1300	982	-24%	1321	1041	-21%	2%	6%

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
A653 S of 28 NB	1238	1074	-13%	1082	1170	8%	-13%	9%
A653 S of 28 SB	659	621	-6%	638	742	16%	-3%	19%
A653 N of 28 NB	1807	1916	6%	1821	2257	24%	1%	18%
A653 N of 28 SB	910	856	-6%	853	887	4%	-6%	4%
A642 S of 30 NB	1021	894	-12%	944	905	-4%	-8%	1%
A642 S of 30 SB	1064	886	-17%	1085	867	-20%	2%	-2%

Table 7-6 Time Period: 08:00-09:00

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-J39 NB	3922	3487	-11%	4265	3961	-7%	9%	14%
M1 J38-J39 SB	3499	2972	-15%	3766	3012	-20%	8%	1%
M62 J28-J29 EB	4855	4286	-12%	5182	4885	-6%	7%	14%
M62 J28-J29 WB	5435	4756	-12%	6091	5208	-14%	12%	10%
M62 J29-J30 EB	3757	N/A	N/A	3993	3889	-3%	6%	N/A
M62 J29-J30 WB	4407	3770	-14%	4551	4516	-1%	3%	20%
A636 SW of J39 NB	1120	1136	1%	1149	1107	-4%	3%	-3%
A636 SW of J39 SB	544	505	-7%	584	596	2%	7%	18%
A636 NE of J39 NB	1104	1596	45%	1098	1648	50%	-1%	3%
A636 NE of J39 SB	868	792	-9%	879	830	-6%	1%	5%
A638 W of J40 EB	1762	1442	-18%	1846	1443	-22%	5%	0%

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
A638 W of J40 WB	1810	1542	-15%	1818	1672	-8%	0%	8%
A638 E of J40 EB	997	945	-5%	973	1016	4%	-2%	8%
A638 E of J40 WB	1386	1142	-18%	1415	1161	-18%	2%	2%
A650 NW of J41 NB	875	754	-14%	692	729	5%	-21%	-3%
A650 NW of J41 SB	608	883	45%	600	927	55%	-1%	5%
A650 SE of J41 NB	1024	1101	7%	1065	1017	-4%	4%	-8%
A650 SE of J41 SB	1439	1150	-20%	1446	1089	-25%	0%	-5%
A653 S of 28 NB	1362	1054	-23%	1310	1071	-18%	-4%	2%
A653 S of 28 SB	722	762	6%	701	820	17%	-3%	8%
A653 N of 28 NB	1814	1892	4%	1824	2015	10%	1%	7%
A653 N of 28 SB	980	879	-10%	948	912	-4%	-3%	4%
A642 S of 30 NB	1000	885	-12%	994	882	-11%	-1%	0%
A642 S of 30 SB	1094	881	-19%	1107	946	-15%	1%	7%

Table 7-7 Time Period: 9:00-10:00

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-J39 NB	3122	2824	-10%	3355	3002	-11%	7%	6%
M1 J38-J39 SB	2957	2539	-14%	3192	2634	-17%	8%	4%
M62 J28-J29 EB	4375	3897	-11%	4674	4261	-9%	7%	9%
M62 J28-J29 WB	4713	4116	-13%	5279	4341	-18%	12%	5%
M62 J29-J30 EB	2927	N/A	N/A	3082	3188	3%	5%	N/A

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M62 J29-J30 WB	3557	3067	-14%	3690	3500	-5%	4%	14%
A636 SW of J39 NB	928	894	-4%	955	891	-7%	3%	0%
A636 SW of J39 SB	568	434	-24%	592	515	-13%	4%	19%
A636 NE of J39 NB	1022	1118	9%	1015	1149	13%	-1%	3%
A636 NE of J39 SB	684	739	8%	674	766	14%	-2%	4%
A638 W of J40 EB	1346	1150	-15%	1414	1185	-16%	5%	3%
A638 W of J40 WB	1290	1109	-14%	1276	1216	-5%	-1%	10%
A638 E of J40 EB	965	797	-17%	966	874	-10%	0%	10%
A638 E of J40 WB	1196	892	-25%	1202	930	-23%	0%	4%
A650 NW of J41 NB	544	604	11%	479	543	13%	-12%	-10%
A650 NW of J41 SB	446	640	43%	454	645	42%	2%	1%
A650 SE of J41 NB	867	693	-20%	899	743	-17%	4%	7%
A650 SE of J41 SB	711	801	13%	688	794	15%	-3%	-1%
A653 S of 28 NB	962	798	-17%	901	847	-6%	-6%	6%
A653 S of 28 SB	512	517	1%	527	579	10%	3%	12%
A653 N of 28 NB	1413	1377	-3%	1436	1562	9%	2%	13%
A653 N of 28 SB	729	662	-9%	747	681	-9%	2%	3%
A642 S of 30 NB	624	545	-13%	608	586	-4%	-3%	8%
A642 S of 30 SB	691	549	-21%	719	568	-21%	4%	3%

Table 7-8 Time Period: Inter Peak

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-J39 NB	2908	2601	-11%	3237	2630	-19%	11%	1%
M1 J38-J39 SB	3275	2867	-12%	3586	2956	-18%	9%	3%
M62 J28-J29 EB	4240	4243	0%	4393	4480	2%	4%	6%
M62 J28-J29 WB	4403	4242	-4%	4832	4345	-10%	10%	2%
M62 J29-J30 EB	3150	N/A	N/A	3277	3499	7%	4%	N/A
M62 J29-J30 WB	3217	3098	-4%	3474	3307	-5%	8%	7%
A636 SW of J39 NB	677	594	-12%	690	653	-5%	2%	10%
A636 SW of J39 SB	701	637	-9%	705	709	1%	1%	11%
A636 NE of J39 NB	959	967	1%	960	1041	8%	0%	8%
A636 NE of J39 SB	1014	978	-4%	991	1040	5%	-2%	6%
A638 W of J40 EB	1369	1086	-21%	1401	1169	-17%	2%	8%
A638 W of J40 WB	1325	1119	-16%	1309	1255	-4%	-1%	12%
A638 E of J40 EB	1147	853	-26%	1145	911	-20%	0%	7%
A638 E of J40 WB	1287	818	-36%	1295	854	-34%	1%	4%
A650 NW of J41 NB	516	625	21%	510	630	23%	-1%	1%
A650 NW of J41 SB	576	608	6%	578	614	6%	0%	1%
A650 SE of J41 NB	785	677	-14%	815	719	-12%	4%	6%
A650 SE of J41 SB	1020	758	-26%	1014	775	-24%	-1%	2%
A653 S of 28 NB	771	666	-14%	710	743	5%	-8%	12%
A653 S of 28 SB	642	658	2%	641	743	16%	0%	13%

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
A653 N of 28 NB	1093	1113	2%	1098	1192	9%	0%	7%
A653 N of 28 SB	973	1093	12%	954	1208	27%	-2%	11%
A642 S of 30 NB	614	553	-10%	609	597	-2%	-1%	8%
A642 S of 30 SB	616	535	-13%	631	563	-11%	2%	5%

Table 7-9 Time Period: 16:00-17:00

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-J39 NB	3348	3242	-3%	3572	3373	-6%	7%	4%
M1 J38-J39 SB	4392	4243	-3%	4809	4987	4%	9%	18%
M62 J28-J29 EB	5547	5357	-3%	5920	5994	1%	7%	12%
M62 J28-J29 WB	5518	4756	-14%	5887	5494	-7%	7%	16%
M62 J29-J30 EB	4694	N/A	N/A	4797	5271	10%	2%	N/A
M62 J29-J30 WB	4083	3677	-10%	4440	4297	-3%	9%	17%
A636 SW of J39 NB	672	595	-11%	694	654	-6%	3%	10%
A636 SW of J39 SB	1038	1119	8%	1087	1331	22%	5%	19%
A636 NE of J39 NB	948	1057	11%	1058	1096	4%	12%	4%
A636 NE of J39 SB	1136	1398	23%	1131	1342	19%	0%	-4%
A638 W of J40 EB	1815	1481	-18%	1902	1610	-15%	5%	9%
A638 W of J40 WB	1651	1473	-11%	1770	1768	0%	7%	20%
A638 E of J40 EB	1452	1191	-18%	1499	1302	-13%	3%	9%
A638 E of J40 WB	1274	960	-25%	1290	1082	-16%	1%	13%

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
A650 NW of J41 NB	508	988	94%	498	998	100%	-2%	1%
A650 NW of J41 SB	794	853	7%	796	841	6%	0%	-1%
A650 SE of J41 NB	945	1087	15%	1008	1133	12%	7%	4%
A650 SE of J41 SB	1020	975	-4%	1023	984	-4%	0%	1%
A653 S of 28 NB	746	846	13%	708	857	21%	-5%	1%
A653 S of 28 SB	1182	1014	-14%	1133	1032	-9%	-4%	2%
A653 N of 28 NB	1280	1225	-4%	1308	1262	-4%	2%	3%
A653 N of 28 SB	1744	1840	5%	1731	1949	13%	-1%	6%
A642 S of 30 NB	973	1010	4%	984	1002	2%	1%	-1%
A642 S of 30 SB	1198	833	-30%	1179	883	-25%	-2%	6%

Table 7-10 Time Period: 17:00-18:00

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-J39 NB	3425	3319	-3%	3664	3246	-11%	7%	-2%
M1 J38-J39 SB	4118	4180	2%	4493	4568	2%	9%	9%
M62 J28-J29 EB	5395	5054	-6%	5755	5746	0%	7%	14%
M62 J28-J29 WB	4855	4287	-12%	5262	4952	-6%	8%	16%
M62 J29-J30 EB	4804	N/A	N/A	4882	5137	5%	2%	N/A
M62 J29-J30 WB	3849	3292	-14%	4086	4025	-1%	6%	22%
A636 SW of J39 NB	637	597	-6%	653	632	-3%	3%	6%
A636 SW of J39 SB	1006	1346	34%	1029	1365	33%	2%	1%

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
A636 NE of J39 NB	1028	1001	-3%	1126	972	-14%	10%	-3%
A636 NE of J39 SB	1044	1319	26%	1037	1009	-3%	-1%	-24%
A638 W of J40 EB	1805	1608	-11%	1849	1657	-10%	2%	3%
A638 W of J40 WB	1666	1639	-2%	1744	1833	5%	5%	12%
A638 E of J40 EB	1599	1254	-22%	1604	1271	-21%	0%	1%
A638 E of J40 WB	1365	1010	-26%	1367	1041	-24%	0%	3%
A650 NW of J41 NB	470	1050	124%	451	1052	134%	-4%	0%
A650 NW of J41 SB	901	865	-4%	894	828	-7%	-1%	-4%
A650 SE of J41 NB	1028	1095	7%	1088	1091	0%	6%	0%
A650 SE of J41 SB	988	965	-2%	1033	1040	1%	5%	8%
A653 S of 28 NB	804	866	8%	790	946	20%	-2%	9%
A653 S of 28 SB	1261	1087	-14%	1225	1037	-15%	-3%	-5%
A653 N of 28 NB	1481	1300	-12%	1520	1308	-14%	3%	1%
A653 N of 28 SB	1861	1963	6%	1864	1972	6%	0%	0%
A642 S of 30 NB	972	976	0%	988	981	-1%	2%	1%
A642 S of 30 SB	1290	1021	-21%	1277	990	-22%	-1%	-3%

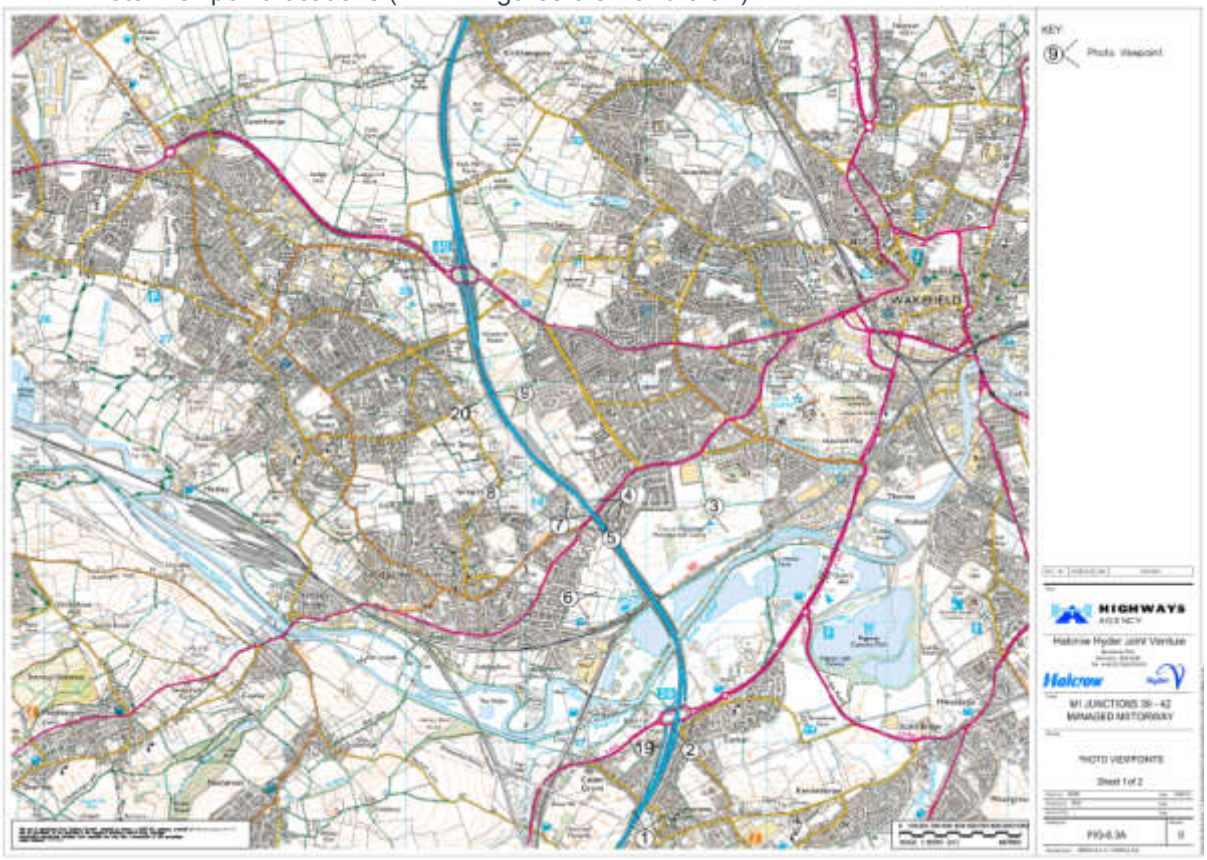
Table 7-11 Time Period: 18:00-19:00

	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
M1 J38-J39 NB	2740	2698	-2%	2866	2773	-3%	5%	3%
M1 J38-J39 SB	2818	2989	6%	2972	3175	7%	5%	6%
M62 J28-J29 EB	4069	3733	-8%	4241	4137	-2%	4%	11%
M62 J28-J29 WB	3762	3480	-8%	4096	3898	-5%	9%	12%
M62 J29-J30 EB	3360	N/A	N/A	3466	3509	1%	3%	N/A
M62 J29-J30 WB	2934	2389	-19%	3141	3016	-4%	7%	26%
A636 SW of J39 NB	667	539	-19%	681	532	-22%	2%	-1%
A636 SW of J39 SB	851	1010	19%	852	981	15%	0%	-3%
A636 NE of J39 NB	837	950	14%	882	919	4%	5%	-3%
A636 NE of J39 SB	737	979	33%	731	960	31%	-1%	-2%
A638 W of J40 EB	1267	1072	-15%	1312	1074	-18%	4%	0%
A638 W of J40 WB	1272	1296	2%	1262	1296	3%	-1%	0%
A638 E of J40 EB	1580	1061	-33%	1580	1035	-34%	0%	-2%
A638 E of J40 WB	1248	803	-36%	1268	800	-37%	2%	0%
A650 NW of J41 NB	532	744	40%	479	728	52%	-10%	-2%
A650 NW of J41 SB	523	686	31%	554	666	20%	6%	-3%
A650 SE of J41 NB	592	776	31%	627	776	24%	6%	0%
A650 SE of J41 SB	1095	957	-13%	1099	858	-22%	0%	-10%
A653 S of 28 NB	665	591	-11%	658	682	4%	-1%	15%
A653 S of 28 SB	894	843	-6%	921	828	-10%	3%	-2%

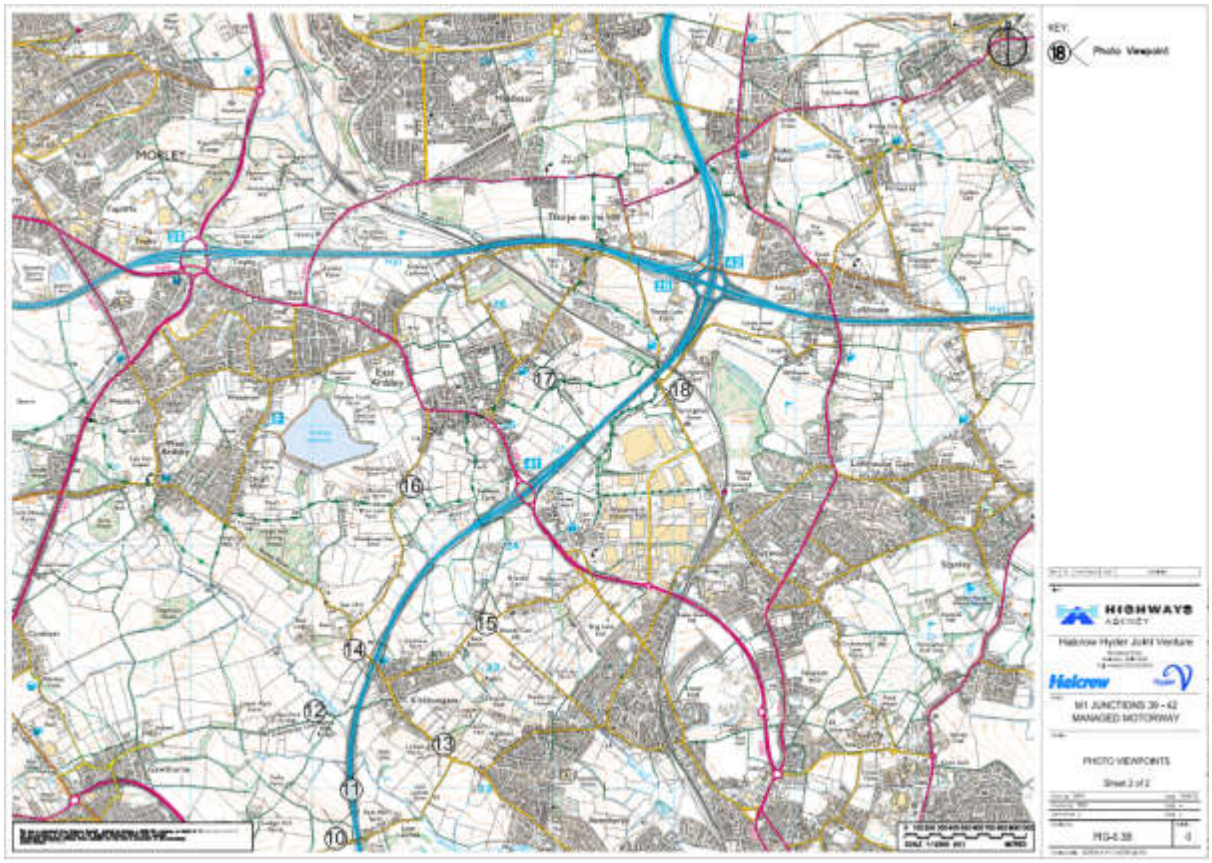
	Pre-Scheme 2013			Post-Scheme 2016			Increase with Scheme	
Location	Forecast DM	Observed	% Diff	Forecast DS	Observed	% Diff	Forecast	Observed
A653 N of 28 NB	857	1052	23%	910	1133	25%	6%	8%
A653 N of 28 SB	1405	1439	2%	1409	1485	5%	0%	3%
A642 S of 30 NB	653	635	-3%	652	608	-7%	0%	-4%
A642 S of 30 SB	1050	755	-28%	1086	752	-31%	3%	0%

Appendix D. EnAR /Scoping Report existing views and OYA Comparison photographs[29]

EnAR Photo Viewpoint locations (EnAR Figures 6.3A and 6.3B)[30].



[29] EAR winter 2012, EAR Scoping Report 2011, OYA May 2017
[30] NB: Views 8, 11 and 20 have not been included in the OYA comparison views



EnAR View 1 (left) looking north from Cliff Road, Crigglestone to M1 (North of J39) crossing Calder Valley

OYA comparison (above right) elevated view north over Calder Valley and motorway corridor - M1 in middle distance with VMS, gantry and signs visible above vegetation.
VMS at J39 is nearer to the residential area and visible see detailed view below

EnAR View 2 (left) looking north from Durkar Lane (summer) and OYA view (right) with VMS screened by vegetation. Durkar Lane rises up and as illustrated in Figure 1.10 in the landscape section of this report, views are possible to the top of the VMS at J39 from some locations.

EnAR View 3 (left) looking south west from clubhouse at City of Wakefield Golf Course towards J39 and OYA view (right) with copse of trees maturing

Similar view at OYA illustrating filtered views to M1 in middle distance, with VMS and gantry signs.

EnAR View 4 looking south west along Lennox Drive, Lupset with M1 on embankment

OYA view which shows that existing planting screens traffic but VMS and CCTV are visible above the canopy – centre view.

EnAR Scoping Report Plate 2 (summer) Lennox Drive, Lupset with properties well screened by semi-mature highway planting.

Similar view at OYA

EnAR View 5 from northbound carriageway with offices on Bennett Avenue (see also View 7 below)

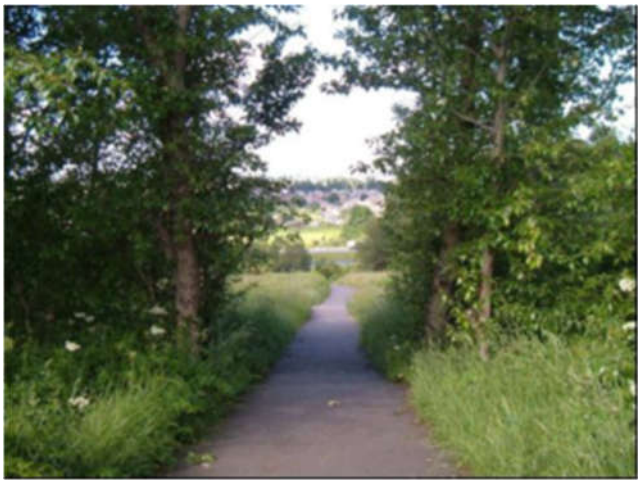
Similar views at OYA illustrating VMS on NB and SB carriageways opposite Bennet Avenue

EnAR View 7 (left) offices on Bennett Avenue facing M1 on embankment and at OYA (right) with traffic closer due to use of hard shoulder as a permanent running lane. VMS visible centre view.

EnAR View 6 (left) looking east across playing fields in Horbury towards M1 crossing Calder Valley and OYA view to right

At OYA detailed view illustrates M1 on embankment with gantry signs above intervening vegetation – distant views available from properties at edge of Horbury residential area south of the A642, playing fields and PRoWs.

EnAR View 9 (left) looking westwards towards Ossett from footpath at end of Dacre Avenue, Lupset and EnAR Scoping Report Plate 5 (right) with summer view to M1 through break in existing mature planting at Lupset



Similar view at OYA with M1 on embankment

EnAR Scoping Report Plate 6 (left) View from residential area in northeast Horbury, northward to M1 with J40 on horizon and OYA view (right)

OYA detailed view from same residential area (Hall Cliffe) to M1 in distance as carriageway rises up to J40 showing VMS and signs on approach to J40

EnAR View 10 (left) Looking north from footpath on Park Mill Lane towards Kirkhamgate and
View 11 (right) travelling northbound onM1 with East Ardsley Ridge and Kirkhamgate in distance

OYA View from footpath on Park Mill Lane with new sign gantry centre view with East Ardlsley Ridge on horizon to left of view and Kirkhamgate to right. As expected carriageway lighting has not been replaced within this section of the route. The change from former grassed central reserve to concrete vertical barrier is also illustrated.

EnAR View 12 South east from Gawthorpe Lane to elevated M1 approaching J40

Similar view at OYA towards M1, new gantry visible in middle distance

OYA enlarged view towards same gantry sign from Gawthorpe Lane and PRoW to illustrate in more detail

EnAR View 13 (left) Southwest view from houses on Batley Road, Kirkhamgate to M1 on embankment crossing valley and similar OYA view (right) with M1 and new gantry in middle distance

Scoping Report Plate 8: View of M1 from the southern tip of Kirkhamgate.

Similar view at OYA illustrating new gantry (centre view)

EnAR view 14 south from Batley Road with M1 climbing and approaching J40 in distance

OYA view illustrating open views to new road signs and VMS in open countryside

OYA enlarged view to illustrate scale of signs within the road corridor

EnAR View 15 View from Brandy Carr Road towards M1 crossing valley

OYA view with new M1 on embankment and side view of gantry sign visible in landscape

OYA Enlarged view to illustrate scale of sign in more detail

EnAR View 16 M1 viewed from Woodhouse

OYA view with M1 visible in open landscape, distant view to VMS through tree belt centre right

Similar OYA detailed view illustrating VMS grouped along route; filtered by intervening vegetation (centre left) and in more open visible location (centre)

EnAR View 17 (left) looking south east from Cave Lane, the Fall to M1 J41 and Wakefield Industrial Park and OYA view (right) with oblique view of gateway gantry through intervening vegetation

Scoping Report plate 13 View from west of motorway at East Ardsley. Continuous screen planting on east of M1, with adjoining large industrial units beyond. Clear views of M1 exist from the edge of the town, which sits on higher ground.

OYA similar view from playing fields at edge of East Ardsley with distant views to M1, gantries and replaced lighting seen in context of existing route corridor.

EnAR View 18 M1 southbound passing close to rear of properties on Lingwell Gate Lane (Lawns Lane)

OYA view with new VMS visible beyond vegetation and inset detail below illustrating VMS and large scale signs

OYA view north from properties on Lawns Lane with an existing M1 gantry sign visible

EnAR View 19 looking north east from Denby Dale Road West, Calder Grove.

OYA view illustrates that M1 is generally well screened at J39 by existing vegetation

OYA view from gateway (in view above) at end of Denby Dale Road West illustrating some occasional filtered views to signs possible depending upon location

Appendix E. Client Scheme Requirements Objectives

Overall Objectives

1. To support and enhance the role of the current M1 as a major national and inter-urban regional transport artery.
2. The scheme shall deliver the minimum scope required to achieve no worsening of safety performance of the network using Managed Motorways techniques.
3. To reduce congestion and to develop solutions that provide additional capacity, increase journey time reliability and ensure the safe and economic operation of the motorway.
4. The scheme should make best use of existing infrastructure providing additional capacity within the existing highway boundary, other than in exceptional circumstances.
5. The scheme should be designed to suit the requirements of ongoing maintenance, the needs of Highways Agency's Traffic Management and Network Delivery & Development directorates and minimise whole life costs.
6. The project should aim to provide maximum value for money against its whole of life costs in accordance with the Department's WebTAG guidance (BCR adjusted for non-monetised impacts should aim to be greater than 2).
7. The scheme should aim to improve on Appraisal Summary Table assessment results produced during the Options Phase where possible within the constraints of affordability.
8. To deliver the scheme in a way which supports the delivery of the Government's transport policy objectives.

Advance Works

9. The advanced works provide a concrete step barrier (CSB) in the central reserve and were completed in June 4 in advance of the main works.
10. The advanced works were planned to minimise traffic management and were programmed link by link to result in a 'seamless' transition to traffic management for the main works.
11. The CSB works should provide an earlier completion date for the whole works, as the advanced works would have otherwise been undertaken as the first phase of the main works.
12. Undertaking the advanced CSB works significantly reduced the risk to the programme to deliver the Pinch-Point schemes at J40 and J41. There is a ministerial commitment to deliver the Pinch-Point scheme at J40 by March 2014 and J41 by March 2015. The J40 Pinch-Point was delivered in line with the ministerial commitment.

Transport and Safety

13. The scheme should address the transport and safety problems identified in the Challenges and Issues section of this document.
14. To achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.
15. The scheme should improve journey time reliability, by improving and better managing traffic flow conditions.
16. The scheme should aim to improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway.

Environment

17. To minimise the detrimental environmental effects of the scheme and offset by mitigation measures where technically feasible and economic to do so, taking account of costs, availability of funding and statutory obligations.

Economy

18. The scheme should maximise the return on public investment.

Social and Distributional Impacts

19. The scheme shall minimise detrimental impacts on vulnerable people groups and provide appropriate mitigation where technically feasible and economic to do so, taking account of costs, availability of funds and statutory obligations.

Interfaces

20. Ensure HA NDD and TMD are consulted and agree with the scheme design and operation.
21. Ensure that the scheme takes into account the capacity improvements planned on adjacent sections of the M1 and the M62
22. Ensure that the adjacent Local Highways Authorities and Emergency Services have input to the scheme design.

Appendix F. Tables and Figures in this report

F.1. Tables

F.2. Figures

Appendix G. Glossary

Term	Meaning
A carriageway, B carriageway	Directional labelling of carriageway in which the A carriageway is Northbound.
AADT	Average of 24 hour flows, seven days a week, for all days within the year.
ADP	Alternative Design Proposal
ADS	Advanced Direction Sign
AED	Advance Ecological Design
ALR	**All Lane Running** is the type of smart motorway in which all lanes are open to traffic at all times. There is no lane which dynamically varies between operating as a hard shoulder or operating as a normal lane.
AIES	Assessment of Implications for European Sites
AQMA	Air Quality Management Area
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
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
CEMP	Construction Environmental Management Plan
COBA	COst Benefit Accident analysis
CM	Controlled Motorway
CRTN	**Calculation of Road Traffic Noise** The methodology used to determine entitlement under the Noise Insulation Regulations 1975 (as amended 1988) (NIR) and is the accepted method for the prediction of traffic noise in the UK.
D3M, D4M	Dual 3 or 4 lane motorway
DHSR	Dynamic Hard Shoulder Running
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 of 2010 was used in the appraisal and used in this report.
DMRB	**Design Manual for Roads and Bridges** This is a series of 15 volumes that provide standards, advice notes and other documents relating to the design, assessment, and operation of trunk roads, including motorways, in the United Kingdom.
Do Minimum (DM)	In scheme modelling, this is the scenario which comprises only the existing road network and other committed schemes.
Do Something (DS)	In scheme modelling, this is the scenario detailing the planned scheme plus improvement schemes that have already been committed
EAR	Economic Assessment Report
EnAR	Environment Assessment Report
EIR	Economic Impact Report
EM	Environmental Masterplan
EPS	European Protected Species

ERA	Emergency Refuge Area
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.
FUNIRA	Final Use Noise Insulation Regulations Assessment
FWI	Fatal & 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.
FWI/bvkm	FWI measure by volume of traffic
FYA	Five Years After
GCN	Great Created Newt
Halogen Data	**Halogen Data** is the record of the overhead gantry settings and message screens forming part of a smart motorway scheme over time.
HEMP	Handover Environmental Management Plan
INCA	**Incident Cost Benefit Assessment** can be used to estimate the benefits of reduce delay and travel time variability caused by unforeseen incidents that reduce capacity such as breakdowns, accidents and debris on the carriageway and major disruptions such as spillages.
KSI	Killed or Seriously Injured
LDEN	Day Evening Night Sound Level
LED	Landscape and Ecology Design
LEAP	Landscape and Ecology Aftercare Plan
LESR	Landscape and Ecology Summary Report
LMP	Landscape Management Plan
MAC	Managing Agent Contractor
MIDAS Data	MIDAS data is held by Highways England which contains lane by lane traffic flows and speeds
MM-ALR	Manage Motorways – All Lanes Running
MtCO2e	Million metric tons of carbon dioxide equivalent
MSA	Motorway Service Area
N	Nitrogen
NMA	Network Managing Agent
NMU	Non-motorised User
NO_2	Nitrogen dioxide
OYA	One Year After
PCF	Project Control Framework
PIC	**Personal Injury Collision** Data on these is obtained from records of road collisions collected from by police officers attending collisions.
PIC/mvkm	Ratio of PIC to the level of travel measured in **million vehicle kilometres** (mvkm)
PM_{10}	Particulate Matter
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.
PMW	Precautionary Method of Working
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

RCB	Rigid Concrete Barrier
RSA	Road Safety Audit
RSI	Road Surface Influence
SAC	Special Area of Conservation
SATURN	Simulation and Assignment of Traffic in Urban Road Networks – A strategic traffic modelling software
SSBJV	Skanska Balfour Beatty Joint Venture
SSSI	Sites of Special Scientific Interest
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 Interest** Designations used by local authorities in England for sites of substantive local nature conservation value
SRN	Strategic Road Network
SVIAR	Scheme Visual Impact Assessment Review
TMER	Twelve Month Evaluation Report
TFR	Traffic Forecasting Report
Traveller Care	In the context of journey ambiance, this covers aspects such as cleanliness, level of facilities, information and the general transport environment.
TTV	Travel Time Variability
VfM	Value for Money
VMSL	Variable Mandatory Speed Limit
WebTAG	Department for Transport’s website for guidance on the conduct of transport studies at https://www.gov.uk/guidance/transport-analysis-guidance-webtag