M1 J28 to 35a Smart Motorway Updated Operating Regime Environmental Assessment Report (SGAR5)

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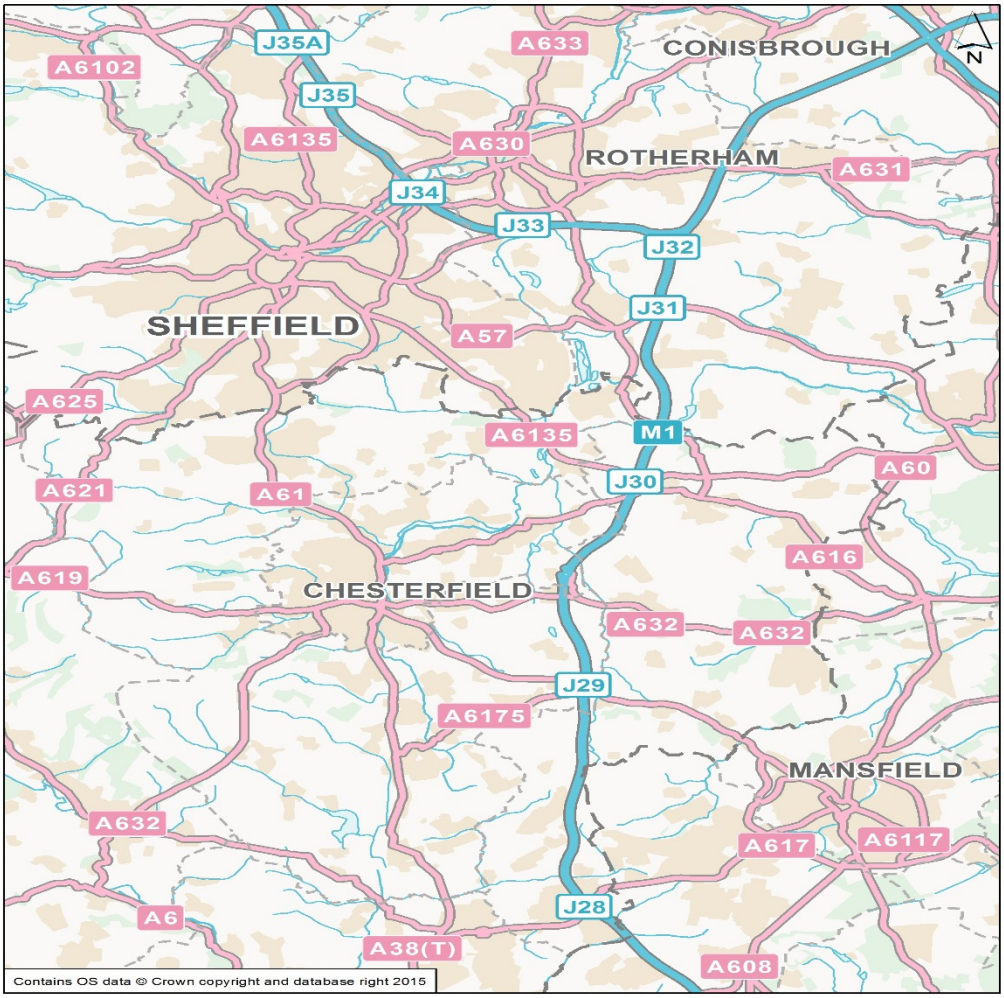
1 Introduction

1.1 Project Overview

In 2011, the Highways Agency (now Highways England and hereafter referred to as such) commissioned Mouchel to design a Smart Motorway scheme to provide improvements to the M1 from Junction J28 to 35a (Marker Post (MP) 214/7+83 to 268/9 + 50) in the Mansfield through to Barnsley area. Smart Motorway (SM) is an operating regime that includes a series of physical interventions and operating procedures to facilitate the dynamic control of traffic for congestion and incident management. It allows the road space to be managed in different ways for varying conditions to maximise capacity whilst providing a safe and informed environment for the travelling public and on-road resources (including emergency services, maintenance operatives and recovery operators).

The commission included the provision of engineering design and environmental assessment services on this stretch of motorway which is approximately 33.8 miles (54.4 kilometres (km)) long. See Figure 1 for an overview of the scheme area.

Figure 1: Scheme Overview Map



Following an initial options selection exercise in 2012, the design of a Smart Motorway All Lane Running scheme (SM-ALR) operating at the national speed limit commenced. The environmental assessment of this 70mph scheme operating 24 hours a day, 7 days a week concluded that it would result in significant adverse air quality impacts. As a result, a number of mitigated operational regimes to address this issue were subsequently investigated. This led to the selection of speed reduction of 60mph from 7am to 7pm as mitigation for the predicted significant adverse air quality impacts. This mitigated operating regime was subject to a detailed air quality assessment which demonstrated that it would not result in significant adverse air quality impacts. Two environmental assessment reports (M1 J28 to 31 and M1 J32 to 35a Smart Motorway All Lane Running (Mouchel, February 2014)) were subsequently prepared, leading to the production of a Record of Determination (RoD). A Notice of Determination (NoD) was subsequently published and subject to a six week challenge period which concluded without challenge by the end of March 2014.

Following completion of the challenge period, on the 8th of July 2014, the Secretary of State for Transport (SoS) gave the following position: *'The Secretary of State has not accepted this approach as the Government's preferred option for managing local air quality on the M1 and tasked Highways England to identify other measures which achieved the necessary reduction. Speed restriction is to be used only to the extent that is absolutely necessary'*.

Mouchel was subsequently instructed by Highways England to rigorously investigate alternative mitigation measures and progress the proposed scheme through its Determination process, whilst construction of the scheme progressed during the next 12 – 18 months. It was made clear that the chosen operating regime must demonstrate that it is sufficient to mitigate the predicted air quality impacts of the scheme, to ensure that it did not result in a significant impact.

Due to the intervening period between commencement of this assessment and the previous environmental assessment, the environmental baseline and traffic data have had to be updated. New assessment guidelines and policies which came into force in the intervening period have also been adopted. These changes have been made to ensure the updated environmental assessment meets the current assessment requirements. In addition to the air quality re-assessment, a brief scoping exercise concluded that due to the aforementioned updates, the noise assessment of the proposed SM-ALR scheme had to be updated also.

This Environmental Assessment Report (EAR) therefore reports on the outcome of the investigation into alternative mitigation operating regimes of the SM scheme and identification of a preferred mitigation option requested by the SoS for Transport. It also contains an assessment of changes to the physical design of the proposed scheme between J28 and 35a since the 2014 EARs were published. A whole scale assessment of the potential impact of physical interventions during construction was undertaken as part of the previous environmental assessment and reported in the M1 J31 to 32 Variable Mandatory Speed Limit (VMSL) EAR, prepared by Mouchel in October 2013 and the M1 J28 to 31 and the M1 J32 to 35a Smart Motorway All Lane Running, Environmental Assessment Reports, prepared by Mouchel in February, 2014.

1.2 Need for an Environmental Assessment

The European Union (EU) Directive 2011/92/EU requires that an Environmental Impact Assessment (EIA) be undertaken by the promoters of certain types of development to identify and assess the environmental effects of certain public and private projects before

development consent is given. Directive 2011/92/EU which consolidates the original Directive 85/337/EEC (now repealed) and its subsequent amendments, specifies the qualification requirements and the process by which statutory EIA should be undertaken.

All developments listed under Annex I of the EIA Directive must be subject to EIA in every case. Developments listed under Annex II may need to be subject to statutory EIA depending on whether the proposal qualifies as a 'relevant project' (meet certain criteria and thresholds defined in Annex II) and gives rise to significant environmental effects. The potential to generate significant environmental effects is described within Annex III of the EIA Directive.

In England and Wales, the requirements of the EIA Directive with regards to road projects has been transposed into United Kingdom (UK) statute by Section 105A of the Highways Act 1980, as amended by the Highways (Assessment of Environmental Effects) Regulations 1988, the Highways (Assessment of Environmental Effects) Regulations 1994, the Highways (Assessment of Environmental Effects) Regulations 1999 and the Highways (EIA) Regulations 2007 (collectively termed the 'EIA Regulations'). Screening procedures which accord with the requirements of the EIA Regulations exist within Highways England to determine whether trunk road and motorway developments qualify for statutory EIA, leading to the preparation of an Environmental Statement (ES). This process is known as Determination and this EAR has been prepared to record this process.

The proposed scheme has been classified as a relevant Annex II Project i.e. statutory EIA is not mandatory. It is not of a type listed in Annex I but it has the potential to change traffic flow and composition which could have significant adverse environmental effects. Under Highways England's procedures, Annex II relevant projects such as the application of SM-ALR on the M1 between J28 and 35a would require an appropriate level of environmental review in accordance with the Regulations. It has therefore been subject to an environmental review and assessment in line with the Design Manual for Roads and Bridges Volume 11 to establish whether significant environmental effects are likely to arise during its operational.

If significant environmental effects are predicted, a statutory EIA leading to the production of an Environmental Statement will be required. In the event of this, the proposed scheme will be subject to the National Infrastructure Planning regime as it would meet the definition of a Nationally Significant Infrastructure Project under Section 22 of the Planning Act, 2008. Where no significant environmental effects are predicted, the conclusions of the environmental assessment, as recorded in a final EAR will be summarised in a RoD.

The RoD will be subject to approval by Highways England's Network Services (NetServ) specialists and Highways England's Project Manager under delegated responsibilities on behalf of the SoS. This decision will be recorded in a NoD which will be published by Highways England in the London Planning Gazette and Local Newspaper. The NoD will be subject to a challenge window for a minimum period of six weeks, to allow objections to be made to the determination.

1.3 Status of the Environmental Assessment

The EAR has been produced as a deliverable in fulfilment of the SGAR5 product requirements of the Highways England's Project Control Framework (PCF) and has been prepared in line with the PCF product description. It comprises:

- Chapters 1 – 5: a background to the proposed scheme, overview of the existing environment and an outline of the environmental assessment process and scope.

- Chapters 6 and 8: the findings of the environmental assessment with a focus on significant residual effects, if any.
- Chapters 9: conclusions on the assessment.

2 Project Background

2.1 Introduction

In the Autumn Statement of 2011, the Government announced the investment of over £1bn to tackle areas of congestion and improve the national road network. To make the UK's infrastructure fit for the 21st century, the Government published its National Infrastructure Plan 2011 alongside the Autumn Statement.

The National Infrastructure Plan 2011 included plans to implement a new specification for Managed Motorways. Key physical design aspects of the next generation of Managed Motorways include the permanent conversion of the hard shoulder to a running lane along SM-ALR with the ability to dynamically control mandatory speed limits and deployment of technology interventions including queue protection and Closed Circuit Television (CCTV) systems.

This specification was to be applied to eight schemes in the Department for Transport (DfT) / Highways England's investment programme which were due to start construction from October 2012 onwards. The M1 J28 to 31 and the J32 to 35a scheme was listed as two of the eight schemes.

2.2 Scheme Development and Consideration of Scheme Alternatives

A South and West Yorkshire Multi-Modal Study (SWYMMS) was undertaken on behalf of the Government Office for Yorkshire and the Humber reported in 2002. One of its main objectives was to identify measures to reduce congestion on the region's motorways and secondly to re-establish the primary role of the trunk road network for strategic traffic. One of the recommendations from the SWYMMS study was that sections of the M1 (J30 to 42) and M62 (J25 to 28) motorway network should be widened to four lanes and that this capacity improvement should be protected by use of ATM and physical demand management measures to control traffic flows on to the widened motorway sections.

The SWYMMS proposals were rejected on cost grounds and in July 2003 the SoS tasked Highways England to investigate means to increase motorway capacity by making the best use of existing infrastructure supported by appropriate Integrated Demand Management initiatives to 'lock-in' capacity and mitigate any risks that maybe realised through the committed and continuing development within the motorway hinterland. To this aim, a strategy South West Yorkshire Making Best Use Study (SWYMBUS) was initiated. The strategy was to provide improvements to capacity and operations comprising of a combination of full standard widening to dual four lane motorway (D4M) and permanent four lane running. This led to the construction of D4M on the M1 between J31 and 32 which was completed in January 2008.

In July 2007, Highways England requested that all M1 and M62 improvement schemes in Yorkshire investigate the feasibility of ATM measures. As part of the feasibility study, at Stage Gateway 1 (SGAR1 – Options Identification), an Environmental Assessment Report (Arup, December 2008) was prepared for various segments of the M1 between J21 to 31 considering up to four possible improvement solutions, including widening and HSR. The results of the feasibility study were used to inform the National Roads Programme. An SM scheme along the M1 between J28 to 31 was initially developed by Arup through to a SGAR2 in 2009. At this point the design was for a fully compliant IAN 111/09: Managed Motorway Implementation Guidance.

In July 2008, Pell Frischmann Consultants Limited was appointed by the Highways England to investigate the use of SM technology to address problems on the M1 between J32 and 42 at SGAR1.

Following the SGAR1 work, in January 2009, the SoS announced plans to invest up to £6 billion to improve the national road network; including the roll out of hard shoulder running across the core motorway network. This included plans to introduce the SM concept (known then as Managed Motorways) on the M1 between J28 and 31 and J32 and 35a.

In 2011, by drawing on operational experience and value engineering expertise, Highways England evolved the design for SM into the current design concept known as 'SM-ALR'. This operating regime at the national speed limit was the focus for the M1 J28 to 31 and the M1 J32 to 35a in its development phase; the aim being to re-design the SGAR2 HSR options to align with requirements of Interim Advice Note (IAN) 161/13: Managed Motorways All Lane Running. As with HSR type schemes, SM-ALR schemes are typically delivered within the existing motorway boundary but with increased spacing of information gantries and use of smaller MS4 based verge mounted signing rather than portal gantries, resulting in less potential for localised visual and ecology effects.

The operational requirements for gantries, emergency refuge areas and supporting infrastructure for SM-ALR schemes along the M1 from J28 to 31 and M1 J32 to 35a commenced in 2011.

2.3 Current Investigations

As outlined in Chapter 1, the SoS for Transport tasked Highways England with investigating an alternative to mitigate the predicted significant adverse air quality impact along the scheme length as opposed proposed SM-ALR operating regime 60mph 7am to 7pm; 70pmh all other times. Mouchel was subsequently instructed by Highways England to investigate alternative mitigation measures and progress the solution through its Determination Process. A four step approach was subsequently adopted to address this:

- **Step 1** - Re-establishment of the baseline condition, both in terms of traffic, air quality and noise to take account of any changes since the previous environmental assessment.
- **Step 2** - Adoption of new policies, best practice updates in terms of new guidance and assessment tools, if any, relating to the traffic modelling, air quality and noise fields.
- **Step 3** - Remodelling the proposed scheme - standard SM-ALR operating regime (70mph, 24 hours a day; seven days a week) in light of the aforementioned changes and if this was still predicted to result in significant adverse environmental impacts, model further operating regimes until a preferred mitigation was identified.
- **Step 4** - If the proposed scheme (operating at 70mph, 24 hours a day, 7 days a week) can not be implemented, in addition to identifying a preferred mitigation, identify the year in which the preferred mitigation would no longer be required i.e. the year it would be possible to operate the proposed scheme without significant adverse environmental impacts.

The following sections provide information on Steps 1 and 2. Further details of the subsequent steps are provided in Chapter 7 – Air Quality and Chapter 8 – Noise and Vibration.

2.3.1 Step 1 - Change in Baseline Conditions

Planned Developments

The traffic model was updated to include a residential development at J28 of the M1. This development is by Taylor Wimpey for a mixture of housing units on Weavers Way and Knitters Road. In view of the fact that this development comprises of sensitive receptors, work was undertaken to plot and include them in the air quality and noise assessments.

Since the previous EAR was completed in February 2014, Sheffield City Council have granted planning permission for an IKEA store around J34 of the M1 in June 2014. The planning permission was for the "erection of a non-food retail unit (Class A1) with ancillary customer restaurant and bistro; and provision of associated car parking, landscaping works, servicing, access and highway works"[1]. Whilst some provision for development in this area was included in the traffic models used for the previous assessment, specific details relating to the IKEA store were not known at the time of the traffic model development work as it pre-dated the planning application. In view of the fact that this development could have potential traffic impacts on the strategic road network, work was undertaken to include additional traffic information on this development in the forecast years.

Base Year

Due to the intervening period between commencement of the previous air quality assessment for the 60mph 7am to 7pm; 70mph all other times operating regime and these investigations, the decision was taken to update the Base Year traffic data for the assessment from 2009/2010 to 2012. Traffic data for an updated Base Year of 2012 has consequently been used for these investigations.

Forecast Assessment Years

The previous traffic related environmental assessments were undertaken assuming the schemes would open for traffic in 2015 thus making its Design year (year 15) 2030. Due to the delays in signing off the aforementioned mitigated operational regime, it is now envisaged that the SM-ALR scheme on the M1 between J28 and 35a would become fully operational in 2017. A revised and more realistic projected Opening Year of 2017 has therefore been adopted for this assessment with a Design Year of 2032.

2.3.2 Step 2 - New and Update Guidance and Assessment Tools

Updates to Value of Time

The values of time (VoT) per vehicle are used in a transport model to influence the way that drivers chose the route between their origin and destination. In May 2014, the latest national forecasts of the Gross Domestic Product (GDP) per person were released following the 2014 budget. As both the forecasts of working and non-working VoT increase in line with real GDP per person, the future year traffic models have been changed to reflect this update. This approach is in line with the standard guidance specified in WebTAG and the values of time used are specified in the WebTAG Databook (May 2014).

Updates to the National Transport Model

Forecasts of road congestion are produced by the DfT's National Transport Model (NTM). The revised national and regional road traffic forecasts were issued in July 2013 and reflect the latest results from the DfT's 'National Transport Model'.

[1] http://publicaccess.sheffield.gov.uk/online-applications/applicationDetails.do?activeTab=documents&keyVal=MN3M84NY09900 – accessed 06/11/2014

As a result of this, and in order to ensure that this environmental assessment was undertaken in line with the latest national guidance specified in WebTAG Unit M4, these revised forecasts have been applied for both Light and Heavy Goods Vehicles (LGV and HGVs).

Table 2-1: Changes in Growth Factors Due to the NTM and VoT Updates

Growth Factors	Vehicle Type	Growth Factors		
		2009 - 2015	2009 – 2025	2009 - 2030
NTM13 (Latest)	LGV	1.085	1.398	1.557
	HGV	0.966	1.036	1.079
NTM11 (Previous)	LGV	1.182	1.544	1.725
	HGV	1.153	1.275	1.332
Adjustment Factor	LGV	0.9186	0.9055	0.9026
	HGV	0.8381	0.8125	0.8099

Table 2-1 highlights the significant reduction in LGV and HGV growth factors between the original and latest NTM growth factors. This is particularly significant for the HGVs which shows an overall drop in demand of around 20% between 2009 and 2030.

Update to Defra's Guidance

Department for Environment, Food and Rural Affairs' (Defra) periodically issue a number of assessment tools for the review and assessment of local air quality. In June 2014, Defra issued its latest update to its Local Air Quality Management (LAQM) assessment tools. These included:

- 2011 based background maps (updated to reflect recent UK wide monitoring);
- Vehicle emission factors v 6.01 in the EFT tool (updated to reflect current and predicted UK vehicle fleets) which allows users to calculate road vehicle pollutant emission rates for NOx, PM_{10}, $PM_{2.5}$ and hydrocarbons for a specified year, road type, vehicle speed and vehicle fleet composition[2]; and,
- NOx to NO_2 conversion factors v4.1 (updated to reflect changes in primary and secondary emissions of NO_2 within the vehicle fleet).

The current air quality assessment has been undertaken using the above listed latest Defra LAQM tools.

[2] http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html - accessed 03/11/2014

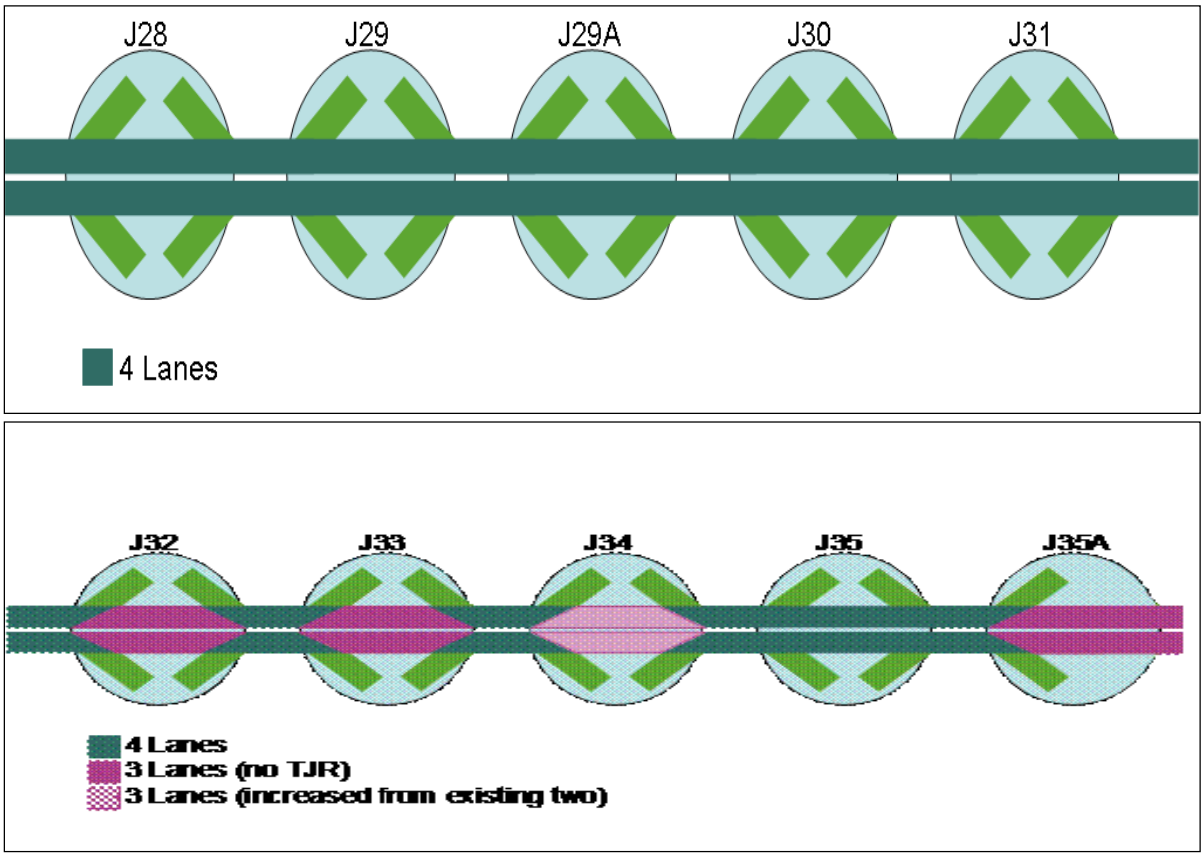
3 The Proposed Scheme

3.1 Proposed Operating Regime

Key elements of the SM-ALR design concept are as follows:

- The hard shoulder on the main line is permanently converted to a controlled running lane.
- Variable mandatory speed limits are utilised.
- Lane specific signalling is only provided at the 'gateway signals and VMSL sign locations and where necessary at intermediate locations.
- Driver information, including mandatory speed limits, is provided at intervals not less than 600m and not exceeding 1500m.
- Queue protection systems are implemented.
- Comprehensive low-light Pan-Tilt-Zoom (PTZ) CCTV coverage is used.
- Emergency Refuge Areas (ERAs) are provided at a maximum of 2500m intervals.

Figure 2: Proposed Scheme Operating Configuration



Within this document, the carriageways will be referenced and considered as running northbound (NB) - J28 to 35a and southbound (SB) - J35a to 28.

The changes to the scheme section as a result of the proposed SM-ALR operating regime are illustrated in Figure 2 and further information on these is provided in Table 3-1.

Table 3-1: Proposed Motorway Configuration

Motorway Section	Proposed Layout
J28	Lane gain / drop at the north facing slip roads.
J28 to 29	Approximately 11km in length - conversion of the hard shoulder to a running lane, with a lane gain/drop at J29.
J29 to 29a	Approximately 6km in length - lane gain / drop at J29a with conversion of the hard shoulder to a running lane.
J29a to 30	Approximately 5km in length - lane gain / drop at J30 with conversion of the hard shoulder to a running lane.
J30 to 31	Approximately 8km in length - lane gain / drop at the south facing slip roads.
J32	Lane gain/drop at the M18 north facing slip roads.
J32 to J33	Approximately 3.9km in length - conversion of the hard shoulder to a running lane, with a lane gain/drop at J33.
J33 to J34 south	Approximately 3.8km in length - lane gain/drop at J33 with conversion of the hard shoulder to a running lane.
J34 south to J34 north	Approximately 2.3km in length - conversion from dual two lane motorway to dual three lane motorway over Tinsley Viaduct.
J34 north to J35	Approximately 3.8km in length - lane gain/drop at J34 north with conversion of the hard shoulder to a running lane.
J35 to J35a	Approximately 3.1km in length - conversion of the hard shoulder to a running lane, with through junction running at J35.
J35a	Lane gain/drop at the merge and diverge.

The lane gain/drop regimes occur at junctions where traffic streams come together or are separated with an associated gain or loss of a traffic lane. Lane gains are included to ensure that joining traffic proceeds ahead in the additional lane without impeding the flow of traffic on the main carriageway and vice versa for leaving traffic with lane drops.

The proposed scheme being assessed is a SM-ALR scheme operating at 70mph, 24 hours a day; seven days a week.

3.2 The Scheme - Key SM-ALR Infrastructure

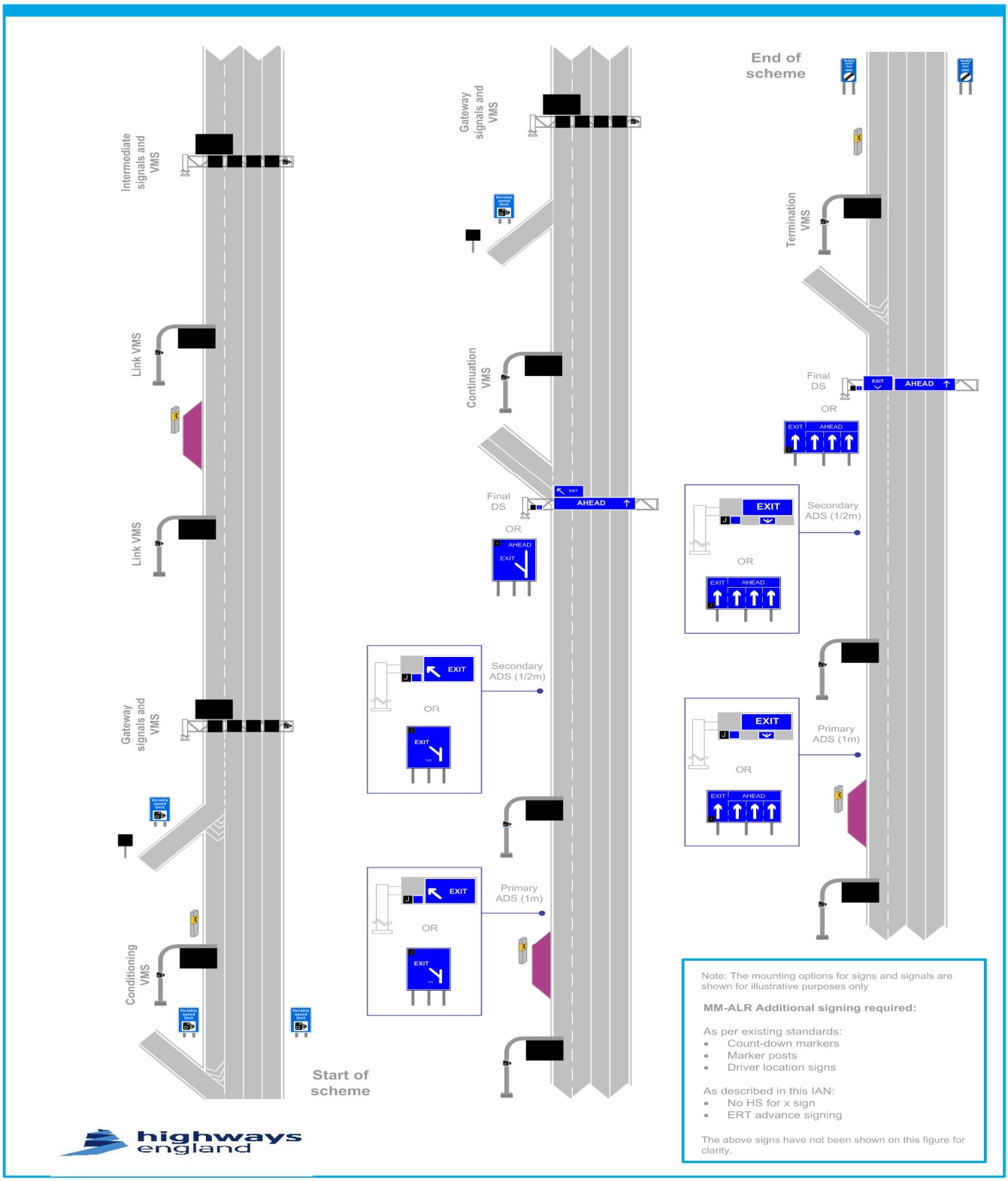
Changes to the physical infrastructure on the M1 between J28 and 35a are fully described in the M1 J31 to 32 VMSL Scheme EAR prepared by Mouchel in October 2013 and the M1 J28 to 31 and the M1 J32 to 35a SM-ALR Environmental Assessment Reports, prepared by Mouchel in February 2014.

Key infrastructure installed as part of a SM-ALR scheme include gantries, ERAs, cantilever message signs and CCTV cameras. Supporting infrastructure include the Highways Agency Digital Enforcement Camera System (HADECS) cameras, advanced motorway indicators, advance direction signs, cabinets and cablings. Table 3-2 provides a brief description of key SM-ALR infrastructure and Figure 3 is an illustration of how these infrastructures are deployed on the motorway.

Table 3-2: Key SM-ALR Infrastructure

Equipment Type	Description
Super-span portal gantries	These generally span both carriageways as a single structure with no “leg” into the central reserve (hence “super-span”). Typically there will be Advanced Motorway Indicators (AMIs), an MS4 and/or Advance Directional Signs (ADS) (See Figure 3) mounted on them. AMIs display speed limits or a red X to indicate if a lane is closed.
Emergency Refuge Areas (ERA)	These measure 100m x 4.6m as indicated in IAN 161/13 and are required to permit vehicles to stop in an emergency without interrupting the flow of traffic in Lane 1. These are constructed within the existing highway verges and will include emergency roadside telephones.
Cantilever Message Signs	These message signs are large panel style signs which will be verge mounted and cantilevered out over the carriageway. The Message Sign MS3 types display a combination of speed limits, pictograms (including lane availability) and text legends whilst the Message Sign MS3 types displays text only and is primarily used for strategic route information.
CCTV cameras (PTZ)	Each camera will also have infra-red lighting. Full coverage of the motorway will be available in the control centre. The height of the CCTV masts will be 15m and would be mounted on separate masts located on foundations, typically in the order of 3m wide x 3m length.

Figure 3: Illustrative drawing of SM-ALR



4 Overview of the Existing Environment

4.1 Introduction

The following sections provide a high level description of the existing environment within which the scheme is situated. It covers the following:

- Location
- Topography
- Land use and transportation pattern
- Air Quality and Noise Planning and environmental designations

It sets the context for the assessments presented in this EAR. The environmental assessment chapters (Chapter 6 to 8) contain detailed description of the environment for the topic being reported.

4.1.1 Location

The M1 between J28 and 35a forms part of a strategic transportation network linking London to Leeds. This section of the M1 provides a link between the Midlands and the North of England and serves inter-city journeys in South Yorkshire, especially between Sheffield and Leeds. From J28 to 35a, the motorway passes through the following Local Planning Authority (LPA) areas:

- North East Derbyshire District Council (NEDDC)
- Chesterfield District Council (CDC)
- Bolsover District Council (BDC)
- Rotherham Metropolitan Borough Council (RMBC)
- Sheffield City Council (SCC)
- Barnsley Metropolitan Borough Council (BMBC)

4.1.2 Topography

The landform around the scheme length varies in elevation and gradient. Adjacent to the motorway at J28 is the settlement of South Normanton, much of it is elevated in relation to the M1. Between Tibshelf Services Area and J29a, the landform becomes more enclosed and the River Doe Lea marks the bottom of a local valley. The eastern slopes are noticeably steeper and continue the elevated landform from the north, accommodating the settlements of Bolsover and Huthwaite, both of which have broad open views to the west. To the west of River Doe Lea, the landform gently rises to a series of local hills ranging between 190-170m Above Ordnance Datum (AOD) between Tibshelf and Heath, just to the south of J29a. Through this stretch, the motorway is typically contained within numerous shallow cuttings or at grade reflecting the local undulations in this more rolling landform.

From Duckmanton (adjacent to J29a) to the north of J31 (Thurcroft), the stretch of the M1 lies on the fringes of a ridgeline. This slope forms the eastern edge of the Rother Valley, a broad landform that incorporates the settlements of Killamarsh and Chesterfield. The landform descends from a series of local high points at approximately 155m AOD to the west, to approximately 50m AOD adjacent to the River Rother itself. The motorway corridor

itself alternates between shallow cutting and broad embankments, particularly to the west, reflecting the local undulations of the valleys slopes.

Around J32, the M1 is generally about 85 - 110 AOD rising on higher ground (130 – 180m AOD) towards J35a around Tankersley. It dips into two valleys defined by the River Rother (Rother Valley) and River Don (Don Valley). These rivers cut across the motorway at J33 and J34 respectively. Around Tinsley, approximately 0.6 miles (1km) of the M1 is elevated on a viaduct.

4.1.3 Land Use and Transportation Pattern

The M1 motorway is a strategic route for regional and local traffic and plays a major role as a national artery providing a direct motorway route between the North and the South of England. As a major inter-urban regional route, it connects the Nottingham area in the south with the Sheffield/Rotherham conurbation to the north and Leeds beyond this. It also forms a strategic link with Hull via the M18 at J32 immediately to the north. It also acts as a major inter-urban regional route connecting two major conurbations – Sheffield and Leeds.

The existing motorway corridor cuts through a largely rural landscape, comprising a mixture of pasture and arable farm methods, interspersed with former mine working operations and settlements. This is particularly evident around J29a, where former mining operations are now giving way to large warehouses and distribution centres. North of J29a, land use is more frequently arable farming and this is particularly noticeable to the far north of the study area, around J31. There are some particular features of note, namely the parkland associated with Hardwick Hall to the east and between J28 to 29, as well as the parkland surrounding Barlborough Hall, which now operates as a school, located to the northeast of J30. Settlements occur throughout the corridor with smaller villages such as Tibshelf and Heath typically occurring to the south of the corridor giving way to larger more nucleated settlements to the north, which include Bolsover, Barlborough and Wales to the north.

The scheme area between J32 and 33 falls within RMBC. It cuts across a rural corridor with the settlements of Upper Whiston and Guilthwaite to the south of the motorway and Morthen and Whiston to the north of the motorway. There is a distinct lack of commercial properties and community facilities between J32 and J33.

Between J33 and 34, the motorway corridor becomes urban east of J33. Around J33 the settlement of Catcliffe can be found to the north of the motorway whilst Brinsworth forms majority of the urban area to the south and southeast of the motorway. Junction 34 is made of two junctions: J34(S) and J34(N) further west. The settlement of Tinsley falls to the north of J34(S) and Wincobank to the south of J34(N). The motorway at Tinsley (from J34(S) to J34(N)) is elevated on a viaduct (Tinsley Viaduct) over River Don, Sheffield and Tinsley Canal and a railway line for approximately 1km. Land use between Catcliffe and Wincobank to the south of the motorway is principally industrial and commercial. The Blackburn Meadows sewage works is located northwest of J34(N). Notable properties between these junctions include the disused Sheffield City Airport, Firth Rixson Aurora sports club, Blackburn Meadows Sewage Works and Meadowhall Shopping Centre. Six schools can be found within 50m of the M1 between J33 and J34, three of these are in Brinsworth and the rest in Tinsley.

Between J34(N) and J35 the motorway falls in Rotherham MBC and Sheffield CC. The settlements of Shiregreen can be found further east of Wincobank separated by Woolley wood. To the north of the motorway, Hill Top and Blackburn make up the urban context with Thorpe Common to the northwest of J35. On approach of J35, land use consists

mainly of parkland and woodland. There is a distinctive lack of commercial / industrial properties along the SB carriageway between J35 and J34.

As with J34, J35 is split into two junctions: J35 and J35a. This section of the M1 is rural with Thorpe Hesley to the north of J35 and Hood Hill northwest of J35a.

The study section of the M1 caters for both strategic and local commuter traffic entering and exiting the afore-mentioned settlements. Interconnecting roads are listed in Table 4-1.

Table 4-1: M1 Interconnecting Roads

M1 Junctions	Interconnecting Roads
J28	A38
J29	A617 and A6175
J29a	A6192
J30	A6135 and A616
J31	A57
J32	M18
J33	A630
J34	A631, A6178 and A6109
J35	A629
J35a	A616

4.1.4 Environmental Designations

Air Quality Management Areas (AQMAs) are declared where the EU limit and Government standards adopted for Nitrogen dioxide (NO_2) and dust particles: particulate matter with an aerodynamic diameter of less than 10µm (PM_{10}) are not being achieved or are in danger of being exceeded. There are nine AQMAs adjacent to the motorway boundary of the proposed scheme length and these have been declared either for exceedence of the annual mean (NO_2) objective or for exceedence of the annual mean (NO_2) objective and dust particles: particulate matter with an aerodynamic diameter less than 10µm (PM_{10}).

There are a total of 34 Defra Noise Important Areas (IAs) along the scheme length proposed for action planning work in Defra's Noise Action Plan.

See **Appendix B**: Figure 4.1- Environmental Constraints Plans for the location of these designations. Further details on these environmental designations are provided in the assessment chapters (Chapters 7 and 8).

There are no other statutory designations in relation to air quality and noise within the study area.

5 The Environmental Assessment Process

5.1 Scoping Process

A scoping exercise undertaken for this assessment concluded that due to the change in traffic data and baseline environment, an update of the noise assessment was required. This EAR therefore covers the environmental assessment of the proposed scheme on air quality and noise during its operational phase.

Update assessments have not been undertaken for the potential air quality and noise impacts of the construction phase as the construction mitigation measures detailed in the October 2013 and February 2014 EARs produced by Mouchel are still considered to be appropriate for the scheme design. At the time of reporting, construction of the scheme was underway and these measures were being implemented.

A whole scale assessment of the potential impact of physical interventions during construction was undertaken as part of the previous environmental assessment and reported in the M1 J31 to 32 Variable Mandatory Speed Limit (VMSL) EAR, prepared by Mouchel in October 2013 and the M1 J28 to 31 and the M1 J32 to 35a Smart Motorway All Lane Running, Environmental Assessment Reports, prepared by Mouchel in February, 2014. An assessment of changes to the physical design of the proposed scheme between J28 and 35a since the 2014 EARs were published has however been undertaken and is presented in Chapter 6.

With regards to the assessment of cumulative environmental effects, there are other road schemes and developments proposed along and in the vicinity of the M1. These have been taken account of in the traffic model which also includes growth factors to account for the future presence and operation of a number of committed developments within the study area. See the M1 J28 to 31 Managed Motorway Traffic Forecasting Report, Atkins, December 2013 and M1 J32 to 35a Managed Motorways Traffic Forecasting Report, Jacobs/AECOM 2013 for further details. As a result of the above, the air quality and noise assessments are inherently cumulative assessments.

5.2 Delivery of the Environmental Assessment

5.2.1 Establishment of the Baseline Environment

The environmental assessment commenced with the identification and review of information relating to known or likely presence of environmental receptors and resources within defined study areas. This was in order to determine their relative value/importance and/or sensitivity towards change.

Desk based data sources have comprised: literature relating to the study area; databases, records relating to environmental designations; national policy documents; historic and current mapping; recent aerial photography; and data from previous environmental studies.

5.2.2 Levels of Assessment

Detailed level assessments have been undertaken for both air quality and noise as previous scoping concluded that the an SM-ALR scheme could result in environmental effect which could be material to the decision-making process. This is in line with DMRB Volume 11 Section 2, Part 1: HA 201/08 and topic specific scoping guidance contained in Volume 11, Section 3.

5.2.3 Impact Identification and Assessment

Impact identification has involved comparison of the existing environmental conditions predicted to exist immediately prior to introduction of the proposed scheme against the conditions that would occur, or be likely to occur, as a consequence of its implementation. Impacts comprise identifiable changes to the environment which may be direct or indirect; short-term/temporary, medium-term, or long-term/permanent; secondary, cumulative and either beneficial or adverse. These are defined in accordance with accepted terminology and standardised methodologies contained in DMRB to predict the order of impact (change) resulting from implementation of the proposed scheme.

5.2.4 Traffic Data Based Environmental Assessments

Traffic data for the environmental assessment was derived from both the Sheffield and Wakefield Area Motorway Model (SWAMM) supplied by Jacobs / AECOM) and East Midland M1 Traffic Appraisal Model (EMM1TAM) supplied by Atkins. This data was supplied for Traffic Reliability Area (TRA); an area considered to have the potential to be significantly and reliably influenced by the proposed scheme. See Figure 4.1 provided in **Appendix B** for the extent of the TRA.

Differences in the traffic model outputs from both traffic models were however noted for the same roads in overlap areas. This had the potential to result in different air quality and noise predictions for the same receptors within these areas. To address this issue, a methodology was prepared by Highways England which led to the production of a hybrid traffic dataset. This was then undertaken by Mouchel in conjunction with the Traffic Modelling Consultants with the hybrid traffic data set reviewed and approved for use by all parties including the Highways England NetServ Environment Group and Traffic Appraisal, Modelling and Economics team and project managers for the previous assessment and this assessment. See **Appendix C** for a report on the rationale and methodology for the creation of the hybrid data traffic forecast for use in this environmental assessment process and to support environmental inputs into the WebTAG appraisal process.

Traffic data was provided for the Base Year (2012), the projected Opening Year (2017) and Design Year (2032). This has been used as the basis for modelling the proposed scheme's environmental effects on air quality and noise. Traffic data used for this air quality and noise assessment is provided in **Appendix C.**

It is worth noting that DMRB Volume 11 requires assessments using traffic data to be carried out for the Do Minimum (DM - without the scheme) and Do Something (DS - with scheme) scenarios, for the Opening Year and possibly a further future year. As the SM-ALR scheme is proposed to the M1 between J28 to 35a, a Do Nothing scenario has been assessed as opposed to a DM scenario. The DN excludes traffic generated by the proposed scheme whilst the DS Scenario includes traffic generated by the scheme. The use of a DN scenario ensures a better reflection of the baseline in the absence of the SM-ALR scheme between J28 and 35a.

6 Design Changes

6.1 Design Change Overview

There have been changes to the design of the proposed scheme since the environmental assessment were undertaken in February 2014. These changes have primarily been as a result of new information on ground conditions in the detailed design stage and changes to standards. An assessment of these design changes has therefore been undertaken to ensure the conclusions of the previous environmental assessment of non-traffic related environmental effects remains valid.

As part of the detailed design stage, changes with a potential to result in environmental effects have been subject to environmental assessment. Where proposed infrastructure have moved greater than 10m from their previous locations or new equipment is proposed, an environmental assessment of the potential effect of this change and an evaluation of the overall significance of this change on relevant environmental topics has been undertaken. A distance of 10m has been adopted for the environmental assessment of change as the environmental assessment of proposed infrastructure are conducted for approximate locations with a 10m capture of significant sensitive and potential impact. Outside this limit, an assessment of change is required.

The change assessment has focused on visual effects and ecology as potential effects to cultural heritage assets and water features by the changed locations of proposed equipment or new equipment are not expected. This is due to the small scale working area of works, restriction of works to the motorway corridor and adoption of mitigation measures outlined in the previous EARs with respect to these environmental topics.

In light of this, the followings changes to the design have been assessed:

- Change to the location of 10 Temporary Traffic Management Signs (TTMS);
- Change to the location of 15 PTZ CCTV and installation of 39 PTZ CCTV;
- Installation of an additional MS4 gantry at MP226/8+34A,
- Change to the location of 4 Enforcement Aspect Verification (EAV) cameras; and,
- Installation of 138 Side Fire Radar (SFR).

Appendix A contains a log of the new equipment locations and **Appendix E**, Figure 1 contain drawings which show the marker post references along the scheme length.

6.1.1 Side Fire Radar

SFR are now to be installed instead of a Motorway Incident Detection and Automatic Signalling (MIDAS) Loop System. SFR like MIDAS loops serve to ensure a better flow of traffic by sending traffic statistics (traffic volume and classification, average speed, individual vehicle speed, lane occupancy and presence) which are utilised for automatic signal setting, queue protection, congestion settings, incident detection, vehicle counting and ramp metering facilities. SFR sensors are typically mounted on masts 7.5m to 14m high (depending on the local terrain and coverage requirements) within the motorway soft estate. These are set back approximately 0.6m to 1.5m from the back of the kerb. The total footprint for the installation of a SFR mast is approximately 25m^2 including the temporary works area.

6.2 Visual Effects

6.2.1 Temporary Traffic Management Signs

By their nature the proposed TTMS signals are small scale and although they contribute to a sense of clutter within the corridor where they are associated with other pieces of infrastructure, their relative size and orientation means that they are not anticipated to give rise to a significant visual effect either in isolation or in combination with other infrastructure.

6.2.2 Closed Circuit Television

The inclusion of the CCTV masts to ensure 100% coverage of the corridor would introduce frequent elements within the context of the existing motorway infrastructure including the assessed SM elements. Majority of these proposed locations are isolated and although taller than the majority of existing roadside vegetation do not represent a significant built structure and impacts are limited to a slightly enhanced awareness of the corridor.

Significance of effect ratings assessed for the inclusion of the CCTV masts have concluded that none of the proposed locations would result in a significant visual effect. Two locations (MP240/0+6A and 226/8+34B) are associated with proposed gantries and as such have the potential to increase localised effects in combination with the gantries – however the assessment has concluded that the significance of effect ratings would be likely to remain as **slight adverse**.

The location of the CCTV masts have been carefully sited to reduce potential impacts on areas considered to be highly sensitive to change including Hardwick Hall. Mitigation measures employed have included reducing the height of masts where appropriate and specifying a colour for the metalwork, to help to integrate the masts into the existing landscape framework.

6.2.3 Gantry relocation

The relocation of gantry G1-13 from MP226/8+64 to 226/8+34 would place the gantry on the edge of the existing roadside planting within the NB verge. This would result in the gantry being marginally more visible from properties to the west on Mill Lane and from Stainsby to the north-west.

To the east and from the Stainsby Mill complex, the proposed relocation of the gantry would move the potentially intrusive element to the south although awareness is likely to remain and impacts are comparable with the original location. In line with the mitigation strategy agreed with the National Trust during the previous assessment, this gantry will be subject to the colour strategy to reduce its visual prominence.

The resulting impact however has to be considered within the context of the removal of an existing MS3 therefore the magnitude of impact would be no greater than minor and the resulting significance of effect **slight adverse**.

6.2.4 Enforcement Aspect Verification Cameras

The proposed changes to the locations of the EAV cameras would in the main not result in any new and significant adverse effects on visual receptors. The locations being set some distance or viewed within the context of the existing motorway corridor. The cameras themselves are not considered significant structures and occur within the context of the proposed gantries which are more likely to form the main focus of any views.

A single EAV location at MP262/1+48B has the potential to result in noticeable effects on residential receptors that exist immediately adjacent to the motorway corridor. For operational reasons the EAV cannot be located to an alternative site within this link. The

operational distance limits of the EAV camera from the gantry have been reviewed and movement of the EAV is constrained by the minimum distance required to the gantry and the existing bridge structure to the north. The existing narrow belt of vegetation that currently provides a foil to views of the traffic is susceptible to changes and as part of the mitigation strategy every effort should be made to minimise vegetation loss in order to retain this in situ.

6.2.5 Side Fire Radar

As isolated structures the SFR locations are not expected to give rise to a significant visual effects and this is the case for the majority of the corridor.

There are a number of stretches of the corridor with greater sensitivity either as result of visual (residential) receptors being adjacent to the corridor or views from heritage resources. Within the vicinity of the historic landscapes associated with the estates of Hardwick, Sutton Scarsdale and Barlborough there was the potential for a marginal increase in the visual awareness in association with other infrastructure positions however the relative distance and the presence of the existing motorway corridor and its associated existing mitigation planting suggests that the magnitude of impacts would be no greater than **negligible** and the resulting visual effects would not be considered significant.

There are several locations where, in combination with other proposed infrastructure elements such as gantries there is the potential for a marginally greater awareness of the newly constructed elements within views from sensitive locations although it is not anticipated that these would increase the significance of visual effect greater than the previously assessed effects. Three SFR poles immediately north of J34 (MP261/9+72A, 262/4+14A and 262/8+78B) would be subject to near distant views from numerous properties on Droppingwell Road, Baring Road, Thundercliffe Road and Barber Wood Road. These however would not represent a significant change in view when taking into account proposed gantries and existing views onto the motorway corridor. The proposed SFR locations would not pose any change to the assessment or any significant visual effects.

6.3 Ecology and Nature Conservation

6.3.1 Closed Circuit Television, EAV Cameras and Temporary Traffic Management Signs

New and relocated PTZ CCTV, EAV cameras and TTMS would not require land take outside of the Highways England soft estate. Given the scale, extent and temporary nature of works there would be no impacts to designated sites.

Habitats suitable for breeding birds and reptiles have been identified at a number of the CCTV PTZ, EAV cameras and TTMS locations. Adoption of mitigation measures with respect to breeding birds and reptiles identified in the previous SM EARs of February 2014 would ensure no significant adverse effects on these species.

6.3.2 Relocated Gantry

The relocation of proposed Gantry G1-13 from MP226/8+64 to 226/8+34A is not expected to have additional adverse effects on sites designated for their ecological value as construction works are restricted to the motorway verge. No additional adverse effects are expected to protected species.

Habitats suitable for reptiles and breeding birds have been identified at this location. Following mitigation measures detailed in Table 8.6 and 8.7 of the M1 J28 to 31 Smart Motorway Scheme Environmental Assessment Report (Mouchel, February 2014),

additional adverse effects over and above those identified in the previous EAR are not expected.

6.3.3 Side Fire Radar

One SFR (MP241/1+20A) is to be located within 500m of a waterbody known to support a great crested newt (GCN) population. This pond was surveys as part of the ecological assessment and the findings of these surveys (medium sized GCN population, approximately 200m from Highways England's boundary) were reported in the M1 J28 to 31 SM GCN Survey Report December 2012. At this location there is the potential that individual GCN may enter Highways England's verge and be killed or injured during construction once the soil has been disturbed or if materials are stored on the verge that may provide shelter. A European Protected Species licence for the development has been acquired for the proposed works in this area and appropriate GCN mitigation measures are being followed. With the implementation of suitable mitigation measures and appropriate licensing of works relating to GCNs, no additional impacts or effects are expected to GCN at this location.

Two proposed SFR are located in close proximity to areas of high bat activity:

- SFR MP 221/4 +05A – Tibshelf and Teversal Railway Underbridge MP221/4+30
- SFR MP 245/0+07B – High House Farm Underpass MP244/9+90

There is the potential for disturbance of areas used by foraging and commuting bats during construction of SFR at these locations. However, works are of temporary and commuting routes are unlikely to be severed permanently. With the implementation of bat mitigation measures in Table 8.7 of the M1 J28 to 31 EAR, February 2014, no additional adverse effects are expected to this species.

The introduction of SFR technology into the motorway verge at MP266/9+34A and MP267/1 +144A would take place within a section of narrow verge adjacent to Hesley Wood and Chapeltown Park Sheffield Local Wildlife Site (LWS). Key features of this LWS are ancient and semi-natural broad-leaved woodland. See Figure 4.1 for the location of these sites. Although works to construct the SFR would be restricted to the Highways England's verge and would not encroach into the LWS land, the removal of overhanging wooded vegetation from the LWS in the motorway verge may be required. This is not expected to impact on the integrity of this LWS and all efforts will be made by the Contractor to avoid removing overhanging vegetation.

The remaining SFR are not anticipated to result in any adverse impacts on any sites designated for their ecological value. The works are restricted to Highways England's soft estate, are of limited scale and extent, and are temporary, impacts to designated sites are unlikely. Habitats suitable for breeding birds and reptiles have been identified at a number of the SFR locations. Following mitigation measures detailed in the previous EARs prepared by Mouchel in, February 2014, adverse effects over and above those identified in the said EARs are not expected.

6.4 Summary

There have been a number of changes to the scheme design principally as a result of new information on ground conditions and changes to standards. These changes have been assessed where new equipment are proposed or when equipment is to be relocated to distances greater than 10m from their previous locations.

In light of this, an assessment of these design changes has been undertaken to ensure the conclusions of the previous environmental assessment of non-traffic related

environmental effects remains valid. This assessment has concluded that the changes to the design are still within the magnitude of impacts identified within the February 2014 EARs. Adoption of mitigation measures detailed with the February 2014 EARs would serve to ensure these changes do not result in significant adverse ecological effects.

The introduction or movement of equipment in new locations would result in the introduction of new visual elements where there are open view to the motorway corridor. However in the context of the motorway corridor this is not expected to result in significant adverse visual effects.

7 Air Quality

7.1 Background and Focus of the Assessment

The following summarises the timeline and rationale of the assessment and development of air quality mitigation for the proposed SM-ALR scheme along the M1 from J28 to 35a.

- **February 2013** – Air quality assessment in line with contemporary air quality guidance predicted that operating an SM-ALR scheme with an Opening Year of 2015 on the M1 between J28 and 31 and between J32 and 35a at 70mph, 24 hours a day, seven days a week, would result in significant adverse impacts on air quality. As a result, the proposal was put on hold and options for mitigation were investigated.
- **July 2013** – An options investigation workshop was held with representatives from Highways England and Mouchel's design team. This concluded that Controlled Motorways (**Option 1**), SM-ALR at 50mph between 7am and 7pm (**Option 2**) or 60mph between 7am and 7pm (**Option 3**) speed control interventions should be investigated further.
- **August to September 2013** – **Option 1** was dropped as it did not offer the additional capacity required along the scheme length. Scenario testing of traffic and air quality screening for SM-ALR operating at 50mph between 7am and 7pm, 7 days a week, 70mph all other times (**Option 2**) and SM-ALR at 60mph 7am to 7pm, 7 days a week; 70mph all other times (**Option 3**) were subsequently agreed with Highways England.
    - **Option 2**: SM–ALR at 50mph (between 7am and 7pm, 7 days a week and 70mph all other times) predicted 6-15% reduction in flows on the motorway but displaced traffic onto wider road network, principally within Air Quality Management Areas (AQMAs[3]). There was also significant concerns over viability of Business Case. This option was dropped.
    - **Option 3**: SM–ALR at 60mph (between 7am and 7pm, 7 days a week, and 70mph all other times) indicated a general stabilisation of traffic volumes, constraining flows to, at, or in some cases below, the predicted scenario without this proposal, hence suggesting no additional significant adverse air quality impacts. Initial testing indicated Business Case still viable. This option progressed to Simple Assessment for local air quality impacts.
- **October 2013** – Opening Year (2015) and Design Year (2030) air quality Simple Assessment utilising 22 receptors in the Tinsley area as a 'worst case' proxy for an SM-ALR operating regime of 60mph 7am to 7pm; 70mph all other times, was completed. The decision to proceed to Detailed Assessment was agreed with Highways England as the Simple Assessment indicated that this mitigated operating regime was unlikely to result in significant adverse local air quality impacts.
- **November 2013** – utilising Highways England's interim advice on air quality long term trend and significance guidance findings for 2015 Opening and 2030 Design

[3] Air Quality Management Areas (AQMAs) are declared where the EU limit and Government standards adopted for Nitrogen dioxide (NO_2) and dust particles: particulate matter with an aerodynamic diameter of less than 10µm (PM_{10}) are not being achieved or are in danger of being exceeded.

Years indicated no significant adverse air quality impacts with the proposed mitigated operating regime.

- **February 2014** – Two Environmental Assessment Reports (EARs) were published by Mouchel for SM-ALR between M1 J28 and 31 and between M1 J32 and 35a under the identified mitigated operating regime. These were subject to the Highways England's Determination process. The Notices of Determination were published on the 6th of February 2014 and subsequently concluded without challenge by the end of March 2014.
- **July 2014 -** The SoS for Transport tasked Highways England with investigating an alternative to mitigate the predicted significant air quality impacts along the scheme length as opposed to the identified mitigated operating regime (60mph 7am to 7pm; 70mph all other times).

Mouchel was subsequently instructed by Highways England to rigorously investigate alternatives and progress the preferred solution through its Determination Process whilst construction of the scheme progressed during the next 12 – 18 months.

As outlined in Section 1.1, an assessment of the potential impact of physical interventions during construction was undertaken as part of previous environmental assessments and reported in the M1 J31 to 32 Variable Mandatory Speed Limit (VMSL) EAR Mouchel, October 2013, the M1 J28 to 31 SM-ALR, EAR and M1 J32 to 35a SM-ALR, EAR, both produced by Mouchel in February 2014. The potential air quality impact of the proposed SM-ALR scheme during its construction phase has not been repeated as there have been no changes in the proposed scheme's physical design that could result in significant air quality impacts during construction.

The air quality assessment therefore focuses on changes to local and regional air quality resulting from changes in traffic speed, flow and volume and invariably traffic emissions caused by the proposed scheme once operational. This is assessed from the impact of the proposed scheme on the concentration of nitrogen dioxide (NO_2) and particulate matter (PM_{10}); key acknowledged air pollutants associated with road traffic. The assessment is based on the proposal to operate the M1 between J28 and 35a as a standard SM-ALR scheme (70mph 24 hours a day, 7 days a week).

Full details of the air quality assessment is presented in **Appendix D**: Air Quality Assessment Technical Report.

7.2 Regulatory / Policy Framework

The following regulations and policies have been considered key to aid with this assessment. Further details are provided within **Appendix D**.

7.2.1 European Directives and National Legislation

- European Clean Air for Europe Directive 2008/50/EC and UK 2010 Regulations – contain air quality limit values established by the European Union for the protection of human health, vegetation and ecosystems.
- Air Quality Strategy for England, Scotland, Wales and Northern Ireland and Air Quality (England) Regulations 2000 and Air Quality (England) (Amendment) Regulations 2002 – define the standards and objectives for each of a range of air pollutants.
- The Environment Act 1995 – places a duty on local authorities to review and assess air quality in their area, a cornerstone of the LAQM system.

Air quality objectives included in the Regulations and current legislation relevant to the study area for NO_2 and PM_{10} are outlined in Table 7-1.

Table 7-1: Air Quality Strategy Objectives Regulations' Objectives and 2008/50/EC Limit Values for the Pollutants of Relevance to the Current Assessment

Pollutant	Objective/ Limit Value	Measured as	Date to be achieved by and maintained thereafter	
			Air Quality Strategy (AQS)	2008/50/EC
NO_2	200µg/m³; Not to be exceeded more than 18 times per year	1 Hour Mean	31-Dec-05	1 January 2010
	40µg/m³	Annual Mean	31-Dec-05	1 January 2010
PM_{10}	50µg/m³; Not to be exceeded more than 35 times per year	24 Hour Mean	31-Dec-04	1 January 2005
	40µg/m³	Annual Mean	31-Dec-04	1 January 2005

The UK air quality objectives for the protection of vegetation set in relation to NO_x is shown in Table 7-2.

Table 7-2: Air Quality Objectives and Limit Value for the Protection of Vegetation Set in Relation to NOx

Pollutant	Measures as	AQS / Limit value
NO_x	Annual Mean	30µg/m³

7.2.2 National Policy

The following national policy documents set out the government's policy on planning and the decision making considerations (including policies relating to air quality) for proposed development:

- National Planning Policy Framework (NPPF, 2012) - Paragraph 124 of the NPPF states that "*Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas (AQMAs) and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in AQMAs is consistent with the local air quality action plan.*"
- National Networks National Policy Statement (NN NPS 2014) - takes into consideration the requirements of the reporting of air quality to the European Commission and sets the policy direction for compliance with the EU Air Quality Directive and significance for air quality impacts. As all projects with impacts on air quality have the potential to affect the UK's compliance with the EU Air Quality Directive, an assessment of the proposal has been undertaken in the context on the NN NPS.

7.3 Methodology

Concentrations of pollutants and their associated health impacts are dependent on traffic composition and density, climatic conditions, vehicle travelling speeds, road layout and the proximity of the road to sensitive receptors.

This section outlines the method of assessment undertaken to determine the potential local and regional air quality impacts caused by the proposed scheme. The methods adopted for the assessment have principally been based on the guidance provided in DMRB Volume 11, Section 3, Part 1 (HA 207/07), IAN 170/12, IAN 174/13, IAN 175/13, WebTAG[4] and the Local Air Quality Management Technical Guidance 2009 (LAQM.TG(09)). See **Appendix D** for further details.

Information gained during consultation undertaken as part of the previous environmental assessment has informed this assessment along with the following data:

- Updated traffic data
- Relevant receptor locations (residential properties, hospitals, schools and care homes)
- Background NO_x, NO_2 and PM_{10} concentrations
- Local pollutant monitoring results
- Representative meteorological data

7.3.1 Local Air Quality Assessment

Changes in local traffic flow characteristics resulting from the operation of the proposed scheme may potentially impact on air quality. The quantity and composition of vehicle emissions is dependent on the type of fuel used, engine type, size and efficiency, vehicle speeds and the type of abatement equipment employed.

The main pollutants of health concern from road traffic exhaust releases are NO_2 and PM_{10} since these pollutants are most likely to approach their respective air quality objectives in proximity to major roads and in congested areas. These two pollutants have therefore been considered within this assessment.

A review of the relevant local authority updating and screening assessment and progress reports revealed that local ambient concentrations of the remaining pollutants identified within the AQS, carbon monoxide (CO), benzene, 1,3-butadiene and sulphur dioxide (SO_2) within the study area were well below air quality objectives and EU limit values within the relevant LPA areas. These were therefore scoped out of this assessment.

The Local Air Quality Assessment included:

- Detailed air quality dispersion modelling.
- Application of Long Term NO_2 Trends Gap Analysis and determination of Significance and Compliance with a risk assessment.
- Ecological Assessment (Designated Sites).

The assessment has considered the following scenarios:

- Baseline Year / Model Verification – 2012: considers measured pollutant levels and traffic characteristics in the study area.

[4] https://www.gov.uk/government/publications/webtag-tag-unit-a3-environmental-impact-appraisal-november-2014

- Do Nothing (DN) future baseline – 2017: takes into account the predicted traffic flow in the TRA assuming that the proposed scheme does not proceed.
- Do Something (DS) Opening Year with proposed scheme in 2017: takes into account the predicted traffic flow in the year of opening assuming that the proposed scheme is constructed.

The Local Air Quality Assessment considers the number and location of receptors subjected to a potential change in air quality against the UK AQS Objectives in the afore-listed scenarios. Changes in local traffic flow characteristics resulting from the operation of the proposed scheme has the potential to impact on air quality at properties near to roads. Particular attention is paid to the locations of the young, the elderly and other susceptible populations, such as schools, care homes and hospitals (sensitive receptors).

Local and Project Specific Monitoring Data

As part of the previous air quality assessment, consultation in regards to local monitoring data (diffusion tubes and continuous monitors) was undertaken with the LPAs through which the scheme passes (listed in Section 4.1.1) as well as Ashfield District Council (ADC), Broxtowe Borough Council (BrDC), Erewash Borough Council (EBC) and Wakefield Metropolitan Borough Council (WMBC). These make up the local authorities within the air quality study area. Monitoring data used in the assessment from each of these local authority was therefore collated to account for baseline conditions in 2012, rather than 2009 used in the previous EARs and to re-verify the model.

Both continuous monitors and NO_2 diffusion tube sites with greater than 75% data capture and representative locations within the study area have been used to inform the air quality assessment and verify the dispersion modelling results. Where local authority data was lacking, monitoring data collected on behalf of Highways England was also evaluated and used where appropriate. Details of the locations of monitoring sites used in the assessment are presented in the Air Quality Technical Report provided in **Appendix D**.

Background NO_x, NO_2 and PM_{10} Concentrations

Defra background maps have been produced for a Base Year of 2011, with the concentration calibrated against monitoring data collected in that year.

The NO_x backgrounds were converted to NO_2 using Defra's 'NO_2 Background Sector Tool (v4.0)'. The main components relating to road traffic that were explicitly modelled have been removed, to avoid double counting of those road emissions (i.e. the motorway). The same components were also removed from the PM_{10} background concentrations in the assessment years.

Traffic Data

As outlined in Section 5.2.4, traffic data used for the air quality assessment, 2012 (Base Year), 2017 (Opening Year) and 2032 (Design Year), was derived from both the SWAMM model and the EMM1TAM model for a TRA. **Appendix B**, Figure 4.1 shows the extent of the TRA.

Due to differences in traffic flow predictions in overlapping areas in the EMMITAM and SWAMM traffic models, a hybrid data set was generated for the environmental assessment. The methodology provided by Highways England for the generation of the hybrid traffic data set is presented in **Appendix C**.

Traffic data was provided for the following parameters for each road link for the Base, Opening and Design Years:

- Annual Average Daily Traffic flow (AADT);
- Annual Average Weekday Traffic flow (AAWT);

- Annual Average Weekend Traffic;
- Percentage Heavy Duty Vehicles (HDV); and
- Vehicle speed (kph).

Traffic data was also provided for peak and off peak weekend and weekday time periods listed in Table 7-3. This took the form of hourly flow, percentage HDV and average vehicle speed for each time period. The provision of this detailed information to be included in the air quality dispersion model allows for a more representative assessment of traffic impact assessments. Any traffic data on roads at the edge of the TRA considered unreliable by the traffic consultants were not included within the detailed air quality modelling.

Table 7-3: Annual Average Weekday and Weekend Time Periods used in the Assessment

Traffic Period	Time Period
AM Peak (AM)	07:00-09:00
Inter-Peak (IP)	09:00-15:00 and 18:00-19:00
PM Peak (PM)	15:00-18:00
Off Peak (OP)	19:00-07:00

Representative Meteorological Data

Meteorological data from Watnall and Robin Hood Airport, the nearest suitable data source for 2012, has been used in the assessment. This year corresponds to the availability of monitoring data, and allows for verification of modelled outputs with the meteorological data for 2012. The predominant wind direction is from the south to westerly quadrant and is associated with the highest wind speeds. The 2012 wind roses from Watnall and Robin Hood Airport are shown in **Annex 4** of the Air Quality Technical Report provided in **Appendix D**.

Relevant Sensitive Receptors of Public Exposure

Relevant receptors (residential, hospitals, schools and care homes) within 200m of the road links which meet the DMRB HA 207(07) air quality affected links criteria were identified using the Ordnance Survey's (OS) Address Layer 2 dataset[5]. Detailed air quality modelling was undertaken to calculate concentrations at the façades of these specific locations.

Long Term Nitrogen Dioxide Trends

Defra issues guidance on future NO_2 emission trends[6]. In April 2012 Defra published a report[7] to address concerns that background concentrations and vehicle emissions were not reducing with time at the rate estimated in LAQM.TG(09). In line with this new report, a review of monitoring data provided by the LPAs was undertaken to identify recent trends in NO_2 concentrations to determine if recent changes in background concentrations follow the annual trends identified in LAQM.TG(09), or confirm the findings of the Defra report[8].

Defra's April 2012 report indicates that it may be appropriate to use a combination of assumptions about both background concentrations and emissions factors where both

[5] http://www.ordnancesurvey.co.uk/oswebsite/products/os-mastermap/address-layer-2/index.html
[6] LAQM Technical Guidance TG(09).
[7] Defra (2012). Note on projecting NO_2 Concentrations.
[8] Defra (2011) Trends in NO_x and NO_2 Emissions and Ambient Measurements in the UK.

background and roadside monitoring data do not appear to be declining. These can then be used to adjust future projected concentrations based on the methods contained in LAQM.TG(09), essentially forming a 'gap analysis' to assess future concentrations more conservatively and in-line with the average national trends in monitoring data that have been observed. The projection gap analysis factors may then be applied to the modelling results to assess the likely maximum predicted concentrations for future years for a more realistic view of prevailing conditions.

In response to this Defra report, Highways England issued IAN 170/12 which provides supplementary advice to users of DMRB Volume 11, Section 3, Part 1 (HA 207/07) on how to adjust verified modelled NO_2 concentrations to account for the long term NO_2 profiles. The methodology is outlined in IAN 170/12v3 together with supplementary information[9] identified in Section 3 of that IAN and presented in **Annex 3** of the Air Quality Technical Report **(Appendix D**) was used in this assessment.

Dispersion Model Verification (Including Assumptions and Limitations)

Detailed modelling was undertaken with advanced dispersion model; ADMS-Roads (Version 3.2) for the Base Year (2012) and DN and DS scenarios in the Opening Year. The main input parameters of the detailed modelling undertaken include:

- The Emissions Factors Toolkit (Version 6.0.1) has been used to calculate vehicle emissions based on vehicle fleet composition, traffic speeds and road type for the different time profiles.
- Meteorological data from Watnall and Robin Hood Airport (see **Annex 4** of the Air Quality Technical Report provided in **Appendix D**).
- All road links were set at ground level. Variations in dispersion associated with the motorway link locations were considered in the verification exercise to improve performance of the model under these circumstances.

There are many components that contribute to the uncertainty of air quality modelling predictions. Dispersion models rely on the output from traffic models, which themselves have an inherent uncertainty. There are additional uncertainties associated with vehicle fleets in the study area conforming to a national or regional composition; emissions per vehicle correspond to those factors published by Defra; meteorological conditions at the study area are the same as those at the location from which the data was derived; and that the dispersion of pollutants conforms to the algorithms utilised in the model. Road geometries and road widths were established in accordance with a model setup note[10] provided by Highways England. Consequently, an important stage in the process is verifying model results against real measurements, as this allows the combined uncertainties in the model to be evaluated.

Verification of the model was undertaken against measured concentrations. See **Appendix D**, **Annex 5** for a baseline year where predicted emissions concentrations can be compared against real monitoring data. Traffic data for 2012 used for the scheme Base Year (2012) were modelled using an appropriate meteorological data set with monitoring data obtained from national and local monitoring programmes. Predictive modelled NOx and NO_2 concentrations for 2012 were compared with the available monitoring data, and model verification was undertaken following guidance detailed in LAQM.TG (09). The

[9] Note on Highways Agency's Interim Alternative Long Term Annual Projection Factors (LTTE6) for Annual Mean NO_2 and NO_x Concentrations Between 2008 and 2030.

[10] HA PSF Technical note Ref SMDH-M1j39-42-030-TN002-V2

model verification factors calculated for the Base Year (2012) were applied to the projected Base and Opening Year (2012 and 2017) results.

The model verification review identified geographical locations where application of individual adjustment factors were required to align the modelled and measured concentrations. Seven verification zones were identified and are discussed in detail in the Air Quality Technical Report provided in **Appendix D**.

In the absence of sufficient PM_{10} data for verification, the road NO_x adjustment was applied to the modelled road PM_{10}. Further details on the model verification and adjustment procedures followed are provided in **Annex 5**, **Appendix D**.

7.3.2 Ecologically Sensitive Receptors (Designated Sites)

There was a single Site of Special Scientific Interest (SSSI) (Bogs Farm Quarry) that meets the DMRB HA 207/07 paragraph 3.13 qualifying criteria lying within 200m of the scheme length. Broadleaved, mixed and yew woodland habitats are Nitrogen (N) sensitive and have been assigned a critical load for N-deposition. The site location of this SSSI is shown in Figure 4.1.

Adjusted modelled NOx at designed site in the Base and Opening Year scenarios (DN and DS) were compared to the limit value for vegetation of (30µg/m^3).

Nitrogen deposition (N-deposition) rates have been derived by calculating the road NO_2 dry deposition rate using verified annual mean NO_2 concentrations and adding this to 5km x 5km square average N-deposition rate from UK Air Pollution Information System (APIS)[11].

7.3.3 Presentation of the Local Air Quality Assessment Results

Evaluation of Significance

When promoting schemes, under the EIA Directive[12], an assessment of the likely significant environmental effects of public and private projects must be conducted on the basis of appropriate information supplied by the developer.

The publication of the NPPF on the 27th March 2012 (paragraph 124) updated the framework for the consideration of air quality in planning. As a consequence of the NPPF, Highways England provided advice on the use of an evaluation process to inform the consideration of any significant air quality effects that may be attributable to a scheme to help inform the decision making process. The NN NPS published in December 2014, in paragraph 5.12 reiterates the weight that should be given to significant air quality impact in relation to EIA, after taking into account mitigation.

This assessment was undertaken in accordance with the Highways England's IAN 174/13. Evaluation of Significant Local Air Quality Effects; for users of DMRB Volume 11, Section 3, Part 1(see **Appendix D**). This approach requires the focus to be on any receptor already in, or with the potential to be in, exceedence of air quality objectives likely to be affected by the scheme. The methodology requires the assessor to determine whether the scheme results in improvements; no change; or worsening of any existing exceedences; or worsening at a receptor creating a new exceedance.

The methodology requires the assessor to determine whether a scheme results in improvements; no change; or worsening of any existing exceedences, how many receptors

[11] UK Air Pollution Information System (APIS). www.apis.ac.uk – accessed 12/12/2014.

[12] EIA Directive - European Directives (85/337/EEC and amended 97/11/EC) http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31985L0337:EN:HTML

will be affected, the magnitude of change and the number of properties constituting a significant effect.

The methodology then requires a professional judgement as to whether the impact of the proposed scheme is significant or not. Guideline bands for determining significant (upper level) and non-significant (lower level) local air quality effects outlined in IAN 174/13 are presented in Table 7-4. Further result analysis and professional judgement is required if counts for a given band lie within the given range.

It is worth noting that only receptors predicted to experience a change of >0.4µg/m^3 (least perceptible change) are taken account of in the significance assessment. It is also worth noting that the significance receptor numbers are aggregated i.e. any receptor experiencing 2µg/m^3 or more magnitude of change above or below the annual average also experience >0.4µg/m^3 change and are therefore accounted for within the lower threshold/s.

Table 7-4: Guideline Bands used in Determining the Significance of Local Air Quality Effects

Magnitude of Change in Annual Average NO_2 or PM_{10} (µg/m^3)	Total Number of Receptors with:	
	Worsening of air quality objective already above objective or creation of a new exceedence	Improvement of an air quality objective already above objective or the removal of an existing exceedence
Large (>4)	1 to 10	1 to 10
Medium (>2)	10 to 30	10 to 30
Small (>0.4)	30 to 60	30 to 60

Risk Assessment of Compliance

The NPPF gives consideration to local air quality and informs the competent authority that policies should sustain compliance with the EU Directive on ambient air quality and clean air for Europe (2008/50/EC), and national objectives for pollutants.

Highways England provided guidance for the assessment of compliance in IAN 175/13. This IAN is to be used in combination with the Defra's National Compliance reporting, consequently providing advice to decision makers. Pollutant Climate Mapping (PCM) datasets provided by Ricardo-AEA on 01/12/2014 for Highways England's compliance risk assessments have been used. PCM road links form a network used to determine compliance with the EU Directive.

Where a proposed scheme is provisionally judged to be at high risk of non-compliance with the EU Directive, guidance is provided on the production of a Scheme Air Quality Action Plan (SAQAP), which contains the relevant mitigation actions required in reducing the risk of non-compliance. The SAQAP may also be developed to support schemes identified as having a significant air quality impacts as set out in IAN 174/13.

The NN NPS published in December 2014 also requires consideration of the UK's compliance with the Air Quality Directive before consent is granted to road schemes with the potential to impact on air quality.

7.3.4 Regional Emissions Assessment

The DMRB assessment of the contribution of the proposed scheme to regional emissions is based on the total annual emissions of pollutants over the study area. The pollutants considered are total hydrocarbon (HC), NO_x and PM_{10} and carbon dioxide (CO_2).

The DMRB regional assessment calculation uses the traffic characteristics and road length for each link in the traffic network area. Total annual emissions for the Base Year (2012), DN and DS scenarios for the Opening Year (2017) and Design Year (2032) are determined.

7.3.5 WebTAG Assessment

A WebTAG Local Appraisal was undertaken with reference to guidance contained in TAG Unit A3 Environmental Appraisal, November, 2014.

7.4 Study Area and Baseline Environment

7.4.1 Study Area

The study area for assessing the operational effects of the scheme was determined by the traffic network considered to have the potential to be influenced by the proposed scheme, the TRA. Predicted changes in traffic characteristics on roads in this network were used to identify road links used in the assessment of local air quality effects. The qualifying criteria for `affected links' provided in DMRB HA 207/07 in paragraph 3.12 was subsequently applied to all traffic links within the TRA to identify those affected links and all links within 200m of the affected links. The qualifying criteria are:

- Road alignment will change by 5m or more; or
- Daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- Daily average speed will change by 10km/hr or more; or
- Peak hour speed will change by 20km/hr or more.

A review of the screened traffic data (the affected road network) identified changes in traffic which trigger the DMRB air quality criteria beyond the immediate vicinity of the scheme. The air quality assessment therefore considered this wider geographical area. The extent of the study area is shown on Figure 1 in the Air Quality Assessment Technical Report provided in **Appendix D**.

The DMRB Regional Assessment was undertaken as described in HA 207/07 paragraph 3.20 identifying roads that are likely to be affected by the proposals. The regional assessment affected roads are those that are expected to have:

- a change of more than 10% in AADT; or
- a change of more than 10% to the number of heavy duty vehicles; or
- a change in daily average speed of more than 20km/hr.

The assessment uses the traffic characteristics and road length for each link in the traffic network area. Total annual emissions for the Base Year (2012), DN and DS scenarios for the Opening Year (2017) and Design Year (2032) are determined.

7.4.2 Traffic Conditions

Road traffic can have a major impact on local air quality. The M1 is a major strategic highway managing high volumes of traffic on a daily basis. Traffic volumes on the M1 between J28 and J35a in the Base Year are greatest between J31 and J32 with 65577 AADT on the northbound (NB) carriageway and 65679 AADT on the southbound (SB) carriageway. The largest AM flow is 5072 vehicle per hour (veh//hour) on weekdays between J32 and J33 on the northbound carriageway, and 5029 veh/hour on weekdays between J35 and J34 on the southbound carriageway. The largest PM flow is 5323 veh/hour on weekdays between J34 and J35 on the northbound carriageway, and 5360 veh/hour on weekdays between J33 and J32 on the southbound carriageway. During day time periods Heavy Goods Vehicles (HGVs) range between 4 - 22% of the total traffic flow depending on the section of the motorway, the day of the week and the time of day. Changes to traffic volumes and flow characteristics have the potential to impact on local air quality.

7.4.3 Air Quality Management Areas

The proposed scheme lies within the boundaries of NEDDC, CDC, BDC, RMBC, SCC, and BMBC. There are nine AQMAs adjacent to the highway boundary alignment of the M1 between J28 and J35a (see Figure 4.1). Five AQMAs are found within the wider study area. These AQMAs were declared as it was predicted that locations within these areas would exceed the annual mean NO_2 AQS objective (see Table 7-5).

Table 7-5: List of AQMAs in the Local Air Quality Assessment Study Area

No	AQMA	Coverage
1	South Normanton (NO_2)	1 to 23 Carter Lane East, South Normanton (J28), Bolsover District Council): The AQMA encompasses 12 properties and their gardens, 1 to 23 (odd) on the east side of the M1. The area extends 100m east of the main carriageway (not including the slip road).
2	Barlborough AQMA No.1	14 Chesterfield Road, Barlborough (J30), Bolsover District Council: The closest property to the A619/A616 roundabout.
3	Barlborough AQMA No.2	17-25 Orchard Close, Barlborough (J30), Bolsover District Council): Residential dwellings where the western property boundaries border the M1.
4	Wakefield City AQMA	An area encompassing most of the Wakefield urban area.
5	Sheffield Citywide AQMA	An area covering the entire eastern part of the City containing the major built up areas (now declared for annual and 1-hour nitrogen dioxide objectives, and the 24-hour PM10 objective).
6	Rotherham AQMA 1 Part 4	An area encompassing the area next to the M1 around Barber Wood Road and New Droppingwell Road in Blackburn.
7	Rotherham AQMA 1 – Part 3	(Wales, Rotherham (J30 to 31), Rotherham Metropolitan Borough Council): An area of the settlement of Wales, Rotherham encompassing a small number of properties on either side of the M1 where the B6059, School Road, crosses the motorway.

No	AQMA	Coverage
8	Rotherham AQMA 1 Part 2	an area to the west of the M1 motorway between Meadowbank Road to the south and New Droppingwell Road to the north and extending east to West Hill Kimberworth.
9	Rotherham AQMA 1 Part 1	An area along the M1 between Upper Whiston (in the east) and the boundary with SCC to the west and extending on either side to encompass Brinsworth and Catcliffe.
10	Erewash Borough Council AQMA No.1	Five dwellings east of the M1 motorway, at Sandiacre, north of J25.
11	Erewash Borough Council AQMA No.2	Dwellings situated to the south of J25 in Long Eaton
12	Broxtowe Borough Council AQMA No.1:	AQMA No.2; AQMA No.3 and AQMA No.4: Properties next to the M1 motorway in Trowell, Nottingham.
13	Barnsley AQMA No. 1	An area along the M1 between J35a and J38, including Haigh, Darton, Cawthorne Dike, Higham, Dodworth, Gilroyd, Rockley, Birdwell and Tankersley. The area extends 100m either side of the central reservation.
14	Barnsley AQMA No.2A	An area encompassing the A628 from J37 of the M1 to Town End roundabout, including part of Summer Lane from Town End roundabout to Wharncliffe Street.

7.4.4 Local Air Quality

The study area is within 10 local authority areas. These local authorities - ADC, BMBC, BDC, BrDC, CDC, EBC, NEDDC, RMBC, SCC and WMBC all manage networks of roadside NO_2 monitoring in the vicinity of the study area. See **Appendix D**, Annex 6 for information on the NO_2 monitoring within the afore-listed AQMAs and LPAs in the vicinity of the study area. Sites with suitable data capture and representation of locations modelled within the study area have been used to inform the air quality assessment and verify dispersion modelling results.

The monitoring results for 2012 indicate that many of the locations assessed exceed the annual mean NO_2 objective value. Monitored annual mean concentrations in 2012 ranged from 25.5µg/m^3 to 60.3µg/m^3 at locations representative of public exposure. Concentrations at these monitoring locations are dependent on the proximity to the emission source and the volume of traffic on the surrounding road network. Monitoring data for 2012 indicate that areas alongside the M1 exceed the annual mean NO_2 objective value.

7.4.5 Ecologically Sensitive Receptors (Designated Sites)

One Site of Special Scientific Interest (SSSI), Bogs Farm Quarry, meets the DMRB qualifying criteria as it is situated within 200m of the proposed scheme. Unit 2 (Broadleaved, mixed and yew woodland – lowland) are nitrogen (N) sensitive and have been assigned a critical load for N-deposition. The site location is shown within Figure 4.1 of **Appendix B**.

Annual mean background 5 x 5km N-deposition rate estimates for Bogs Farm Quarry SSSI (South West corner 448000, 353000) is 44.7kg N ha^{-1} y^{-1}, in exceedence of the UNECE critical load for broadleaved deciduous woodland (10-20kg N ha^{-1} y^{-1})[13].

7.5 Impact Assessment

7.5.1 Operational Phase Impacts

A Detailed Assessment has been carried out in accordance with the DMRB air quality assessment methodology using traffic forecasts for the proposed scheme; an SM-ALR scheme; operating at the mandatory national speed limit (70mph) at all times.

Receptors have been selected for assessment based on the following criteria:

- proximity to roads meeting the DMRB screening criteria,
- existing exceedences;
- potential for new exceedences, and;
- potential for removal of exceedences of the annual mean NO_2 objective as a result of the proposed scheme.

In areas where air quality was predicted to improve and areas where the annual mean NO_2 objective were unlikely to be exceeded, worst case receptors have been identified and assessed to confirm there is not a risk of exceedence.

Annual mean NO_2 and PM_{10} concentrations for all relevant receptors in the Base, DN or DS are provided in **Appendix D**: Annex 7.

Base Year (2012)

There were 561 modelled exceedences of the annual mean NO_2 objective in 2012. These exceedences are predominantly found at receptors in close proximity (typically within 50m) to the motorway across the motorway network. These exceedences are primarily attributed to traffic emissions due to high volumes of AADT and HDV traffic flows on the motorway network.

The DMRB local air quality assessment identified a number of geographical areas within the air quality study area where identified sensitive receptors are located. Base Year annual mean NO_2 results in exceedence of AQS Objectives are presented in Table 7-6 for the aforementioned receptors in these geographical discussion areas. Modelled Base Year results for Ashfield, A617, Duckmanton and J31-J33 did not exceed the annual mean or 1-hour mean objectives at any modelled receptors and are therefore not discussed further.

Table 7-6: Geographical Breakdown of Modelled Base Year Annual Mean NO_2 Results in Exceedence of AQS Objective

Geographic Area	Maximum Annual Mean NO_2 Exceedence			Exceedences of annual mean AQS Objective	Exceedences of 1-hour mean AQS Objective
	Receptor	Address	Concentration (µg/m³)		
Erewash	E944	6 Cuillin Close, NG10 4NT	57.5	262	0
Broxtowe	TR213	15 Iona Drive, NG9 3RF	56.4	40	0

[13] http://www.apis.ac.uk – accessed 17/06/2014

Geographic Area	Maximum Annual Mean NO_2 Exceedence			Exceedences of annual mean AQS Objective	Exceedences of 1-hour mean AQS Objective
	Receptor	Address	Concentration (µg/m³)		
Bolsover	B257	1, Carter Lane East, DE55 2DY	61.4	23	1
Barlborough	BARL155	17, Orchard Close, S43 4NX	45.8	21	0
Wales	W092	32, School Road, S26 5QJ	42.9	1	0
Brinsworth-Catliffe	R2118	47, Derwent Crescent, S60 5EN	53.7	5	0
Blackburn-Tinsley	R1356	250C, Sheffield Road, S9 1RD	61.9	181	1
J35-J38	R61	329, Dodworth Road, S70 6PN	55.1	25	0
Wakefield	R12	108, Hollin Lane, WF4 3DF	42.8	3	0

R1356 (61.9µg/m^3) in Blackburn-Tinsley and B257 (61.4µg/m^3) (see Figure 4 in **Appendix D**) in Bolsover are both predicted to be above an annual average NO_2 concentration of 60µg/m^3 objective and consequently according to Defra's Technical Air Quality Guidance the short term 1-hour mean NO_2 objective may have been exceeded at these locations. These were the only two receptors with modelled Annual mean NO_2 results greater than 60µg/m^3 in the Base Year.

The 561 modelled exceedences of the annual mean NO_2 objective are distributed across nine geographical area (see Table 7-6). The number of receptors exceeding 1-hour and annual mean objectives and the receptors with the maximum annual mean NO_2 concentration in each of these areas are presented in Table 7-6. Erewash and Blackburn-Tinsley had the most modelled exceedences at receptors in the Base Year, with 262 and 181 respectively.

There are no modelled exceedences of the annual mean PM_{10} objective limit in 2012, and no concentrations greater than 23µg/m^3. Therefore exceedence of the 24 hour mean PM_{10} objective is unlikely in 2012. As a consequence of this, there is no risk of the PM_{10} air quality thresholds being exceeded in the Base Year, further discussion of PM_{10} in the Base Year has been scoped out.

Summary of Opening Year (2017) Results – 70mph SM-ALR

A screening assessment was undertaken for 2017. Traffic flows are predicted to rise along the motorway within the study area in the Opening Year with a standard SM-ALR. With the 70mph SM-ALR scheme, the largest increase in AADT (using two way flows) is on the J30 to 31 link where an additional 7627 AADT is predicted. This is the difference between the Do Nothing and Do Something scenarios in the Opening Year of 2017. On the link with the greatest AADT in the Base Year (between J31 and J32 where there are 65577 AADT on the NB carriageway and 65679 AADT on the SB carriageway), with the 70mph scheme, there would be an additional 4701 AADT (two way flows).

The verified annual mean NO_2 concentrations for each of the receptors modelled were inputted into the Long Term Gap Analysis Calculator in accordance with IAN 170/12 utilising the updated LTTE6 profile as provided by Highways England. The modelled annual mean NO_2 and PM_{10} results for each receptor are presented in **Annex 7** of

Appendix D and annual mean NO_2 results are illustrated on Figures 5 – 7 of **Appendix D**: Air Quality Technical Report.

Under the 70mph SM-ALR operating regime, there are 247 modelled exceedences of the annual mean NO_2 objective in 2017. As a result of this, the maximum decrease in NO_2 concentration is 3.7µg/m^3 at receptor B200 (40µg/m^3 in the DN and 36.3µg/m^3 in the DS) located in Bolsover, north of J28. This receptor is not predicted to be in execedence either in the DN or DS scenarios. The reduction in NO_2 concentration at this receptor is as a result of the scheme improving speeds, reducing congestion and therefore reducing emissions from vehicles travelling on the motorway with the scheme. None of the receptors subject to a decrease in NO_2 are in exceedence of the annual mean objective limit of 40µg/m^3 and are therefore not included in the judgement of whether the scheme leads to a significant impact (in accordance with IAN 174/13).

The maximum increase in NO_2 concentration as a result of the 70mph SM-ALR scheme is 2.6µg/m^3 at receptors R2118 (48.1µg/m^3 in the DN and 50.7µg/m^3 in the DS) located in Brinsworth, west of J33. This receptor is predicted to be in exceedance both in the DN and DS scenarios. The increase in NO_2 at this receptor is as a result of an increase in flow of approximately 4,800 vehicles per day (veh/day) on the motorway near to this receptor.

The modelling of PM_{10} has indicated that the maximum predicted concentration in the study area, in either the DN or DS scenario was 21.8µg/m^3 as an annual mean. The maximum predicted change in annual mean PM_{10} was an increase of 0.2µg/m^3. Therefore, it is concluded that there is no risk of exceedence of the air quality objectives for PM_{10}, as a result of the proposed scheme, and so no further discussions of PM_{10} are made.

Receptors that exceed the annual mean NO_2 objective are predominantly within 50m of the motorway. These exceedences are primarily attributed to traffic emissions due to high volumes of traffic flows on the motorway network. Further discussion of these results can be found later in this section.

7.5.2 Significance Assessment

A summary of the significance assessment for the Opening Year (2017) of the proposed scheme is provided in Table 7-7.

Table 7-7: Local Air Quality Receptors Informing Scheme Significance – 70mph SM-ALR (2017)

Magnitude of Change in Annual Average NO_2 or PM_{10} (µg/m^3) (Significance Threshold for each Band)	Total Number of Receptors with:	
	Worsening of air quality objective already above objective or creation of a new exceedence	Improvement of an air quality objective already above objective or the removal of an existing exceedence
Large (>4) (1 to 10)	0	0
Medium (>2) (10 to 30)	8	0
Small (>0.4) (30 to 60)	85	0

Whilst 247 sensitive receptors are predicted to be in exceedence of the annual mean NO_2 objective within the study area in the Opening Year with and without the 70mph scheme,

the vast majority of them have changes less than 0.4µg/m³ which are deemed imperceptible and consequently do not contribute to the significance assessment.

A total of 85 receptors are assessed to be above the air quality thresholds and have a level of change to be considered as part of a judgement of air quality significance. These 85 receptors received a small (>0.4µg/m³) worsening, eight of which have a medium (>2µg/m³) worsening. No sensitive receptors in exceedence of annual mean NO_2 concentrations within the study area are predicted to have an improvement in air quality.

It is worth noting that the significance receptor numbers are aggregated i.e. any receptor experiencing 2ug/m³ or more magnitude of change above or below the annual average also experience >0.4µg/m³ change and are therefore accounted for within the lower threshold/s.

The location of the 85 receptors contributing to the significance assessment are identified in **Annex 1** (Figures 5 – 7) of **Appendix D**. Further details on the localised geographical distribution of significant impacts are outlined in Table 7-8.

Table 7-8: Geographical Distribution of Significant Air Quality Impacts of the Proposed Scheme

Area	Number of Significantly Effected Receptors	Magnitudes of Change at Receptors	New Exceedences	Changes in Traffic Contributing to Change
Blackburn and Tinsley	63	0.5µg/m³ to 2.5µg/m³	11	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 5300 veh/day (2-way)
Brinsworth and Catcliffe	2	1.8µg/m³ to 2.6µg/m³	0	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 4800 veh/day (2-way)
Wales	1	1.9µg/m³	1	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 7650 veh/day (2-way)
Barlborough	7	1.6µg/m³ to 2.0µg/m³	2	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 7650 veh/day (2-way)
Bolsover	12	0.6µg/m³ to 2.4µg/m³	0	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 6900 veh/day (2-way)

Blackburn and Tinsley are the most significantly affected geographical area with 63 receptors experiencing increases in annual mean NO_2 concentration between 0.5µg/m^3 and 2.5µg/m^3. Other areas predicted to experience significant deteriorations in air quality are Brinsworth and Catcliffe, Wales, Barlborough and Bolsover. A major contributor to significant adverse impacts in all areas is increases motorway traffic following implementation of the proposed scheme.

Irrespective of any air quality impacts on any designated habitats or the risk of affecting the UK's ability to comply with the Air Quality Directive, the operation of a SM-ALR scheme operating at 70mph on air quality is considered to be significant for an Opening Year of 2017. This is due to the number of receptors (85) predicted to be adversely affected by the scheme being more than the upper level of the guideline band (60, see Table 7-7) and in our professional opinion this is considered to be a significant effect.

7.6 Mitigation Measures

Modelling of the potential air quality impact of the operation of the standard SM-ALR scheme was shown to result in significant adverse air quality effect. As a result of this, mitigation is required. This section describes the additional air quality mitigation options investigated and the outcome of this investigation. In addition to identifying the preferred mitigation, the air quality assessment also identified the year in which the mitigation can be removed and the 70mph SM-ALR operating regime implemented as it will no longer considered to cause a significant effect. The outcome of this assessment is also included in this section.

7.6.1 Mitigation Options Investigated

As outlined in Chapter 1 and Section 7.1, the SoS for Transport tasked Highways England with investigating an alternative to mitigate the predicted significant adverse air quality impacts along the scheme length as opposed to the identified mitigated operating regime (60mph 7am to 7pm; 70mph all other times). Mouchel was subsequently instructed by Highways England to investigate alternative mitigation measures. The Minister expressed a wish that as much of the network as possible should operate close to the national standard i.e. at 70mph for as long as possible. This was on the proviso that the preferred alternative operating regime did not result in significant adverse environmental effects. Three options (Controlled Motorway, a 50mph speed limit between 7am and 7pm and a 60mph speed limit for the same time period) were previously investigated (see Section 7.1 for details of **Options 1 to 3**). Four additional mitigation options were defined for assessment with an Opening Year of 2017:

- **Option 4** - 60mph weekday AM and PM peak, 70mph IP, 70mph OP and 70mph weekend;
- **Option 5** - 60mph weekday 7am to 7pm, 70mph weekdays OP and 70mph weekends;
- **Option 6** - J28 - J30 running at 70mph and J30 - J35a running at 60mph and,
- **Option 7** - J28 - J31 running at 70mph and J31 - J35a running at 60mph.

AM Peak, PM peak and inter-peak periods relate to the various modelled time periods for all options and are as defined in Table 7-3.

An additive approach has been used in the development of the mitigation options i.e. as the options progress the greater the duration of 60mph or the greater area to be covered

by a speed control has been examined. This is a proportionate approach and means that when the appropriate level of mitigation has been achieved further options do not need to be modelled.

Using this consequential approach to mitigation, **Option 4** (60mph weekday AM and PM peak, 70mph inter-peak, 70mph overnight and 70mph weekend) was considered as not resulting in significant adverse air quality effect and was therefore taken forward as the preferred air quality mitigation. The remaining options were therefore not considered further.

7.6.2 Operational Phase Impacts

Summary of Opening Year (2017) Mitigation Option 4

Traffic data for the DN and DS scenarios of the proposed mitigated operating regime (60mph weekday AM and PM peak, 70mph inter-peak, 70mph overnight and 70mph weekend between J28 and 35a) was screened in accordance with the DMRB air quality assessment methodology for an Opening Year of 2017. With the mitigated operating regime, traffic flows are predicted to rise along the motorway within the study area in the Opening Year, with the largest increase occurring between J32 and J33, where there are predicted to be on average an additional 5,030 vehicles per day (using two way flows). On the link with the greatest AADT in the Base Year (between J31 and J32 where there are 65577 AADT on the NB carriageway and 65679 AADT on the SB carriageway), with the Mitigated Operating Regime, there would be an additional 2330 AADT (two way flows).

The verified annual mean NO_2 concentrations for each of the receptors modelled were inputted into the Long Term Gap Analysis Calculator in accordance with IAN 170/12 utilising the updated LTTE6 profile as provided by Highways England. The modelled annual mean NO_2 and PM_{10} results for each receptor are presented in **Annex 7** of **Appendix D** and annual mean NO_2 results are illustrated in **Annex 1** (Figures 8 – 10) of **Appendix D**.

Under the mitigated operating regime, 242 modelled exceedences of the annual mean NO_2 objective in 2017 are predicted, of these 52 experience a perceptible change (>0.4 µg/m³) and therefore contribute to the significance assessment discussed in Section 7.4. As a result of the mitigated operating regime, the maximum decrease in NO_2 concentration is 4.1µg/m³ at receptor B200 (40µg/m³ in the DN and 35.9µg/m³ in the DS mitigated) located in Bolsover, north of J28 (See Figures 20 and 21). This receptor is not predicted to be in exceedance either in the DN or with the mitigated operating regime scenarios. The reduction in NO_2 concentration at this receptor is as a result of the mitigated operating regime improving speeds, reducing congestion and therefore reducing emissions from vehicles travelling on the motorway. None of the receptors subject to a decrease in NO_2 are in exceedence of the annual mean objective limit of 40µg/m³ and are therefore not included in the judgement of whether the mitigated operating regime leads to a significant impact

The maximum increase in NO_2 concentration as a result of the mitigated operating regime is 2.2µg/m³ at receptors R859 (46µg/m³ in the DN and 48.2µg/m³ in the DS mitigated) located in Blackburn, north-west of J34(N) (see Figures 38 and 39 of **Appendix D**). This receptor is predicted to be in exceedance with and without the mitigated operating regime. The increase in NO_2 at this receptor is as a result of an increase in daily 2-way motorway flow of approximately 4,600 veh/day at this receptor.

7.6.3 Ecologically Sensitive Receptors (Designated Sites)

Bogs Farm Quarry SSSI is a broadleaved, mixed and yew woodland habitat that lies within 92m of a section of the M1 which meets the DMRB qualifying criteria i.e. more than a 1000

veh/day increase in traffic. The locations of the modelled points are shown in Figure 44 of **Appendix D**.

The annual mean background NOx concentrations at this location were predicted to be 19.6µg/m^3 in 2012 and 16.5µg/m^3 in 2017 based on 1 x 1km background maps produced by Defra. The results show that in the Opening Year, the limit value of vegetation 30µg/m3 is exceeded at all modelled points within 200m of the motorway alignment for the DN and DS scenarios.

The implementation of the mitigated operating regime is predicted to add a maximum of 0.4 µg/m^3 to annual NOx concentrations in the Opening Year at Bogs Farm Quarry SSSI at the nearest point to the motorway (92m). Beyond 100m changes in NOx concentrations with the mitigation option are modelled to be less than 0.4µg/m^3 of NOx and are therefore considered imperceptible.

Annual mean background 5 x 5km N-deposition rate estimate for Bogs Farm Quarry SSSI (SW corner 448000, 353000) was 44.7kg N ha^{-1} y^{-1} in 2012 and is predicted to be 40.4kg N ha^{-1} y^{-1} 2017[14]. The results shows that annual mean N-deposition rates at all modelled points within 200m of the motorway alignment, are in exceedance of the UNECE critical load for broadleaved deciduous woodland (10-20kg N ha^{-1} y^{-1}), although it should be noted that background N-deposition rates are more than double the upper limit of the critical load classification.

The implementation of the mitigated operating regime is not predicted to add significantly to N-deposition rates at Bogs Farm Quarry SSSI, with a predicted increase of less than 0.1kg N ha^{-1} y^{-1} across the site.

7.6.4 Significance Assessment

A summary of the significance assessment for the Opening Year (2017) of the mitigated operating regime is provided in Table 7-9.

Table 7-9: Local Air Quality Receptors Informing Mitigated Operating Regime Significance (2017)

Magnitude of Change in Annual Average NO_2 or PM_{10} (µg/m^3) (Significance Threshold for each Band)	Total Number of Receptors with:	
	Worsening of air quality objective already above objective or creation of a new exceedence	Improvement of an air quality objective already above objective or the removal of an existing exceedence
Large (>4) (1 to 10)	0	0
Medium (>2) (10 to 30)	1	0
Small (>0.4) (30 to 60)	52	0

As a result of the mitigated operating regime, 52 receptors are predicted to receive a small (>0.4µg/m^3) worsening in NO_2 concentration, a single receptor received a medium (>2µg/m^3) increase and no receptors received a large (>4µg/m^3) worsening. No potential

[14] http://www.apis.ac.uk/

sensitive receptors in exceedence of annual mean NO_2 concentrations within the study area are predicted to receive a measurable (small, medium or large) improvement.

The location of the 52 receptors contributing to the significance assessment are identified in **Annex 1** (Figures 8 – 10) of **Appendix D**. Further details on the localised geographical distribution of significant impacts are outlined in Table 7-10.

Table 7-10: Geographical Distribution of Significant Impacts of the Mitigated Operating Regime

Area	Number of Significantly Effected Receptors	Magnitude of Change at Receptors	New Exceedences	Changes in Traffic Contributing to Change
Blackburn and Tinsley	43	0.5µg/m³ to 2.2µg/m³	9	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 4600 veh/day (2-way)
Brinsworth and Catcliffe	2	1.2µg/m³ to 1.9µg/m³	0	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 3900 veh/day (2-way)
Barlborough	6	0.9µg/m³ to 1.3µg/m³	1	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 3550 veh/day (2-way)
Bolsover	1	1.9µg/m³	0	A major contributor to the deterioration in air quality is the predicted increase in motorway traffic flow of up to approximately 3550 veh/day (2-way)

Blackburn and Tinsley are still the most significantly affected geographical area with 43 receptors predicted to experience increases in annual mean NO_2 concentration between 0.5µg/m³ and 2.2µg/m³. Other areas predicted to experience significant deteriorations in air quality are Brinsworth and Catcliffe, Barlborough and Bolsover. A major contributor to significant adverse impacts in all areas is the predicted increases motorway traffic following implementation of the mitigated operating regime.

Overall, implementation of the mitigated operating regime is not adjudged to be result significant, using professional judgement and the terms of reference of the IAN 174/13, as demonstrated in Table14 of **Appendix D**. A key element of the professional judgement was evaluating the distribution the 52 receptors within the guideline band (30 to 60) of the small change threshold. Twenty receptors (38% of the 52 included in the band) are predicted to experience a change of 0.5µg/m³, only just large enough for inclusion in the band. An additional nine receptor are below a 1µg/m³ level of change (56% of the 52 included in the band), the midpoint of the band. As a consequence of this, all receptors

experiencing a small change are expected to return to pre-scheme levels within one year. This suggests that the effects on those receptors (56%) in the lower half of the band will have an even shorter duration. This evaluation confirms that most adverse air quality effects will not be long lasting due to predicted improvements in air quality and further mitigation is not required.

7.6.5 Opening Year Geographical Area Discussion (Mitigation Option 4)

The DMRB local air quality assessment identified a number of geographical areas within the modelled areas which exhibit trends in traffic and air quality changes as a result of the mitigated operating regime. These geographic areas have been defined by the identified sensitive receptors within the air quality study area. The areas are Erewash (25), Broxtowe (J26), Ashfield, Bolsover, A617, Duckmanton, Barlborough (J30), Wales (J30-31), J31-33, Brinsworth – Catcliffe, Blackburn – Tinsley, J35-38 and Wakefield.

Detailed information of the local air quality assessment for the Opening Year in these modelled areas are presented in the Air Quality Assessment Technical Report provided in **Appendix D**. **Annex 7** of the Air Quality Technical Report provides details of the change in concentration of NO_2 and PM_{10} at modelled sensitive receptors in the Opening Year. Information on the maximum worsening, improvement and overall impact on those receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment are presented below for the geographical areas.

Erewash (J25)

There are no perceptible (>0.4µg/m^3) worsenings predicted at receptors in the Erewash area within the air quality study area. The maximum predicted increase of 0.2µg/m^3 at a receptor (E674) located adjacent to the SB carriageway 1.5km north of J25. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. The maximum predicted decrease in NO_2 concentration of 0.5µg/m^3 is at a receptor (E1158) situated at the top of the SB off slip at J25. This decrease is due to alleviation of congestion on the J25 roundabout. There are no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 11 – 13 of **Appendix D** for the modelled results and location of these receptors.

Broxtowe (J26)

There are no perceptible (>0.4µg/m^3) worsenings predicted at receptors in this modelled area. The maximum predicted increase of 0.3µg/m^3 (BX62) is situated adjacent to the SB carriageway 600m north of the roundabout at J26. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. No receptors are predicted to receive an improvement a result of the mitigated operating regime. There are no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 14 – 16 of **Appendix D** for the modelled results and location of the aforementioned receptor.

Ashfield

There are no perceptible (>0.4µg/m^3) deteriorations predicted at receptors in this modelled area. The maximum predicted increase of 0.3µg/m^3 is at a receptor (SEL003) situated 1.9km northwest of the roundabout at J27. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. No receptors are predicted to receive an improvement a result of the mitigated operating regime. There are no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 17 – 19 of **Appendix D** for the modelled results and location of the aforementioned receptor.

Bolsover (J28)

The maximum predicted increase in NO_2 concentration of 1.9µg/m^3 is at a receptor (B611) situated adjacent to the SB carriageway 2.8km north of the roundabout at J28. This receptor is predicted to be in exceedence with and without the mitigated operating regime. The worsening in air quality is caused by a predicted increase in in 2-way motorway traffic flow (approximately 3550 veh/day) adjacent to the property. The maximum predicted decrease in NO_2 concentration of 4.1µg/m^3 (B200) is situated adjacent to the end of the NB on slip at J28, is due to alleviation of congestion on the J28 NB on slip and a joining motorway carriageway. The impact on receptors in this area above the NO_2 annual mean air quality threshold contributing to the significance assessment is presented in Table 7-10. See Figures 20 – 22 of **Appendix D** for the modelled results and location of these receptors.

A617

There are no perceptible (>0.4µg/m^3) worsenings predicted at receptors in this modelled area. The maximum predicted increase of 0.3µg/m^3 is at a receptor (CHES126) situated on the A617, approximately 3.5km west of the roundabout at J29. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. The maximum predicted improvement in NO_2 concentration of 2.1µg/m^3 is at a receptor (CHES095) situated next to the SB off slip at J29. This predicted improvement is due to alleviation of congestion on the J29 SB off slip and a joining motorway carriageway. There were no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 23 – 25 of **Appendix D** for the modelled results and location of these receptors.

Duckmanton

The maximum predicted increase in NO_2 concentration of 0.6µg/m^3 is at a receptor (DMN001) located adjacent to the NB carriageway at J29a. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 3600 veh/day) adjacent to the property. No receptors are predicted to receive an improvement a result of the mitigated operating regime. There were no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 23 – 25 of **Appendix D** for the modelled results and location of the aforementioned receptor.

Barlborough (J30)

The maximum predicted worsening in NO_2 concentration of 1.3µg/m^3 is at a receptor (BARL212) located adjacent to the SB carriageway 300m north of the SB off slip at J30. This receptor is not predicted to be in exceedence without the mitigated operating regime, therefore creating a new exceedence with implementation of the mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 3550 veh/day) adjacent to the property. No receptors are predicted to receive an improvement a result of the mitigated operating regime. The impact on receptors in this area above the NO_2 annual mean air quality threshold contributing to the significance assessment is presented in Table 7-10. See Figures 26 – 28 of **Appendix D** for the modelled results and location of the aforementioned receptor.

Wales

The maximum predicted worsening in NO_2 concentration of 1.2µg/m^3 is at a receptor (W092) located adjacent to the SB carriageway 2.4km south of the roundabout at J31. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 3550 veh/day) adjacent to the property. No receptors are

predicted to receive an improvement in NO_2 concentration as a result of the mitigated operating regime. There were no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 29 – 31 of **Appendix D** for the modelled results and location of the aforementioned receptor.

J31 to 33

The maximum predicted increase in NO_2 concentration of 0.7µg/m^3 is at a receptor (R2081) situated adjacent to the NB carriageway 1.8km east of the roundabout at J33, This receptor is not predicted to be in exceedence with or without the mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 5050 veh/day) adjacent to the property. There are not expected to be any perceptible (>0.4µg/m^3) improvements at receptors in this area; the maximum predicted decrease of 0.1µg/m^3 is at receptor R2482, east of J32 and this receptor is not predicted to be in exceedence with or without the mitigated operating regime. There are no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 32 – 34 of **Appendix D** for the modelled results and location of these receptors.

Brinsworth – Catcliffe (J33 to 34)

The maximum predicted increase in NO_2 concentration is 1.9µg/m^3 at a receptor (R2118) situated adjacent to the SB carriageway 1.6km west of the roundabout at J33. This receptor is predicted to be in exceedence with and without the mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 3900 veh/day) adjacent to the property. No receptors are predicted to receive a benefit as a result of the mitigated operating regime. The impact on receptors in this area above the NO_2 annual mean air quality threshold contributing to the significance assessment is presented in Table 7-10. See Figures 35 – 37 of **Appendix D** for the modelled results and location of the aforementioned receptor.

Tinsley – Blackburn (J34)

The maximum predicted increase in NO_2 concentration of 2.2µg/m^3 is a medium magnitude change at receptor R859, situated adjacent to the SB carriageway 800m north of J34(N). This property is predicted to be in exceedence with and without mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 4600 veh/day) adjacent to the property. No receptors are predicted to receive an improvement as a result of the mitigated operating regime. The impact on receptors in this area above the NO_2 annual mean air quality threshold contributing to the significance assessment is presented in Table 7-10. See Figures 38 – 40 of **Appendix D** for the modelled results and location of the aforementioned receptor.

J35 – 38

The maximum predicted increase in NO_2 concentration is 0.9µg/m^3 at receptor R633, located adjacent to the SB off slip at J35. This property is not predicted to be in exceedence with or without the mitigated operating regime. The worsening in air quality is caused by a predicted increase in 2-way motorway traffic flow (approximately 3800 veh/day) adjacent to the property. No perceptible (>0.4µg/m^3) improvements are expected at receptors in this modelled area. The maximum predicted decrease of 0.3µg/m^3 is at receptor R78, situated to the west of the roundabout at J37. This property is not predicted to be in exceedence with or without the mitigated operating regime. There are no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 32 – 34 of **Appendix D** for the modelled results and location of these receptors.

Wakefield

There are no perceptible (>0.4µg/m^3) deteriorations predicted at receptors in this modelled area. The maximum predicted increase of 0.2µg/m^3 is at receptor (R12) situated at the bottom of the NB off slip at J29. This receptor is not predicted to be in exceedence with or without the mitigated operating regime. No receptors are predicted to receive an improvement as a result of the mitigated operating regime. There are no predicted impacts on receptors above the NO_2 annual mean air quality threshold contributing to the significance assessment. See Figures 35 – 37 of **Appendix D** for the modelled results and location of the aforementioned receptor.

7.6.6 Compliance Risk Assessment

During the intervening period between the previous air quality assessment and this investigation, the NN NPS, December 2014, was published as official government policy for development consent orders for nationally significant infrastructure projects. This policy takes into consideration the requirements of the reporting of air quality to the European Commission and compliance with the EU Air Quality Directive. As all projects with impacts on air quality can affect the UK's compliance with the EU Air Quality Directive. As the revised air quality mitigation is not considered to result in significant adverse air quality impact in accordance with the advice in IAN 174/13, its compliance with the EU Air Quality Directive has been assessed in the context on the NN NPS and IAN 175/13.

Within the NN NPS, of particular relevance for air quality decision making, is that decision makers must consider the requirements in paragraphs 5.12 and 5.13. Paragraph 5.11 provides context for consideration of substantive weight judgements described in paragraph 5.12.

5.11- *Air quality considerations are likely to be particularly relevant where schemes are proposed:*

- *Within or adjacent to Air Quality Management Areas (AQMA); roads identified as being above Limit Values or nature conservation sites (including Natura 2000 sites and SSSIs, including those outside England); and*
- *Where changes are sufficient to bring about the need for a new AQMAs or change the size of an existing AQMA; or bring about changes to exceedences of the Limit Values, or where they may have the potential to impact on nature conservation sites.*

5.12 - *The Secretary of State must give air quality considerations substantial weight where, after taking into account mitigation, a project would lead to a significant air quality impact in relation to EIA and / or where they lead to a deterioration in air quality in a zone/agglomeration.*

5.13 - *The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the scheme will:*

- *Result in a zone/agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant; or*
- *Affect the ability of a non-compliant area to achieve compliance within the most recent timescales reported to the European Commission at the time of the decision.*

Within the air quality study area, there are a number of zones and agglomerations for the purposes of reporting on compliance with the EU Directive on ambient air quality (Sheffield

Urban Area Agglomeration, East Midlands Zone, Nottingham Urban Area Agglomeration, Yorkshire and Humberside Zone and the West Yorkshire Urban Area Agglomeration).

Considering the absolute requirements of paragraph 5.13, of the PCM links in exceedance of the annual mean objective predicted to experience an increase in annual mean NO_2 concentration, seven are situated within the Sheffield Urban Area (UK0007) with a predicted compliance year of 2022 and one is situated in the East Midlands (UK0032) with a compliance year of 2025. Despite an overall a deterioration in air quality on these eight PCM links all equivalent PCM link annual mean concentrations (maximum 48.7µg/m^3) are lower than the maximum predicted roadside concentrations in the Sheffield Urban Area (53.6µg/m^3) and East Midlands (57.8µg/m^3) for 2017. The mitigated operating regime would therefore not affect the overall achievement of the compliance date for the Sheffield Urban Area or East Midlands Agglomerations. The outcome of the air quality assessment has demonstrated that the mitigated operating regime would not change of any of the zones / agglomerations from compliant to non-compliant nor would it delay the reported date for achieving compliance.

Using the guidance set in within IAN 175/13, the risk of delaying compliance with the EU Air Quality Directive is considered to be **low**. Full details of this assessment and justification of the low risk rating are provided in Annex 8 of **Appendix D**.

7.6.7 WebTAG Appraisal

A WebTAG appraisal has been completed in respect of PM_{10} and NO_2 exposure. This assessment has been developed using the WebTAG methodology which considers individual links in isolation. The results of this assessment are provided as required by DMRB guidance, in Table 7-11 and Table 7-12.

The mitigated operating regime is anticipated to lead to a deterioration in air quality (exposure to PM_{10} concentrations) overall. No properties experience exceedence of the annual mean PM_{10} EU Limit Value. No properties are to be demolished or constructed as a result of the mitigated operating regime.

Table 7-11: Local Air Quality Results for PM_{10}

PM_{10}, SUMMARY OF ROUTES: THE AGGREGATED TABLE	0-50m (i)	50-100m (ii)	100-150m (iii)	150-200m (iv)	0-200m (v=i+ii+iii+iv)
Total properties across all routes (min)	338	1383	994	954	3669
Total properties across all routes (some)	338	1383	995	956	3672
DN PM_{10} assessment across all routes	6,389.10	25,136.70	17,055.10	16,203.40	Total assessment PM_{10} (I): 64,784.30
DS PM_{10} assessment across all routes	6,399.70	25,159.50	17,090.60	16,249.30	Total assessment PM_{10} (II): 64,899.10
Net total assessment for PM_{10}, all routes (II-I)					114.80

The mitigated operating regime is anticipated to lead to a deterioration in air quality (exposure to NO_2 concentrations) overall.

No properties are demolished or constructed as a result of the mitigated operating regime.

Table 7-12: Local Air Quality Results for NO_2

NO_2, SUMMARY OF ROUTES:	0-50m	50-100m	100-150m	150-200m	0-200m
THE AGGREGATED TABLE	(i)	(ii)	(iii)	(iv)	(v=i+ii+iii+iv)
Total properties across all routes (min)	338	1383	994	954	3669
Total properties across all routes (some)	338	1383	995	956	3672
DN NO_2 assessment Across all routes DS NO_2 assessment	12,540.60	41,414.40	25,825.20	22,098.50	Total assessment NO_2 **(I)**: 101,878.70
Across all routes Net total assessment for NO_2, all routes (II-I)	12,638.60	41,707.90	26,088.70	22,321.80	Total assessment NO_2 **(II)**: 102,757.00 865.30

7.6.8 Regional Assessment

A comparison of the DN and DS scenarios (**Appendix D**, Table 30) indicates that there is an overall decrease in all emissions from the Base Year (2012) to the Opening Year (2017) without the mitigated operating regime (DN).

A comparison of the DN and DS scenarios indicates that there would be a small increase in all emissions, associated with the mitigated operating regime in the Opening Year (2017). The increase in NOx and CO_2 emissions is predicted to be 5.4% and 2.5% respectively.

A comparison of the DN and DS scenarios for the Design Year indicates that there would be an increase in all emissions, associated with the mitigated operating regime in the Design Year (2032) as traffic growth is predicted. The increase in NOx and CO_2 emissions is predicted to be 14.6% and 7.4% respectively.

7.6.9 Mitigation Timeframe Projection

Methodology

In addition to identifying a suitable mitigation, the air quality assessment undertook work to identify how long the mitigation would be required i.e. a potential year in which a standard 70mph SM-ALR operating regime can be implemented. Further assessment and analysis of modelled annual mean NO_2 concentrations at sensitive receptors was carried out to determine a guideline time frame for implementation of unmitigated operation.

Projection factors were derived from the current long term NO_2 trend profile (LTTE6) (see Annex 3 of **Appendix D**). These factors were applied to modelled concentrations to determine when any changes in air quality brought about by the 70mph SM-ALR scheme would no longer be considered to cause a significant effect. These factors were calculated

by dividing the factor in the LTTE6 profile for the projection year by the factor for the Opening Year.

Projection Factor = LTTE6 Projection Year Factor / LTTE6 Opening Year Factor

The DN and DS annual mean Gap Analysis NO_2 results for the proposed SM-ALR scheme (operating at 70mph, 24hours a day, seven days a week) were multiplied by various projection factors to give an indication of the results in five future years (2018 to 2022). These projected results were then assessed against the significance criteria outlined in IAN 174/13 to determine the timescales where the scheme operating at 70mph is unlikely to be significant.

As a result of the scheme requiring mitigation, at the time of reporting 11 NOx CM were being installed adjacent to various sections of the scheme alignment. Measured air quality data from these CMs will be used to confirm when it is appropriate for the mitigation to be removed.

Assessment

Projection factors were derived from the current long term NO_2 trend profile (LTTE6) using the methodology outlined in Section 7.3, and applied to the DN and DS annual mean Gap Analysis NO_2 results for the unmitigated standard SM-ALR scheme to give an indication of the results in five future years (2018 to 2022). These projected results were then assessed against the significance criteria outlined in IAN 174/13 to determine the timescales where the scheme operating at 70mph is unlikely to be significant.

Projection factors applied to the 2017 annual mean Gap Analysis NO_2 results for the proposed scheme are outlined in Table 7-13 and projections of these results at the 85 sensitive receptors informing the Opening Year scheme significance for the 70mph SM-ALR scheme are presented in Table A9 in Annex 9 of **Appendix D**.

Table 7-13: Projection Factors Applied to Opening Year NO_2 Results

Projection Year	Factor
2018	0.959
2019	0.921
2020	0.887
2021	0.862
2022	0.840

Table 7-14 presents an overview of significance assessments for unmitigated Opening Year and projected unmitigated Opening Year annual results (2018 to 2022) in accordance with IAN 174/13. These tables have been used to establish a guideline timeframe for a potential implementation of an unmitigated operation.

Table 7-14: Local Air Quality Receptors Informing Scheme Significance for the Proposed Scheme without Mitigation Projected from 2017 to 2022

Magnitude of Change in Annual Average NO_2 or PM_{10} (µg/m³) (Significance Threshold for each Band)	Total Number of Receptors with worsening of air quality objective already above objective or creation of a new exceedence					
	2017	2018 *	2019 *	2020 *	2021 *	2022 *
Large (>4) (1 to 10)	0	0	**0**	**0**	0	0
Medium (>2) (10 to 30)	8	7	**5**	**4**	3	1
Small (>0.4) (30 to 60)	85	67	**32**	**25**	16	12
** Projection Years* *Please note: There are no perceptible (<-0.4µg/m³) improvements.*						

Evaluation of the projected long term NO_2 concentrations at receptors against significance criteria outlined in IAN 174/13 suggests there will be a 3 to 5 year period for which the mitigation will be required (see bold text in Table 7-14). The large reduction in significantly effected receptors between 2018 and 2019 is due to the projected uptake of euro 6 engines by vehicles using the motorway. However, prior to a switch over to unmitigated operation CMs installed adjacent to various sections of the scheme monitors will be used to confirm when it is appropriate for the scheme mitigation to be removed. Measured data from the CMs will be used to verify that the timeline determined for switch over to unmitigated operation is still appropriate.

This mitigation (reduced speed limit of 60mph at weekday AM and PM peak times) must remain in place until the air quality monitoring indicate that air quality has improved sufficiently to allow the speed limit to be raised to 70mph pursuant to a monitoring strategy developed in consultation with the relevant planning authorities.

7.6.10 Staggered Implementation of the ALR Operating Regime

This EAR covers the final operating regime impacts once this section of motorway is operated as an all lane running "SM" in 2017. Along this stretch of M1, there are two discrete construction phases: M1 J28 to J31 and M1 J32 to J35a. It has been identified that a two stage approach is required to ensure that air quality issues are mitigated following the staggered introduction of all lane running along the M1 J28 to J35a corridor.

Stage 1: When all lane running becomes operational on J28 to J31 in late 2015, it will operate at the national speed limit (70mph), with variable speed limits utilised for operational reasons such as congestion or accident management and not to manage additional demand. This is due to the constraints on traffic flow provided by the roadworks

in place on the section of the M1 between J32 and 35a until early 2017 in the form of narrow lanes and a temporary maximum speed limit of 50mph. These should address air quality concerns, as the roadworks are expected to control the rate of growth in traffic facilitated by the additional capacity created by the all lane running scheme on J28 to J31.

Stage 2: When all lane running becomes operational on J32 to J35a in early 2017, the requirement for the operating regime of a maximum 60mph speed limit in weekday peak periods between the M1 from J28 to 35a is triggered to maintain demand management (i.e. to manage traffic flows through the corridor) required to address air quality concerns. This mitigation then remains in place until it has been determined that the speed restriction can be removed without introducing unacceptable air quality issues. As outlined in Section 7.6.9, this is expected to be for 3 to 5 years from opening in 2017.

7.7 Summary

7.7.1 Proposed Scheme

Exceedences of the annual mean NO_2 AQS Objective are predicted with and without the implementation of the standard SM-ALR scheme (70mph 24 hours a day, 7 days a week) in the Opening Year. There are no predicted exceedences of the 1-hour mean NO_2, annual mean PM_{10} or 24 hour mean PM_{10} AQS Objectives in the Opening Year with or without the proposed scheme.

A total of 85 sensitive receptors predicted to be in exceedence of annual mean NO_2 objective within the study area in the Opening Year with the proposed scheme operating received a small (>0.4µg/m^3) worsening of annual mean NO_2 concentrations and 8 received a medium (>2µg/m^3) worsening. No receptors received a large (>4µg/m^3) worsening annual mean NO_2 concentrations with the proposed scheme. No potential sensitive receptors in exceedence of annual mean NO_2 concentrations within the study area are predicted to receive a measurable (small, medium or large) improvement.

Overall the implementation of the proposed 70mph SM-ALR scheme on local air quality is considered to result in significant adverse air quality effects in the Opening Year of 2017 using professional judgement and the terms of reference of IAN 174/13. This is due to the number of receptors predicted to be adversely affected (85), being more than the upper guideline band determining a significant effect.

7.7.2 Mitigation

A number of mitigation options were considered. However, the preferred mitigation option was an SM-ALR scheme with 60mph weekday AM and PM peak, 70mph inter-peak, 70mph overnight and 70mph weekend on the M1 between J28 and J35a for the operational phase only (Mitigation **Option 4**).

Exceedence of annual mean NO_2 AQS objective are predicted with and without the mitigated operating regime. There are no predicted exceedences of the 1-hour mean NO_2, annual mean PM_{10} or 24 hour mean PM_{10} AQS objectives in the Opening Year with or without the mitigated operating regime in the Opening Year.

A total of 52 sensitive receptors predicted to be in exceedence of annual mean NO_2 objective within the study area in the Opening Year with the mitigated operating regime operating received a small (>0.4µg/m^3) worsening of annual mean NO_2 concentrations and one received a medium (>2µg/m^3) worsening. No receptors received a large (>4µg/m^3) worsening in annual mean NO_2 concentrations with the mitigated operating regime. No potential sensitive receptors in exceedence of annual mean NO_2 concentrations within the study area are predicted to receive a measurable (small, medium or large) improvement.

Overall the implementation of the mitigated operating regime on local air quality is not considered to result in significant adverse air quality effect in the Opening Year of 2017 using professional judgement and the terms of reference of IAN 174/13.

7.7.3 Compliance Assessment

Using guidance set within IAN 175/13, the risk of the mitigated operating regime delaying compliance with the EU Air Quality Directive is considered to be **low**.

7.7.4 Mitgation Timeframe Projection

In addition to identifying the preferred solution, the air quality assessment involved work to identify a potential year in which a standard SM-ALR operating regime can be implemented. Current long term NO_2 trend profile for future years were used to derive factors and project modelled Opening Year annual mean NO_2 concentrations at sensitive receptors.

Evaluation of the projected long term NO_2 concentrations at receptors against significance criteria outlined in IAN 174/13 suggests there will be a 3 to 5 year period for which the mitigation will be required. The mitigation will remain in place until the results of the air quality monitoring and further assessment indicate that air quality has improved sufficiently to allow a switch to a standard SM-ALR operation. However, Highways England is continuing to see if other mitigation options can be developed that would allow the scheme to operate at the national speed limits at all times by the Opening Year of 2017. Imposing speed control will only be used as a last resort.

8 Noise and Vibration

8.1 Focus of the Assessment

The proposed scheme seeks to alleviate congestions on the M1 between J28 and 35a by converting the hard shoulder to a permanent running lane. This is expected to make this section of the M1 more attractive to users of the motorway thereby altering the current traffic volume, composition and speed. The permanent use of the hard shoulder as a running lane will also move the source of road traffic noise closer to receptors adjacent to the motorway carriageway. This chapter presents a summary of the findings of the noise assessment of the proposed SM-ALR scheme (operating at 70mph; 24 hours a day, 7 days a week) on the M1 between J28 and 35a.

Full details of the noise assessment are presented in **Appendix E**: Noise Technical Report.

8.2 Regulatory / Policy Framework

The requirements of the following legislation and policies have been considered in undertaking this noise assessment. These requirements are described in more detail in **Appendix E**: Noise Technical Report.

- The Noise Insulation Regulations 1975 as Amended 1988 – defines conditions which dwellings must meet to qualify for an offer of noise insulation.
- The Environmental Noise (England) Regulations 2006 – relates to the assessment and management of environmental noise from transport and industry.
- Noise Policy Statement for England NPSE 2010 - sets out the long term vision of Government noise policy, to promote good health and a good quality of life through the management of noise.
- National Planning Policy Framework 2012 - outlines the Government's planning policies for England and how these are expected to be applied within the context of sustainable development.

8.3 Methodology

8.3.1 General

The assessment of noise and vibration impacts of the proposed scheme has been undertaken in accordance with guidance contained in the DMRB Volume 11, Section 3, Part 4, HD 213/11. In addition to HD 213/11, the prediction of noise generated during the operational phase of the proposed scheme has followed the guidance contained in the DfT's Calculation of Road Traffic Noise (CRTN).

For the operation phase of the scheme, a noise scoping assessment undertaken as part of the previous environmental assessments (M1 J28 to 31 and M1 J32 to 35a Environmental Assessment Report, February, 2014) identified that exceedences of the threshold values (1dB(A) in the short term and 3dB(A) in the long term) were possible. In light of this, a detailed assessment of the noise and vibration impacts during the operation phase has been undertaken as recommended within HD 213/11.

The noise assessment has involved noise modelling following which an assessment of the significance of the changes in noise level was undertaken. Information gained during consultation undertaken as part of the previous environmental assessment has informed this assessment along with the following data:

- Baseline noise levels with data taken from noise surveys.
- Updated traffic data.
- Sample receptor locations defined in DMRB as sensitive receptors including dwellings (residential), health facilities, schools, community facilities and places of worship and care/ nursing homes.

8.3.2 Baseline Noise Survey

A baseline noise survey was undertaken in 2012 to quantify the noise climate in the vicinity of the scheme. Noise surveys are used to ascertain the influence of traffic and non-traffic noise sources. The measured absolute levels have been used as a sense check of the predicted noise levels. Attended noise measurements were undertaken at 37 locations, 25 within 600m of the motorway and the remaining 12 farther away from the M1. These surveys were undertaken between 23 May and 25 October 2012. Despite being undertaken in 2012, the noise survey measurements are still considered appropriate for use for a sense check of the model prediction as the baseline noise climate in the study area has not changed significantly i.e. there have been no major additional noise sources.

Measurements of three hours in duration, between the hours of 10:00 and 17:00 were carried out in accordance with the DfT's CRTN shortened measurement procedure. Furthermore, peak-time monitoring, defined as being within the periods 07:00-09:00 and 16:00-18:00 was carried out at the 23 locations for a period of up to an hour.

Night time monitoring was also undertaken during weekday nights within the period 00:00 and 06:00 at the 21 monitoring locations.

Appendix E: Annex 1: Figure 1 show the noise measurement locations.

The baseline survey was undertaken in accordance with the principles of British Standard (BS) 7445 and following guidance given in CRTN. **Appendix E**, Annex 1 contains further information on the baseline noise monitoring programme.

Traffic Data

As with the air quality assessment, a hybrid data set has been used for the noise assessment. Data provided for the noise model includes 18hr Annual Average Weekday Traffic (AAWT) flows (06:00 to 00:00 hours) which was used to predict short and long term noise level changes in the daytime while night time (23:00 to 07:00) flows were used to predict night time noise level changes. Flow data included traffic composition expressed as the percentage of HGVs greater than 3,500kg (unladen weight) and the average speed of traffic in kilometres per hour (km/h) for the respective periods.

Receptor Locations

Property counting to ascertain the number of potentially affected dwellings and other sensitive receptors within the noise study area using Address Layer 2 (AL2) data using GIS software. Other Sensitive receptors include schools, community facilities, places of worship, health facilities and care/nursing homes.

8.3.3 Operation Phase Assessment

As outlined in Section 8.3.1, a detailed level of assessment has been undertaken for the proposed SM-ALR scheme as screening of traffic data showed that there are potential flow changes of a magnitude likely to cause significant noise impacts.

The objective of a detailed assessment is to understand the impact on the noise and vibration climate both with and without the scheme, referred to as the Do Something (DS) and Do Nothing (DN) scenarios respectively. These scenarios are required to be assessed for the proposed Opening and Design Year. NoiseMap Server Edition noise mapping software, in accordance with CRTN and HD 213/11, was used to predict noise levels at residential properties and other potentially sensitive receptor locations within the study area. The following scenarios were modelled:

- Opening Year (2017), DN scenario (without scheme).
- Opening Year (2017), DS scenario (with scheme).
- Design Year (2032), DN scenario.
- Design Year (2032), DS scenario.

The DMRB detailed level of assessment of noise impacts involved a comparison of the predicted noise levels resulting from the proposed scheme for the following scenarios:

- Short term impacts (difference in noise levels between 2017DS and 2017DN).
- Long term noise climate without the proposed scheme (difference in noise levels between 2032DN and 2017DN).
- Long term impacts (difference in noise levels between 2032DS and 2017DN).

Calculation points for all sensitive receptors were defined on all the external facades of dwelling and other non-dwelling sensitive receptors within a calculation study area of 600m each side of the M1. Non-dwelling receptors in the study area include schools, health facilities and care homes. For a more detailed explanation of the DMRB threshold criteria used for the traffic noise assessment, the DN / DS assessment scenarios and CRTN please refer to **Appendix E**.

8.3.4 Impact Evaluation

The magnitude of impact has been assessed by comparing the increase or decrease in noise levels between scenarios. The magnitude of noise impacts associated with road traffic noise is defined in DMRB HD 213/11 (Table 3.1 and 3.2); and reproduced in Table 8-1 (Short Term) and Table 8-2 (Long Term). Changes in noise level can either be increases (adverse) or decreases (beneficial).

Table 8-1: Classification of Magnitude of Noise Impacts in the Short Term

Noise Change $L_{A10,18h}$ (dB)	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5 +	Major

Table 8-2: Classification of Magnitude of Noise Impacts in the Long Term

Noise Change $L_{A10,18h}$ (dB)	Magnitude of Impact
0	No Change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10 +	Major

8.3.5 Night Time Assessment

In accordance with the HD213/11 detailed assessment, a night time noise assessment has also been undertaken for the Design Year (2032). The assessment of noise associated with road schemes within the UK is based upon the $L_{A10,18hr}$ daytime levels between 06:00 and 00:00. This is as stated within the UK accepted prediction methodology of CRTN. However, the road network is increasingly used at night, with potential of an increase in road traffic noise levels at receptors and the perception of nuisance. Therefore an assessment of night time road traffic noise is now a requirement when undertaking a DMRB detailed assessment. The assessment was undertaken for receptors where traffic noise levels are predicted to exceed 55dB $L_{night, outside}$ in any scenario. Method 2 of the TRL report "Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping" as recommended in the HD 213/11 guidance, has been followed to calculate the night time noise levels for each scenario. See **Appendix E**: Noise Technical Report for further information on the methodology adopted for this assessment.

8.3.6 Nuisance Assessment

The DMRB notes that the nuisance caused by noise mainly affects people in their homes. Nuisance is measured in terms of the percentage of the population as a whole that is bothered "very much" or "quite a lot" by virtue of a specific traffic related noise level. The correlation between specific levels and the percentage population bothered for the purposes of the assessment has been developed from studies which have been focused on reported nuisance where traffic-related noise has changed over a relatively long period of time. The change in nuisance ratings as a result of a standard SM-ALR scheme is presented in this chapter.

Noise nuisance takes into account both the long term and short term impacts. The methodology requires the reporting of the worst case noise changes as a result of the comparisons undertaken within the first 15 years following opening of the scheme. The results are presented for the DN and DS scenarios. The noise nuisance level changes are directly calculated from the predicted noise level changes. Therefore, any action taken would be based on the noise level changes.

8.3.7 Vibration Assessment

The DMRB outlines a method for the assessment of traffic induced vibration and this includes the assessment of the numbers of people bothered by airborne vibration. It states that vibration associated with road traffic sources would not normally have any influence at distances outside of 40m from an affected road. As such the assessment of vibration has been limited to buildings within 40m of the centre line of the scheme. Additionally, as recommended by DMRB, only properties which have predicted traffic noise levels greater than 58dB $L_{A10,18hour}$ have been assessed.

Ground borne vibration is not anticipated to be a major issue for the scheme as ground borne vibrations are only generally perceptible where the road surface is uneven[15] (Watts, 1992) which is not the case with the scheme section. Irregularities in the hard shoulder will be addressed as part of the development of the hard shoulder as a potential running lane.

8.3.8 Assumptions and Limitations

In order to construct the noise model, a number assumptions were made. The key made assumptions are listed below:

- All buildings are a height of 6m representing a two storey building. This is in view of the English Housing Survey Home 2010 published by the Department for Communities and Local Government which states that majority of houses in England have two storeys. The height of a standard plasterboard sheet is 2.4m. Allowing for floor decking, an assumption of 2.5m as being used per storey and an additional metre for a pitched roof.
- Receivers at dwellings are positioned 4m above ground level, 1m from the façade whilst receivers at other sensitive receptors are positioned 1.5m above ground level, 1m from the façade.
- Intervening ground between any road and a receiver is acoustically 'soft' as the majority of the scheme corridor passes through rural areas;
- For the DN scenario in 2017, road surfaces were modelled as hot rolled asphalt (HRA) except for areas of Thin Wearing Course (TWC) identified by data obtained from the Highways Agency Pavement Management System (HAPMS) database.
- For existing areas of TWC, a surface correction of -2.5dB has been applied for the DN scenario in the Opening Year. Where a single surface type has not covered the entire width of the carriageway, the predominant surface type covering the carriageway was assumed. Where equal amounts of different surfaces were identified to be present, the worst case has been assumed, i.e. HRA.
- -3.5dB for the surface correction has been applied for all carriageways i.e. all road surfaces in the DS Opening Year of 2017 and Design Year of 2032 as TWC is to be installed for both the DN and DS scenario.
- In accordance with DMRB, a -3.5dB road surface correction is only applicable for roads where traffic speeds are predicted to be above 75km/hr. A -1dB correction is applied for roads where future traffic speeds are anticipated to be below 75km/hr.
- A visual survey was undertaken to determine the heights and function of the barriers along the proposed scheme length. Only those considered to function as acoustic barriers, i.e. visual observations confirming barriers with no gaps, close boarded timber fencing and acoustic barriers highlighted by Network Delivery and Development Directorate have been included within the noise model. This should be treated as a rough guide and not as a detailed and accurate specification of barrier location / construction. In the event that there are differences between the actual height and function of the barriers and the information collated, the noise change

[15] Watts G R (1992). The generation and propagation of vibration in various soils produced by the dynamic loading of road pavements. Journal of Sound and Vibration 156(2), pp191 - 206

predictions are not expected to be under-reported because the barrier heights and function information are consistent across the DN and DS scenarios.

- From their visual appearance, existing barriers have been assumed to be reflective.
- Where underbridge structures are being re-waterproofed to provide better corrosion protection, for maintenance purposes, HRA which has a superior impermeability when compared to TWC is to be applied as a lower binder course with TWC applied above it. The noise abating properties of this hybrid surface is currently unknown, as a result the motorway road surface in the carriageway of these underbridges has been modelled as HRA for the noise assessment which is a worst case scenario. It is acknowledged however that application of TWC over these structures will have some noise abatement benefits, the degree of which is unknown.
- In the carriageway of the remaining underbridge structures, where no waterproofing is planned, the carriageway is to be reinstated over the structures with a HRA surface course as HRA offers a more superior impermeability over TWC.
- As a result of the last two assumptions/limitations, the carriageway of all underbridges within the scheme area has been modelled as HRA.

8.3.9 Mitigation and Enhancement Measures

Scheme Impact Mitigation

The DMRB states "*In terms of permanent impacts, a change of 1dB(A) in the short-term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long-term, a 3dB(A) change is considered perceptible. Such increases in noise should be mitigated if possible*." In addition, it is necessary that in all cases where it is considered, mitigation should comply with acceptable standards in terms of traffic, safety, environmental and economic issues (DMRB Volume 11, Section 3, Part 7, Chapter 4 – Design and Mitigation, paragraph 4.10). Examples which could preclude the use of mitigation are disproportionate cost or have unacceptable visual impact.

Defra Priority Areas

The Environmental Noise (England) Regulations of 2006 required strategic noise maps and action plans to be prepared for urban areas agglomerations), major roads, major railways and major airports. In response to this, Defra published the noise maps for England's roads in 2008, with the noise action plans following in 2010. The purpose of the Noise Action Plans is to assist in the management of environmental noise and its effects, including noise reduction if necessary, in the context of government policy on sustainable development.

Noise Action Plans are intended to apply in particular to the most 'important areas (IAs)' identified by the results of strategic noise mapping published in 2008. Noise Action Plans have been developed for each of the IAs identified. Highways England has responsibility for motorways and trunk roads, while LPAs are responsible for all other roads. Where motorways or trunk roads intersect other roads there is a shared responsibility. Where the Highways Agency are the noise making authority (NMA) for identified IAs (for motorways and all-purpose trunk roads), they are required to investigate noise mitigation measures in consultation with the noise receiving authority (usually the LPAs) and develop noise action plans.

'Important Areas' which apply to major roads are areas where the 1% of the population that are affected by the highest noise levels from major roads are located according to the results of Defra's strategic noise maps. According to Defra, IAs give a very good indication

of the places exposed to the highest levels of noise. LPAs in conjunction with Highways England are required to investigate identified IAs and develop noise action plans.

Highways England in a Major Projects Instruction (MPI 09-052013: Policy Position on Noise and Application to Major Improvement Schemes) outlined an approach to investigate the impacts of major projects on identified IAs where traffic noise has been identified as a key issue. This should be done whilst having regard to any ongoing noise mitigation initiatives, identifying if opportunities for further noise mitigation measures could be implemented and considering if the noise environment could be improved.

Taking the above into consideration, Highways England incorporated its planned application of TWC; a low noise surfacing; into the proposed scheme proposal. TWC will be applied for all carriageway lanes along the scheme length prior to the operation of the scheme in 2017. This assessment considers the impact of the proposed scheme on Defra Noise IAs with the scheme study area.

To further address the requirements of the NSPE and the aforementioned MPI, a high level review of potential additional noise mitigation measures along the scheme corridor has been undertaken. This involved a review of:

- identified IAs within 600m of the scheme length in line with HD 213/11;
- the number of properties within the IAs;
- distance of the properties within the IAs to the motorway carriageway (middle of the nearest carriageway);
- physical context and constraints to barrier construction
- indicative locations and lengths of barriers; and
- potential environmental impacts of constructing a barrier at identified locations.

Opportunities for additional noise mitigation measures in the form of acoustic barriers were identified using on a number of assumptions / relevant guidance. The rationale adopted for the review is as follows:

- Initial barrier locations based on a “line-of-sight” method.
- Barrier net effect likely to be negligible at distances over 300m (in line with HA 66/95 – Environmental Barriers: Technical Requirements)
- Assumes TWC on the entire scheme lengths and along the slip roads.
- For IAs where Highways England is identified as a joint NMA with the LPA, no measures have been suggested as discussions will be required with the LPA to agree a course of action to address noise problems in the IAs.

The impact of the proposed noise mitigation / enhancement measures on dwelling within IAs is presented in Section 8.6.3.

8.4 Study Area and Baseline Environment

8.4.1 Study Area

The noise study area for the assessment of impact during operation has been defined in accordance to guidance contained in HD 213/11 and this has informed the detailed assessment of noise.

In accordance with DMRB, the noise model has included an area of 1km from the edge of the existing carriageway (M1 J28 to 35a) and 600m from any other affected routes within this 1km study area. The calculation area has been taken as 600m from the carriageway edge of both the main route (M1 J28 to 35a) and affected routes under consideration. There was no affected road links outside the 1km boundary of the scheme as per HD 213/11 therefore a calculation of basic noise levels was not required.

Receiver calculation points have been defined on all the external facades of all relevant receptor locations, within a calculation study area of 600m each side of the M1, in accordance with DMRB. The noise assessment study area is shown on Figures 2, 3 and 4 of Annex 2, provided in **Appendix E**.

8.4.2 Relevant Noise Receptors

There are 13,304 residential properties within the detailed assessment study area of the scheme and 74 other sensitive receptors. Of these non-dwelling sensitive noise receptors, there are 23 schools, nine health facilities and three nursing homes. The location of these receptors are shown on Figure 5, Annex 2 provided in **Appendix E**.

8.4.3 Baseline Noise Levels

As outlined in Section 8.3.2, baseline noise monitoring was undertaken during weekday peak and daytime off-peak periods in order to establish background levels around the existing motorway corridor and identify the principal sources of noise within the study area. Ambient noise measurements (LA_{eq}) recorded at these locations indicate levels ranging from:

- 53 - 75dB(A) during peak periods
- 47 - 75dB(A) during the daytime periods
- 35 - 65dB(A) during the night time

There were no significant industrial noise sources within the vicinity of the scheme. At all monitoring locations, traffic noise from the M1 was dominant and clearly a constant steady-state noise source. Within the study area, ambient noise levels are dominated by background traffic noise on the M1. However, there were other minor sources that contribute to the background noise levels. These include:

- Traffic on minor roads close to the measurement position;
- High jet aircraft; and
- Light aircraft overhead.

The noise level at a specific monitoring location varies with time. This can be attributed to the following:

- Changes in the traffic volume, HGV percentage, distribution or speed of traffic on the road network;
- Periods of congestion;
- Changes in wind direction and speed, causing noise to ‘come and go’;
- Sources of distant non-road traffic noise, such as aircraft; and
- Sources of noise local to the monitoring point, for example car door slamming, car horns, emergency sirens, pedestrians and barking dogs.

Please see **Appendix E**, Annex 1 for further details on the background noise monitoring survey.

8.4.4 Baseline Vibration Levels

Subjective observations were undertaken during the noise monitoring survey which indicated that there were no major sources of vibration in the vicinity of the proposed scheme. Therefore, baseline vibration monitoring was not considered to be required in the context of this assessment.

As outlined in Section 8.3.7 and 8.4.1, the study area for potential vibration impact is within 40m of the scheme. A count revealed that there are 55 dwellings within 40m of affected roads in the study area.

8.4.5 Defra Important Areas (IAs)

A total of 34 IAs have been identified within the noise study area. Of these, Highways England has been identified as the NMA for 25 IAs, the relevant LPAs have been identified as the NMA for five IAs whilst Highways England and the relevant LPAs have been identified as joint NMAs for four IAs. **Appendix B**: Figure 4.1 and **Appendix E**: Table 1-4 contain the location and further information on the location of these IAs.

8.4.6 Existing Noise Reduction Measures

Noise mitigation is defined as measures taken in order to control the level of noise perceived at a receiver point. These measures can include changing the characteristics of the noise source or obstructing the propagation of the noise through the receiving environment. To achieve this along a motorway, TWC or acoustic barriers may be used respectively.

Information on existing locations of TWC on the scheme length was provided by Highways England's Managing Area Contractors and from HAPMS. Table 8-3 provides a summary of locations currently benefiting from TWC.

Table 8-3: Location of Thin Wearing Course along the Scheme

Carriageway	Approximate Maker Post Extents		Surface Correction (dB)
	Start	End	
NB	216/8A	217/3A	-2.5
SB	216/7B	217/4B	-2.5
SB	218/4B	221/4B	-2.5
NB	218/5A	221/5A	-2.5
SB	227/8B	239/6B	-2.5
NB	228/4A	238/6A	-2.5
SB	249/6A	250/3A	-2.5
NB	252/5A	252/7A	-2.5
SB	252/8B	253/4B	-2.5
NB	253/5A	253/6A	-2.5
SB	253/5B	254/5B	-2.5
NB	254/0A	255/2A	-2.5
NB	255/2A	260/2A	-2.5

Carriageway	Approximate Maker Post Extents		Surface Correction (dB)
	Start	End	
SB	255/2B	256/0B	-2.5
SB	256/3B	256/6B	-2.5
SB	256/7B	260/2B	-2.5
NB	260/3A	260/5A	-2.5
NB	260/6A	260/7A	-2.5
NB	261/0A	261/2A	-2.5
SB	261/2B	262/6B	-2.5
NB	261/3A	262/5A	-2.5
NB	263/5A	263/7A	-2.5
SB	267/9B	269/2B	-2.5

A review of the existing motorway corridor highlighted that several residential areas are currently afforded noise protection from motorway related noise through provision of intervening barriers. Information on the location of acoustic barriers was provided by the Asset Support Contractors. Table 8-4 below provides details of the existing noise barriers.

Table 8-4: Existing Noise Barrier Locations

Marker Post	Direction	Length	OS Grid Ref	Height above ground
217/4J	Northbound	153	SK4556	2.4m
218/1L	Southbound	149	SK4556	2.4m
217/9L	Southbound	71	SK4556	2.4m
218/2L	Southbound	233	SK4556	2.4m
217/8K	Northbound	307	SK4556	2.4m
218/3A	Northbound	117	SK4556	2.4m
218/7A	Northbound	284	SK4457	2.4m
217/5J	Northbound	26	SK4556	2.4m
216/1A	Northbound	1000	SK4655	2.4m
262/7B	Southbound	347	SK3892	2.4m
259/8J	Northbound	112	SK3990	2.0m
259/8A	Northbound	308	SK3990	2.0m
260/2B	Southbound	297	SK3990	2.0m
259/9M	Southbound	462	SK4090	2.0m
256/7A	Northbound	852	SK4289	2.4m
257/9B	Southbound	513	SK4189	2.4m
257/1B	Southbound	756	SK4289	2.4m

8.5 Impact Assessment

8.5.1 Operation Phase Assessment

The results of the noise modelling exercise are given in Tables 8-5 to 8-7. These tables provide details on the number of dwelling and non-dwelling receptors subject to increases, decreases or no change in noise levels in the short and long term as defined in Section 8.3.4. The results are also ascribed magnitudes of impact for predicted noise level increase and decrease.

Short Term Impacts (2017DS, 2017DN)

Table 8-5: Summary of Short Term Noise Impacts

Scenario: Short term Traffic Noise Impacts			
Comparison: DS scenario in 2017 relative to the DN scenario in 2017			
		Daytime	
Change in noise level (dB)		Number of Dwellings	Number of other sensitive receptors
Increase in noise level $L_{A10, 18h}$	0.1- 0.9 (Negligible)	415	9
	1 - 2.9 (Minor)	5	0
	3 - 4.9 (Moderate)	0	0
	5+ (Major)	0	0
No Change	0	1109	13
Decrease in noise level, $L_{A10, 18h}$	0.1 - 0.9 (Negligible)	7405	38
	1 - 2.9 (Minor)	4344	13
	3 - 4.9 (Moderate)	26	1
	5+ (Major)	0	0

In the short term (the 2017DS scenario compared to 2017DN), the opening of the proposed scheme is predicted to have a negligible to moderate decreases in noise levels at majority of the dwellings, with no dwellings predicted to experience moderate or major increases in noise levels. These beneficial decreases in traffic noise levels are attributable to the application of TWC in the Opening Year of the scheme.

Short term changes in noise levels at five dwellings are predicted to exceed 1db. These five dwellings are:

- Pipes Farm, Huthwaite Lane, Blackwell: 1.4dB
- The Cottage, Huthwaite Lane, Blackwell: 1.5dB
- The Bungalow, Hilcote Lane, Blackwell: 1.0dB
- 151 Blackburn Road, Sheffield: 1.0dB

- 152 Blackburn Road, Sheffield: 1.2dB

Two of these dwellings (located on Huthwaite Lane), are close to Blackwell-Huthwaite Road underbridge which is modelled as having HRA. This represents a worst case scenario, as Blackwell-Huthwaite Road underbridge is set to be surfaced with the TWC/HRA hybrid as mentioned in Section 8.3.8. The predicted noise change is therefore expected to be less in reality than predicted but the degree of this reduction is unknown.

The Hilcote Lane dwelling is located close to Hilcote Lane which is to be resurfaced with HRA whilst 151 and 152 Blackburn Road, Sheffield are located within IA 2181. See Figure 2, Sheets 2 and 15 provided in Annex 2, **Appendix E** for the location of these five dwellings.

The traffic noise results for all receptors are presented in **Appendix E**: Annex 2, Figures and Annex 4, Receptor Table Data.

Long Term Impacts, Do Nothing Change (2017DN, 2032DN)

Table 8-6 summarises the predicted changes in noise levels without the proposed scheme in the long term (future baseline) by comparing the two DN scenarios in 2017 and 2032. This comparison is undertaken as a requirement of the DMRB in order to quantify the effect of inherent traffic growth between the proposed year of Opening and Design Year, if the scheme was not constructed.

It is worth noting that the magnitude of impact bandings in the long term table differs from those in the short term table as greater magnitudes of change in noise level are required for them to be perceptible over the long term (2017DN against 2032DN).

Table 8-6: Long Term Changes in Noise Levels without the Proposed Scheme

Scenario: Long Term Traffic Noise Impacts				
Comparison: DN Scenario in 2032 relative to the DN scenario in 2017				
		Daytime		Night Time
Change in noise level (dB)		Number of Dwellings	Number of other sensitive receptors	Number of Dwellings
Increase in noise level, $L_{A10, 18h}$	0.1- 2.9 (Negligible)	2081	31	4309
	3- 4.9 (Minor)	22	0	0
	5- 9.9 (Moderate)	0	0	0
	10+ (Major)	0	0	0
No Change	0	545	2	385
Decrease in noise level, $L_{A10, 18h}$	0.1- 2.9 (Negligible)	10221	39	2747
	3- 4.9 (Minor)	435	2	2
	5- 9.9 (Moderate)	0	0	0
	10+ (Major)	0	0	0

In 2032, without the proposed scheme, the majority of dwellings (approximately 80%) are predicted to experience either a negligible or minor decrease in noise levels. These

decreases in traffic noise levels are attributable to the presence of TWC in 2032 as part of Highways England's maintenance programme.

Minor increases in noise level are predicted at 22 dwellings located in Duckmanton. These are due to proposed third party developments included in the traffic model near J29a of the M1 which influence traffic volumes in the local area in the Design Year[16]. The proposals include:

- Approximately 18 hectares of B1, B2 and B8 Employment use for the land at Seymour (Part of Markham Vale). This development is anticipated to generate additional traffic flows on the A6192 Erin Road; and,
- Markham Employment Growth Zone - Approximately 65 hectares of B1, B2 and B8 Employment use, resulting in traffic loading onto Markham Lane.

All other predicted increases (approximately 16%) in traffic noise when comparing the DN scenario in 2017 and 2032 are predicted to be negligible.

Long Term Impacts, Do Something Change (2032DS, 2017DN)

Table 8-7 presents the result of permanent long term noise impacts due to the introduction of the proposed scheme. This comparison is undertaken to quantify the effect of the proposed scheme, plus projected traffic growth (in line with national traffic growth) between the Opening and Design Year. In the long term, comparing the DS in the Design Year of 2032 relative to the DN situation in 2017, a high proportion of dwellings (approximately 55%) are predicted to experience negligible and minor decrease in noise levels with the implementation of the proposed scheme and resulting traffic growth over a 15 year period.

Table 8-7: Summary of Long Term Noise Impacts with the Proposed Scheme

Scenario: Long Term Traffic Noise Impacts				
Comparison: DS Scenario in 2032 relative to the DN scenario in 2017				
		Daytime		Night Time
Change in noise level		Number of Dwellings	Number of other sensitive receptors	Number of Dwellings
Increase in noise level, $L_{A10, 18h}$	0.1- 2.9 (Negligible)	5053	42	3580
	3- 4.9 (Minor)	29	0	22
	5- 9.9 (Moderate)	5	0	0
	10+ (Major)	0	0	0
No Change	0	922	5	260
Decrease in noise level, $L_{A10, 18h}$	0.1- 2.9 (Negligible)	7294	27	3579
	3- 4.9 (Minor)	1	0	2
	5- 9.9 (Moderate)	0	0	0
	10+ (Major)	0	0	0

[16] M1 Junction 28 – 31 Managed Motorway Traffic Forecasting Report, December 2013, Atkins.

A total of 34 dwellings (approximately 0.3%) are predicted to experience minor and moderate increases in noise level, all dwellings are in Duckmanton. This is compared to the 22 (approximately 0.2%) dwellings experiencing a minor increase in the 2017 DN verses 2032 DN. These dwellings are not adjacent to the M1 carriageway. The minor and moderate increases in traffic noise are a cumulative effect of the proposed developments in the Duckmanton area, together with negligible increases in traffic noises at these receptors due to the proposed scheme. Investigation of the noise modelling results at these 34 dwellings has shown that the overall contribution to the traffic noise levels due to the proposed scheme is between 0.6 and 1.0dB(A) and therefore a negligible contribution in traffic noise levels at these receptors in the long term.

Following a review of the noise prediction in the long term with and without the standard SM-ALR scheme, it is clear that the proposed SM-ALR scheme will result in more receptors experiencing increases in noise levels at day time.

It is worth noting that the noise level magnitude of impact bandings in the long term tables differ from those in the short term table as greater magnitudes of change in noise level are required for them to be perceptible over the long term (2017 DN against 2032 DN).

Night Time Noise Impacts

Tables 8-6 and 8-7 present the changes in permanent night time noise levels for the long term scenario comparisons – that is the traffic growth 2032 DN versus 2017 DN and the long term impact 2032 DS versus 2017 DN. In both comparisons, majority of increases in traffic noise at dwellings are predicted to be negligible (less than 3dB). A total of 22 dwellings are expected to experience a minor increase in night-time noise level. These dwellings are on the B6019 in South Normanton, and the increases are directly attributable to local traffic changes and therefore are not directly attributed to the proposed scheme.

The DMRB requires a night time noise impact assessment to be undertaken where an $L_{night, outside}$ noise level is greater than 55dB and there is a noise level increase of 3dB $L_{night, outside}$ in the long term[17]. All properties are predicted to experience an $L_{night, outside}$ noise level greater than 55dB, however there are no increases of 3dB(A) $L_{night, outside}$ or more in the long term as a result of the scheme. No further assessment of night time noise impacts has therefore been undertaken.

Other Sensitive Receptors

There are a number of other sensitive (non-dwelling) receptors (schools, community facilities, care/nursing homes) with the study area for noise during operation of the scheme.

With the proposed scheme in place, in the short term (2017DN compared to 2017DS), all but nine non-dwelling sensitive receptors in the study area are predicted to experience either a decrease or no change in noise levels. The nine receptors are predicted to experience a negligible increase in noise levels. In the long term, both with and without the proposed scheme in place, all noise levels changes at non-dwelling sensitive receptors are predicted to be either negligible or no change.

The location of the non-dwelling sensitive receptors (schools, community and health facilities) are shown on Figure 5 in Annex 2 (**Appendix E**). The tables in Annex 5,

[17] $L_{night, outside}$ is defined as the equivalent continuous sound level $L_{Aeq, 8hr}$ for the period 2300 to 0700 hours assessed outside a dwelling and is free-field.

Appendix E, provide details of the predicted noise impacts in the short and long term (with and without the scheme).

Sample Receptor Locations

To present an overview of the predicted noise levels for each scenario across the scheme area, 32 locations have been selected as being typically representative of the operational assessment study area. These locations are shown on Figure 6: **Appendix E**. The results for the sample receptors are deemed to be representative of their locality, at first floor, for both the Opening and the Design Years, with and without the proposed scheme. These are presented in **Appendix E**: Annex 6 with their associated magnitudes of impact.

Appendix E: Annex 4 and Annex 5 contain the predicted noise levels for all dwellings and other sensitive receptors respectively in the study area.

Noise Nuisance Impact

Noise nuisance impact is calculated in both the Opening (2017) and future assessment year (2032) with the worst case within the first 15 years following opening of the scheme being reported. The DN nuisance impacts are based solely on the future assessment year, as continual traffic growth implies that this will be the year with the highest percentage of annoyed residents.

Table 8-8 gives the predicted noise nuisance impacts for the day time period and shows that without the proposed scheme. The DN nuisance impacts are predicted to be less than 10% for majority of the dwellings. With the scheme, majority of dwellings (7351 dwellings) are expected to experience a decrease in nuisance of less than 10% but 170 dwellings are predicted to be subject to nuisance level increases of between 10 and 30%.

When comparing DN and DS, there are more dwellings experiencing increases in nuisance in the DS scenario. This is likely to be due to the use of the hard shoulder as a running lane which moves traffic closer to dwellings.

Table 8-8: Change in Traffic Noise Nuisance Levels

Comparison: Traffic Noise Nuisance Impacts			
		DN	DS
Change in noise level		Number of Dwellings	Number of Dwellings
Increase in nuisance level	< 10%	1920	4691
	10 < 20%	0	164
	20 < 30%	0	6
	30 < 40%	0	0
	> 40%	0	0
No Change	0 %	601	1092
Decrease in nuisance level	< 10%	10783	7351
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0

Comparison: Traffic Noise Nuisance Impacts			
		DN	DS
Change in noise level		Number of Dwellings	Number of Dwellings
	> 40%	0	0

Vibration Impacts

A vibration nuisance assessment has been undertaken for all buildings within 40m of the centre line of the scheme, the results are presented in Table 8-9. As recommended by DMRB, only properties which have predicted traffic noise levels greater than 58dB $L_{A10, 18hr}$ have been included within the assessment.

Table 8-9: Vibration Nuisance Assessment Results

Comparison: Vibration Nuisance Impacts			
		DN	DS
Change in vibration level		Number of Dwellings	Number of Dwellings
Increase in nuisance level	< 10%	4	14
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No Change	0 %	0	44
Decrease in nuisance level	< 10%	54	0
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

Without the proposed scheme, all but four dwellings which qualify for this assessment experience a decrease (between 0% and 10%) in vibration nuisance impacts. The remaining four, experience an increase in vibration nuisance impacts of between 0% and 10%.

With the scheme, the majority (44 dwellings, approximately 76%) of dwellings experience no change. The remaining 14 dwellings are predicted to experience an increase in vibration nuisance of less than 10%.

8.6 Mitigation and Enhancement Measures

8.6.1 Operation Phase Assessment

The DMRB states "*In terms of permanent impacts, a change of 1dB(A) in the short-term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long-*

term, a 3dB(A) change is considered perceptible. Such increases in noise should be mitigated if possible."

With the use of the hard shoulder as a running lane traffic will move closer to dwellings. However, the application of TWC in the Opening Year of the proposed scheme mitigates further increases in road traffic noise levels and provides some benefit i.e. reduction in traffic noise levels.

Analysis of the scheme identified that there are five dwellings in the short term that exceed 1dB. Two of these dwellings on Huthwaite Lane, in Blackwell are located next to an Blackwell-Huthwaite Road underbridge, which have been modelled with HRA surfacing. This represents a worst case scenario as this underbridge is set to be surfaced with a TWC/HRA hybrid which has some noise reducing properties. The predicted noise changes at these two dwellings are therefore expected to be less in reality than predicted but the degree of this reduction is unknown.

One dwelling (The Bungalow) is located close to Hilcote Lane underbridge, which is to be resurfaced with HRA. The remaining two dwellings are 151 and 152 Blackburn Road, Sheffield located within IA 2181 (Rotherham and Sheffield Councils). Appropriate mitigation to address these predicted short term change over 1dB were considered, however, as the impacts are for a short duration only, a permanent intervention in the form of acoustic barriers has not been deemed cost effective.

In the long term (2032 DS – 2017 DN), 34 dwellings are predicted to be subject to an increase of over 3dB(A). All 34 dwellings are located along Markham Road, Duckmanton. These minor to moderate predicted increases in traffic noise are attributable to local traffic associated with the considerable development proposed in the surrounding area, as outlined in Section 8.5.1. The increases in traffic noise are therefore not directly attributable to the proposed SM-ALR scheme.

8.6.2 Noise Impacts of the Proposed Air Quality Mitigation

The noise assessment shows that the proposed scheme (70mph, 24/7) would have no significant adverse noise impacts. The noise assessment takes account of noise mitigation measures in the scheme design. Mitigation applied to the scheme consists of TWC on all lanes in both directions and existing noise barriers.

To address the predicted significant adverse air quality effects of the proposed scheme, a mitigated operating regime – 60mph peak time weekday, 70mph inter-peak, off peak and weekend is proposed from the Opening Year 2017 till the proposed scheme can be operated without resulting in significant adverse air quality impact which is currently predicted to be within 3 to 5 years of the 2017 opening year. This noise assessment is considered to represent a worst case scenario and therefore the noise impacts for the mitigated operating regime can only be expected to be better than the noise impacts of the standard SM-ALR scheme. This is because as motorway traffic speed limit changes from 70mph to 60mph, the mean motorway traffic speed reduces, this reduction in speed leads to a reduction noise level. Mainline motorway flows are also higher with the standard SM-ALR scheme when compared against the mitigated operating regime; a reduction in the motorway flow leads to reduction in noise level.

8.6.3 Defra Noise Important Areas

For the purposes of the strategic noise mapping exercise the Environmental Noise Directive requires; "*the determination of exposure to environmental noise, through noise mapping; and the adoption of action plans, based upon the noise mapping results which*

should be designed to manage noise issues and effects, including noise reduction if necessary."

As a result of the Defra noise mapping exercise, 34 IAs have been identified within the study area. According to Defra, IAs give a good indication of the places exposed to the highest levels of noise. To present the overall impact of the proposed scheme on IAs in the study area, an assessment of noise level changes over 1dB was undertaken; 1dB being the smallest perceptible change in noise levels in the short term.

Within the 34 IAs, 1490 dwellings have been identified. Of these, a total of 766 dwellings (51%) have predicted decreases and the remaining 719 dwellings (48%) are not predicted to experience any change in noise levels with the proposed scheme. Overall the proposed scheme results in an improvement in the IAs within the study area.

The five dwellings predicted to experience an increase in noise level of 1dB or more in the Opening Year of the proposed scheme are within IAs. These five dwellings are located within IAs 8217, 2181 and 7790 (See Annex 2, Figure 2: Sheets 2 and 15). As outlined in Section 8.5.4, two dwellings in Blackwell (also within IA 2181) are adjacent to Blackwell-Huthwaite Road underbridge which has been modelled with HRA surfacing. This represents a worst case, as the surfacing at this location is set to be a TWC/HRA hybrid mentioned in Section 7.3.8, and as such the noise impact will be less than predicted but the degree of this reduction is unknown.

The dwelling within IA 7790, The Bungalow, is located close to Hilcote Lane underbridge, which is to be resurfaced with HRA whilst there are two dwellings within IA 2181, 151 and 152 Blackburn Road, Sheffield.

To further meet the aims of the NPSE and MPI 09-502013, additional noise mitigation measures was considered at each of the Defra Noise IAs along the scheme for which Highways England is the NMA. A high level review of potential additional noise mitigation measures along the scheme corridor has been undertaken. The feasibility of additional noise mitigation measures in the form of acoustic barriers was assessed using assumptions / relevant guidance outlined in Section 8.3.9 and the conclusion at each relevant IA is presented in Annex 7 of **Appendix E**.

The review concluded that the acoustic barrier at IA 2181 in Blackburn (see Table 8-4, barriers location MP262/7B) can be extended to offer additional protection to properties within this IA. For this acoustic barrier, a 3m high noise barrier between MP262/0 and 262/9+80B is proposed, replacing a smaller existing barrier at this location. This reduces noise levels by more than 3dB at 56 receptors, including Blackburn Primary School. The exact length and extent of the proposed barrier is currently being designed and is therefore subject to change from the length reported.

It is worth noting that the aforementioned two dwellings on Blackburn Road with short term increases above 1dB, though located within this IA, do not benefit from the proposed barrier as they are located on the opposite side of the carriageway. No further locations are suitable for noise barriers, either due to barriers at the location being ineffective, or due to construction difficulties and limitations.

8.7 Summary

A review of the existing motorway corridor highlighted that several residential areas are currently afforded noise protection from highway related noise through provision of intervening barriers, which indicates that traffic noise needs to be managed along the proposed scheme corridor.

8.7.1 Baseline Noise Monitoring

Monitoring was undertaken during weekday peak and daytime off-peak periods in order to establish background levels around the existing motorway corridor, and to enable correlation between measurements and observed congestion. Ambient noise measurements (L_{Aeq}) recorded at these locations indicate levels ranging from: 53 - 75dB(A) during peak periods, 47 - 75dB(A) during off-peak periods and 36 - 65dB(A) during the night time.

8.7.2 Predicted Scheme Noise Impacts

A DMRB detailed level of assessment of noise impacts at 6933 residential dwellings and 35 other sensitive receptors has been carried out for proposed scheme. The following assessment scenarios were considered for this assessment:

- Short term impacts (difference in noise levels between 2017DS and 2017DN)
- Long term noise climate without the scheme (difference in noise levels between 2032DN and 2017DN).
- Long term impacts (difference in noise levels between 2032DS and 2017DN).

As part of the proposed scheme, TWC will be applied along the scheme length (in both directions) in the Opening Year of the scheme, except across the M1 bridge sections where either a hybrid of HRA overlaid by TWC or HRA is to be applied to offer better protection to the structures.

Short Term Traffic Noise Impact

The short term comparison for the Opening Year (2017DS) indicates that there would be negligible to moderate decreases in traffic noise impact at majority of receptors. These beneficial decreases in traffic noise levels are attributable to the application of TWC in the Opening Year of the scheme.

Five receptors are predicted to experience minor increases as a result of traffic on the motorway making use of its greater capacity. Two of the dwellings experiencing over 1 dB increases in the short term are located next to Blackwell-Huthwaite Lane underbridge, which has been modelled with HRA surfacing. This represents a worst case scenario for these two dwellings located on Huthwaite Lane, as the Blackwell-Huthwaite Lane underbridge is set to be surfaced with the TWC/HRA hybrid. The predicted noise changes at these two dwellings are therefore expected to be less in reality than predicted but the degree of this reduction is unknown.

A third dwelling is located close to Hilcote Lane underbridge, which is set to be surfaced with HRA. The two remaining dwellings, at 151 and 152 Blackburn Road, Sheffield are located within IA 2181 (Rotherham and Sheffield Councils). Additional mitigation (over and above the application of TWC) to address the predicted short term change over 1 dB has been considered. However, as the predicted impact is for a short duration only, a permanent intervention in the form of acoustic barriers has not been deemed cost effective.

Long Term Traffic Noise Impact

For the long term daytime comparison (2032DN – 2017DN) without the proposed scheme, majority of the receptors are predicted to experience negligible decreases in noise level.

Minor increases in noise level are predicted at 22 dwellings in Duckmanton along Markham Road in the long term without the proposed scheme. These increases are attributable to proposed third party developments in proximity to J29A of the M1. The proposals include 18 hectares of B1, B2 and B8 Employment use for the land at Seymour (Part of Markham Vale); 65 hectares of B1, B2 and B8 Employment use; 400 residential dwellings proposed at Duckmanton; and 900 residential dwellings on land between Marlpit Lane and Oxcroft.

The long term noise impacts due to the introduction of the proposed scheme show that majority of receptors are to experience negligible decreases with the implementation of the proposed scheme and resulting traffic growth over a 15 year period. A total of 34 dwellings are predicted to experience minor to moderate increases in noise level. The minor to moderate increases in traffic noise are a cumulative impact of the proposed committed developments at Junction 29a and Duckmanton; in conjunction with the scheme. Investigation into the predicted results show that the overall contribution to the traffic noise levels due to the SM-ALR is small (between 0.6 and 1.0 dB(A)).

8.7.3 Scheme Impact on Defra Noise Important Areas

There are 34 Defra IAs within the scheme study area and these contain a total of 1490 dwellings. Within the study area, five dwellings are predicted to experience an increase over 1dB in noise level in the Opening Year of the proposed scheme.

Due to the application of TWC in the Opening Year of the proposed scheme, an overall improvement in the IAs within the study area is predicted in the short term; bringing about improvements in noise levels to 766 dwellings (51%) and no change to 719 (48%) of the receptors in the study area despite projected normal growth in traffic.

The five dwelling predicted to be subject to an increase in noise (greater than 1dB) are located within IAs. Two dwellings in Blackwell (also within IA 2181) are adjacent to Blackwell-Huthwaite Lane which has been modelled with HRA surfacing. This represents a worst case, as the surfacing in this location is set to be the TWC/HRA and as such the impact will be less. The dwelling within IA 7790, The Bungalow, is located close to Hilcote Lane underbridge, which is to be resurfaced with HRA whilst there are two dwellings within IA 2181, 151 and 152 Blackburn Road, Sheffield.

Following consideration of further noise mitigation in the scheme IAs in accordance with the NPSE and the Highways England MPI, additional mitigation in the form of a barrier is to be erected at IA 2181, located in Blackburn. This is expected to offer noise level reductions in excess of 3dB to 56 receptors at this location. The two dwellings on Blackburn Road with short term increases above 1dB; within this IA; do not benefit from the proposed barrier as they are located on the opposite side of the carriageway. No further locations are suitable for noise barriers, either due to barriers at the location being ineffective, or due to construction difficulties and limitations.

8.7.4 Noise Impact of the Proposed Air Quality Mitigation

To address the predicted significant adverse air quality effects of the proposed scheme, a mitigated operating regime – 60mph peak time weekday, 70mph inter-peak, off peak and weekend is proposed from the Opening Year 2017 till the year the proposed scheme can be implemented with resulting in significant adverse air quality impact which is currently predicted to be within 3 to 5 years of opening in 2017. It is considered that the noise impacts of the standard SM-ALR scheme when compared to the proposed air quality mitigation operating regime with 60mph weekday AM and PM speed restrictions is a worst case scenario. As the worst case standard SM-ALR scheme does not result in significant

adverse noise impacts, operation with a speed restriction and eventual switch to the standard operating regime are not expected to result in significant adverse noise impacts also. This conclusion is supported by a review of traffic characteristics with the mitigated operating regime which revealed that flows on the main line would be reduced in addition to the speed reductions leading to reduced noise impacts.

8.7.5 Conclusion

In summary, across the DS scenarios, the predicted negligible increases in traffic noise levels can be attributed to the use of the hard shoulder as a permanent running lane which moves traffic closer to dwellings. However, the application of TWC in the Opening Year of the scheme mitigates further increases in road traffic noise levels and subsequently reduces the impact magnitude. In general, majority of the predicted changes in noise level due to the introduction of the proposed scheme are of a “negligible” magnitude of impact and those changes are predominantly decreases in noise level.

9 Recommendation on Determination and Conclusion

9.1 Introduction

Chapters 7 to 9 set out the findings of the environmental assessment of the proposed standard SM-ALR scheme on the M1 between J28 and 35a. The following briefly sets out the conclusions of the environmental assessment.

9.2 Summary of Potential Effects

9.2.1 Physical Design Changes

No significant adverse environmental effects are expected as a result of the changes to the physical design of the proposed scheme. Adoption of mitigation measures detailed in the October 2013 and February 2014 EAR would further serve to ensure this.

9.2.2 Air Quality

The proposed scheme (standard SM-ALR operating 24 hours a day, 7 days a week) is not predicted to give rise new exceedences of the annual mean or 24 hour mean PM_{10} AQS objectives in its Opening Year. A total of 85 sensitive receptors however are predicted to be in exceedence of annual mean NO_2 objective within the study area in the Opening Year with the proposed scheme operating. It is therefore considered to give rise to significant adverse air quality impacts.

A number of mitigation options were identified and assessment of a preferred mitigating operating regime (60mph weekday AM and PM peak, 70mph IP, 70mph OP and weekend) concluded that this operating regime would not give rise to significant adverse air quality impacts using professional judgement and the terms of reference of the IAN 174/13. Using guidance set within IAN 175/13, the risk of the mitigated operating regime delaying compliance with the EU Air Quality Directive is considered to be **low**.

The mitigation timeframe projection assessment suggests that there would be a three to four year period for which the mitigated operating regime would be required. This mitigation will remain in place until the results of the air quality monitoring from CM installed along the scheme length and further assessment confirm that air quality has improved sufficiently to allow a switch to standard SM-ALR operation.

9.2.3 Noise and Vibration

No significant adverse noise impacts are expected with implementation of a standard SM-ALR scheme (70mph 24/7). Short term increases in noise over 1dB as a result of the proposed scheme is predicted at five properties. Over and above application of TWC, additional mitigation in the form of a barrier has not been deemed cost effective at these five locations.

An existing barrier at Blackburn is to be extended in length and height to offer additional protection to nearby receptors. This is in fulfilment of the requirements of the NPSE and Highway England's MPI 09-052013.

9.3 Recommendation on Determination

With mitigation, the overall impact of the proposed scheme on air quality is judged to be not significant. No long term increases in predicted traffic noise levels directly attributable to the proposed scheme are expected.

The outcome of this environmental assessment exercise suggest that a formal Environmental Impact Assessment process leading to the production of an Environmental Statement is not required for the proposed scheme. The information from this environmental assessment will form the basis of a Record of Determination.

9.4 Conclusion

The previous EAR published in February 2014 proposed a 60mph speed limit that would operate between 07:00-19:00 daily in order to mitigate predicted significant adverse impacts on local air quality. The SoS did not accepted this approach as the Government's preferred option for managing local air quality on this section of the M1 and tasked Highways England to identify other mitigation measures. Speed restriction is to be used only to the extent that is absolutely necessary.

The outcome of this review identified an alternative mitigation, with 60mph speed restrictions for a reduced duration for the morning (AM - 07:00-09:00) and evening (PM - 15:00-18:00) peak weekday periods only. This proposed mitigation is a significant reduction in the duration of the previously proposed speed control, although it still provides the necessary mitigation of the air quality impacts associated with the scheme. However, Highways England is continuing to see if other mitigation options can be developed that would allow the scheme to operate at the national speed limits at all times by the Opening Year of 2017. Imposing speed control will only be used as a last resort. A number of automatic air quality continuous monitors have been installed alongside the M1 and data from these continuous monitors will be used to evaluate the mitigation measures and the date when the measures can be lifted.

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Glossary of Terms

Term	Meaning
Annual Average Daily Traffic (AAWT)	It is the total volume of vehicle traffic of a motorway or road for a year divided by 365 days.
Advanced Motorway Indicator	A LED lane based variable message sign allowing the display of both variable mandatory speed limits and lane status
Air Quality Standard	The concentration of a pollutant, over a specified period, above which adverse effects on health (or the environment) may occur and which should not be exceeded.
Air Quality Management Area (AQMA)	An Air Quality Management Area (AQMA) is an area of land where air quality levels are breeching the national limits and require action to deal with or 'manage' this. Thus in places where National Air Quality Objectives are not likely to be achieved, the LPAs must declare an Air Quality Management Area.
Amenity	A feature that increases attractiveness or value, especially of a piece of real estate or a geographic location.
Analysis	The process of breaking something down into its component parts to understand how it is made up.
Appraisal	A process (with methodologies that differ to those of environmental assessment) that looks at the worth of a course of action.
Assessment	A process by which information about effects of a proposed plan, project or intervention is collected, assessed and used to inform decision-making.
Baseline Environment	The environment as it appears (or would appear) immediately prior to the implementation of the project together with any known or foreseeable future changes that will take place before completion of the project.
Best Practice	The undertaking of assessments in line with nationally and internationally recognised assessment guidelines.
Biodiversity	The variety of life forms, the different plants animals and micro-organisms, the genes they contain and the eco-systems they form. Considered at three levels: genetic, species and ecosystem diversity.
Classification	A process of sorting attributes into different types using selected criteria.
Compensation	Measures taken to offset or compensate for residual adverse effects that cannot be mitigated, or for which mitigation cannot entirely eliminate.
Consultation	A process by which regulatory authorities, statutory and non-statutory bodies are approached for information and opinions regarding a development proposal.
Connectivity	The degree to which habitat patches in an urban or agricultural matrix are interconnected by linear habitats; or the degree to which rights of way and local roads interact with each other.
Controlled Motorways	The dynamic management of traffic in the designated running lanes (either in 3 or 4 lane operation using variable mandatory speed limits).
Countryside	The rural environment and its associated communities.
Cultural Heritage	Encompasses the qualities and attributes of places that have aesthetic, historic, scientific or social value for past, present or future generations.
Cumulative Effects	Effects that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project
Department for the Environment, Food and Rural Affairs	UK Government department with responsibilities for uncultivated land and semi-natural areas in England and Wales.
Desk Study	A review of secondary information/resources i.e. studies of historical maps and written text.

Term	Meaning
Designations	Notable sites, areas, buildings or structures protected by planning or other laws. Can be applied at Local, Regional and National and International level.
Design Year	Defined as 15 years after scheme opening.
Diversity	Where a variety of qualities or characteristics occurs.
Design Manual for Roads and Bridges	A set of documents that provide a comprehensive manual system which accommodates all current standards, advice notes and other published documents relating to the design, assessment and operation of trunk roads (including motorways).
Detailed Assessment	Method applied to gain an in-depth appreciation of the beneficial and adverse consequences of the project and to inform project decisions. Detailed Assessments are likely to require detailed field surveys and/or quantified modelling techniques.
Diffusion Tubes	Passive gas collection (e.g. NO2) devices consisting of a small tube containing a chemical absorbent. Diffusion tubes are used to determine relatively long period average concentrations, typically weekly, fortnightly or monthly.
Do Nothing Scenario	The conditions that would persist in the absence of the implementation of a construction or improvement project, but given that maintenance is ongoing.
Dynamic Hard Shoulder Running	The controlled use of the hard shoulder during times of heavy congestion or during incident management
Effect	Term used to express the consequence of an impact (expressed as the 'significance of effect'), which is determined by correlating the magnitude of the impact to the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria. For example, land clearing during construction results in habitat loss (impact), the effect of which is the significance of the habitat loss on the ecological resource.
Emissions Standard	The maximum amount or pollution concentration allowed to be released from a specific source.
Environment	Our physical surroundings, including land, air and water.
Environmental Assessment	A method and a process by which information about environmental effects is collected, assessed and used to inform decision-making. Assessment processes include Strategic Environmental Assessment, Assessment of Implications on European Sites and environmental impact assessment.
Environmental Designation	A defined area which is protected by legislation that is threatened by change from manmade and natural influences e.g. Ramsar sites, Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC).
Environmental Impact Assessment	A statutory process by which certain planned projects must be assessed Assessment (EIA) before a formal decision to proceed can be made. Involves the collection and consideration of environmental information, which fulfils the assessment requirements of Directive 85/337/EEC (as amended), including the publication of an Environmental Statement.
Environmental Management Plan	Developed prior to any works commencing on site, the primary purpose of Plan the Environmental Management Plan is to guide environmental management of implementation of the project.
Environmental Screening	The formal process undertaken to determine whether it is necessary to carry out a statutory Environmental Impact Assessment and publish an Environmental Statement in accordance with the EIA Regulations.
Environmental Statement	A document produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Evaluation	The determination of the significance of effects. Evaluation involves making judgements as to the value of the receptor/resource that is being affected and the consequences of the effect on the receptor/resource based on the magnitude of the impact.
Feature	A prominent, eye-catching element.
Gantry	Commonly constructed above high traffic roads, a gantry is a traffic sign and/or signal assembly on which signs/signals are mounted on an overhead support. Gantries in the United Kingdom display exit (junction) numbers, distances to junctions / exits (1 mile, 1/2 mile, 1/4 mile, 1/3 mile, 3/4 mile, 2/3 mile) and destinations reached, and if necessary what lane to use for them.

Term	Meaning
Hard Shoulder	A paved strip beside a motorway, usually only used for stopping in emergencies, however it is often used as a running lane in Managed Motorways schemes.
Heritage	Historic or Cultural Associations.
Impact	Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact).
Improvement	The doing of any act under powers conferred by Part V of the Highways Act 1980 (as amended).
Indirect Impact	Indirect or induced changes in the environment, population, economic growth and land use and other environmental effects resulting from these changes in land use, population and economic growth. The potential effects of additional changes that are likely to occur later in time or at a different place as a result of the implementation of a particular action.
LA_{10} hourly dB(A)	Noise level exceeded for just 10% of the time over a period of one hour giving an indication of the upper limit of fluctuating noise such as that from road traffic.
LA_{90}	Sound level that is exceeded for 90% of the sample period; generally used to quantify background noise.
$LA_{eq\ T}$	A weighted equivalent continuous sound level during the sample period (T) and effectively represents an average value.
$L_{A10,18h}$	The arithmetic average of the values of L_{10} hourly dB(A) for each of the eighteen one-hour periods between 0600 to 2400 hours.
LA_{max}	Maximum A-weighted sound level during the sample period; the highest level of environmental noise during the measurement.
$L_{night\ outside}$	The equivalent continuous sound level $L_{Aeq,\ 8hr}$ for the period 2300 to 0700 hours assessed outside a dwelling and is free-field.
Land cover	Combinations of land use and vegetation that cover the land surface.
Landform	Combinations of slope and elevation that produce the shape and form of the land.
Landscape	Human perception of the land contained by knowledge, cultural associations and identity with a place.
Landscape Character	The distinct and recognisable pattern of elements that occur consistently in a particular type of landscape, and how this is perceived by people. Character reflects combinations of geology, landform, soils, vegetation, land use and settlement pattern, inferring a sense of place.
Landscape Character Zone	A landscape type expressing broadly similar physical characteristics, discernible from maps and field surveys.
Landscape Effects	Change in the elements, characteristics and overall character and qualities that make up the landscape as a result of development, both positive and negative.
Land take	Extent of land required for a proposed development.
Land Use	The primary use of land, encompassing both rural and urban activities.
Legislation	A law or set of laws suggested by a government and made official by a parliament.
Link	A stretch of road or route identified as lying between two defined points.
Magnitude	A combination of the scale, extent and duration of a given effect.
Managed Motorways	Managed Motorways is a 'tool-box' of systems and technologies which facilitates the dynamic control of traffic for congestion and incident management, allowing road space to be managed in different ways for varying conditions to maximise capacity.
Methodology	The specific approach and techniques used for a given study.
Mitigation	Measures intended to avoid, reduce and, where possible, remedy significant adverse environmental effects.
Mitigation Measures	Methods employed to avoid, reduce, remedy or compensate for significant adverse impacts of development proposals.

Term	Meaning
Monitoring	A continuing assessment of the performance of the project, including mitigation measures. This determines if effects occur as predicted or if operations remain within acceptable limits, and if mitigation measures are as effective as predicted.
Operational	The functioning of a project on completion of construction.
Operational Regime	The process by which a managed motorways scheme is operated. Different operational regimes may be deployed according to traffic conditions, in order to appropriately manage changing traffic flows safely and efficiently.
Ordnance Survey	Digital mapping agency of the British Isles.
Perception	The psychology of seeing and attaching value and/or meaning to something.
Plan	A document setting out the intention or intentions of the Overseeing Organisation.
Pollution	An increase of matter or energy to a level considered harmful to living organisms or their environment.
Preferred Option	The chosen design option that most successfully achieves the project objectives and becomes subject to further design and assessment.
Programme	A series of steps that have been identified by the Overseeing Organisation, or series of projects that are linked by dependency.
Project	One, or more, aspect of a programme or plan that has been identified by the Overseeing Organisation and which usually involves a direct physical intervention.
Receptor	A defined individual environmental feature usually associated with population, fauna and flora that has potential to be affected by a project.
Regulations	Official rules or acts to control something.
Relevant Project	A project that falls under Annex II of the Council Directive 85/37/EEC (as amended) and for which Determination is required.
Scenario	A picture of a possible future.
Scoping	The process of identifying the issues to be addressed by the environmental impact assessment process. It is a method of ensuring that an assessment focuses on the important issues and avoids those that are considered to be not significant.
Sensitivity	The extent to which the receiving environment can accept and accommodate change without experiencing adverse effects.
Significance of effect	A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.
Statutory	Related to legislation or prescribed in law or regulation.
Statutory Organisations	Any principal council for the area where the land is situated, Natural England, English Heritage, the Environment Agency; and any other public authority which has environmental responsibilities and which the Secretary of State considers likely to have an interest in the project.
Study Area	The spatial area within which environmental effects are assessed (i.e. extending a distance from the project footprint in which significant environmental effects are anticipated to occur). This may vary between the topic areas.
Technique	A specified working practice.
Threshold	A specified level in grading effects, for example, of magnitude, sensitivity or significance.
Through Junction Running	Managed motorways operational regime which allow drivers using the hard shoulder approaching a junction, to remain on the hard shoulder through the junction.
Traffic Modelling / Forecasting	The process used to estimate the number of vehicles using a specific section of road or defined network of roads.
Visual Amenity	The value of a particular area or view in terms of what is seen.
Zone of Visual Influence	Extent of potential visibility to or from a specified location, area or feature.

Abbreviations

Abbreviation	Meaning
ADS	Advanced Directional Sign
AHLV	Area of High Landscape Value
AL2	Address Layer 2
AM	Ante Meridiem – After noon
AMI	Advanced Motorway Indicator
AADT	Average Annual Daily Traffic
ADMS	Air Dispersion Modelling System
APIS	Air Pollution Information System
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
BDR	Barnsley, Doncaster and Rotherham Waste Plan
BMBC	Barnsley Metropolitan Borough Council
BS	British Standard
CSR	Comprehensive Spending Review
CCD	Cross Carriageway Duct
CCTV	Closed Circuit Television
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CoPA	Control of Noise Pollution Act
CRTN	Calculation of Road Traffic Noise
CM	Continuous Monitor
CSR	Comprehensive Spending Review
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DM	Do Minimum
DN	Do Nothing
DP	Delivery Partner
DS	Do Something
ESM1TAM	East Midland M1 Traffic Appraisal Model
EA	Environment Agency
EAR	Environmental Assessment Report
EAV	Enforcement Aspect Verification Camera
EC	European Community
EEC	European Economic Community
EH	English Heritage
EHO	Environmental Health Officer

Abbreviation	Meaning
EI	Electricity Interface
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Act
ERA	Emergency Refuge Area
ERT	Emergency Roadside Telephone
ES	Environmental Statement
EU	European Union
HADEC	Highways Agency Digital Enforcement Camera
HC	Hydrocarbon
HRA	Hot Rolled Asphalt
HSR	Hard Shoulder Running
HAPMS	Highways Agency Pavement Management System
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
IA	Important Area
IAN	Interim Advice Note
IEEM	Institute of Ecology and Environmental Management
J	Junction
LPA	Local Planning Authority
LTTE6	Long Term Trend Annual Projection Factor
LBS	Lane Below Signal
LED	Light Emitting Diode
LAQM .TG	Local Air Quality Management. Technical Guidance
LWS	Local Wildlife Site
LGV	Light Goods Vehicle
MS4	Motorway Signal Mark 4
MS3	Motorway Mark Signal 3
MIDAS	Motorway Incident Detection and Automatic Signalling
MAC	Managing Agent Contractor
MAGIC	Multi-Agency Geographic Information for the Countryside
MBC	Metropolitan Borough Council
MP	Marker Post
NE	Natural England
N	Nitrogen
NB	Northbound
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
NE	Natural England
NoD	Notice of Determination
NPPF	National Planning Policy Framework
NPSE	Noise Policy Statement for England

Abbreviation	Meaning
NTM	National Transport Model
NN NPS	National Networks National Policy Statement
NMA	Noise Making Authority
O_2	Oxygen
MPI	Major Project Instruction
PCF	Project Control Framework
PCM	Pollutant Climate Mapping
P4L	Permanent Four Lane Running
PIE	Public Information Exhibition
PM	Post Meridiem – After noon
PM_{10}	Particulate Matter with an aerodynamic diameter of less than 10 micrometres
PTZ	Pan Tilt Zoom camera
RoD	Record of Determination
RMBC	Rotherham Metropolitan Borough Council
SM	Smart Motorway
SM-ALR	Smart Motorway All Lane Running
SWAMM	Sheffield and Wakefield Area Motorway Model
SCC	Sheffield City Council
SGAR	Stage Gateway Review
SB	Southbound
SWYMMS	South and West Yorkshire Multi-Modal Study
TAME	Traffic Appraisal Modelling and Economics
TAG	Transport Appraisal Guidance
TRA	Traffic Reliability Area
TTMS	Temporary Traffic Management Signs
TWC	Thin Wearing Course
UK	United Kingdom
VoT	Value of Time
VP	View Point
VR	Visual Receptor
WHO	World Health Organisation
ZVI	Zone of Visual Influence
Measurements	
dB(A)	A weighted decibels
Bgl	Below ground level
ha	hectares
km	kilometre
km/hr	Kilometre per hour
m	metre
m^3	Metres cubed
m^2	Metres squared
$\mu g/m^3$	Microgram per metre cubed

Appendices

Appendix A – Design Change Log

Appendix B – Environmental Constraints Plan

Appendix C – Traffic Data and Hybrid Traffic Data Methodology

Appendix D – Air Quality Technical Report

Appendix E - Noise Technical Report