HIGHWAYS AGENCY

Safe roads, reliable journeys, informed travellers

Managed Motorways
All lanes running
Concept of Operations
(to accompany IAN 161/12)

An executive agency of the Department for Transport

Version Control

Version	Status	Date
0.1	Draft for HA review (Subject Matter Experts and Programme Board)	31 Jan 2012
0.2	Draft for Steering Group Review	5 March 2012
0.3	Draft for final comment by SRO	21 March 2012

Approvals

Version	Approved by	Date
1.0	Mike Wilson	23 March 2012

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1. Introduction

1.1 Purpose of Document

1 This Concept of Operations document sets out, at a high level, guidance around the operational elements of managed motorways designed to IAN 161/12. For convenience, this design will be known as MM-ALR (Managed Motorways – All Lanes Running) throughout the rest of this document). The intended audience for this Concept of Operations is all those who will be responsible for either the design or operation of MM-ALR schemes; including those involved in incident management or maintenance activities, as well as those involved with communicating MM-ALR to customers and stakeholders.

2 The material contained within this Concept of Operations is largely based on the experience gained by the Highways Agency and its stakeholders in operating those parts of the network with features similar to those proposed by the new design. These include managed motorway schemes with a dynamic hard shoulder (MM-DHS) designed to IAN 111/09; controlled motorways; and the wider APTR. This experience, combined with information on best practice gathered during consultation with both industry and subject matter experts, has led to the MM-ALR design set out in IAN 161/12, and this corresponding Concept of Operations.

3 The document also recognises that the Highways Agency is currently reviewing the way it will operate the network in the future, and as such has been deliberately written at a high level to introduce the concepts behind the physical design. It is not intended to set out detailed operational procedures or processes within this document – these will follow in due course.

4 The generic requirements contained within this document are intended to demonstrate how an MM-ALR scheme designed to IAN 161/12 can be safely operated and maintained. These generic requirements are given in black boxes. Reasons why the operation of a particular scheme might vary from this guidance must therefore be discussed with, and approved by, the scheme's Senior User (normally the Network Delivery and Development Directorate Regional Divisional Director) and recorded in the appropriate PCF products.

5 The specific Project Control Framework ("PCF") products that will be informed by this Concept of Operations are:

PCF Product	Relevant Chapters
Operating Regime	Chapter 3
Compliance Strategy	Chapter 4
Implications on Core Responders	Chapter 5
RCC Technology and Capacity Implications Report	Chapter 7
TOS Training Requirements	Chapter 7
Operational (RCC) Handover Documentation & Certificate	Chapter 7
Maintenance and Repair Strategy Statement	Chapter 6
Civils Maintenance (MAC) Handover Documentation & Certificate	Chapter 6
Technology Maintenance (TechMAC) Handover Documentation & Certificate	Chapter 6

1.2 Relationship to MM-ALR Implementation Guidance and other Documents

6 This MM-ALR Concept of Operations supports the Interim Advice Note IAN 161/12 that provides guidance on the design, construction, and implementation of MM-ALR[1].

7 The material contained within this document must be considered alongside existing standards, guidance and procedures governing how the strategic road network (SRN) is operated and maintained; the vast majority of which will continue to apply to an MM-ALR scheme.

8 Highways Agency documents of particular importance in this regard are:

- the *"Traffic Officer Manual"*;
- the HA/ACPO *"Network Operations National Guidance Framework"*;
- the *"Network Management Manual"*;
- the *"Routine and Winter Service Code"*;
- the *"Asset Maintenance and Operational Requirements"* [2];
- the *"Technology Management & Maintenance Manual"*;
- the HA/ACPO *"Traffic Incident Management Guidance Framework"*;
- the *"HADECS3 Implementation Guidance"*;
- the *"Highways Agency policy for the use of Variable Signs and Signals (VSS)"*.

9 A bibliography giving details of the latest version of all of the documents referenced within this Concept of Operations is available from the email address below.

1.3 Further Information or Clarifications

10 Any requests for further information, and comments or suggestions for changes to this guidance, should be sent to the following address:

MMOperations@highways.gsi.gov.uk

[1] Controlled All Lane Running (CALR) links within an MM-DHS scheme are covered by the relevant documentation for MM-DHS schemes even though those links do not themselves have a dynamic hard shoulder, as in all other respects they can be considered as MM-DHS where the hard shoulder is always open.

[2] AMOR is the replacement for the Highways Agency's current Routine and Winter Service Code and Network Management Manual (RWSC & NMM) in use by incumbent Providers. The AMOR represents a shift to a more outcome based approach, to encourage efficiency savings for the Highways Agency and innovation by the Provider, with no compromise to safety.

2. The Managed Motorways Design

2.1 The Case for Evolving the Managed Motorways Design

11 Evaluation of the M42 pilot[3,4] demonstrated that managed motorways are able to deliver clear benefits in terms of: improved journey time reliability through reduced congestion; at lower cost and with less environmental impact than conventional widening programmes; and without negatively impacting the safety performance. The subsequent programme to roll-out managed motorways with dynamic hard shoulders designed to IAN 111/09 (referred to throughout this document as MM-DHS) has delivered similar benefits to conventional road widening programmes, but at significantly lower cost. Experience from these schemes suggests that there is scope to further reduce both the capital and operating costs, whilst continuing to meet the congestion and safety objectives.

2.2 Design Features

12 The design features of an MM-ALR scheme (to IAN 161/12) include:

- Removal of the hard shoulder from the main line, and permanent replacement by a controlled running lane;
- Variable mandatory speed limits (VMSL) with an associated enforcement/compliance system;
- Driver information, including lane availability, provided at intervals not exceeding 1500m. Information will be provided through a mixture of signs and signals capable of displaying appropriate combinations of: mandatory speed limits; lane closure wickets; pictograms; and text legends, and will also include entry slip signals (ESS);
- A queue protection system and congestion management system;
- Comprehensive[5] low light pan-tilt-zoom (PTZ) CCTV coverage;
- Refuge areas provided at maximum intervals of 2500m. Refuge areas may either be bespoke facilities (e.g. an emergency refuge area, or ERA) or alternatively may be converted from an existing facility, for example a wide load bay. A Motorway Service Area (MSA), the hard shoulder on an exit slip/link road, or the hard shoulder of an intra-junction link may also be considered to provide a refuge;
- Emergency Roadside Telephones (ERT) provided in all dedicated refuge areas. Existing ERT elsewhere will be removed, apart from those within a junction where the existing hard shoulder is retained.

[3] "*M42 ATM Monitoring and Evaluation: Project Summary Report*" – Issued November 2009.

[4] *"M42 MM Monitoring and Evaluation – Three Year Safety Review"* – Issued January 2011.

[5] 'Comprehensive' coverage is defined in IAN 161/12 as "*the ability of operators to see in excess of 95% of the total scheme area in real-time". "Blind spots must not include ERAs, exit slip road refuges, ERTs, maintenance hard standings, viaducts or locations where it is not possible for a vehicle to leave the carriageway, for example, in the case of a breakdown".* CCTV coverage is provided to support event management, in line with TD17/85 and MCH 2530.

2.3 Key Features of the MM-ALR Design

13 The key feature of the MM-ALR design is the permanent replacement of the hard shoulder with a controlled running lane. Permanently removing the hard shoulder eliminates the complex operational processes associated with opening and closing the dynamic hard shoulder found on existing MM-DHS schemes. By extension, the hard shoulder monitoring cameras and the associated technology and systems used on MM-DHS schemes to confirm that the hard shoulder can be opened safely will not be required on future schemes, and do not form part of the MM-ALR physical design.

14 The permanent removal of the hard shoulder is expected to impact the management of incidents to some degree, as it will affect the ability to move broken down or damaged vehicles from the live traffic lane into a dedicated hard shoulder, or to use the hard shoulder as an emergency access route. Maintenance vehicle stops on the carriageway will now occur in live traffic lanes and will require appropriate Temporary Traffic Management (TTM).

15 Eliminating the dynamic hard shoulder element will serve to reduce any potential confusion over whether or not it is available as a running lane at a particular time, and will therefore eradicate hard shoulder abuse/misuse within the scheme (since there will no longer be a hard shoulder).

16 Refuge areas equipped with an emergency roadside telephone (ERT) are included in the design requirements at up to 2.5km intervals, providing a place for vehicles to stop in emergency or breakdown. The 2.5km spacing is consistent with the frequency with which lay-bys are provided on the all purpose trunk road network, as set out in TD 69/07[6]. Refuge areas can also be used to provide maintenance access, to commence the setting out of Traffic Management to Chapter 8, or to assist with the recovery of vehicles or removal of debris during incident management.

17 Provision of sufficient variable signing and signalling infrastructure is necessary to ensure that drivers receive adequate guidance of the mandatory speed limits and lane availability. Increasing the typical distance between consecutive information points, while migrating the majority of signalling information to verge mounted signs (rather than mounting lane specific signals on every gantry) is expected to make a significant contribution to both capital and operational cost savings[7].

18 Where strategic signing capability currently exists (including where driver information is provided through shared access to signs nominally provided for tactical use), that capability must be retained. This is because the signalling infrastructure necessary to safely operate a MM-ALR scheme is likely to be required for long periods of the day, making it unlikely that those signs will be available for strategic use when needed (see Section 5). The exact strategic signing capability that will be retained must be agreed for each scheme in discussions between TMD and the scheme's Senior User.

[6] TD 69/07: *"The location and layout of lay-bys and rest areas",* November 2007

[7] In comparison with the construction, operation and maintenance costs of a scheme designed to IAN 111/09

19 Creating and preserving the controlled environment on MM-ALR schemes will largely depend on the ability to achieve compliance with the posted speed restrictions and lane closures. The compliance and enforcement strategy is covered in more detail in Section 4.

20 Control room operators will have access to images from low-light CCTV cameras, positioned to provide comprehensive coverage of the managed motorway sections of the network. Operators will be able to use the CCTV images to remotely confirm incidents[8], as well as conduct general observation of conditions on the network.

2.4 Operational Implications of the MM-ALR Design

21 MM-DHS schemes currently in operation have successfully demonstrated how providing additional capacity where required can have a positive impact on metrics such as network performance, journey time variability, and safety.

22 The safe operation of all managed motorway schemes is dependent on delivering a controlled, compliant environment; which in turn encourages appropriate driver behaviour. The design features outlined in section 2.2 above are intended to ensure clear, appropriate and unambiguous information is provided to drivers, for example regarding speed limits or lane availability. Information must be delivered to the driver in such a way that it does not cause overload or leave the driver in doubt as to what behaviour is required of them. Simulator work has been used to provide a level of assurance that the design will perform as expected, prior to actual on-road implementation.

23 When compared to the MM-DHS design, the MM-ALR design is expected to deliver significant capital savings. This will be achieved in part through the reduced provision of technology assets, as well as completely eliminating the requirement for dedicated hard shoulder monitoring (HSM) CCTV cameras, and their associated control systems. There will also be a corresponding drop in civil infrastructure expenditure: with fewer gantries being required; fewer dedicated refuge areas constructed; and in many cases a reduced amount of near side vehicle restraint system needed - since there will be fewer assets to protect.

24 The MM-ALR design is also expected to reduce operational costs. Eliminating the need to check the dynamic hard shoulder is clear before opening it will remove this element of operational workload in the control room, which on current schemes is typically concentrated in the peak periods approaching the morning and evening rush hours. Reducing the amount of technology installed while improving the ability to remotely detect and repair faults will further reduce the costs of maintenance, though providing maintenance access without a dedicated hard shoulder will introduce certain challenges which are addressed further in Section 6.

25 Providing and preserving the controlled environment is expected to lead to fewer collisions, with lower typical severity. This will have a corresponding impact on the resources required for incident management. This is discussed further in Section 5.

[8] The MM-ALR design does not require RCC resource to conduct close monitoring of CCTV images solely for the purposes of incident detection.

26 Further resourcing benefits may be realised through increasing the centralisation of certain functions. This is not currently possible for MM-DHS schemes, given the need for localised operation of a dynamic hard shoulder.

27 With the majority of driver information now being provided through verge-mounted signing and signalling (as opposed to solely through overhead gantries), both the frequency of traffic management associated with offside lane closures and the challenges of conducting routine repair and maintenance of infrastructure positioned above live lanes are expected to reduce significantly. The MM-ALR design ensures that the additional capacity provided by the extra lane is available by default, meaning there are no critical technology faults that would prevent the extra lane from being made available to traffic.

28 Unlike MM-DHS schemes, the additional capacity will be available at all times, without necessarily requiring speed restrictions to be implemented.

29 The MM-ALR design is not fundamentally different to those sections of the existing motorway network that do not have a hard shoulder. However, it has the added advantage of providing technology to detect and monitor events that are happening on the network, coupled with dedicated systems able to communicate appropriate advice or instructions to drivers, such as lane availability or mandatory speed limits. When these are used together, they help to create the necessary controlled, compliant environment.

2.5 Lane Referencing Terminology for MM-ALR Schemes

General Requirements

1. MM-ALR schemes will use the conventional lane referencing terminology of Lane 1, Lane 2, ..., Lane n; numbering from the left to the right in the direction of travel (nearside to offside).
2. MM-DHS schemes where the hard shoulder is used dynamically as a running lane will continue to use specific lane naming terminology, referring to “lane below signal” to unambiguously number the lanes. This results in LBS 1 (Lane Below Signal 1) for the hard shoulder, LBS 2 for lane 1, LBS 3 for lane 2, etc.
3. This terminology must be retained for any scheme with a dynamic hard shoulder.

3. Operating Regimes

30 The following operating regimes describe, in broad terms, how a generic MM-ALR scheme built to IAN 161/12 would be operated under 'normal' conditions, during both the peak and off-peak periods[9].

31 They set out the principles of how the Highways Agency will respond to certain circumstances in order to ensure the benefits of the scheme are realised.

32 The scenarios outlined below do already exist on the network. For example, there are sections of motorways without a dedicated hard shoulder, and this environment is typical on the APTR network. Maintenance work is conducted on these sections, and incidents do occur and are managed. Therefore in many cases, the existing policy and procedures used in these situations will either already be sufficient, or will only require slight modification or extension.

3.1 Off-Peak Operation

33 The off-peak period is expected to occur typically on weekdays; starting in the evening, and continuing overnight. Off-peak conditions may also apply throughout the weekends; or between the morning and afternoon peak periods (the "inter-peak"), depending on the location and traffic patterns.

34 During off-peak operation traffic volumes will be low. With all lanes available for traffic to use, headways will be large, with traffic flowing freely. The national speed limit will apply, and electronic signs and signals will not be required for purposes relating to the operation of MM-ALR, and as such will remain blank (if not required for other, non-managed motorways related purposes such as strategic signing, or campaign messages, etc).

35 There are no specific generic requirements introduced by an MM-ALR scheme during these periods of off-peak operation, (over and above the normal roles and responsibilities of operational staff). The off-peak period provides the most appropriate conditions to perform maintenance or other activities that may impact network availability, without unduly compromising network performance.

3.2 Operation During Peak Times

36 The peak period will usually occur on weekdays: typically starting in the morning and extending into the early evening. Certain locations may also routinely experience peak conditions outside of these times – this will be apparent from the traffic flow profiles which will be generated as an early deliverable by scheme designers and recorded in the Operating Regime PCF product.

37 During peak times traffic volumes will be higher. The extra capacity provided by the conversion of the hard shoulder to an additional running lane may help to increase headways, but on occasions, flow breakdown may still occur.

[9] Management of 'abnormal' conditions, including the presence of debris or broken down vehicles, abnormal load movements, severe weather, and road works are addressed in Chapter 5 of this document.

38 The queue protection system will continuously monitor the flow of vehicles, and when necessary the congestion management system will trigger the automatic setting of appropriate mandatory speed restrictions, applicable to the entire carriageway, in an attempt to first prevent, and subsequently limit the effects of flow breakdown.

39 Appropriate supporting information will be displayed on the variable message signs to further encourage compliant driver behaviour. Modifications to the signal control software will enable a single variable message sign to display three simultaneous elements: in addition to the speed restriction and supporting text legend, the sign will also be able to display either a warning pictogram (typically a 'red triangle') or lane closure 'wicket' aspect, as indicated in the examples below.

40 RCC Operators will be able to remotely monitor network conditions, confirm incidents and (where they are visible) verify signal settings by utilising the comprehensive PTZ CCTV coverage provided throughout the scheme. The MM-ALR design and operation does not of itself require additional close monitoring for schemes, although given that MM-ALR schemes tend to be on the busiest parts of the network, TMD may consider them higher priority in terms of supervision and monitoring.

41 All message signs will retain the capability to display a higher priority message should the need arise. Newly approved messages will be incorporated into the VMS message prioritisation hierarchy prior to the first MM-ALR scheme becoming operational.

42 When variable message signs are in use to display combinations of variable speed limits, wickets or pictograms as illustrated above, they will not be available to display text associated with strategic traffic management or driver information. This is because of the potential confusion for road users if the tactical information is displayed on the same sign as strategic information.

Generic Requirements

1. To ensure that the strategic signing capability is not lost during the peak hours of operation, wherever strategic VMS existed within an MM-ALR scheme area before the scheme was built, provision will be retained (although not necessarily in the same location within the link).
2. Where 2x12 or 2x16 VMS existed before the scheme was built to provide NTOC with a Strategic Traffic Management or Driver Information capability, this capability should be retained. The exact level of provision will be agreed on a scheme by scheme basis, in discussions between TMD and the Scheme Senior User. Any signs provided to retain the strategic capability must be prioritised for strategic use within the message hierarchy.

43 One key difference between a conventional and managed motorway is that any speed limit(s) displayed within a managed motorway scheme will be mandatory, whereas on a conventional motorway they are advisory. The speed limit will be enforced using strategically positioned HADECS cameras able to detect and record speeding offences and initiate the prosecution process. It is therefore critical that the displayed speed limit is appropriate to prevailing traffic conditions to protect the credibility of the system and enforcement regime.

Generic Requirements

1. The congestion management system will determine the speed limit(s) necessary to keep traffic flowing smoothly;
2. Where a speed restriction is generated, signals and/or message signs will display mandatory speed limits as appropriate. Where the national speed limit is in operation, the signs and signals will either be blank, or will display the standard national speed limit symbol (as defined by the signalling rules). For a gantry housing lane specific signals, the same speed limit must be displayed above all the open lanes of a particular carriageway[10];
3. Although DMRB permits a maximum drop in the speed limit displayed on consecutive signals of 30mph; for safety reasons, operational policy is that the speed limit should not drop by more than 20mph. There may be instances on MM-ALR schemes where the distance between signals makes even a 20mph drop in speed limit undesirable. The Scheme needs to consider this issue when preparing the Operating Regime PCF product;
4. When a primary signal is set, the signal sequencing rules will result in appropriate secondary supporting information being automatically set, based on the primary settings and the distance between signals;
5. Configuration settings for the queue protection system will be tuned and reviewed regularly to ensure that appropriate speed limits continue to be set. RCC operators should note any instances of inappropriate speed limits so that these can be considered as part of this review, for example, sections where queues on the exit slip routinely build back onto the mainline generating speed limits over all lanes where the offside lane is free flowing. This is particularly important on a managed motorway given that speed limits are mandatory and there is a requirement to protect the credibility of the enforcement regime;
6. In an emergency, drivers can exit the network at the next available downstream junction, or stop in a refuge area. The hard shoulder adjacent to an exit slip may also be considered to provide a safe location to stop, however they will not usually be fitted with an ERT;
7. There will be no automatic alert to RCC operators whenever a vehicle enters or leaves an ERA[11], however the driver will be instructed by fixed signs in the ERA to contact the RCC using the ERT. Operators will be able to monitor the vehicle using CCTV, and if necessary dispatch a TOS patrol and/or set signs and signals to assist the vehicle's safe exit.

[10] With the exception of lane specific signal gantries which span multiple carriageways – for example those at complex junctions which extend across both the mainline carriageway and a parallel exit slip road or diverge.
[11] There is no automatic alert to the RCC when a vehicle enters an ERA because there is no dynamic lane alongside the ERA for the RCC to manage as there is in the MM-DHS design, and provision of the alert does not mitigate any specific hazards. This is in line with the rest of the network, where there is no automated alert if a vehicle enters the hard shoulder or lay by. There is no requirement for the RCC to monitor an ERA unless alerted via the ERT or some other means that they need to do so.

4. Compliance and Enforcement

44 A compliant environment is one in which drivers understand what is expected of them and behave accordingly. This is particularly important with MM-ALR, where speed limits and lane configurations change dynamically, and where the controlled environment provides the mitigation for some of the hazards associated with removing the hard shoulder.

45 In undertaking the design, Designers must have due regard for the operation of the scheme and must ensure that the creation of a compliant environment is undertaken in a holistic way for the entirety of the scheme, the lead-in from the section immediately upstream and the lead-out into the next adjacent section downstream.

46 In designing for and evidencing that compliance can be achieved, Designers should consider the application of the 4 E's (Engineering, Education, Encouragement and Enforcement) and how, when considered together, these will achieve a compliant and operable environment that meets the scheme objectives.

4.1 Compliance Issues Specific to MM-ALR

47 MM-ALR raises a number of specific issues:

Area of potential Non Compliance	Comment
Exceeding Variable Mandatory Speed restrictions	Does not arise on a conventional motorway where speed limits are advisory
Driving under Stop Indicator (Solid Red X) signals displayed above running lanes, or past closures set using wickets on a message sign	Potential for more abuse on an MM-ALR scheme due to the greater volume of signals and higher propensity for their use
Non emergency stops in Emergency Refuge Area (ERA)	Does not arise on a conventional motorway, although unauthorised stops on the hard shoulder are observed

4.2 Achieving Compliance on Individual Schemes

48 Each MM-ALR scheme is required to produce a Compliance Strategy, which must highlight exceptions to the "HADECS3 Implementation Guidance". This Project Control Framework (PCF) product will define the actions being taken by the scheme to ensure that an appropriate level of compliance is achieved.

49 The advice in the "HADECS3 Implementation Guidance" regarding the deployment of enforcement cameras, coupled with the generic compliance strategy form part of the work of NetServ and the Emergency Services Liaison Team. The advice must be complied with unless exceptional circumstances warrant a departure, that is: agreed by the Scheme Senior User; does not conflict with the documented enforcement agreements; and is accepted by the prosecuting authorities.

Generic Requirements

1. The Compliance Strategy PCF product must start with an assessment of the potential for non-compliance with specific rules, and identify any safety hazards that non-compliance would affect.
2. The above assessment should take account of aspects such as: the physical characteristics of the road; the proportion of different vehicle types expected to use the scheme; and levels of motorist familiarity with managed motorways, recognising that the latter two may vary by time and day.
3. The assessment must consider the potential impact not just on the scheme itself, but also on adjoining stretches of road.
4. The Compliance Strategy must consider engineering, education, encouragement and enforcement measures that could be deployed to improve compliance.
5. Compliance with signs and signals improves when drivers understand why they have been set. Wherever possible, supporting information (pictograms or text) will be set on the message signs to explain why lane closures and/or reduced speed limits have been implemented.

4.3 Agreements with Enforcing Bodies

50 The HA's Emergency Services Liaison Team has agreed a National Enforcement Strategic Agreement between the Highway Agency, the Association of Chief Police Officers (ACPO), the Crown Prosecution Service (CPS) and Her Majesty's Courts Service (HMCS) on the enforcement regime for contravention of Variable Mandatory Speed Limits.

51 The intention is that the processing of offenders is conducted by one or two centralised Police Fixed Penalty Offices within a given region. Likewise, the payment of fixed penalties will be centralised into one or two Court Offices and the prosecution of offenders in one or two Magistrates' Courts per region. Processing will be done regionally to encourage consistent standards. Regional Enforcement Coordinators within NDD Directorate will be responsible for managing the evidential trail to ensure that variable mandatory speed limits can be enforced; and for maintaining local Memoranda of Understanding (MoU) with the Police, which will be set up during scheme handover.

52 A jointly agreed MM Enforcement National Guidance Framework (ENGF) document sets out the national principles, processes and procedures for enforcement. This framework forms the baseline for local agreements.

4.4 Achieving Compliance with Specific MM-ALR Features

4.4.1 Variable Mandatory Speed Limits

Generic Requirements

1. Variable Mandatory Speed Limits (VMSL) will be enforced through the Highways Agency Digital Enforcement Compliance System (HADECS).
2. The HA will reimburse the local Police Forces, Courts Service, and Crown Prosecution Service (as appropriate) for the resource to process and prosecute Variable Mandatory Speed Limit offences on MM-ALR schemes. The enforcement of the national speed limit will remain at the discretion of the local Police Force.
3. Each scheme will need to consider how many HADECS cameras it requires and where they should be deployed. This must be in accordance with the "HADECS3 Implementation Guidance".
4. If the RCC identify or are made aware of instances where automatically set speed limits are not credible or appropriate to traffic conditions, they should take immediate action to remove or amend those speed restriction settings. Where displayed limits are clearly not reasonable, compliance will be affected both on the link on which they are signed, as well as potentially on nearby links.
5. Once an incorrect or inappropriate sign has been removed, the RCC should notify both the Police, so that compliance with speed limits is not enforced during this period; and Traffic Technology Division, so that the cause of the incorrect setting can be investigated.
6. The Police may refuse to enforce limits that are clearly not reasonable, or which regularly lack credibility in their setting.

4.4.2 Red X (Stop) Signals on Gantries and Lane Closure Wickets on Message Signs

Generic Requirements

1. As with the rest of the network, any enforcement of Red X (Stop) signals will need to be carried out by the Police at the scene, as there are currently no Home Office type-approved automated enforcement devices available.
2. Similarly, Police at the scene may prosecute drivers for dangerous driving offences, including failure to comply with lane closure wickets. Full carriageway closure wickets are mandatory when accompanied by flashing red lanterns.

4.4.3 Non Emergency Stops in ERAs

53 Data collected from MM-DHS schemes indicates that refuge areas are occasionally used for non-emergency (and therefore unlawful) stops. However, evidence from those sections of the network where there is reduced provision for stopping (such as through road works, on bridges, or on elevated sections of road) shows that the location of refuge areas can influence the frequency of vehicle stops, according to whether they are seen as a desirable place to stop by the public. It is anticipated that MM-ALR schemes will experience a reduced breakdown rate compared to the levels observed before the scheme was built. The hazards associated with the entry, occupancy and exit of ERAs are also a factor that has been considered in determining their provision within the MM-ALR design.

Generic Requirements

1. Engineering design will have a particular impact on the appropriate use of Emergency Refuge Areas, given their potential attractiveness to drivers as a place to make short duration stops. Observed examples of non emergency (and therefore illegal) use include drivers stopping for phone calls, comfort breaks, map reading, tachograph breaks, etc.
2. Education of road users is an important tool to remind them of the lawful purposes of ERAs, and of the dangers inherent in making stops in ERAs for non-emergency use. Scheme designers should consider the make-up of road users of their scheme to understand what type of non-emergency stops might be expected. For example, evidence suggests that where freight users constitute a high proportion of traffic, ERAs may be used more frequently for tachograph breaks. These issues must be addressed in Schemes' Communications Plans.
3. The MM-ALR design requires each emergency refuge area to be fitted with a pair of fixed "No stopping except in emergency" signs, to further discourage unlawful use.

5. Management of Incidents and other Heightened Situations

54 Experience has shown that creating and maintaining a controlled driving environment can result in a reduction in both the frequency and severity of collisions. However, with the removal of the hard shoulder, the number of live lane obstructions is expected to increase, since a proportion of the vehicles that would previously have stopped on the hard shoulder will now be unable to reach the next refuge area or exit slip, and will therefore have no option but to stop in one of the live lanes.

55 Once an RCC operator is made aware of an incident (whether through an automated alert from the queue protection system, a phone call, or by some other means) the CCTV cameras can be used to validate the location and confirm the key features of the incident.

56 The RCC operator then has the ability to set a lane closure pattern with supporting information messages and appropriate reduced mandatory speed limits. This will warn approaching drivers of the potential hazard, enabling them to safely reduce their vehicle's speed to appropriate levels whilst merging into the remaining available lanes past the scene.

5.1 Dealing with Incidents - Key Differences on an MM-ALR Scheme

57 On both MM-DHS and MM-ALR schemes, as compared to a conventional motorway, there is a greater need for agreements (see Section 5.2) and communications between the Highways Agency, and the other "Core Responders". In this context, the Highways Agency includes the RCC and on-road Traffic Officer Service, Service Providers and their traffic incident management vehicles, the National Vehicle Recovery Manager and any other parties contracted by the HA. The other Core Responders include the Emergency Services, Vehicle Recovery Services and Motorist Assistance Organisations involved in responding to or otherwise managing an incident.

58 This greater need for commonly agreed processes and procedures arises due to the different operating environments encountered between managed motorway schemes and conventional motorways. The increased deployment of technology on the network provides staff in the relevant control rooms with greater knowledge of what is happening during incidents on the strategic network, as well as the opportunity to assist the on-road response by setting supporting signs and signals and providing information to core responders, even while they are still en-route to the scene.

59 As with incidents on any road, the management process can be considered in four distinct phases, namely: Incident Detection; Responder Access; Incident Management; and Network Restoration.

60 From the perspective of responding to and managing incidents and other 'unusual' situations, the main differences between standard three lane motorways (D3M), MM-DHS schemes and MM-ALR schemes are:

- *Incident detection:* A change in incident profile – the controlled environment and additional capacity mean there is likely to be a reduction in the severity of incidents on MM-ALR when compared to D3M; however most incidents will now affect a live lane. During busy periods, a live lane obstruction will quickly cause traffic to slow down, with the resultant queues detected by the queue protection system. This will set message signs designed to help prevent secondary incidents and may also serve to alert the control room. Comprehensive CCTV camera coverage will enable the details of an incident to be determined quickly from the control room and allow additional signs and signals to be set to further protect the scene. As with any live lane incident, details should be passed to NTOC for onward dissemination;

- *Responder Access:* Due to the permanent replacement of the hard shoulder with a controlled running lane, responders will need to attend incidents without making use of a dedicated hard shoulder. Signs and signals can be set to facilitate incident access by whichever lane is most appropriate;

- *Incident Management:*
    - Mandatory Speed Limits, whether automatically generated by a queue protection system, or manually set by the operator, help to create and maintain a controlled environment to protect those involved in managing the incident;
    - Mandatory Speed Limits may be shown on either signs or signals, with consecutive information points provided at maximum intervals of 1500m;
    - Using verge mounted signs provides operational flexibility, as the speed restriction can be accompanied by appropriate combinations of lane closure wickets, pictograms, or text on a single piece of infrastructure;
    - Information and instructions displayed on the verge mounted signs are applicable to the entire carriageway;
    - The lack of hard shoulder will mean that the RCC may be requested to set signs and signals, for example to protect a lane for police/TOS to stop or escort vehicles, or to assist with the recovery of a live lane obstruction;

- *Network Restoration:*
    - With no hard shoulder, a greater proportion of incidents will now be expected to impact live lanes;
    - Vehicles and debris will need to be recovered to an off–carriageway location, due to the absence of a hard shoulder;
    - Refuge areas may be utilised as temporary off-network storage locations, and will be provided at intervals not greater than 2.5km. This requirement will typically result in the provision of at least one refuge area per link.

Generic Requirements

1. Variable signs and signals are the primary mechanism through which the RCC can control traffic on a managed motorway.
2. Before the lanes that are affected by an incident are confirmed, all signs and signals must be non lane specific (i.e. the same advice must apply to all lanes). Current policy[12] dictates that until a report is confirmed, a 50mph restriction is put in place, supported by message signs bearing a legend such as “Incident”.
3. Once the lanes that are affected by an incident have been confirmed, lane specific closures will be set on the most appropriate signals (for example displaying a ‘wicket aspect’ signal on a verge mounted variable message sign, or lane specific signals on gantries to indicate the lane closure pattern).
4. Once a lane closure has been set, the signal sequencing rules will set secondary signals (upstream lane divert signals and appropriate speed restrictions across all lanes).
5. At any time RCC operators may override an automated speed restriction with a lower speed limit.
6. RCC Operators should ensure that all appropriate signs and signals are set (or cleared) according to the requirements of the Lead Responder on scene.
7. The provision of signs and signals on MM-ALR means that many drivers will be able to see messages even if they are stationary. This increases the potential benefit from signing as compared to a conventional motorway, as it enables the Highways Agency to communicate with trapped traffic following an incident.

[12] “Highways Agency policy for the use of Variable Signs and Signals”, December 2011

5.2 Emergency Responder National Agreements and Guidance

5.2.1 National Agreements

61 Responding to incidents on MM-DHS and MM-ALR schemes requires a collaborative approach that reflects the national character of the managed motorways programme.

62 To support the above, the Highways Agency has established the following national level agreements, which have been jointly agreed by the Highways Agency and the Association of Chief Police Officers, the Chief Fire Officers Association and the National Health Service Ambulance Chief Executive Group:

- The **National Strategic Agreement** establishes broad based principles of operation and communications with the Emergency Services, including how the Emergency Services will access and respond to incidents on a managed motorway, and the response to other heightened situations (e.g. vehicle escorts, forced stopping of vehicles);
- The **National Guidance Framework** (NGF) document takes the principles encapsulated in the National Strategic Agreement and expands them into a set of operational requirements and procedures that are agreed with the Emergency Services. The audience for the NGF is those at a senior operational level responsible for delivering these services in the new environment.

63 The NGF contains guidance covering areas including: the roles and responsibilities of the Highways Agency and the Emergency Responders on managed motorways; dealing with incidents on managed motorways from the point of view of the core responders; escorting convoys through managed motorway schemes; and stopping vehicles on managed motorways.

5.2.2 Regional and Scheme Level Agreements

Generic Requirements

1. Each scheme must establish suitable regional agreements with the Emergency Services. These agreements should replicate the principles of the NGF, unless a strong justification can be provided to deviate from them. Any variance must first be agreed with the HA Traffic Management Directorate, and subsequently approved by the Scheme's Senior User.
2. The preference is for each region to have a single agreement, signed by all three of the Emergency Services, as an addendum to the existing "Detailed Regional Operational Agreements" that were set up when the Traffic Officer Service was created. However, it is recognised that this may not be possible or desirable in all cases, and that individual agreements with the Police, Fire and Ambulance services separate from the existing Detailed Regional Operational Agreements may be necessary in exceptional cases.

3. Regardless of the precise form, these agreements will need to take the principles of the National Guidance Framework, apply them to the characteristics of the individual scheme, and record the agreed operating practices based on scheme-specific requirements. It is anticipated that these agreements would record acceptance of the NGF principles apart from where specific exceptions are deemed necessary; these exceptions must be included in the "Implications on Core Responders" PCF product.

5.3 Ability to Confirm Incidents

64 The "Highways Agency policy for the use of Variable Signs and Signals" states that lane specific signals and VMS messages related to an incident can only be set once the location and the lanes that are affected by the incident have been confirmed by an approved source agreed by the Traffic Officer Service (these approved sources include a police officer, Traffic Officer, traffic incident management vehicle at the scene, MAC or TechMAC, NTOC or identified via CCTV).

65 This policy is designed to ensure the lane specific messages that are set represent the correct lane blockage pattern.

5.4 Broken Down and Abandoned Vehicles

66 Traffic Officers have powers under the Removal and Disposal of Vehicles (Traffic Officers) (England) Regulations 2008 that enable them to deal with vehicles that have broken down and are either causing an obstruction or danger to others; are in contravention of a restriction or prohibition; or appear to have been abandoned without lawful authority. Where there is no police interest in the vehicle, drivers are given a "reasonable" time to organise their own recovery. If suitable arrangements are not made, a statutory removal may be invoked by Traffic Officers.

67 As an MM-ALR scheme has no hard shoulder, all lanes are live lanes. Any vehicle that is unable to leave the main carriageway (by stopping in a refuge area or continuing to the next exit slip road), will by definition become a live lane breakdown. Since this will inevitably cause an obstruction, the vehicle will therefore be a candidate for an immediate statutory removal.

Generic Requirements

1. If Traffic Officers are suitably trained and equipped (e.g. with an appropriate vehicle type), they should, if possible, clear the broken down vehicle to the nearest place of safety, for example: a refuge area; a nearby motorway service area; or a downstream junction or exit slip road.
2. If a vehicle has broken down in a live lane, it meets the definition of causing an obstruction or danger to others, and therefore statutory powers of removal should immediately be invoked if it cannot be cleared. If the Traffic Officer is unable to remove the vehicle, specialist support will be required from, in the first instance, the National Vehicle Recovery Manager[13].

[13] Or any subsequent replacement contract.

3. If a vehicle is broken down in, or cleared to, a refuge area or the hard shoulder of a slip road, the on road TOS patrol, as for any other road, should make an assessment of the obstruction or danger posed by that vehicle to determine whether a statutory removal is justified, or whether "owners choice" of vehicle recovery can be used.

5.5 Debris

68 As elsewhere on the network, debris is categorised as either that requiring immediate collection, (e.g. debris of a distressing or hazardous nature), or routine debris, (e.g. tyre or exhaust debris).

Generic Requirements

1. For "immediate collection" debris, an incident assessment will be made by the attending Traffic Officer who will determine whether the debris should be removed to the edge of the carriageway (or verge), or left *in situ* awaiting removal by the maintenance service provider.
2. If the debris is to be left *in situ,* the TO must remain at scene, and appropriate live lane procedures deployed.
3. If the debris is to be left at the edge of the carriageway, the TO will need to return to support the Service Provider.
4. For "routine collection" debris, the TOS may need to deploy a rolling road block to temporarily hold traffic while the debris is removed to the verge and placed near to a marker post. The Maintenance Service Provider will return in periods of lower flow, or when other maintenance work requires lane closures to collect the debris. Supporting signs and signals will be set, as per agreed procedures, by the RCC.

5.6 Abnormal Loads

Generic Requirements

1. Managed motorways do not fundamentally affect the preferred times or routes for abnormal loads and normal guidance should be followed in scheduling such movements on an MM-ALR scheme. As for other parts of the network, deviation from the agreed routes must not be made without appropriate consultation[14].
2. Managed motorways provide significantly enhanced capabilities to monitor the movement of the abnormal load. The NTOC will have (if possible) established communication with the driver of the abnormal load, and the RCC should communicate via the NTOC to ensure that the driver is aware of downstream traffic conditions, and to facilitate communication should an incident occur.

[14] For Special Order Movements no deviation from the agreed route should be made without consultation with the Highways Agency. For all other abnormal loads, no deviation from the agreed route should be made without consultation with the Police Abnormal Loads Officer and/or Highway and Bridge authorities or RCC Team Manager outside office hours. Any deviation must be considered suitable by them before being used.

5.7 Severe Weather

Generic Requirements

1. The combination of message signs capable of displaying lane closure 'wickets' with supporting text and pictograms, coupled with the ability to implement mandatory speed limits, provides the operator with useful tools to mitigate the impacts of severe weather on traffic.
2. Where emergency services or road workers are working on the carriageway in very severe weather conditions, it may be appropriate to manually set low speed limits.
3. Certain weather conditions (e.g. fog, heavy rain) can reduce visibility and increase the risk of accidents. This risk is primarily related to excess speed. If drivers are driving slowly due to the conditions, the queue protection system will automatically set speed restrictions to reduce the associated risk of accidents. More information regarding the use of message signs to communicate abnormal weather information is contained within the "Highways Agency policy for the use of Variable Signs and Signals".
4. The Severe Weather Plan (SWP) that must be produced by each Asset Support Contractor describes the procedures and operational arrangements necessary for the delivery of an effective winter service, and as such must identify network features (such as managed motorway sections or ERAs) or local issues (such as high altitude or steep gradients) which require special consideration.
5. The Severe Weather Plan must also define the process for snow clearance, for example by setting out the number of lanes which must be kept clear for a particular route, and the order in which lanes should be cleared if a 'phased' approach is followed. Message signs and signals can be utilised to display warning information, or inform motorists if certain lanes are not available for use.

5.8 Road Works Management

Generic Requirements

1. As on the rest of the network, road works will generally be scheduled to take place at times that minimise the impact on traffic. This means works will generally happen at night; in periods of lower flow in the middle of the day; or at weekends. As these periods are dependent on traffic flows, they will need to be agreed on a scheme by scheme basis adopting the principles of 'Working Windows'[15].

[15] 'Working Windows' is a road works management tool which uses historic data to predict lane demand through road work schemes. This allows for lane closures to be planned so as to cause minimal congestion, thereby reducing delays and other impacts of congestion.

2. During road works the contractor may request that the RCC set signs and signals to support the set up, modification or removal of Traffic Management. The policy governing requests from contractors for signal settings is currently being considered by the Highways Agency, and is set out in Annex F of IAN 162/12, the *"Highways Agency policy for the use of Variable Signs and Signals*

6. Maintenance of Highway and Technology Assets

6.1 Impact of MM-ALR on Maintenance

69 MM-ALR schemes are comprised of a specific mix of technology and civil infrastructure. These assets require regular maintenance in order to remain operational and deliver the operational and safety benefits required of the scheme. However, the scheme's design itself changes how Maintenance Service Providers carry out maintenance, due to factors including:

- the pressure of road space booking arising from the increase in roadside infrastructure and field electronics; and
- the lack of a hard shoulder from which to carry out maintenance, or set out Traffic Management.

70 Designers have a statutory duty through the Construction (Design and Management) Regulations 2007 to reduce health, safety and welfare risks for, amongst other things, the maintenance of completed highway schemes.

71 The following section gives generic guidance on issues to be considered by designers and maintenance service providers in the design and maintenance of schemes. Each scheme must undertake its own specific review of the hazards associated with maintenance, and ensure that the scheme has been designed and can be operated and maintained so that the risks are As Low As Reasonably Practicable (ALARP).

6.2 Design and Build for Maintenance

72 With the replacement of the hard shoulder by a controlled running lane, all maintenance activities within a MM-ALR scheme will need to be carried out either from a designated area for maintenance (e.g. a refuge area or maintenance hard standing), or from a lane closure under traffic management.

73 To reduce the number of lane closures for maintenance, schemes must consider at the design stage what maintenance will be needed, and the ways in which maintenance can safely be performed. This consideration should include the following items, which are not an exhaustive list, as each scheme will have specific local issues:

6.2.1 Removal of Assets

74 In order to reduce risk to maintainers (and to support design for maintenance) designers must catalogue all the assets that are currently installed within the scheme, identify all redundant or potentially redundant infrastructure, and assess whether it should be removed. As is the policy for the rest of the network, non-essential infrastructure or technology, including soft estate, should be removed.

75 To support the setting out and removal of traffic management, remotely operated traffic management signs may be permitted following the introduction of a fourth running lane, however the inclusion of a new gantry leg in the central reserve is not permitted if a super-span gantry could be used.

76 Assets that could be *removed* include, but are not limited to:

- Fixed signage, marker posts, barriers, lighting, fog sensors, signs & signals and ramp metering sites.

6.2.2 Re-Positioning of Assets

77 Designers must assess all existing assets to ascertain whether any could be repositioned to enable their maintenance activities to be conducted either off network, or from within a designated area for maintenance. Where appropriate, items located in the former hard shoulder (such as manhole covers) should be removed from what will become a permanent running lane. The capital cost of moving the items should be weighed against the operational costs and risks of maintenance, and the associated loss of capacity over the life of the scheme.

78 Assets that could be *repositioned* include, but are not limited to:

- ANPR cameras, CCTV Cameras, Environmental sensors

6.2.3 Combining Asset Locations

79 When installing new assets, designers must consider co-locating them to enable multiple maintenance activities to be undertaken within the same deployment of Temporary Traffic Management. The capital cost of co-locating items should be weighed against the operational costs and risks of maintenance and the associated loss of capacity over the life of the scheme.

80 Assets that could be *combined in a single location* include, but are not limited to:

- The cabinets for technology assets. These cabinets could be co-located next to each other or even share the same cabinet (reducing the quantity of cabinets required).

6.2.4 Renewal of 'Problem' Assets

81 Designers must work with the existing maintenance service provider to identify whether any existing technology assets are known to either be unreliable; or have unreasonably short maintenance intervention intervals, and should consider replacing those assets with more reliable alternatives or components requiring less frequent maintenance.

82 Assets that could be *renewed* include, but are not limited to:

- VMS Signs & Signals, CCTV cameras, ANPR cameras, ERT

6.2.5 Accessibility of New Assets for Maintenance

83 Designers should ensure new assets are positioned to facilitate maintenance access. This could include locating components off network, in refuge areas, or within a designated area for maintenance. This may mean additional assets are required in certain circumstances, but improving maintenance access is expected to deliver an overall safety and operational benefit. Designers should also consider providing mechanical access facilities to assets as part of the design.

84 In accordance with current standards (IAN 86/07) gantries must not be provided with a fixed means of access for inspection and maintenance. A departure from standard will be required if a fixed means of access is required.

6.2.6 Bring Forward Renewal Programmes

85 In advance of the MM-ALR scheme construction, the Highways Agency, designers and maintenance providers should consider undertaking maintenance interventions that are scheduled to take place during (or shortly after) the implementation of the MM-ALR scheme,.

86 Assets should be left with a minimum life span (to be agreed with the Senior User, but likely to be 3 to 5 years) after the scheme has gone live.

6.2.7 Utilise Low Maintenance Items

87 Designers should consider the use of longer life and/or low maintenance items and assets where they will need to be replaced or installed as part of the scheme. This consideration should also include assets that have extended reactive maintenance periods (e.g. curing of concrete on bridge repairs) as this will greatly reduce planned and reactive maintenance requirements.

88 Assets that could be renewed include, but are not limited to:

- Road studs, road markings, structures, bridges, central reserve barriers.

6.2.8 Reduce Site Visit Requirements

89 Designers must, in designing for maintenance, make every effort to reduce or eliminate the need for roadside maintenance activities for new and existing equipment on the mainline carriageway, including making use of remote fault diagnosis facilities. Wherever possible, maintenance and repair should be undertaken away from the network

6.2.9 Improved Installation Techniques

90 Designers and Maintenance Service Providers should review the technology assets to be installed, and consider methods to enable easier/quicker swap out of faulty equipment to reduce the time spent performing maintenance actions.

6.3 Operation and Maintenance

6.3.1 Guiding Principles for Maintenance

91 The Asset Maintenance and Operational Requirements (AMOR) and The Technology Management & Maintenance Manual (TMMM) together set out the HA's requirements in relation to the carrying out of maintenance and operational activities on the network. These documents replace the Network Management Manual (NMM) and Routine & Winter Service Code (RWSC).

92 Contained within the AMOR and TMMM specifications is the requirement that the Maintenance Service Provider must adopt a risk based approach to the execution of maintenance and operational activities, in order to deliver value for money whilst demonstrating that risks are acceptably mitigated with no detriment to the safety of either road users or road workers.

93 The AMOR defines the primary risks that must be mitigated by the maintenance service provider, which are to safety, and network availability:

- **Safety**: risks must be mitigated to ensure that:
  - the Area Network is not dangerous to traffic;
  - the Area Network does not present a risk to road user or road worker safety; and
  - the Highways Agency is provided with a 'special defence' under Section 58 of the Highways Act 1980[16].
- **Availability**: risks must be mitigated to ensure the Maintenance Provider:
  - secures the expeditious movement of traffic on the HA's Area Network; and
  - facilitates the expeditious movement of traffic on road networks for which another authority is the traffic authority.

94 Although each MM-ALR scheme will be designed for maintenance, with off network access to assets and designated areas for maintenance being used wherever possible, there will be certain maintenance activities where this approach will not be suitable. In these instances, maintenance activities will require appropriate temporary traffic management in accordance with Chapter 8 of the Traffic Signs Manual, in addition to the setting of any motorway signals. With the permanent replacement of the hard shoulder by a controlled running lane, the setting out of TTM will, in the majority of cases, need to start from a live lane. This will require a different approach to that used when setting out TM from a hard shoulder (see Section 7.4)

95 The high traffic volumes expected during peak hours will restrict the periods of the day when temporary traffic management can be installed without causing an unacceptable impact to network performance; a factor which must be considered when determining response and repair timescales.

[16] Section 58 provides the defence that "*the Authority had taken such care as in all the circumstances was reasonably required to secure that part of the highway to which that action related was not dangerous for traffic.*"

6.3.2 Prioritisation of Maintenance Activities Specific to MM-ALR

96 AMOR requires the maintenance service provider to prioritise their activities in order to optimise the use of (and achieve the best value from) the available resources. They are required to produce a Quality Plan, which must include fully detailed Processes, Procedures and Timescales in relation to inspection, make safe, and repair of the asset; detailing exactly what activities the Provider will undertake to deliver the required outcomes whilst avoiding danger to road users.

97 For an MM-ALR scheme, this Quality Plan must reflect the fact that their ability to access certain assets may be compromised by the factors outlined above, including physical access (e.g.: no hard shoulder), or other restrictions (e.g.: no routine maintenance permitted during peak periods).

98 The Maintenance Service Provider is also required to produce a Maintenance Requirements Plan, which must detail:

- The planned Programme of Inspections;
- The Response and Repair timescales, covering:
    - Defect identification;
    - Verification;
    - Response; and
    - Repair;
- A description of how work is packaged to minimise network occupancy (including road space booking requirements, traffic management requirements, and temporary traffic regulation orders).

99 Designers and Maintenance Service Providers must give careful consideration to the requirement to minimise network occupancy, both from the point of view of reducing lane closures and reducing the exposure of road workers to the risks of working adjacent to live traffic. Hence the number of traffic management maintenance interventions must be minimised. Maintenance Service Providers and designers must therefore consider the items in the rest of this section within their design and maintenance proposal for each scheme.

100 AMOR also requires that separate plans are produced for key operational areas, including the Severe Weather Service and Incident Response. These plans must detail the activities which will be undertaken to deliver the required outcomes and avoid danger to users of the highway.

6.3.2.1 Full Asset Inventory

101 With access to MM-ALR schemes expected to provide additional challenges (when compared to D3M sections), survey work may prove more difficult and so the planning of routine maintenance activities needs to be more rigorous. During the construction phase of the MM-ALR scheme the scheme designer (supported by the maintenance service provider, delivery partner and construction contractor) should collate a full asset inventory, containing all assets, their quantities, location and condition, together with details of the date and nature of the most recent maintenance activity.

102 This inventory must be kept up to date during the construction period. Once the scheme is operational, any survey activities necessary to keep the inventory current will need to be carefully planned to maximise the utilisation of any temporary traffic management being set out for maintenance work so as not to require any additional traffic management installations.

103 The asset inventory should be used to establish asset management plans, enabling work to be scheduled accordingly.

6.3.2.2 Scheduling

104 The high traffic volumes that MM-ALR schemes are expected to experience during a typical weekday means that the main opportunity to conduct maintenance works will be overnight. Closing lanes during working days is likely to create significant congestion and delays to travellers. Hence weekday, inter-peak closures are not feasible (except for emergency works). Therefore the majority of activities will need to be scheduled at night, with additional temporary lighting provided as appropriate.

105 Intelligent road space management (e.g. Working Windows) will establish when it may be possible to permit lane closures during daylight hours to allow activities that are deemed to be unfeasible, or too high risk, to be carried out in the dark (e.g. litter picking, soft estate clearance). This will be scheme specific: designers and Maintenance Service Providers should not assume that such a window exists; and so alternative methods of scheduling maintenance access may be required.

6.3.2.3 Planned Maintenance Activities

106 There is increased pressure to minimise the number of occasions when TTM is in place, both to minimise the safety risks to road workers and drivers, and to improve the efficiency of maintenance activities.

107 The Maintenance Requirements Plan introduces the need to minimise network occupancy, meaning the number of activities that are carried out during a single installation of temporary traffic management will be increased wherever possible.

108 Adopting this approach becomes even more crucial on MM-ALR schemes, where the opportunities for maintenance access are reduced. However the ability to group maintenance activities together is subject to maintainers having adequate resources available to conduct the work, and there being no adverse impacts on safety associated with the undertaking of different activities within the same area.

6.3.2.4 Reactive Maintenance

109 Defects and equipment failures are inevitable. Except where the item can be safely accessed from off the network with the necessary tools, plant and materials; all repairs will require TTM. Both the frequency with which faults or defects occur, and the time needed to make a repair are key factors in determining the need for TTM. Consideration should be given to providing taper

positions and signs for TTM at appropriate distances from gantry locations so that these signs could be used in association with the signing required by the TSM Chapter 8.

110 Deciding when to undertake reactive maintenance requires an assessment of the operational criticality of each component to enable the network to continue to be safely operated despite the presence of a fault: either until a planned maintenance activity with the required temporary traffic management layout is place; or until sufficient 'other' faults occur to enable them all to be repaired in a single maintenance intervention.

111 There is also the reverse opportunity in that some planned activities could be re-scheduled to make use of a TTM installation required to fix a fault or defect.

6.3.2.5 Plan for Reduced Maintenance Access

112 Maintenance Service Providers should take advantage of the TTM installed for the construction period of the scheme to undertake any necessary longer term maintenance activities, such as soft estate management, vegetation clearance for visibility, and other routine maintenance activities. This will enable Maintenance Service Providers to reduce the time spent performing maintenance activities once the MM-ALR scheme becomes operational.

6.3.2.6 Plan for Incident Maintenance / Longer Term Maintenance

113 Designers and Maintenance Service Providers must review existing and new structures within the MM-ALR scheme to identify any structures or assets that require TTM to be left in place for an extended period (i.e. longer than overnight), in order to allow a repair to be completed.

114 Examples might include the repair of a bridge parapet where the curing of the concrete requires protection for several days until the required minimum strength has been reached, or assets where non-stock materials are needed to make a repair, but traffic must be kept away from the vicinity while those materials are sourced.

115 Action plans for these circumstances must be established and agreed, as it is a requirement of AMOR that they are included in the Maintenance Requirements Plan.

6.3.3 Severe Weather

116 The permanent replacement of the hard shoulder by a controlled running lane will have an implication on the procedures and operational arrangements necessary for the delivery of an effective winter service plan for MM-ALR schemes. Snow accumulations are likely to be moved to either lane 1 or 4 for a longer period of time, and if snow is moved to lane 1 arrangements for clearing slip roads will have to be made. Wider carriageways will typically need echelon ploughing. Salting will require two passes instead of one to effectively cover four lanes of running traffic. These arrangements will be defined in the Severe Weather Plan (see also Section 5.7 for implications on the RCCs).

6.4 Installation of Temporary Traffic Management

117 Where the need for a maintenance intervention cannot be avoided, TTM must be used. The key differences when installing TTM on a road with four live lanes without a hard shoulder involve the safe installation of the advance warning signs and the initial set up of the taper. Once these are in place then the remainder of the installation is the same as for a conventional motorway.

118 There are two key issues relating to the installation of TTM in an MM-ALR environment: the initial positioning of signs and taper cones has to take place in live lanes; and setting out the offside signs to Chapter 8 requires workers to cross four lanes of traffic. If the central barrier is concrete then there is no effective position of refuge for a road worker installing a sign adjacent to the barrier.

119 In order to deploy temporary advance fixed plate signs, a safe working area needs to be created. One method for achieving this could be to use a “rolling block” to create a gap in the traffic flow of a suitable length to enable the advance signs and initial taper cones to be put in place.

120 At present this approach could not be adopted without a change in policy in respect of use of rolling road blocks, which are currently reserved for emergency situations. The rolling road block must be performed by an on road TOS patrol (unless the necessary powers were also given to maintenance service providers). There is also a risk of vehicles ignoring the block and entering an area where road workers are not expecting to encounter fast moving vehicles.

6.4.1 Pre-determined Taper and Fixed Traffic Management Signs

121 Pre-determined taper positions and remotely operated traffic management signs may be used to aid in the setting out of TTM. Dedicated electronic (or electromechanical) signs installed upstream of each selected taper location at the distances described in Chapter 8 of the Traffic Signs Manual eliminate the safety risks to the road maintainer created by the requirement to physically place temporary fixed plate signs adjacent to a live running lane. These signs may be mounted in either the verge or central reserve as required, and can be operated remotely from an approaching maintenance vehicle (such as an Impact Protection Vehicle) or from an accessible, secure, safe location (e.g. the RCC).

122 Remotely operated traffic management signs in the central reserve and verge must only be included if the benefits of their installation can be shown to outweigh the dis-benefits of introducing additional ‘permanent’ assets, particularly in the central reserve.

123 Sufficient taper locations must be identified to allow all the assets, including any signage required to support traffic management, to be maintained within a suitable temporary traffic management layout. Therefore, the frequency and location of the taper positions needs to be agreed by scheme designers and the maintaining agent.

6.4.2 Electronic Sign Utilisation

124 The number of dedicated signs required solely for advance warning of road works could be reduced if the electronic signs and signals within the MM-ALR design for driver information and control are used to form part of the advance signing. For example, a fixed taper location could be positioned 800m downstream from a sign or signal, which would be used to display the appropriate legends and aspects for the 800m advance warning under Chapter 8. The next sign upstream will not be more than a further 1500m; and on most schemes will probably be at about 1000m upstream because of sight line considerations. This would display an early warning sign to the motorist. This eliminates the risk to the road maintainer associated with placing the equivalent fixed sign in a live running lane.

125 The final sign required for the TM installation would be a hard sign, placed before the taper. Any further signs or signals located within the extent of the taper or TM may be used to display supporting information relating to the temporary road layout.

6.5 Network Occupancy

6.5.1 Existing and emerging policy

126 As defined in the Network Management Manual (NMM) and the Asset Maintenance & Operational Requirements (AMOR), the Maintenance Provider has overall responsibility for managing all activities and occupancies on the network, including those by third parties.

127 Section 6.1.3.2 and 6.1.3.3 of the NMM (entitled "Network Occupancy Management") states that:

> *"The primary responsibility for coordinating works activity […] is contractually delegated to the Service Providers […] any activity on the network that may contribute, either directly or indirectly, to congestion on the network is covered by this process".*

128 Part 2 of the AMOR sets out the Operational Requirements for Managing Network Occupancy, and relates to all occupancies[17] on the area network, as well as all activities which may adversely impact road users. The Maintenance Provider is required to maintain a complete knowledge of all such occupancies or activities on the network.

129 The Maintenance Service Provider is required to deliver (and comply with) a Network Occupancy Plan, which must contain occupancy booking procedures and pro-formas. They must also maintain a fully populated record of all occupancies and any activities which cause an adverse impact on road users; with a view to optimising all occupancies, and minimising the effect of activities.

130 There is therefore no additional operational requirement for a "Permit to Access" system specific to managed motorway schemes. The requirements set out in AMOR for a Network Occupancy Plan which outlines the Provider's Processes and Procedures for Managing Network

[17] Occupancy is a defined term referring to all works, all Abnormal Indivisible Load Movements, all Incidents, or all Events that take place on the Area Network.

Occupancy are deemed to be sufficient. Under the ASC contract these general requirements are considered to be a lump-sum duty which will not incur additional costs to the Agency.

131 Any system employed must ensure that the MAC/ASC is able to monitor and make contact with all contractors, including third-party maintainers.

Generic Requirements

1. Effective communication systems will be needed to ensure that if the RCC needs to request that maintenance personnel leave the network, the maintainer is able to comply with that request in an expeditious manner.
2. Any ICT systems used to track road space bookings must be operated entirely by the MAC/ASC themselves, with no expectation placed on the RCC to access these systems in order to obtain information.

6.6 Permission to Access Equipment

132 Remote access to signs and signals is being developed and Maintenance Service Providers will make use of this where possible to minimise visits to the roadside. The Maintenance Service Provider will need to obtain permission from the RCC to take over the piece of equipment, as they would currently for physical repairs, to ensure that the equipment is not being used for operational purposes.

7. RCCs and the Traffic Officer Service

7.1 Staffing Levels

133 An exercise being carried out by the Future Operating Model (FOM) team will review the future staffing needs across TOS as a whole. Their approach will take account of the resource requirements that will be necessary to safely operate MM-ALR schemes as intended. Therefore no additional work will be needed to assess staffing levels for MM-ALR schemes in isolation. The "Operating Regime" PCF Product for each individual scheme will formally record that an assessment has been completed for their schemes, and that the staffing requirements to operate the scheme have been agreed.

7.2 RCC and Outstation Space Requirements

134 As MM-ALR schemes do not have a dynamic hard shoulder, there is no need for a hard shoulder monitoring (HSM) subsystem to be housed within the RCC, so it is not anticipated that any additional server space will be required for this purpose.

7.3 Traffic Officer Procedures for Managed Motorways

135 The TOS Procedures Team will produce national procedures for managed motorways, which will be approved by both the National Health & Safety Team (NHST) and the Resource and Capability Group[18] (R&CG). The result will be a standardised set of core procedures covering the majority of managed motorways operations (both MM-DHS and MM-ALR).

136 It is the responsibility of each scheme to identify any specific considerations that require a "non standard" operational procedure. In particular, the scheme will need to identify any hazards that may not have been included in the MM-ALR generic hazard log, and where necessary determine appropriate mitigations.

137 The national TOS Procedures Team will work with each scheme to develop a set of procedures to cover such scheme specific conditions and to gain the necessary approvals. Where applicable these will form a set of regional procedures that will be described for each TOS region.

138 The core and regional (scheme specific) procedures will be held and maintained centrally on the Traffic Officer Procedures Index on the Highways Agency Portal by the TOS Procedures Team.

[18] Formerly known as the Traffic Learning Centre (TLC)

7.4 Competence Standards, Learning Requirements and on-going Competence Assurance

139 Traffic Management Division, through the Resource and Capability Group, will be coordinating the national approach to all Traffic Officer learning requirements associated with MM-ALR schemes. To deliver this work, R&CG will:

- analyse the competence requirements associated with the operation of each scheme for all TOS roles (mapping legal, safety and national standards requirements);
- determine any gaps between the existing operational standards and any new standards required to operate MM-ALR schemes;
- create new and/or adjust current learning interventions and assessments required to deliver the required competence standards;
- record individual achievement against these standards; and
- maintain competence within TOS through appropriate interventions/ existing R&CG services.

140 Detailed training delivery plans will be agreed with the TOS regions.

8. Glossary

Term	Definition
3L VMSL	3-Lane Variable Mandatory Speed Limit
4L VMSL	4-Lane Variable Mandatory Speed Limit
Access Control	A process to regulate the number of vehicles joining a motorway at a given point by limiting the flow on the access slips using signals. Also known as Ramp Metering.
ACPO	Association of Chief Police Officers
ADS	Advance Direction Sign
Airwave	The Highways Agency's preferred communications technology between Core Responders for incident management
AMM	Area Management Memo
AMOR	Asset Maintenance & Operational Requirements – the replacement for the RWSC and NMM which sets out the HA's requirements for the delivery of routine maintenance and operational service within the ASC.
ANPR	Automatic Number Plate Recognition cameras
APTR	All Purpose Trunk Road network
ASC	Asset Support Contract – the replacement for the Managing Agent Contractor (MAC) contracts, which form the basis of maintenance agreements on most parts of the Agency's network.
ATM	Active Traffic Management
CCTV	Closed Circuit Television
CFOA	Chief Fire Officers' Association
COBS	Control Office Based System: In-station software and servers enabling RCC operators to interact with roadside infrastructure and equipment.
Conditioning	A process whereby a link with a dynamic hard shoulder is prepared for hard shoulder running by first equalising the speed across all running lanes to ensure smooth traffic flow
Core Responders	Those organisations involved in responding to incidents on the HA network. The Traffic Incident Management Guidance Framework defines Core Responders as: the Highways Agency, (including the RCC and on-road Traffic Officer Service, Service Providers and their Traffic Incident Management Vehicles, the National Vehicle Recovery Manager and any other party contracted by the HA); and the Emergency Services, Vehicle Recovery Services and Motorist Assistance Organisations involved in responding to an incident See also “Approved Core Responders”
CPS	Crown Prosecution Service
D3M	Dual 3-lane motorway
D4M	Dual 4-lane motorway
DBFO	Design, Build, Finance & Operate
DDS	Dynamic Display System
DfT	Department for Transport
DLOA	Detailed Local Operating Agreements

Term	Definition
DLS	Driver Location Sign: A sign by the side of a motorway or all-purpose trunk road that gives the road number, direction of travel and distance from the start of the motorway of that location.
DMRB	Design Manual for Roads and Bridges
DROA	Detailed Regional Operating Agreements
EMS	Enhanced Message Signs
ENGF	Enforcement National Guidance Framework
ERA	Emergency Refuge Area
ERT	Emergency Roadside Telephone
ESS	Entry Slip Signals
FOM	Future Operating Model – a series of projects intended to create and shape the future of TMD in terms of sustainable, affordable service delivery.
HA	Highways Agency
HADECS	Highways Agency Digital Enforcement Compliance System
HATMS	Highways Agency Traffic Management System
HATOMS	Highways Agency Traffic Operations & Management System
HGV	Heavy Goods Vehicle
HMCS	Her Majesty's Courts Service
HSM	Hard Shoulder Monitoring
IAN	Interim Advice Note
ICT	Information & Communication Technologies
ISU	Incident Support Unit
LBS	Lane Below Signal
LDL	Lane Divert Left signal
LDR	Lane Divert Right signal
LGV	Large Goods Vehicle
Link	A length of motorway between junctions
MAC	Managing Agent Contractor. Being replaced by ASC.
MEWP	Mobile Elevating Work Platform, also known as a 'Cherry Picker'
MIDAS	Motorway Incident Detection and Automatic Signalling
MM	A managed motorway scheme designed to IAN 111/09 standards
MM-ALR	A managed motorway scheme designed to IAN 161/12 standards
MSA	Motorway Service Area
MSS	Message Sign Subsystem (of COBS)
NDD	Network Delivery and Development Directorate (of the Highways Agency)
NGF	National Guidance Framework
NHST	National Health & Safety Team
NMCS2	National Motorway Communications System 2

Term	Definition
NMM	Network Management Manual
NPUG	National Procedures User Group
NRTS	National Roadside Telecommunication System
NSCRG	National Safety Control Review Group
NSSUG	HA National Signs and Signals User Group
NTIS	National Traffic Information Service
NTOC	National Traffic Operations Centre
Operating Regime	A PCF product developed for each Scheme which sets out any divergence from this Concept of Operations document that may be necessary to deal with scheme specific issues capable of affecting operational practice
PartnerNET	the HA Extranet – now replaced by the Supply Chain portal
PCF	Project Control Framework - This is a joint Department for Transport (DfT) and Highways Agency approach to managing major projects. It comprises: • A standard project lifecycle • Standard project deliverables • Project control processes • Governance arrangements
PTZ	Pan-Tilt-Zoom (CCTV cameras)
Ramp Metering	A process to regulate the number of vehicles joining a motorway by limiting the flow on the access slips using signals. Also known as access control.
RCC	Regional Control Centre
RDD	Regional Divisional Director
Red X	Indicator on signals used to indicate that the lane is closed (stop indicator with flashing lanterns).
R&CG	Resource and Capability Group (formerly Traffic Learning Centre)
ROM	Regional Operations Manager
RWSC	Routine & Winter Service Code (replaced by AMOR)
SHARE	Sharing Highways Agency Records Electronically: an electronic file sharing system for the HA
SIG	Signalling Subsystem - the subsystem of the COBS system that is used to transfer RCC operator actions into signal settings on road
SRN	Strategic Road Network
SRO	Senior Responsible Owner
SWG	Severe Weather Group
SWP	Severe Weather Plan
TechMAC	Technology Managing Agent Contractor. Being replaced by TMMM
TLC	Traffic Learning Centre – (now renamed the Resource and Capability Group)
TMD	HA Traffic Management Directorate
TMMM	Technology Maintenance and Management Manual – a document setting out the HA's performance requirements in relation to the carrying out of maintenance

Term	Definition
	services on all traffic technology systems.
TOS	(Highways Agency) Traffic Officer Service
TSSE	TechMAC Technical Support Service Engineer
TTD	HA NDD Traffic Technology Division
VMS	Variable Message Sign
VMSL	Variable Mandatory Speed Limit

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Highways Agency Media Services Bristol. Job number M110488.

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