M4 junctions 3 to 12 smart motorway
TR010019
7.3 Engineering and design report
5(2) (q)
Revision 0
March 2015
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
EXECUTIVE SUMMARY

The Highways Agency (the "Agency") is making an application (the "Application") for development consent to improve the M4 motorway ("M4") to a smart motorway between junction 3 (Hayes) in west London and junction 12 (Theale), which is near Reading, (the "Scheme"). This Engineering and Design Report ("EDR") accompanies the Application and its purpose is to explain the design principles and design rationale for the Scheme. It describes how the design has been influenced by the technical and operational requirements of creating all-lane running and smart motorway infrastructure. It is similar to a Design and Access Statement ("DAS"), but provides additional Scheme-specific information beyond that usually provided for within a DAS. It also supports the environmental impact assessment of the Scheme.

The Strategic Road Network ("SRN") in England comprises motorways and all-purpose trunk roads. The SRN is operated, maintained and improved in England by the Agency on behalf of the Secretary of State. The Agency is an executive agency of the Department for Transport ("DfT").

The M4 is the main strategic route between London and the west of England, and on to South Wales. The M4 currently suffers from heavy congestion between junctions 3 (Hayes) and 12 (Theale), which leads to unpredictable journey times. Traffic flows are predicted to increase further, which, without road improvements, will result in more severe congestion. The strategic need for the Scheme was originally discussed in 2003 by the Thames Valley Multi Modal Study which recommended against widening in favour of using technology to manage traffic flow.

Improvement of the M4 to a smart motorway will help to relieve congestion by permanently converting the hard shoulder to a running lane and using technology to vary speed limits and manage traffic. Signs and signals will be used to inform drivers of conditions on the highway network, when and where variable speed limits are in place, and when lanes are closed.

The Scheme is a nationally significant infrastructure project ("NSIP") to which the Planning Act 2008 ("PA 2008") applies. Therefore, the Agency is required to make an application to the Secretary of State for a Development Consent Order ("DCO") to build and operate the Scheme.

The Scheme is some 51km (32 miles) in length, between junctions 3 and 12. Preliminary design is complete and the Scheme comprises the following principal elements:

a) conversion of the hard shoulder to a permanent running lane and, where no hard shoulder is in place at present, the construction of a new lane. This will mainly take place between junction 4b and junction 8/9;
b) replacement of overbridge structures where portals are too narrow to accommodate the improved motorway;

c) extension of underbridges and other structures such as culverts and subways to accommodate the improved motorway;

d) changes to junctions and slip roads needed to accommodate traffic joining and leaving the improved motorway, and to allow use of the hard shoulder as a running lane, as well as allowing 'through junction running' ("TJR");

e) provision of new gantries and signs to allow the motorway to function as a smart motorway with a variable speed limit, and to provide messages to road users; and

f) other infrastructure needed for the improved motorway, such as Emergency Refuge Areas ("ERAs"), enhanced communication systems, closed circuit television ("CCTV") and electrical supplies, as well as works to accommodate statutory undertakers’ apparatus and other parties who may be affected by the Scheme.

Detailed design will commence during the examination period. The Detailed Design will build on the Preliminary Design and also take into account the Government’s Road Investment Strategy ("RIS") which was published in December 2014 and sets out the performance specification for Highways England – the public sector company, owned by the Government, which will replace the Agency in April 2015. The Infrastructure Bill received Royal Assent on 12th February 2015, and will become an Act of Parliament – the Infrastructure Act 2015. Receipt of Royal Assent means that, amongst other things, Highways England can be appointed as a strategic highways company and the RIS will be a legal requirement.

If the Application is successful and the Scheme is granted development consent, it is anticipated that construction will commence in late 2016 and the Scheme will be operational by 2022.
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1 INTRODUCTION

1.1 Scheme overview

1.1.1 The Highways Agency (the "Agency") is making an application (the "Application") for development consent to improve the M4 motorway ("M4") to a smart motorway between junction 3 (Hayes) in west London and junction 12 (Theale), which is near Reading, (the "Scheme").

1.1.2 This Engineering and Design Report ("EDR") accompanies the Application. The EDR has been submitted pursuant to Regulation 5(2)(q) of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 ("APFP Regulations 2009") (Ref 1) as a document necessary to support the Application. Whilst it is not a requirement for an EDR to be produced for a linear scheme, it is considered that this EDR will assist in the examination and the determination of the Application.

1.1.3 The Strategic Road Network ("SRN") in England, comprising motorways and all-purpose trunk roads, is constructed and managed by the Agency, which is an executive agency of the Department for Transport ("DfT"). The Agency is responsible for operating, maintaining and improving the SRN in England on behalf of the Secretary of State.

1.1.4 The Agency is to become a government owned company known as 'Highways England', with the Secretary of State as sole shareholder on 1\textsuperscript{st} April 2015. The new company will be set up as a highway authority for the SRN and will have conferred upon it the necessary powers and duties to operate, manage, maintain and enhance the strategic roads network. Regulatory powers will remain with the Secretary of State. The legislation establishing Highways England will make provision for all legal rights and obligations of the Agency, including those in respect of the Application, to be deemed rights and obligations of Highways England.

1.1.5 The M4 is the main strategic route between London and the west of England, and on to South Wales. Major towns and cities along the M4 include London, Reading, Swindon, Bristol, Newport, Cardiff and Swansea.

1.1.6 The M4 between junctions 3 and 12 carries over 130,000 vehicles per day, and more in places. At peak times, traffic flows on many links are close to or exceed the total flow that the link is designed to handle and traffic on the M4 therefore suffers from heavy congestion, which leads to unpredictable journey times. Although traffic volumes reduced in 2008 at the start of the global financial crisis, long-term traffic trends still show significant growth. Traffic flows are forecast to increase to an average of 160,000 vehicles per day over the next 20 years, which will result in more severe congestion without road improvements.
1.1.7 Improvement of the M4 to a smart motorway will help to relieve congestion by permanently converting the hard shoulder to a running lane and using technology to vary speed limits and manage traffic. Signs and signals will be used to inform drivers of conditions on the highway network, when and where variable speed limits are in place, and when lanes are closed.

1.1.8 The Scheme is a nationally significant infrastructure project ("NSIP") to which the Planning Act 2008 ("PA 2008") (Ref 2) applies. Therefore, the Agency is required to make an application to the Secretary of State for a Development Consent Order ("DCO") to build and operate the Scheme.

1.2 Purpose and requirements of the EDR

1.2.1 The purpose of this EDR is to explain the design principles and design rationale for the Scheme. It describes how the design has been influenced by the technical and operational requirements of creating all-lane running, smart motorway infrastructure. It is similar to a Design and Access Statement ("DAS"), but provides additional Scheme-specific information beyond that usually provided for within a DAS. It also supports the environmental impact assessment of the Scheme as described below. The EDR itself constitutes environmental information for the purpose of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (Ref 3).

1.2.2 As detailed design will commence during the examination period, this EDR addresses the preliminary design which has been completed. The aim of this EDR is to provide the Examining Authority, and the Secretary of State as decision-maker, with comfort as to how the design of the Scheme will be developed. The EDR is intended to allow the design to be understood and assessed, and to provide parameters for that assessment, which will also ensure that the Scheme is carried out within the limits that have been assessed. The DCO, if granted, will provide consent for the design, however, the Agency will retain an ability to bring forward amendments to the design within the parameters described in the EDR and the limits of deviation given in the DCO. The result is that the Agency should have reasonable flexibility within clear parameters to review the design products to ensure the most appropriate designs are incorporated into the Scheme as built.

1.2.3 The design approach included in this EDR takes account of comments received during pre-application consultation under sections 42, 47 and 48 PA 2008 (Ref 2), as well as the outputs of the environmental assessments of the Scheme.

1.2.4 The National Networks National Policy Statement ("NN NPS") (Ref 4) was designated in January 2015. It makes clear the requirements for good design in road schemes. At 4.32, the NN NPS states:
“Scheme design will be a material consideration in decision making. The Secretary of State needs to be satisfied that national networks infrastructure projects are sustainable and as aesthetically sensitive, durable, adaptable and resilient as they can reasonably be (having regard to regulatory and other constraints and including accounting for natural hazards such as flooding).”

1.2.5 At 4.35, the NN NPS states:

“Applicants should be able to demonstrate in their application documents how the design process was conducted and how the proposed design evolved. Where a number of different designs were considered, applicants should set out the reasons why the favoured choice has been selected.”

1.2.6 The NN NPS suggests that the explanatory statement which accompanies the environmental statement ("ES") is a suitable place for providing the design evolution. However, an explanatory statement to an ES is not a document hitherto ordinarily produced; consequently this EDR communicates how the requirements for good design and access provision have been considered in the preparation of the Application. This EDR should be read in conjunction with the Application drawings/plans and ES, all of which are contained within the suite of Application documents.

1.3 Terminology

1.3.1 Some of the terminology used with the EDR may be unfamiliar to the Reader. Although the terminology is explained throughout the EDR, a tabulated glossary is included from page 148 onwards.
2 PROPOSED DEVELOPMENT

2.1 Summary of proposed development

2.1.1 The Scheme is some 51km (32 miles) in length, between junctions 3 and 12, and will have a number of principal elements:

a) conversion of the hard shoulder to a permanent running lane and, where no hard shoulder is in place at present, the construction of a new lane. This will mainly take place between junction 4b and junction 8/9;

b) replacement of overbridge structures (bridges over the motorway) where portals are too narrow to accommodate the improved motorway;

c) extension of underbridges (bridges under the motorway) and other structures such as culverts and subways to accommodate the improved motorway;

d) changes to junctions and slip roads needed to accommodate traffic joining and leaving the improved motorway, and to allow use of the hard shoulder as a running lane, as well as allowing "through junction running" ("TJR");

e) provision of new gantries and signs to allow the motorway to function as a smart motorway with a variable speed limit, and to provide messages to road users; and

f) other infrastructure needed for the improved motorway, such as Emergency Refuge Areas ("ERAs"), enhanced communication systems, closed circuit television ("CCTV") and electrical supplies, as well as works to accommodate statutory undertakers' apparatus and other parties who may be affected by the Scheme.

2.2 Aims and objectives of the Scheme

2.2.1 The Scheme involves improving both carriageways along approximately 51km (32 miles) of the M4 to a smart motorway between junction 3 and junction 12 and other works in that section of the M4. The Scheme’s objectives are to:

a) reduce congestion, smooth the flow of traffic to improve journey times and make journeys more reliable;

b) support and enhance the role of the M4 as a major national and inter-urban regional transport artery;

c) support the economy and facilitate economic growth within the regions, by providing much needed capacity on the motorway;

d) continue to deliver a high level of safety performance of the network using smart motorway techniques; and
e) deliver environmental improvements and mitigation where appropriate and required.

2.3 Environmental objectives

2.3.1 In addition to the objectives listed above, the Agency has an overall objective of ensuring “the best practicable environmental outcomes across all our activities, while working in the context of sustainable development and delivering value for money” (Ref 5).

2.3.2 Where environmental impacts are predicted as a result of the Scheme, which may be adverse, the Scheme seeks to address these. In the first instance, environmental impacts should be avoided altogether. However, this is not always possible. In such circumstances, mitigation measures have been adopted to reduce, and where appropriate, remedy any significant adverse impacts identified, with compensation measures being provided if and where required. Adverse environmental effects of the Scheme have been avoided and minimised where possible by way of:

a) the Scheme design and the adoption of appropriate working practices;

b) incorporating appropriate measures during the detailed design process; and

c) the Outline Environmental Management Plan (“EMP”) which includes a Construction and Environment Management Plan (“CEMP”) (Appendix 4.2) and is included in the ES, Document Reference 6.1.
3 LEGISLATIVE AND POLICY CONTEXT

3.1.1 The Scheme is a NSIP to which the PA 2008 applies. Therefore, the Agency is required to make an application to the Secretary of State for a DCO to build and operate the Scheme. The Order limits, which encompass the land required for the Scheme to be built, and which include land required for permanent and temporary purposes for the Scheme, are shown on the General Arrangement drawings in Annex F of this EDR.

3.1.2 Section 104 of PA 2008 provides that application for development consent should be decided in accordance with any relevant National Policy Statement unless certain exceptions apply, including that the adverse impacts of the development outweigh its benefits.

3.1.3 The Government has produced the NN NPS under the Planning Act 2008, which was designated in January 2015. The NN NPS relates to national networks transport infrastructure development, including motorways, and establishes the national need for development of the national road network.

3.1.4 The Scheme will be assessed against the NN NPS, the National Planning Policy Framework and, where appropriate, local planning policies. Detailed explanation of this is included in the Planning Statement.
4 SCHEME CONTEXT

4.1 Current challenges

4.1.1 The M4 between junctions 3 and 12 carries over 130,000 vehicles per day, and more in places. At peak times, traffic flows in many links are close to or exceed the total flow that the link is capable of handling, i.e. its capacity. Therefore, the motorway suffers from heavy congestion, which leads to unpredictable journey times. Section 4.3 provides detail of predicted capacities. Although traffic volumes reduced in 2008 at the start of the global financial crisis, long-term traffic trends still show significant growth. Traffic flows are forecast to increase further, which, without road improvements, will result in more severe congestion.

4.1.2 The Organisation for Economic Co-operation and Development ("OECD") has highlighted previously that the current road transport infrastructure network is one of three key barriers to UK growth requiring action from government (Ref 6).

4.1.3 The physical works comprised in the Scheme, and the implementation of smart motorway infrastructure, will help to relieve congestion by permanently converting the hard shoulder to a running lane and using technology to vary speed limits and manage traffic. Signs and signals will be used to inform drivers of conditions on the highway network, when and where variable speed limits are in place, and when lanes are closed.

4.2 Site context

4.2.1 The Scheme passes through eleven local authority areas:

a) Greater London Authority;
b) London Boroughs of Hillingdon and Hounslow;
c) West Berkshire Council;
d) South Bucks District Council;
e) Buckinghamshire County Council;
f) The Royal Borough of Windsor and Maidenhead; and
g) Boroughs of Slough, Bracknell, Wokingham and Reading.

4.2.2 The main conurbations along the proposed Scheme are Reading, Maidenhead, Slough, Hillingdon and Hounslow. Smaller, but notable urban areas include Wokingham, Bracknell, Windsor, West Drayton and Hayes. Figure 1 provides an overview of the location of the Scheme and Table 1 below provides a summary of locations accessed from the Scheme.
Figure 1: M4 junctions 3 to 12 smart motorway Scheme
Table 1: Locations accessed directly off the Scheme

<table>
<thead>
<tr>
<th>Junction</th>
<th>Locations accessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>A4, Reading (west), Theale</td>
</tr>
<tr>
<td>Services</td>
<td>Reading Motorway Service Area (“MSA”)</td>
</tr>
<tr>
<td>11</td>
<td>A33, Basingstoke, Reading (central and south)</td>
</tr>
<tr>
<td>10</td>
<td>A329(M), Reading (east), Wokingham, Bracknell</td>
</tr>
<tr>
<td>8/9</td>
<td>A404(M), High Wycombe, Henley, A308(M), Maidenhead</td>
</tr>
<tr>
<td>7</td>
<td>A4, Slough (west)</td>
</tr>
<tr>
<td>6</td>
<td>A355, Slough (central); A322, Windsor</td>
</tr>
<tr>
<td>5</td>
<td>A4, Colnbrook, Langley; B470, Eton, Datchet</td>
</tr>
<tr>
<td>4b</td>
<td>M25, M40, M1, M11, M3, M23, M20, Heathrow Airport (Terminals 4, 5 &amp; Cargo), Gatwick Airport, Watford, Oxford, Stansted Airport, Maidstone</td>
</tr>
<tr>
<td>4</td>
<td>Heathrow Airport (Terminals 1, 2 &amp; 3), A408, Uxbridge, Hillingdon</td>
</tr>
<tr>
<td>3</td>
<td>Heathrow Airport (Terminals 4, 5 &amp; Cargo), A312, Hayes, Harrow, Hillingdon, Hounslow</td>
</tr>
</tbody>
</table>

Junction 12 to junction 11

4.2.3 Between junctions 12 (Theale) and 11 (Three Mile Cross) of the M4, the motorway skirts the southern edge of Reading, which forms the principal settlement in this location.

4.2.4 To the western extremity of the Scheme, west of junction 12, lies the North Wessex Downs Area of Outstanding Natural Beauty (“AONB”), the Sulham and Tidmarsh Woods and Meadows, and Pincent’s Kiln Site of Special Scientific Interest (“SSSI”). To the east of junction 12, the M4 crosses the Kennet and Avon Canal and then skirts south of the Reading urban area, through an area of agricultural land within which extensive gravel extraction activity has occurred, resulting in water filled gravel pits.

4.2.5 Reading MSA (eastbound and westbound) is located between these junctions.

4.2.6 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 109,800 vehicles per day, of which 10% are heavy goods vehicles (“HGVs”).
4.2.7 This link of the M4 is located within the local authority areas of West Berkshire, Wokingham Borough Council and Reading Borough Council respectively.

**Junction 11 to junction 10**

4.2.8 From junction 11 (Three Mile Cross), the M4 continues around the southern Reading suburbs of Whitley and Lower Earley to Winnersh at junction 10. To the south of the motorway, the area is characterised by smaller villages and settlements, including Shinfield and Sindlesham, until reaching the outskirts of Wokingham to the south of junction 10.

4.2.9 Between junction 11 and junction 10, the M4 passes through an area of agricultural land predominantly within the low lying floodplain of the River Loddon, and to the east passes between the urban edges of Sindlesham, Winnersh and Wokingham. Agricultural land is interspersed with a number of woodlands and copses, with trees along the River Loddon corridor. The urban areas nearest to the M4 predominantly comprise modern residential suburbs situated to the north of the M4.

4.2.10 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 117,100 vehicles per day, of which 11% are HGVs.

4.2.11 This section of the M4 is located within the Reading Borough Council and Wokingham Borough Council areas respectively.

**Junction 10 to junction 8/9**

4.2.12 Between junction 10 (Winnersh) and junction 8/9 (Holyport), the M4 passes through a relatively sparsely populated rural area, characterised by scattered farms, homesteads and rural businesses. This rural area lies between Reading/Wokingham to the west and Maidenhead to the east.

4.2.13 The M4 is located within the Green Belt from The Straight Mile overbridge (east of junction 10) to junction 8/9. Gently undulating agricultural land is interspersed with considerable woodland cover, and mature hedgerows define field boundaries. Settlement is limited, with Shurlock Row, White Waltham, Paley Street and Stud Green forming the principal villages prior to reaching Maidenhead. The M4 verges provide established tree planting which integrates well with the local wooded landscape.

4.2.14 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 124,300 vehicles per day, of which 9% are HGVs.

4.2.15 This section of the M4 is located within Wokingham Borough Council, Bracknell Forest Borough Council and the Royal Borough of Windsor and Maidenhead’s areas respectively.
**Junction 8/9 to junction 7**

4.2.16 From junction 8/9 (Holyport) to junction 7 (Huntercombe), the motorway is located within the Green Belt and passes to the north of Holyport before crossing the A330 and through the urban fringe area to the south of Maidenhead, before returning to the Green Belt east of the A308. From here, the M4 passes the village of Bray to the north before crossing the River Thames on an existing, three-span bridge and then continuing east past the villages of Dorney Reach and Dorney to the south.

4.2.17 The River Thames and the nearby man-made Jubilee River (which functions as a flood alleviation channel) and recreational lakes, together with adjacent wet pasture, occupy most of the land between settlements. These watercourses and areas of open water are lined by riparian tree species, giving considerable vegetation cover to the local landscape.

4.2.18 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 132,400 vehicles per day, of which 10% are HGVs.

4.2.19 This section of the M4 is located within the Royal Borough of Windsor and Maidenhead and South Bucks District Council's areas.

**Junction 7 to junction 6**

4.2.20 Between junction 7 (Huntercombe) and junction 6 (Chalvey), the M4 is located within the northern fringe of the Green Belt and between the outskirts of Slough to the north (including the area of Cippenham) with Eton Wick and the River Thames floodplain to the south.

4.2.21 Slough sewage treatment works occupies land to the south-east of junction 7, between the M4 and the Jubilee River.

4.2.22 As it approaches junction 6, the motorway lies immediately north of, and runs parallel to, the Jubilee River. The River Thames is located further south of the M4 beyond the villages of Dorney and Eton Wick.

4.2.23 To the south of junction 6 are the towns of Windsor and Eton where Windsor Castle and Eton College are located. The town of Windsor is located on an escarpment to the south of the River Thames and south east of junction 6.

4.2.24 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 132,200 vehicles per day, of which 9% are HGVs.

4.2.25 This section of the M4 is located within Slough Borough Council and South Bucks District Council’s areas.
Junction 6 to junction 5

4.2.26 Junction 6 (Chalvey) lies immediately to the north of the Green Belt, and the M4 crosses the Windsor Branch railway line on the Windsor Branch Railway overbridge en route to junction 5 (Langley). After passing over the A332, as it continues to the south of the Slough suburbs, including the areas of Upton Court Park, Ditton Park and Langley, the motorway again lies within the Green Belt until reaching junction 5. This link of the M4 also passes to the north of the confluence of the Jubilee River with the River Thames, the town of Datchet and the Queen Mother reservoir.

4.2.27 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 143,700 vehicles per day, of which 9% are HGVs.

4.2.28 This section of the M4 is located within Slough Borough Council and the Royal Borough of Windsor and Maidenhead’s areas.

Junction 5 to junction 4b

4.2.29 After passing under Sutton Lane overbridge, the motorway between junction 5 (Langley) and junction 4b (M25) is located within the Green Belt. From junction 5, the M4 passes from the eastern edge of Slough, through semi-rural surroundings, to the M25 intersection at junction 4b. Where the urban area of Slough lies immediately adjacent to the Scheme, it predominantly comprises modern residential estates.

4.2.30 To the east of Slough, Richings Park, Richings Park golf course and farmland (traversed by high voltage power lines) lie to the north of the M4; a gravel pit, gravel pit lakes, sewage works, an industrial estate, and farmland (traversed by high voltage power lines) lie to the south of the M4.

4.2.31 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 152,800 vehicles per day, of which 10% are HGVs.

4.2.32 This section of the M4 lies on the boundary of Slough Borough Council’s area to the west, with the London Borough of Hillingdon’s area to the east and South Bucks Council’s area to the north-west.

Junction 4b to junction 4

4.2.33 From junction 4b (M25) to junction 4 (Heathrow), the M4 crosses the Wraysbury River and the River Colne before passing Saxon Lake to the south. The motorway in this link is located within the Green Belt west of Saxon Lake and forms the northern boundary of the Green Belt between Saxon Lake and junction 4.
4.2.34 The motorway then passes into the London Borough of Hillingdon between the urban area of West Drayton to the north which predominantly comprises modern residential and commercial estates and the villages of Harmondsworth, Sipson and Heathrow to the south.

4.2.35 Harmondsworth and Sipson are situated between the Green Belt to the south of the M4, featuring active and reclaimed gravel pits, farmland and Heathrow Airport, the internationally important transport hub. The presence of the airport to the south of these settlements together with its extensive ancillary developments, represents a major land-use within the area.

4.2.36 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 166,600 vehicles per day, of which 7% are HGVs.

4.2.37 This section of the M4 is located within the London Borough of Hillingdon.

**Junction 4 to junction 3**

4.2.38 The M4 between junction 4 (Heathrow) and junction 3 (Hayes) is located within the Green Belt and crosses over Frogs Ditch and the River Crane. The motorway in this link is bounded to the north by the modern residential areas of Hayes and to the south by the village of Harlington and more open areas including Little Harlington Playing Fields and Cranford Park. Further south from the motorway corridor lies the eastern section of Heathrow Airport.

4.2.39 Areas to the south of the M4 include open areas and wooded parkland, including Cranford Park.

4.2.40 Immediately west of junction 3, the motorway passes from the London Borough of Hillingdon into the London Borough of Hounslow.

4.2.41 Average weekday traffic flows along the M4 taken from the Agency’s traffic counting system in 2013 indicate that this link carries 149,600 vehicles per day, of which 7% are HGVs.

4.2.42 Between junction 4b and junction 3 the M4 is located within the London Borough of Hillingdon and on the approach to and at junction 3 the motorway is located within the London Borough of Hounslow.

4.3 **Forecast traffic flows**

4.3.1 As discussed in ES chapter 1, although traffic volumes reduced at the start of the global financial crisis in 2008, long-term traffic trends still show significant growth. Traffic flows are forecast to increase further, which is predicted to result in more severe congestion without road improvements.
4.3.2 The ratio of actual traffic flow to its capacity (the total flow that a link is capable of handling), is a general way of indicating congestion. Capacity per lane is calculated based on information from DMRB which was set out in ES chapter 13.

4.3.3 Table 2 shows forecast ratios for each link without implementation of the Scheme. Traffic flow forecasts are taken from the traffic model developed to assess the Scheme. Two years’ data are shown - 2022 and 2037 - for the morning and evening peak periods. In each case, without the Scheme, the number of links shaded red (where the ratio of flow to capacity exceeds 85%, which indicates that the links are predicted to become congested) increases over time. Similarly, the number of links where flow has reached capacity (shaded black) is also forecast to increase. The links which are shaded yellow in Table 2 are those which are predicted to be near to having a ratio of flow to capacity exceeding 85%. Those links shaded green do not have capacity issues.

Table 2: Forecast ratios of traffic flow to capacity without implementation of the Scheme

<table>
<thead>
<tr>
<th>Link</th>
<th>Morning peak-hour (07:00-08:00)</th>
<th>Evening peak-hour (17:00-18:00)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eastbound</td>
<td>Westbound</td>
</tr>
<tr>
<td>J12-J11</td>
<td>99.4</td>
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<tr>
<td>J11-J10</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>J10-J8/9</td>
<td>96.7</td>
<td>100.0</td>
</tr>
<tr>
<td>J8/9-J7</td>
<td>97.0</td>
<td>100.0</td>
</tr>
<tr>
<td>J7-J6</td>
<td>91.6</td>
<td>93.5</td>
</tr>
<tr>
<td>J6-J5</td>
<td>96.9</td>
<td>99.6</td>
</tr>
<tr>
<td>J5-J4b</td>
<td>74.0</td>
<td>76.2</td>
</tr>
<tr>
<td>J4b-J4</td>
<td>77.2</td>
<td>78.5</td>
</tr>
<tr>
<td>J4-J3</td>
<td>84.2</td>
<td>88.5</td>
</tr>
</tbody>
</table>
Table 3 shows forecast ratios for each link with implementation of the Scheme.

**Table 3:** Forecast ratios of traffic flow to capacity with implementation of the Scheme

<table>
<thead>
<tr>
<th></th>
<th>Morning peak-hour (07:00-08:00)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eastbound</td>
<td>Westbound</td>
<td>Eastbound</td>
<td>Westbound</td>
<td>Eastbound</td>
<td>Westbound</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2022</td>
<td>2037</td>
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<td>2037</td>
<td>2022</td>
<td>2037</td>
<td>2022</td>
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<tr>
<td>J12-J11</td>
<td>83.7</td>
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<td>65.9</td>
<td>72.4</td>
<td>77.0</td>
<td>86.0</td>
<td>73.3</td>
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<tr>
<td>J11-J10</td>
<td>92.6</td>
<td>97.7</td>
<td>72.8</td>
<td>78.9</td>
<td>80.4</td>
<td>88.2</td>
<td>78.5</td>
</tr>
<tr>
<td>J10-J8/9</td>
<td>86.2</td>
<td>92.6</td>
<td>70.0</td>
<td>74.9</td>
<td>74.1</td>
<td>80.1</td>
<td>88.4</td>
</tr>
<tr>
<td>J8/9-J7</td>
<td>86.6</td>
<td>92.6</td>
<td>69.0</td>
<td>74.9</td>
<td>74.1</td>
<td>80.1</td>
<td>88.4</td>
</tr>
<tr>
<td>J7-J6</td>
<td>83.0</td>
<td>87.0</td>
<td>72.1</td>
<td>78.0</td>
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<td>78.3</td>
<td>83.2</td>
<td>83.9</td>
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<tr>
<td>J5-J4b</td>
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<td>87.3</td>
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<td>82.1</td>
<td>86.9</td>
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<tr>
<td>J4-J3</td>
<td>67.4</td>
<td>71.0</td>
<td>68.4</td>
<td>69.5</td>
<td>72.4</td>
<td>72.7</td>
<td>65.9</td>
</tr>
</tbody>
</table>

Key:

- **Capacity reached**
- Ratio of flow to capacity >85%
- Ratio of flow to capacity nearly 85%
- No capacity issues
5 DESIGN EVOLUTION

5.1 Background to the development of the Scheme

5.1.1 The following section outlines the chronology of events that has led to the development of the Scheme and a design solution that reflects these emerging design concepts.

January 2003

5.1.2 The strategic case for providing additional capacity on the M4 within the Thames Valley was first identified in the Thames Valley Multi-Modal Study (“TVMMS”) (2003) (Ref 7), prepared by the Government Office for the South East. The TVMMS sought to identify the most effective means of addressing current and future transport-related problems in the Thames Valley by understanding the root causes of transport problems within the area and how these problems were likely to develop and change in future. The TVMMS was predicated on the strong links between transport and wider economic, environmental and social policy, not just on improving transport provision itself. The TVMMS ensured that its recommended strategies were supportive of the then draft Regional Transport Strategy that had recently been published for consultation, and also consistent with two other studies, namely:

a) London Orbital multi-modal study (“ORBIT”) (Ref 8) undertaken on behalf of the Government Office for the South-East; and

b) London to South West and South Wales multi-modal study (“SWARMMS”) (Ref 9) undertaken on behalf of Government Office for the South West.

5.1.3 The TVMMS recommended against widening the M4 prior to 2016 in favour of traffic flow management through design and technology, including the uses of Intelligent Transport Systems (“ITS”) and Integrated Demand Management (“IDM”). Box 1 contains an extract from the recommended strategy.

Box 1 – Extract from TVMMS recommended strategy

IDM is a term used by the Highways Agency to cover a variety of measures to improve journey time reliability, reduce congestion and possibly marginally increase highway capacity without general widening. These measures might include better incident detection measures, more electronic traffic signs to manage incidents, more CCTV coverage, and variable speed limits.

This study recognises the need and strongly supports the implementation of such measures in advance of, and alongside, other key elements of the Thames Valley strategy, recognising the continuing need throughout and beyond the strategy implementation period to tackle road-based congestion.
5.1.4 The Secretary of State for Transport subsequently endorsed these recommendations in early 2003 and, in July of that year, the M4 through the Thames Valley was included in a DfT discussion paper, Managing our Roads (Ref 10), which examined options for managing the road network in the light of the forecast increase in traffic.

**March 2008**

5.1.5 Subsequently, the Advanced Motorway Signalling and Traffic Management Feasibility Study ("AMSTMFS") (Ref 11), published by the DfT in March 2008, made extensive use of the DfT’s National Transport Model ("NTM") (see Figure 2) to analyse the business case for hard shoulder running at various locations on the Agency’s network, following the encouraging early results from the dynamic hard running scheme implemented on the M42 between junction 3a and junction 7 ("M42 Pilot").

![Figure 2: Outline structure of NTM](image)

5.1.6 The AMSTMFS identified the M4 junction 3 to junction 12 as a priority for the provision of additional capacity and highlighted the following causes of congestion in the area of the proposed Scheme:

a) the large number of commuters using the strategic road network;

b) the number of commuters willing to travel significant distances;

c) low vehicle occupancy;

d) widely dispersed origins and destinations; and

e) a low proportion of trips starting or ending in urban centres.
5.1.7 In addition, the AMSTMFS also concluded that both the number of trips and trip-miles would increase significantly over time, therefore exacerbating the existing situation. Ministers agreed that hard shoulder running, as an alternative to widening, should be investigated.

**July 2008**

5.1.8 The Agency’s Command Paper (‘Roads – Delivering Choice and Reliability’) (Ref 12) confirmed the need to address the particularly fast growth of traffic on motorways. The Paper supported the approach of making better use of existing assets and proposes pursuing Active Traffic Management (‘ATM’) measures, including making use of the hard shoulder as a running lane, in conjunction with IDM.

**January 2009**

5.1.9 In January 2009, the DfT detailed the approach planned for improving capacity and reliability on the motorway network (‘Britain’s Transport Infrastructure Motorways and Major Trunk Roads’) (Ref 13). The paper presented the Managed Motorways concept, developed with the aim of further reducing capital and operating costs whilst optimising the benefits for road users and maintaining a high level of safety. The NTM was used again to perform a strategic analysis of the impacts on traffic, congestion and emissions of the revised roads programme.

5.1.10 The paper also detailed a programme of Managed Motorways schemes to commence construction by 2015, which included the M4 junction 3 to junction 12.

**February 2010**

5.1.11 Scheme development commenced for improvements to the M4 motorway. Following a strategic review of the Scheme scope and objectives, Ministerial and Highways Investment Board (‘HIB’) approval was granted in February 2010 to extend the scope and investigate a range of options. The four operational regime options and design concepts were identified (Table 4), developed and reviewed, by the Agency based on the knowledge gained from delivering Managed Motorway schemes and incorporating the latest emerging concepts.
### Table 4: Operational Scheme options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: Interim Advice Note 111/09 Managed Motorways implementation guidance - Hard shoulder running solution</td>
<td>Dynamic hard shoulder operating regime utilising the hard shoulder as a running lane during peak periods or for event management.</td>
</tr>
<tr>
<td>Option 2: Cantilever message signs Message Sign with bookend gantries</td>
<td>Dynamic hard shoulder operating regime with gantries at the start and end of the managed motorway section (bookend gantries). Inter-visibility, i.e. distances between gantries achieved through message signs at a nominal distance of 800m.</td>
</tr>
<tr>
<td>Option 3: All lane running</td>
<td>All lane running incorporating the controlled use of the hard shoulder as a permanent running lane. Gantry mounted overhead lane signals displaying warning and information provided at nominal 800m intervals along the main scheme section.</td>
</tr>
<tr>
<td>Option 4: Light message signs more widely spaced with no bookend gantries</td>
<td>Dynamic hard shoulder operating regime utilising absolute minimal infrastructure implemented in order to operate the dynamic hard shoulder, whilst meeting the overall objectives of the scheme, including highway safety. This option relies on the intuitive behaviour of the motorist, with message signs more widely spaced (at intervals of up to 3km).</td>
</tr>
</tbody>
</table>

5.1.12 Design and cost assessments were undertaken in 2010 for each of the above design solutions, although work on developing engineering options was halted pending the completion of a traffic model and the development of a second generation Managed Motorway solution.

July 2011

5.1.13 Following verification of the traffic model for the Scheme for forecasting purposes in July 2011, the Agency held a design strategy workshop in August 2011 to review emerging second generation Managed Motorway designs for the schemes identified in ‘Britain’s Transport Infrastructure Motorways and Major Trunk Roads’ (Ref 13).

5.1.14 In order to optimise opportunities for identifying efficiency savings, while maintaining safety, the design options were further examined and a single scheme design for all such schemes, Managed Motorways, was established based on providing dynamic hard shoulder running (i.e. use of the hard shoulder during periods of congestion) and a complementary Controlled All Lane Running design solution.
5.1.15 A detailed operational review of the design concept applied to the M4 Managed Motorway scheme was undertaken which recommended that the Managed Motorway Controlled All Lane Running design was the optimum solution for the Scheme. The Controlled All Lane Running Scheme was taken through Option Identification stage in December 2011.

**May 2012**

5.1.16 In May 2012, the Roads Minister announced the Scheme as one of six Highways Agency Major Road schemes for development, at which point work commenced on the Option Selection stage.

**February 2013**

5.1.17 In February 2013 the Agency’s Roads Programme Steering Group (“RPSG”) reviewed the three TJR options available for the Scheme (see Table 5).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>12</th>
<th>MSA</th>
<th>11</th>
<th>10</th>
<th>8/9</th>
<th>7</th>
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<th>5</th>
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<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

5.1.18 The RPSG determined that the Scheme should be based on the operational principles of Managed Motorways all-lane running (“MM-ALR”), as set-out within Interim Advice Note (“IAN”) 161/13. It provided the following direction for future development of the Scheme:

- a) no additional TJR scenarios were suggested other than the three scenarios proposed;
- b) Scenario 1 should not be progressed any further so as to maximise TJR as much as possible;
- c) the project team should focus their attention on Scenario 2 because of air quality concerns at junction 4; and
- d) TJR should be implemented at junction 4 (Heathrow) unless significant operational disbenefits justify otherwise. It was seen as possible that issues over air quality might provide a significant disbenefit. It was considered that Scenario 3 would provide useful comparative output to ensure a robust decision as to whether to exclude TJR at junction 4 at a later date.
5.1.19 The design solution proposed for the Scheme at this stage was a controlled all lane running scheme. This was in line with the emerging second generation of Managed Motorway design criteria that maintain safety whilst minimising the technology and infrastructure required to support the proposed operational regimes. The Scheme contained the following key features:

a) operate verge mounted electronic signage advising of the start and end of the Scheme;

b) portal gantries positioned near the start of each link, capable of providing lane specific signalling Advanced Motorway Indicator and supporting information on message signs;

c) verge mounted cantilever variable message signs at a maximum spacing of 1500m capable of providing the same types of information but using pictograms, wickets, etc.;

d) additional intermediate gantries may be provided on links in excess of 5km;

e) ERAs at up to 2.5km intervals with potentially less monitoring equipment than the previous design of ERAs;

f) no hard shoulder as the existing hard shoulder becomes a full-time permanent running lane (not just a temporary running lane during periods of congestion as previously considered); and

g) the operational regime runs at variable speed to the national speed limit.

**June 2013**

5.1.20 In the June 2013 Spending Review, the Government announced the M4 junction 3 to junction 12 as a pipeline scheme, to which the Government committed itself to providing funding support, subject to consideration of value for money and deliverability.

**September 2013**

5.1.21 A Managed Motorways All Lane Running Scheme was taken through Option Selection stage in September 2013. Although that stage was termed Option Selection, the Scheme was classified as a single option scheme in terms of the overall concept – that of a Managed Motorway. Within the scope of the various elements which comprise the Scheme design, there were alternative options, such as different options for bridge replacement. These alternative options were further explored during the development of the current Preliminary Design.

**November 2013**

5.1.22 In November 2013, the Agency changed the terminology of Managed Motorways to "smart motorways".
January 2014

5.1.23 The current stage of work commenced in January 2014 to take the M4 junction 3 to junction 12 smart motorway scheme through the Development phase which includes Preliminary Design and preparation of the Application.

December 2014

5.1.24 The Scheme was included in the top 40 priority infrastructure investments in the Government’s National Infrastructure Plan (Ref 14) which accompanied the Chancellor’s Autumn Statement (Ref 15). It was also included in the Government’s first Roads Investment Strategy (Ref 16).

5.2 Alternatives considered for specific Scheme elements

5.2.1 The technical details and further explanation of the range of details relating to the Scheme elements is presented in sections 6.3 and 6.4 of this EDR.

Structures

5.2.2 A number of alternative options were considered for the replacement of each of the bridges affected by the Scheme. These included:

a) replacement online with the bridge closed for the duration of the works and traffic diverted onto a suitable diversion route agreed with the local authority;

b) replacement offline to the east or west of the existing bridge. The road would remain open for the duration of the works, except for short closures or shuttle working that would be necessary to accommodate highway works where the new road ties back into the existing road; for operations involving lifting of elements of the new structure into position using cranes; and for demolition of the existing structure; and

c) non-replacement of a structure if it was now considered to be redundant by the local authority – although none of the existing structures were found to be in this category.

5.2.3 A number of different span arrangements were considered: These included:

a) single-span bridge supported on full height abutments located at the back of the M4 verge;

b) two-span bridge supported on a central reserve pier and abutments located within the embankments; and

c) three-span bridge with piers at the back of verge and bank seats at the top of the embankments.
5.2.4 The Preliminary Design concluded that both the single-span and three-span structures provided the most buildable and economic solution. Initial cost analysis showed that the single-span generally had a slight cost advantage and was therefore the preferred solution at most sites.

5.2.5 Although a two-span structure had benefits in terms of reduced construction depths and impact on side road construction, it was decided from a health and safety perspective to avoid pier construction within the central reserve. There was also, in the case of the offline construction, insufficient space to create a safe working zone to build the piers whilst maintaining three lanes of traffic in each direction. Working in the central reserve would also have had a significant impact on the construction programme, as it was considered likely that overnight working would be necessary, which would lead to very inefficient working patterns.

5.2.6 Steel-concrete composite deck construction was considered the most suitable form of construction for the replacement overbridges. This form of deck provides a cost effective solution for the spans required to cross the M4. The use of weathering steel (unpainted steel) reduces the cost and impact on traffic associated with the repainting of other materials.

5.2.7 During detailed design, the options will be subject to further review following stakeholder engagement and subsequent value engineering with the appointed contractor. This may identify benefits that could be achieved by re-considering some of the alternatives once more details about the proposed construction of the wider Scheme are established.

5.2.8 Possible changes could include:

a) span arrangements, if temporary works and detailed cost estimates demonstrate significant benefits;

b) reinforced concrete abutments/wing-walls being replaced by reinforced soil where appropriate and where a cost saving can be demonstrated;

c) online solutions changing to offline solutions if diversion routes are considered undesirable; and

d) online solutions changing to offline solutions if significant costs are associated with utility diversions and, directional drilling of services under the M4 carriageways is not feasible.

5.2.9 Tables 6 and 7 describe the main alternatives considered in relation to particular overbridge and underbridge structures respectively.
<table>
<thead>
<tr>
<th>Structure</th>
<th>Alternatives considered</th>
<th>Option selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascot Road overbridge</td>
<td>Online/Offline construction</td>
<td>Offline construction is required because the high traffic volumes on the A330</td>
</tr>
<tr>
<td></td>
<td></td>
<td>prevent a suitable diversion which is acceptable to the local authority. An offline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>replacement to the east provides an improved highway alignment compared to a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>solution to the west, and avoids impacting on the residential properties and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>communication masts.</td>
</tr>
<tr>
<td></td>
<td>One/three-span construction</td>
<td>Single-span construction, to eliminate the need for a central pier and thereby</td>
</tr>
<tr>
<td></td>
<td></td>
<td>improving safety for construction workers and enabling three lanes of traffic to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>be maintained during peak hours.</td>
</tr>
<tr>
<td>Monkey Island Lane</td>
<td>Online/Offline construction</td>
<td>Offline construction to the east required. This bridge is the only means of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>access into the properties on Monkey Island. Realignment to the east avoids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>impacting on adjacent residential properties.</td>
</tr>
<tr>
<td>Marsh Lane</td>
<td>Online/Offline construction</td>
<td>Online construction, to minimise land-take, with Lake End Road being the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>diversion route.</td>
</tr>
<tr>
<td>Lake End Road</td>
<td>One/two/three-span construction</td>
<td>Single-span construction, to eliminate the need for a central pier and thereby</td>
</tr>
<tr>
<td></td>
<td></td>
<td>improving safety for construction workers and enabling three lanes of traffic to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>be maintained during peak hours.</td>
</tr>
<tr>
<td></td>
<td>Online/Offline construction</td>
<td>Offline construction to maintain suitable access to Dorney for buses and boat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>trailers.</td>
</tr>
<tr>
<td></td>
<td>One/two/three-span construction</td>
<td>Single-span construction, to eliminate the need for a central pier and thereby</td>
</tr>
<tr>
<td></td>
<td></td>
<td>improving safety for construction workers and enabling three lanes of traffic to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>be maintained during peak hours.</td>
</tr>
<tr>
<td>Structure</td>
<td>Alternatives considered</td>
<td>Option selected</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Huntercombe Spur</td>
<td>Online/Partially offline construction</td>
<td>An online replacement was rejected because during construction it would require temporary closure of junction 7 for access and egress of westbound traffic. Traffic would need to be diverted via junction 6 or junction 8/9 to the A4 through Slough or Maidenhead. Such a diversion was considered to create an unacceptable level of disruption. Partially offline construction selected. Online construction without implementing a junction closure would require running traffic across the structure in a part-demolished state. The structural form of the existing bridge made this approach not feasible.</td>
</tr>
<tr>
<td></td>
<td>One/two/three-span construction</td>
<td>Three-span preferred over single-span. This limits the temporary works associated with this phased construction and provides an open aspect more closely matching the existing bridge.</td>
</tr>
<tr>
<td>Oldway Lane</td>
<td>Online/offline construction</td>
<td>Online replacement to minimise land-take.</td>
</tr>
<tr>
<td></td>
<td>Footbridge/vehicular bridge</td>
<td>Lightweight footbridge; a like-for-like vehicular replacement is unnecessary as the route is not accessible for unrestricted vehicle usage from either north or south.</td>
</tr>
<tr>
<td>Wood Lane</td>
<td>Offline construction only</td>
<td>Offline to the east - Wood Lane is the only means of providing vehicular access to the Sewage Treatment Works and residential properties on the south side of the motorway. This precludes the online option which would require temporary closure of the road.</td>
</tr>
<tr>
<td></td>
<td>One/three-span construction</td>
<td>Single-span construction, to eliminate the need for a central pier and thereby improving safety for construction workers and enabling three lanes of traffic to be maintained during peak hours.</td>
</tr>
</tbody>
</table>
### Structure

<table>
<thead>
<tr>
<th>Structure</th>
<th>Alternatives considered</th>
<th>Option selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datchet Road</td>
<td>Online/offline construction</td>
<td>Offline solution required. There is no acceptable diversion route during construction. A diversion along the A4 via either junction 6 or junction 5 would be over five miles (8.047km) long and the only other available diversion would be via B3026 Pococks Lane which is not considered to be suitable for the level of traffic on Datchet Road. The new road will be realigned to the east to avoid impacting on residential properties. Online solution utilising traffic running across the structure with contraflow in a partially-demolished state was rejected. There is insufficient width for safety, and the structural form of the existing bridge is unsuitable, so this approach is not feasible.</td>
</tr>
<tr>
<td>Recreation Ground</td>
<td>One/three-span construction</td>
<td>Single-span solutions were considered but due to the skew and span length, a three-span option was considered more suitable. The three-span bridge provides a cost effective solution that minimises the amount of temporary works and provides an open aspect that more closely matches the original bridge.</td>
</tr>
<tr>
<td>Recreation Ground</td>
<td>Online/offline construction</td>
<td>Online replacement to minimise land-take. Refer to ES Chapter 4 for proposed diversion route.</td>
</tr>
<tr>
<td>Recreation Ground</td>
<td>One/two/three-span construction</td>
<td>Single-span construction, to eliminate the need for a central pier and thereby improving safety for construction workers and enabling three lanes of traffic to be maintained during peak hours.</td>
</tr>
</tbody>
</table>
### Structure

<table>
<thead>
<tr>
<th>Alternatives considered</th>
<th>Option selected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Riding Court Road</strong></td>
<td>Offline construction. The side road in the vicinity of the existing bridge is re-aligned to the west to achieve an improved horizontal alignment. The new alignment has been developed to avoid impacting on property and communications masts on the southern side of the motorway. An online replacement was considered with a potential diversion route identified. However, a planning application has been submitted to extract aggregate from the land around Riding Court Farm. The volumes of traffic and defined routing of vehicles would cause considerable disruption on the surrounding local road network if the existing bridge was closed to traffic during replacement. This combined with the long vehicular diversion and requirement for diversion of statutory undertakers’ apparatus has driven an offline bridge replacement to be preferred.</td>
</tr>
<tr>
<td><strong>Old Slade Lane</strong></td>
<td>Single-span construction, to eliminate the need for a central pier and thereby improving safety for construction workers and enabling three lanes of traffic to be maintained during peak hours.</td>
</tr>
<tr>
<td><strong>One/two/three-span construction</strong></td>
<td>Online replacement constrained by slip-roads to M25 and presence of a lake to the south-east; While a temporary diversion route is available, extensive additional works would be required to bring the route to an appropriate standard for use by the public. The route would also be lengthy.</td>
</tr>
<tr>
<td>Offline construction</td>
<td>Single-span construction – multi-span options were rejected because of the proximity to the M25 junction, leading to high-vehicular turning movements, so an increased likelihood of an incident involving the workforce.</td>
</tr>
<tr>
<td>Structure</td>
<td>Alternatives considered</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Thames Bray</td>
<td>Asymmetric widening to north/south side</td>
</tr>
<tr>
<td>Chalvey Culvert</td>
<td>Symmetric widening both sides</td>
</tr>
<tr>
<td>Windsor Branch Railway</td>
<td>Asymmetric widening to north/south side</td>
</tr>
<tr>
<td>Structure</td>
<td>Alternatives considered</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Symmetric widening both sides</td>
<td>Symmetric widening on both sides rejected due to the increased number and complexity of construction operations, and the greater impact on road users, vegetation, the Recycling Centre and nearby residents.</td>
</tr>
<tr>
<td>Water and Gas Main culvert</td>
<td>Symmetric widening both sides</td>
</tr>
<tr>
<td>Asymmetric widening to north/south side</td>
<td>Asymmetric widening not beneficial for this small-scale structure due to the significant length of highway realignment that would be required.</td>
</tr>
<tr>
<td>Infilling of structure with possible service diversions</td>
<td>Alternative option to infill and possibly divert services away from this structure is currently being discussed with Thames Water.</td>
</tr>
<tr>
<td>Water Main culvert</td>
<td>Symmetric widening both sides</td>
</tr>
<tr>
<td>Asymmetric widening to north/south side</td>
<td>Asymmetric widening not beneficial for this small-scale structure due to the significant length of highway realignment that would be required.</td>
</tr>
<tr>
<td>Infilling of structure with possible service diversions</td>
<td>Alternative option to infill and possibly divert services away from this structure is currently being discussed with Thames Water.</td>
</tr>
<tr>
<td>Ashely's Arch culvert</td>
<td>Asymmetric widening to north/south side</td>
</tr>
<tr>
<td>Symmetric widening both sides</td>
<td>Symmetric widening on both sides rejected due to significant highway realignment and associated widening of the adjacent culvert structure.</td>
</tr>
<tr>
<td>Langley Interchange West</td>
<td>Symmetric widening both sides</td>
</tr>
<tr>
<td>Asymmetric widening to north/south side</td>
<td>Asymmetric widening rejected due to the associated realignment works and land-take which would be needed in relation to the junction 5 slip roads.</td>
</tr>
<tr>
<td>Structure</td>
<td>Alternatives considered</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Widening in steel/concrete composite or pre-stressed concrete deck construction</td>
<td>Steel/concrete composite construction selected in favour of pre-stressed concrete beams due to reductions in crane sizes and overall speed of deck construction achieved.</td>
</tr>
<tr>
<td>Langley Interchange subway</td>
<td>Symmetric widening both sides</td>
</tr>
<tr>
<td>Asymmetric widening to north/south side</td>
<td>Asymmetric widening rejected due to the associated realignment works and land-take which would be needed in relation to the junction 5 slip roads.</td>
</tr>
<tr>
<td>Langley Interchange East</td>
<td>Symmetric widening both sides</td>
</tr>
<tr>
<td>Asymmetric widening to north/south side</td>
<td>Asymmetric widening rejected due to the associated realignment works and land-take which would be needed in relation to the junction 5 slip roads.</td>
</tr>
<tr>
<td>Widening in steel composite or pre-stressed concrete deck construction</td>
<td>Steel/concrete composite construction selected in favour of pre-stressed concrete beams due to reductions in crane sizes and overall speed of deck construction achieved.</td>
</tr>
<tr>
<td>Sipson Road North subway</td>
<td>Asymmetric widening to north/south side</td>
</tr>
<tr>
<td>Symmetric widening both sides</td>
<td>Symmetric widening on both sides rejected due to the increased number and complexity of site operations, greater impact on vegetation, the local school and nearby residents.</td>
</tr>
</tbody>
</table>
Central reserve

5.2.10 It is proposed to provide a 900mm high Rigid Concrete Barrier ("RCB") and paved central reserve throughout the Scheme. Provision of steel safety barrier in the central reserve was rejected as an alternative, as it would not comply with the Agency’s design standards. However, a safety assessment of constructing the RCB on an unpaved central reserve was undertaken. After consulting the Agency’s maintenance service provider for Area 3 (the Agency’s maintenance area through which this section of the M4 passes) and presenting the options to the Project Safety Control Review Group in November 2013, it was decided that the RCB should be constructed on a paved central reserve as this would:

a) eliminate stone scatter caused by errant vehicles and the need to sweep back scattered stones;

b) avoid the need for maintenance of the storm drain (provision of a hardened central reserve would allow a mobile sweep);

c) avoid the need for vegetation control (expected to be undertaken three times per year);

d) avoid the risk of rutting in the soft central reserve and accidents due to loss of control of vehicles as result of rutting;

e) provide better control of planned and unplanned maintenance as maintenance of hardened central reserve can be undertaken within Traffic Management ("TM") for technology maintenance;

f) provide a refuge for workers walking along the central reserve (especially at night as a paved central reserve is safer to walk on than a soft central reserve);

g) reduce the time required for lane closures to remediate the RCB after a vehicle impact;

h) lower whole life cycle costs; and

i) provide consistency with M3 and M25 maintenance and operating regimes.

5.2.11 The original design option for junction 5 to junction 4b eastbound was for four lanes with a fifth lane for the final 500m before the exit to the M25 (auxiliary lane drop) and three lanes continuing towards London. A fifth lane has been introduced, on the eastbound carriageway, directly east of Sutton Lane Bridge providing two exit lanes dedicated to the M25, to reduce the potential for queuing traffic to tail back on the M4 mainline.
5.3 On-going iterative design process for the Scheme

5.3.1 Chapter 6 of this EDR describes the Scheme based on the current Preliminary Design. The Scheme design was produced through an iterative design process involving:

a) review of Scheme objectives and emerging requirements for smart motorways;

b) consultation with relevant statutory consultees and other interested parties;

c) engagement with the public through public consultation, and review of responses from the consultation; and

d) collaborative working between the environmental disciplines and engineering teams to address any environmental effects including mitigation measures, as required, and take into consideration consultation responses as part of the on-going environmental assessment process.

5.3.2 The preliminary design of the Scheme is the design upon which the Application is based. Detailed design is expected to commence in parallel with the examination of the Application. This is necessary in order to ensure delivery of the Scheme in a timely manner. However, where alternatives are still currently under consideration, all potential options are included within the Application. The design assessed in the ES may be considered to represent a worst-case scenario, in terms of environmental impact and required land-take, so as to ensure that all foreseeable significant environmental effects of the Scheme have been assessed.
6 SCHEME PROPOSALS

6.1 Overview of Scheme design

6.1.1 The Scheme is approximately 51km (32 miles) in length from junction 3 (Hayes) to junction 12 (Theale). It will result in the conversion of the hard shoulder of the M4 to a permanent running lane, while providing the necessary signing and technology to manage traffic using variable mandatory speed limits ("VMSL"). This will require the construction of gantries with lane-specific, variable message signs. A motorway with these features is referred to as a “smart motorway” as explained in chapter 5 of this EDR. The operation of the Scheme as a smart motorway is described in chapter 8 of this EDR.

6.1.2 There are a number of hard shoulder discontinuities, i.e. there is no hard shoulder for short lengths where existing bridges limit the available carriageway width, between junction 4b and junction 8/9. It is proposed that these bridges are widened or demolished and rebuilt in order to enable ALR, and TJR within the Scheme. Other minor works are also required to enable the appropriate lane widths to be achieved including alterations to the central reserve of the motorway.

6.1.3 The majority of the works along the motorway corridor will be within land currently owned by the Secretary of State. This is because the Secretary of State is the highway authority for, and landowner of, Special Roads such as the M4. The Agency manages and operates the strategic road network on behalf of the Secretary of State. Additional land will be required permanently to accommodate the Scheme, such as for side road realignment at overbridges and underbridge widening. This will be kept to the minimum area required. Land will also be required temporarily for access, storage and construction activities, and in most cases will be reinstated to its former use on completion of construction. Both permanent and temporary land-take is included within the Order limits shown on the General arrangement drawings in Annex F of this EDR.

6.1.4 A preliminary design has been prepared for the Scheme to allow EIA to take place and the Application to be made. There are aspects of the Scheme design which are not yet fixed or where alternatives are still under consideration. Where alternatives are still under consideration, then all options are included within the Order limits. As such, the areas affected by the Scheme are shown indicatively at this stage, and are expected to reduce as the design is developed and Scheme areas are refined.
6.1.5 Design development will continue to be informed by the EIA through iterative working between designers and environmental specialists, and through consultation with stakeholders. However, the design being assessed in the EIA is considered to represent a worst case scenario, in terms of environmental impact and required land-take, to ensure that all foreseeable significant environmental effects of the Scheme have been assessed.

6.1.6 Detailed design for implementation purposes will commence after the Application has been submitted. Some details of the preliminary design may change as a result, but any changes will be within the previously assessed parameters. This will be secured by the wording of the DCO.

6.2 Design guidance

6.2.1 The development and design of major highway projects are addressed by guidance and standards set out in the Design Manual for Roads and Bridges (“DMRB”) (Ref 17). The DMRB is supplemented by a number of IANs that provide up-to-date and detailed guidance in relation to certain aspects of design, assessment and network management. DMRB and IANs are published by the DfT and the Agency respectively.

6.3 Improving a traditional motorway

6.3.1 This section describes the civil engineering works to the existing M4 motorway that are required for the Scheme. It provides an overview of the general approach to the Scheme, describing the principles of TJR and the general works required to structures along the M4. The preliminary design is illustrated on the General arrangement drawings in Annex F and an explanation of the specific works proposed within each section of the M4, on a junction-by-junction basis (referred to as links), is contained in chapter 7 of this EDR.

**Improving the traditional motorway: general approach**

6.3.2 Wherever possible, the proposed alignment of the road(s) for the Scheme has been designed to remain within the extent of the existing carriageway and the Secretary of State’s land ownership. Some carriageway widening will be required at junctions to accommodate slip roads, and in areas where there is no existing hard shoulder (generally at overbridges above the M4 between junction 4b and junction 8/9).
6.3.3 The majority of the M4 within the Scheme will be converted to four-lane ALR. In addition, five-lane carriageways are proposed between junction 4b (M25) and junction 4 (Heathrow), which currently has four lanes in each carriageway, to provide additional capacity for traffic exiting/joining the main carriageway, whilst enabling TJR at junction 4. Five lanes will also be provided on the eastbound carriageway from Sutton Lane overbridge (east of junction 5) to junction 4b to give additional diverge capacity for traffic leaving the M4 to join the M25. These are shown on the Scheme plans.

6.3.4 The motorway will be re-aligned over the Thames Bray and Windsor Branch Railway underbridges to allow for asymmetric widening (widening one side of the motorway rather than both sides – see Figure 3). This is required in some locations due to engineering constraints and as a means of minimising disruption to the motorway during construction. These areas of asymmetric widening are indicated on the underbridge General Arrangement drawings in Annex F.

![Figure 3: Typical arrangement of asymmetric widening at Windsor Branch railway bridge](image)

**Improving a traditional motorway: lane widths**

6.3.5 The proposed lane widths of the improved motorway are shown in Table 8 with regard to four-lane ALR and five-lane ALR operations.
### Table 8: ALR lane widths

<table>
<thead>
<tr>
<th></th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
<th>Lane 4</th>
<th>Lane 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four lane ALR</td>
<td>3.65m</td>
<td>3.50m</td>
<td>3.40m</td>
<td>3.20m</td>
<td>n/a</td>
</tr>
<tr>
<td>Five lane ALR</td>
<td>3.65m</td>
<td>3.65m</td>
<td>3.50m</td>
<td>3.40m</td>
<td>3.20m</td>
</tr>
</tbody>
</table>

6.3.6 In locations where the existing carriageway width is insufficient to accommodate the minimum ALR lane widths the additional width will be achieved by widening the carriageway into the central reserve. In most locations, this widening will be between 0mm and 500mm. Between junction 8/9 (Holyport) and junction 5 (Langley), this widening will reduce the central reserve width to a minimum of 2.6m, which is nevertheless within the required safety standards.

6.3.7 Any proposed deviation from the lane widths quoted above is noted in the relevant part of chapter 7 of this EDR.

**Improving the traditional motorway: hard shoulder discontinuities (junction 8/9 to junction 4b)**

6.3.8 The structures on the M4 from junction 8/9 (Holyport) to junction 4b (M25) were mostly built during the 1960s to accommodate a dual two-lane motorway. In the 1970s the motorway was widened to three lanes, but the structures were generally not modified. This resulted in the hard shoulder being discontinuous at some overbridges, as shown in Figure 4, and at some underbridges.

![Typical existing overbridge with discontinuous hard-shoulder](image)

**Figure 4:** Typical existing overbridge with discontinuous hard-shoulder
6.3.9 These discontinuities prevent ALR, so provision of ALR will require these constraints to be removed so that the hard shoulder can function as a continuous running lane. In total, 11 overbridges, all situated between junction 8/9 (Holyport) and junction 4b (M25), will be demolished and replaced. There are two broad approaches to such works - replacement in situ, or "online", and replacement alongside/ nearby, or "offline" (in this context). Of the 11 bridges, it is proposed that seven will be replaced as offline improvements to the side roads, allowing the existing bridges to remain in use to carry traffic during construction. It is proposed that the remaining four will be replaced as part of online improvements to the side roads requiring temporary closure of the side road. See chapter 7 of this EDR for details.

6.3.10 It is proposed to widen the existing structure(s) where there is insufficient width at underbridges. Four underbridges, two subways and four culverts require widening. See chapter 7 of this EDR for details.

**Improving the traditional motorway: TJR**

6.3.11 The provision of TJR along a route corridor allows long distance, through traffic to remain in lane 1 and not make successive lane changes, prior to and after each junction. This reduces the number of lane changes and the associated hazards. TJR is the preferred operating regime for ALR schemes, with the exception of motorway-to-motorway interchanges and at junctions at either end of the Scheme, i.e. junction 3 (Hayes) and junction 12 (Theale) where the Scheme ties back into the existing lane configuration. TJR is proposed at junction 4 (Heathrow), junction 5 (Langley), junction 6 (Chalvey), junction 7 (Huntercombe), junction 8/9 (Holyport) and junction 11 (Three Mile Cross) and at the access to Reading MSA.

6.3.12 TJR is not proposed at the terminal junctions where the Scheme begins and ends, namely junction 12 and junction 3. On the approach to these junctions, from outside the Scheme, the left hand lane of the entry slip road would feed into the new lane 1 of the four-lane motorway (lane gain). At the end of the Scheme, lane 1 would diverge from the motorway (lane drop) into the exit slip road. The remaining three lanes will continue through the junction and align with the existing layout beyond the Scheme boundary.

6.3.13 TJR is also not proposed at junction 4b (M25) or junction 10 (Winnersh). These two junctions have free flow motorway-to-motorway two lane slip roads with high traffic flows. Use of TJR at these junctions would create additional traffic flow conflict between through traffic in lane 1 and diverging traffic approaching the junction in lane 2. At these junctions a “lane drop, lane gain” layout is proposed as shown in Table 9.
### Table 9: Junction schematics

<table>
<thead>
<tr>
<th>Traffic Flow</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LANE GAIN</strong></td>
<td>Typical lane gain and lane drop junction layouts.</td>
</tr>
<tr>
<td><strong>LANE DROP</strong></td>
<td></td>
</tr>
<tr>
<td><strong>THROUGH JUNCTION RUNNING</strong></td>
<td>Typical lane layout for through junction running.</td>
</tr>
<tr>
<td><strong>NON-THROUGH JUNCTION RUNNING</strong></td>
<td>Typical lane drop / lane gain layout at a junction without through junction running.</td>
</tr>
</tbody>
</table>

**Improving the traditional motorway: ERAs**

6.3.14 For a motorway with ALR, ERAs, which are similar to laybys, are required to provide a safe area for vehicles to stop in an emergency without interrupting the flow of traffic. This is because there will no longer be a hard shoulder. The current design for the Scheme is for 33 ERAs, no more than 2.5km apart, as indicated on the General Arrangement drawings in Annex F of this EDR. These will measure 100m in length (25m entry taper, 30m full width, 45m exit taper) and will be a minimum of 4.6m wide. So far as possible, they will be built on existing highway verges and within the existing highway boundary (and hence within the existing ownership of the Secretary of State).
6.3.15 In the event of a vehicle using an ERA in an emergency, additional signing in the ERA encourages drivers to contact the Regional Control Centre (“RCC”). The RCC will offer safety advice and ask if the driver requires assistance. Operators in the RCC will be able to monitor the vehicle using CCTV, and if necessary dispatch a traffic officer patrol and/or set signs and signals to assist the vehicle’s safe exit, either under the vehicle’s own power or under tow from a recovery agent.

6.3.16 Although it is expected that the majority of drivers will not need assistance to exit the ERA, options range from setting warning legends on the variable message signs, through reducing carriageway speed limits, to setting up a rolling road block to allow a slow moving vehicle to leave. These procedures are tried and tested, and are currently used on the Agency network.

Improving the traditional motorway: Police Observation Platforms

6.3.17 Police Observation Platforms (“POPs”) provide a safe area for stationary police vehicles. On the M4 currently the police access the POPs by pulling up on the hard shoulder and reversing into the POP. On completion of their observation they then re-access the motorway after accelerating to motorway speed on the hard shoulder.

Figure 5: Typical ERA with police observation platform

6.3.18 With no hard shoulder on the Scheme it will not be possible to operate in this manner, so the existing POPs will be removed and new POPs positioned adjacent to ERAs (Figure 5). An assessment of the number and location of the new POPs is currently being undertaken in conjunction with key stakeholders (Police and Agency Customer Operations). The assessment will include sight lines to the POPs and available space to construct the raised platform.
Improving the traditional motorway: overbridges

6.3.19 For the 11 sites where bridge reconstruction work is required, four will be replaced online and seven offline as follows:

a) where a suitable temporary road diversion route is agreed with the local authority (i.e. an alternative way of reaching the same areas without a significant increase in distance) then a temporary closure of the side road will be implemented, the existing bridge demolished and the new bridge built at the same location as the old bridge (online replacement). Traffic, pedestrians, cyclists and equestrians will be diverted on to this alternative route during the active construction; and

b) where a suitable temporary diversion route does not exist, and closure during construction is not feasible, then the new bridge will be built to one side of the existing bridge (offline reconstruction), whilst the existing bridge remains open to traffic. Following completion of the new bridge, traffic will then be diverted onto the new bridge and the old bridge will be demolished.

6.3.20 As part of the replacement of overbridges, the existing carriageway and footpath/cycleway/equestrian provisions will be maintained on a broadly like-for-like basis.

6.3.21 The height or “vertical alignment” of each of the 11 side roads will be increased to provide the required clearance height above the motorway and to accommodate the increased depth of the new replacement bridge.

6.3.22 Before describing the bridge works included in the Scheme in the link-by-link explanation provided in chapter 7 of this EDR, it is useful to outline some of the terms used:

a) “Super-structure” is the term used for the deck and parapets of the bridge;

b) “Sub-structure” is the columns and other supports on which the super-structure rests;

c) an “abutment” is the sub-structure at the end of a bridge. Abutments provide vertical and lateral support for the super-structure;

d) a “full height abutment” sits at the back of the under-road verge and acts as a retaining wall to hold back the earthworks fill material of the bridge approach embankments;

e) a “bank seat abutment” is smaller than a full height abutment. It sits at the top of the approach embankment and results in a bridge with a more open aspect, but with a longer deck; and
f) a “pier” is an intermediate element of the sub-structure required on multi-span bridges. A pier usually consists of a column, a group of columns or a wall.

6.3.23 All structural steelwork is proposed to be fabricated using improved atmospheric corrosion resistance “weathering” steel that does not require painting. A number of different structural configurations have been considered for each of the replacement bridges. A summary of these options is contained in Table 6 for overbridges and 7 for underbridges.

6.3.24 Three different overbridge span arrangements are used in the current iteration of the Preliminary Design:

a) single-span deck supported on full height abutments (Figure 6). This is proposed rather than a two-span bridge which would need a pier to be built in the central reserve with consequential traffic delay, safety, cost and programme disadvantages. It is the preferred solution at most sites;

b) three-span with piers at the back of the verge and bank seat abutments (Figure 7) are proposed for the two longest bridges: Datchet Road and Huntercombe Spur. A three-span bridge is preferred because of construction benefits. The use of bank seats, rather than full height abutments, will reduce the amount of temporary works required to construct immediately adjacent to the existing structure; and

c) single-span steel truss footbridge (Figure 8). This is suitable only for non-vehicular loading and is proposed only at Oldway Lane.

![Figure 6: Typical elevation of proposed single-span structure](image1)

![Figure 7: Typical elevation of proposed three-span structure](image2)
6.3.25 Construction of overbridges and embankments will require works on land not currently owned by the Secretary of State. Both temporary and permanent land requirements are within the Order limits shown on the General Arrangement drawings in Annex F of this EDR.

6.3.26 The locations of structures that need to be demolished and reconstructed are indicated on the General Arrangement drawings in Annex F of this EDR and details of the specific proposals at each location are included in chapter 7 of this EDR. The 11 overbridges to be demolished and replaced are listed in Table 10.

Table 10: Overbridges to be demolished and reconstructed

<table>
<thead>
<tr>
<th>Overbridge</th>
<th>Location</th>
<th>Replacement structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascot Road</td>
<td>J8/9 – J7 Offline, single-span</td>
<td></td>
</tr>
<tr>
<td>Monkey Island Lane</td>
<td>J8/9 – J7 Offline, single-span</td>
<td></td>
</tr>
<tr>
<td>Marsh Lane</td>
<td>J8/9 – J7 Online, single-span</td>
<td></td>
</tr>
<tr>
<td>Lake End Road</td>
<td>J8/9 – J7 Offline, single-span</td>
<td></td>
</tr>
<tr>
<td>Huntercombe Spur</td>
<td>J7 Offline, three-span</td>
<td></td>
</tr>
<tr>
<td>Oldway Lane</td>
<td>J7 – J6 Online, single-span footbridge</td>
<td></td>
</tr>
<tr>
<td>Wood Lane</td>
<td>J7 – J6 Offline, single-span</td>
<td></td>
</tr>
<tr>
<td>Datchet Road</td>
<td>J6 – J5 Offline, three-span</td>
<td></td>
</tr>
<tr>
<td>Recreation Ground</td>
<td>J6 – J5 Online, single-span</td>
<td></td>
</tr>
<tr>
<td>Riding Court Road</td>
<td>J6 – J5 Offline, single-span</td>
<td></td>
</tr>
<tr>
<td>Old Slade Lane</td>
<td>J5 – J4b Online, single-span</td>
<td></td>
</tr>
</tbody>
</table>
Improving the traditional motorway: underbridges, subways and culverts

6.3.27 As explained above, there are currently a number of links where the existing hard shoulder is discontinuous due to the width of the underbridges, subways and culverts. To accommodate ALR the four underbridges, two subways and four culverts listed in Table 11 require widening.

6.3.28 The preferred solution for each bridge is to extend the existing structure with a matching structural form. A number of different structural configurations have been considered for the widening of underbridges. A summary of these options are contained in Table 7.

6.3.29 As with the overbridges, widening of the underbridges and embankments will require works on land not currently owned by the Secretary of State. Both temporary and permanent land requirements are within the Order limits shown on the General Arrangement drawings in Annex F of this EDR.

6.3.30 The most notable of the underbridges are Thames Bray underbridge, which requires 7.8m of widening, and Windsor Branch Railway underbridge, which requires 8.85m of widening. The locations of structures that need to be widened are indicated on the General Arrangement drawings in Annex F of this EDR and details of the specific proposals at each location are included in chapter 7 of this EDR.

Table 11: Underbridges to be widened

<table>
<thead>
<tr>
<th>Underbridge</th>
<th>Location</th>
<th>Nature of widening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thames Bray</td>
<td>J8/9 – J7</td>
<td>7.8m asymmetric widening to the north</td>
</tr>
<tr>
<td>Calvey culvert</td>
<td>J7 – J6</td>
<td>4.0m symmetric widening both sides</td>
</tr>
<tr>
<td>Windsor Branch Railway</td>
<td>J6 – J5</td>
<td>8.85m asymmetric widening to the south</td>
</tr>
<tr>
<td>Water and gas main culvert</td>
<td>J6 – J5</td>
<td>2.1m symmetric widening both sides</td>
</tr>
<tr>
<td>Water main culvert</td>
<td>J6 – J5</td>
<td>3.1m symmetric widening both sides</td>
</tr>
<tr>
<td>Ashley’s Arch culvert</td>
<td>J6 – J5</td>
<td>1.5m asymmetric widening to the north</td>
</tr>
<tr>
<td>Langley Interchange West</td>
<td>J5</td>
<td>4.5m symmetric widening both sides</td>
</tr>
<tr>
<td>Langley Interchange subway</td>
<td>J5</td>
<td>2.1m symmetric widening both sides</td>
</tr>
</tbody>
</table>
### Improving the traditional motorway: earthworks widening

**6.3.31** Existing earthwork embankments and cuttings will need to be widened and/or retained in the following situations:

a) where localised widening is required to accommodate motorway and slip road widening;

b) for all realigned side roads;

c) to support foundations for new structures and gantries in areas of narrow verge width;

d) for the purpose of constructing ERAs and POPs; and

e) to support cabinets or chambers, where the existing verge width will not accommodate these elements.

### Improving the traditional motorway: drainage

**6.3.32** Highway drainage is designed to remove rainfall from the carriageway surface to ensure safe operation of the road network. The drainage strategy for the Scheme has been produced by the Agency and is included with the suite of Application documents (Volume 7, Document 7.5).

**6.3.33** New drainage systems will be required in the central reserve and the verges where appropriate.

**6.3.34** Drainage in the central reserve will largely be replaced with linear drains in sloped/cambered sections of carriageway. New coplanar lengths (areas of existing hard shoulder that currently slopes in the opposite direction to the carriageway are changed to slope in the same direction as carriageway camber and where linear drainage is necessary.

**6.3.35** In the verge, it is proposed to replace the existing kerb and gully system with linear drains and combined kerb and gully systems where appropriate. Verges are typically 1.5m to 2m wide. On that basis, it is likely that there will be a requirement to provide a bound surface above filter drains to prevent stone scatter. Therefore, an alternative surface water collection system (i.e. surface water channel or slot drain) will be required.
6.3.36 Where existing areas of non-coplanar hard shoulder are to change to coplanar surfaces, modelling of the existing drainage system would be undertaken to confirm the extent of any upgrade requirements.

6.3.37 At ERAs, attenuation of run-off from the additional carriageway areas will be in the form of oversized kerb units; pipes and/or manhole chambers with flow and spillages control devices prior to connection into the existing drainage system or a soakaway. This will maintain the existing established discharge rates.

6.3.38 In line with the Agency's design standards, existing maximum discharge rates from the highway drainage system to the receiving watercourses will not be increased, and therefore there will be no impact on flood risk from the mainline works (see ES chapter 15 (Water)). Spillage control devices and other pollution interceptors will be provided at all ERA sites, prior to the outfalls.

6.3.39 Flood risk to third parties could increase as a result of the works to alter the overbridge alignments being located within the floodplain. Mitigation to compensate for any loss of floodplain as a result of the proposed side road alignment will be provided. There is sufficient land available within the Agency’s land to provide suitable flood compensation. In addition slopes of the road embankment may be adjusted to further reduce the impact on flood levels

**Improving the traditional motorway: signs**

6.3.40 Detail in relation to the signage to be used for the Scheme is provided in chapter 7. The majority of new signs required for the Scheme will be mounted overhead on gantries.

**Improving the traditional motorway: road restraint system**

6.3.41 It is proposed to provide a 900mm high RCB (see Figure 9 for an example) and paved central reserve throughout the Scheme. This will prevent cross-over accidents, resulting in improved safety for road users. RCBs also require minimal maintenance and therefore reduce the amount of maintenance works required, improving safety for road workers.

6.3.42 The RCB will include maintenance cross-overs which take the form of steel sections of barrier that can be unbolted to facilitate implementation of contraflow TM (i.e. reversing the direction of a lane) and also allow access for emergency services during severe incidents.
6.3.43 It is envisaged that the majority of the existing safety barrier in the verges will be removed and replaced with a new safety barrier, in order to facilitate the construction of the works. Additional safety barriers will be provided at new hazards in the verge, such as gantries, signs and CCTV cameras. Where a new safety barrier is to be provided in the verge, this will normally be a steel safety barrier system, either using tensioned corrugated beams or open box beams as illustrated in Figures 10 and 11 respectively.

Figure 9: Rigid concrete barrier

Figure 10: Steel safety barrier: tensioned corrugated beam
The full extent of the Scheme, except for the link from junction 8/9 to junction 10, is currently lit with either central reserve or verge lighting. The Scheme includes the retention of lighting in the links that are currently lit as shown on the schematic plan in Annex F of this EDR. Lighting Columns will be mounted on top of the RCB to carry LED luminaires 12m above the carriageway. The lighting design will be finalised during Detailed Design on the following assumptions:

a) all the existing sections of the motorway and slip roads that are currently lit will remain lit;

b) the unlit section between junction 8/9 and junction 10 will remain unlit; and

c) where lighting is required, existing lighting will be removed and replaced with modern light emitting diode ("LED") lighting with a central management control system.

The LED luminaires use much less energy than the existing luminaires.

Improving a traditional motorway: road surfacing

The existing hard shoulders are surfaced in either Hot Rolled Asphalt ("HRA") with stone chippings or Thin Surface Course System ("TSCS"). HRA is the traditional asphalt surfacing material that has been used in the UK since the 1960s. TSCS has been available since the early 1990s and is classified as 'low-noise surfacing'. It is the Agency’s policy (Ref 17) to use TSCS for all new roads and for replacement of life-expired surfacing.
6.3.47 The Scheme will provide TSCS throughout. It is assumed that lane 1 and lane 4 (existing hard shoulder and lane 3 respectively) will require a new surface course following the verge and central reserve works. HRA in lane 2 and lane 3 (existing lane 1 and lane 2 respectively) will be replaced with TSCS. This will reduce the noise impact of the Scheme, and will minimise the need for further maintenance work in the five years after Scheme opening.

**Improving the traditional motorway: noise barriers**

6.3.48 Barriers, in the form of fencing to mitigate noise effects, will be included within the Scheme where the EIA identifies that this form of environmental mitigation is required. This is addressed in greater detail in chapters 8 (Landscape) and 12 (Noise) of the ES.

**Improving the traditional motorway: replacement planting**

6.3.49 Vegetation lost to construction activities will be replanted where possible with locally appropriate species. Environmental enhancement will also be applied in appropriate circumstances, see chapter 8 of the ES. This will be developed through the preparation of an Environmental Masterplan, which will set out the proposed approach to environmental design. The Environmental Masterplan will be secured by a requirement attached to the proposed DCO. The draft Environmental Masterplan is discussed in section 7.12 of this EDR and the vegetation clearance and Environmental Masterplan drawings are included as Annex A to this EDR.

6.3.50 Semi-natural habitat cleared during construction will be re-planted using local species that are considered appropriate to the nature of the soil and the pre-existing vegetation composition. In the medium to long-term this planting will mature to provide habitats and visual screening, which will replace the vegetation removed.

6.4 **Features of a smart motorway**

6.4.1 This section describes the technology, signal and gantry works that are required for the Scheme. It provides an overview of the general approach to the Scheme, describing the individual items that will be used in the Scheme. An explanation of what specific works are proposed at each section of the M4 on a junction-by-junction basis is contained in chapter 7 of this EDR. The operation of the smart motorway using this infrastructure to manage traffic flow and speed is described in chapter 9.

**Features of a smart motorway: motorway signals**

6.4.2 Operation of the smart motorway will be controlled via LED signals mounted on overhead gantries. There are three main types of LED signals which are described below.
6.4.3 Advanced Motorway Indicators ("AMI") (Figure 12) are used to display VMSL for each lane using programmable high resolution LEDs. These will be located on gateway gantry structures after each entry slip road to the Scheme and on intermediate gantries at intervals of not more than 6km.

![Figure 12: Typical view of AMI signals](image)

6.4.4 Motorway Signals Mark 4 ("MS4") (shown in Figures 13 and 14) is a type of variable message sign ("VMS") used to provide driver information in the form of text and pictograms. These will be located at regular intervals along the Scheme either above a gantry boom, generally positioned over lane 1, or on the verge, mounted on a cantilever structure.

![Figure 13: Typical MS4](image)
6.4.5 The other type of VMS proposed for use in the Scheme is a Message Sign Mark 3 ("MS3") (Figures 15 and 16). These will be deployed in advance of strategic junctions and provide information to road users in the form of text messages (3x18 Characters). MS3s are located on cantilever gantries in the verge.

Figure 15: Typical MS3

Figure 16: A cantilever gantry solely supporting an MS3 over lane 1.
6.4.6 VMS signals will be located on the gateway gantries and on additional gantries all along the scheme. The distance between successive VMS signals varies but, generally the distance between one signal and the start of the visibility of the next signal will not exceed 500m. The average distance between VMSs in the preliminary design is 900m.

Features of a smart motorway: signs

6.4.7 Overhead signs will be mounted on gantries to provide drivers with information and to help them select the most appropriate lane. Signs types include Advance Direction Signs (“ADS”) (shown at Figure 17), route confirmation signs and other information signs. All gantry mounted signs will be illuminated at night.

![Figure 17: Typical direction sign (westbound approach to junction 11)](image)

Features of a smart motorway: gantries

6.4.8 Gantry structures are required to support overhead signs, signals, vehicle detection and enforcement equipment. To minimise the number of new gantry structures required, the design includes multi-function gantries, e.g. a single gantry may carry ADSs, AMIs and/or a VMS. The positioning of the gantries has also been optimised to ensure maximum reuse of existing gantry structures.

6.4.9 Cantilever structures are used to mount signs located in the motorway verge. A cantilever structure is supported on a single leg in the verge of the motorway (Figure 18). There are various types of cantilever depending on the equipment or signs that they are supporting. The largest cantilever gantries support signs and signals; these are known as super-cantilever gantries (Figure 19).
6.4.10 Portal gantry structures are used to provide overhead support for signs over one motorway carriageway. A portal gantry has two supporting legs, one at each end of the horizontal boom (Figure 20).

Figure 18: Typical sign-only cantilever gantry (one leg)

Figure 19: Typical super cantilever gantry
6.4.11 Super-span portal gantries (Figure 21) provide overhead support for signs over both motorway carriageways. A super-span portal gantry is a lightweight structure which enables a single portal to span the entire motorway with no support in the central reserve. A super-span portal gantry is not designed for maintenance loading and has no walkway.

6.4.12 The anticipated quantity of each type of gantry included in the Scheme is shown in Table 12. Locations of the individual signs are shown in the Scheme plans in Annex F of this EDR.
### Table 12: Gantry types used in the Scheme

<table>
<thead>
<tr>
<th>Gantry type</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portal</td>
<td>5</td>
</tr>
<tr>
<td>Super-span portal</td>
<td>18</td>
</tr>
<tr>
<td>Super cantilever</td>
<td>25</td>
</tr>
<tr>
<td>Sign only cantilever</td>
<td>26</td>
</tr>
<tr>
<td>MS4 cantilever</td>
<td>51</td>
</tr>
<tr>
<td>MS3 cantilever</td>
<td>8</td>
</tr>
<tr>
<td>Existing portal</td>
<td>9</td>
</tr>
<tr>
<td>Existing MS4 cantilever</td>
<td>20</td>
</tr>
<tr>
<td>Existing MS3 cantilever</td>
<td>0</td>
</tr>
</tbody>
</table>

6.4.13 These estimates are maxima, and are subject to the iterative design process for the Scheme. As detailed design will continue beyond the application for development consent, the numbers of signs and gantries needed may reduce. However, the design assessed in the EIA for the Scheme will be based on a worst-case scenario.

**Features of a smart motorway: Temporary Traffic Management ("TTM") signs**

6.4.14 Remotely controlled signs (Figure 22) will be provided to support TTM to allow for ongoing maintenance activities once the Scheme is completed. These will be located in the central reserve or the verge and can be turned on remotely to warn road users of lane closures ahead.
6.4.15 Approximately 130 Pan, Tilt and Zoom ("PTZ") CCTV cameras (Figure 23) installed on 15m masts will be provided to ensure there is full coverage of all driving lanes. This enables Traffic Officers at the Agency’s existing RCC at South Mimms to manage incidents and set the appropriate signs and signals. A typical detail for a CCTV camera is included in Annex F of this EDR.
7 LINK-BY-LINK DESCRIPTION

7.1.1 This section of the EDR describes, on a link-by-link basis, the Scheme as it is proposed to be implemented. The description is undertaken commencing at junction 12 and proceeding eastwards. In siting some elements of the Scheme, DMRB (Ref 17) standards are used which are based upon imperial measurements. In such cases, the measurement is given in imperial measurements with metric measurements also provided.

7.2 Junction 12 to junction 11

Existing

7.2.1 The M4 between junction 12 (Theale) and junction 11 (Three Mile Cross) is 7,312m long with three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway and lighting columns to the central reserve. The general landform through this link is rural and wetlands, with industrial areas around both junctions. A detailed description of the surrounding landscape, the settlements served by this link and any relevant local landscape designations is provided in chapter 4 of this EDR.

7.2.2 Junction 12 is formed as a gyratory, elevated above the main carriageway of the motorway on two overbridges: Theale Interchange West and Theale Interchange East. Both overbridges take the same form: a three-span structure with the piers situated to both verges. No work is anticipated to either overbridge. The slip roads linking junction 12 to the M4 take a similar form. There is a two-lane slip road merging to a single lane slip on to the eastbound carriageway of the M4. The westbound carriageway off slip consists of a single lane slip road which expands firstly into two lanes and then further into four lanes once it reaches junction 12.

7.2.3 Immediately at the end of the eastbound slip road, situated on a slight crest in the motorway, is the Theale railway underbridge which carries the M4 over the Western Region mainline railway. This structure is not affected by the Scheme.

7.2.4 The motorway then follows a downward gradient towards the next three structures, which are Holy Brook underbridge, River Kennet underbridge and Wellmans Farm access underbridge. These are situated 200m, 300m and 400m respectively further along the carriageway from Theale railway underbridge. These structures are not expected to be affected by the Scheme.

7.2.5 Further on from Wellmans Farm access underbridge is the Reading MSA, which is located on both sides of the motorway. The merge and diverge slips for the MSA are all single lane roads. The motorway through this area is on a slight downward gradient.
7.2.6 Burghfield Road overbridge, a two-span bridge structure, spans over the eastbound merge and westbound diverge slip roads for the Reading MSA. This structure is not affected by the Scheme.

7.2.7 Further along the motorway, situated on a slight crest is Mortimer Line railway underbridge. From a road user point of view, this structure takes on much the same form as Theale railway underbridge. This structure will also not be affected by the Scheme.

7.2.8 Poundgreen Road overbridge, located east of Mortimer Line railway underbridge is a four-span structure and is situated in a slight dip in the motorway. This structure will not be affected by the Scheme.

7.2.9 The M4 then continues uninterrupted through to junction 11. The eastbound diverge consists of two lanes separated by a ghost island, which expands out to four lanes on reaching the gyratory. The westbound merge consists of two lanes which reduce to one lane as it joins the M4. junction 11 is a gyratory, elevated above the main carriageway of the motorway on four overbridges. These overbridges are described as part of the junction 11 to junction 10 link.

**Proposed works on the motorway**

*Lane configuration*

7.2.10 Junction 12 (Theale) is at the western end on the Scheme. Lane provision on the M4 through the junction is not affected by the Scheme. It will remain as three lanes and a hard shoulder in each direction. The eastbound entry slip road merges with the M4 in a lane gain configuration to create a fourth lane on the motorway. Similarly, but in the opposite direction, the westbound exit slip road results in a lane drop.

7.2.11 ALR will be provided for the entire length of this section, with the existing three lanes and the hard shoulder converted to create four running lanes with no hard shoulder. Slightly reduced lane widths will be used on the River Kennet underbridge where the available width for each carriageway is 200mm less than that required for full lane widths. Two ERAs are to be provided on the eastbound carriageway and three on the westbound carriageway. There are no existing POPs on this section, and no new ones are proposed.

7.2.12 TJR will be implemented at the Reading MSA and at junction 11 (Three Mile Cross). This will require reconfiguration of the slip roads at these junctions.
Offside and central reserve works

7.2.13 For much of the length of the scheme it will be necessary to widen the existing carriageway by 200mm to 500mm. This will be done within the existing central reserve. Other features of the Scheme in the central reserve and offside lanes are:

   a) a hard surface and RCB will be installed for the full length of the central reserve. This will benefit road worker safety by minimising the requirement for future maintenance work; and

   b) new lighting will be provided for the whole length of this section. Lighting Columns will be mounted on top of the new concrete barrier to carry LED luminaires 12m above the carriageway.

Nearside and verge works

7.2.14 Where necessary the existing hard shoulder will be strengthened to enable it to carry motorway traffic. Other features of the Scheme in the verges and nearside lanes are:

   a) underground ducts will be installed in the verge to carry the cables required for the new signals and other technology;

   b) new steel safety barriers will be installed around hazards in the verge such as bridges, gantries and large signs;

   c) drainage will be modified and improved as required to accommodate ALR and to suit the new gantries, ERAs and other features;

   d) new verge lighting will be provided only at the junction slip roads; and

   e) existing environmental barriers will be retained or replaced. In some locations it will be necessary to take down the existing barriers during construction either to relocate them or to create temporary working space.

Carriageway resurfacing

7.2.15 Low-noise surfacing will be provided throughout the Scheme as part of the works.

Gantries

7.2.16 There will be 19 gantries between junction 12 and junction 11, 16 of these will be cantilever type structures and three will be super-span portals. The super-span portals will display information to both eastbound and westbound carriageways. In total there will be 11 gantries facing the traffic on each carriageway. The location of the gantries is shown on the Scheme plans in Annex F of this EDR.
7.2.17 Gantries on the eastbound carriageway:
   a) one gateway gantry positioned shortly after the junction 12 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;
   b) one Intermediate gantry similar to the gateway but positioned half-way along the section;
   c) six additional MS4s positioned over the nearside lane at regular intervals;
   d) two ADSs positioned at 2/3 mile (1.07km) and 1/3 mile (0.54km) in advance of junction 11 showing the exit destination of Basingstoke and Reading (S&C); and
   e) one final direction sign on the approach to junction 11, showing exit destination as above, and M4 through traffic destinations of Greater London and Reading (E).

7.2.18 Gantries on the westbound carriageway:
   a) one gateway gantry similar to eastbound gateway but positioned downstream of the junction 11 entry slip road;
   b) two intermediate gantries, one similar to and on a shared structure with the eastbound intermediate gantry and one prior to junction 12 with four AMIs but no variable message signal;
   c) five additional MS4s positioned over the nearside lane at regular intervals;
   d) two ADSs positioned at 1 mile (1.61km) and ½ mile (0.815km) in advance of junction 12 showing the exit destinations of Reading (W) and Theale; and
   e) one final direction sign on approach to junction 12, showing exit destination as above and M4 through traffic destinations of the South West, Bristol and Newbury.
### Proposed land-take

#### Table 13: Schedule of proposed land-take between junctions 12 and 11

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity (ha)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary land-take</td>
<td>2.57</td>
<td>Associated with Construction Compound 2 (see 8.2.11)</td>
</tr>
<tr>
<td>Temporary land-take</td>
<td>2.70</td>
<td>Associated with Construction Compound 3 (see 8.2.11)</td>
</tr>
<tr>
<td>Temporary land-take</td>
<td>0.21</td>
<td>Total quantity of temporary land-take required between junctions 12 and 11 aside from that associated with construction compounds or third party (other) land.</td>
</tr>
<tr>
<td>Third Party (other) (Temporary)</td>
<td>1.15</td>
<td>For necessary improvements to access to Reading MSA which will be maintained at all times.</td>
</tr>
</tbody>
</table>

#### 7.3 Junction 11 to junction 10

**Existing**

7.3.1 The M4 between junction 11 (Three Mile Cross) and junction 10 (Winnersh) is 8,730m long with three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway and lighting to the central reserve. The general landform through this link is residential to the north of the carriageways and rural to the south. A detailed description of the surrounding landscape, the settlements served by this link and any relevant local landscape designations is provided in chapter 4 of this EDR.

7.3.2 Junction 11 is formed of a gyratory, elevated above the main carriageway of the motorway on four overbridges. There are two overbridges to each side of the junction. Both pairs of overbridges take the same form. The inner structures on the gyratory consist of three-spans supported by bank seats to each verge embankment and piers to each verge, while the outer structures are single-spans supported on full height abutments to each verge. No work is anticipated to any of these overbridges. The eastbound merge consists of two lanes, which reduces to one lane as it joins the M4 while the westbound diverge has two lanes separated by a ghost island which expands out to four lanes on reaching the gyratory.
7.3.3 After the junction 11 slip roads, the M4 continues past Shinfield Footbridge, gradually rising up to Shinfield Road overbridge which carries the A327 over the motorway and has four spans with bank seat supports on the verge embankments and piers to verges and the central reserve. The proposed Scheme will not affect this structure. There are proposals being promoted by a third party to construct a new overbridge adjacent to this structure to carry the proposed Reading Eastern Relief Road. This overbridge will take the form of a three-span structure with bank seat abutments. The Scheme will not affect this structure.

7.3.4 Further east, situated in a slight dip in the M4 is Cutbush Lane overbridge. This structure has a single-span supported by full height abutments, which carries Cutbush Lane over the M4. No works are anticipated to this structure.

7.3.5 The M4 then levels out before passing over the River Loddon underbridge. The Scheme will not affect this structure.

7.3.6 Further on, the M4 rises over Mill Lane underbridge which has a single-span over Mill Lane and is supported on full height embankments. The Scheme will not affect this structure.

7.3.7 Midway between Mill Lane underbridge and the next structure, King Street Lane underbridge, an environmental barrier is located on both verges. This barrier continues over the next structure, with the barrier on the westbound verge ending a few hundred metres after the structure, whilst the barrier to the eastbound verge ends just before the start of the junction 10 slip roads.

7.3.8 King Street Lane underbridge is situated approximately 800m after Mill Lane underbridge. The M4 slightly crests over this structure. The structure takes the form of a single-span deck supported by full height abutments to either side of King Street Lane. No works are anticipated to this structure.

7.3.9 The M4 then follows a slight downward gradient for 875m to the next structure, Reading Road underbridge. This structure carries the M4 over the A329 (Reading Road) and takes the form of a single-span deck supported by full height abutments. Over the structure, steel parapets are present to both verges and there is an environmental barrier on the eastbound verge. The Scheme will not affect this structure.

7.3.10 The downward gradient steepens slightly before the M4 reaches the Southern Region Winnersh underbridge. This structure supports the M4 over the Southern Region railway line. Steel parapets are present to both verges and there is an environmental barrier on the eastbound verge over this structure. No works are anticipated to this structure.
7.3.11 The M4 then continues for 200m on a downward gradient to the slip roads for junction 10. The eastbound diverge has one lane which expands to two lanes, while the westbound merge is constantly two lanes through the junction and as it joins the M4. junction 10 is an interchange between the M4 and the A329(M). The overbridges through this junction are described as part of junction 10 to junction 8/9 in chapter 4 of this EDR.

**Proposed works on the motorway**

*Lane configuration*

7.3.12 ALR will be provided for the entire length of this section, with the existing three lanes and the hard shoulder converted to create four running lanes with no hard shoulder. Three ERAs are to be provided on each carriageway. One ERA in each direction will incorporate a new POP. The existing POPs, one to each carriageway, will be removed.

7.3.13 TJR will be implemented at junction 11 (Three Mile Cross) this will require reconfiguration of the slip roads. TJR is not proposed at junction 10 (Winnersh). As the motorway passes through this junction it will retain its current provision of three lanes and a hard shoulder in each direction. Slip roads will be configured to create lane gain or lane drop as appropriate.

*Offside and central reserve works*

7.3.14 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the link from junction 12 to junction 11. It includes widening the existing carriageway by 200mm to 500mm and in the central reserve: provision of a hard surface, construction of RCB, modifications to the drainage system and replacement road lighting.

*Nearside and verge works*

7.3.15 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11. Where necessary, the existing hard shoulder will be strengthened to enable it to carry motorway traffic. Other verge features included in the Scheme are: underground ducts to carry power and communication cables, steel safety barriers around hazards, drainage modifications, lighting (at junction slip roads only), environmental barriers and replacement planting.

7.3.16 Where the motorway passes over Mill Lane, to the northwest of Sindlesham, there will be 200m of new 2m high noise fence in the northern verge and 50m in the southern verge.

*Carriageway resurfacing*

7.3.17 Low-noise surfacing will be provided throughout the Scheme as part of the works.
Gantries

7.3.18 There will be 24 gantries between junction 11 and junction 10. 20 of these will be various cantilever type structures and four will be super-span portals. Three of the super-span portals will display information to both eastbound and westbound carriageways. In total, there will be 14 gantries facing the eastbound traffic and 13 facing the westbound traffic. The location of the gantries is shown on the Scheme plans in Annex F of this EDR.

7.3.19 Gantries on the eastbound carriageway:

- One gateway gantry positioned shortly after the junction 11 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;
- One intermediate gantry similar to the gateway, but positioned half way along the section;
- Nine additional VMSs (one MS3 and eight MS4s) positioned over the nearside lane at regular intervals;
- Two ADSs positioned at 1 mile (1.61km) and ½ mile (0.81km) in advance of junction 10 showing the exit destinations of Reading (E) Bracknell and Wokingham; and
- One final direction sign on approach to junction 10, showing exit destination as above and M4 through traffic destinations of Greater London and Maidenhead.

7.3.20 Gantries on the westbound carriageway:

- One gateway gantry positioned downstream of junction 10 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;
- One intermediate gantry similar to the gateway but positioned half way along the section;
- Eight additional MS4s positioned over the nearside lane at regular intervals;
- Two ADSs positioned at 2/3 mile (1.07km) and 1/3 mile (0.54km) in advance of junction 11 showing the exit destinations of Basingstoke and Reading (S&C); and
- One final direction sign on approach to junction 8/9, showing exit destination as above and M4 through traffic destinations of the South West, Bristol and Reading (W). This gantry will also carry a set of four AMIs, one over each lane.
Proposed land-take

Table 14: Schedule of proposed land-take between junctions 11 and 10

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity (ha)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent land-take</td>
<td>0.08</td>
<td>Access for transmission station</td>
</tr>
<tr>
<td>Temporary land-take</td>
<td>0.88</td>
<td>Total quantity of temporary land-take required between junctions 11 and 10</td>
</tr>
<tr>
<td>Third party (other)</td>
<td>0.23</td>
<td>Short-term possession in relation to railway underbridge</td>
</tr>
</tbody>
</table>

7.4 Junction 10 to junction 8/9

Existing

7.4.1 The M4 between junction 10 (Winnersh) and junction 8/9 (Holyport) has three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway, but there is no lighting between these junctions. The general landform through this link is rural. A detailed description of the surrounding landscape, the settlements served by this link and any relevant local landscape designations is provided in chapter 4 of this EDR.

7.4.2 Junction 10 is an interchange between the M4 and the A329(M), with the A329(M) crossing the M4 on a two-span overbridge supported by full height abutments and a pier to the central reserve. The junction 10 link road overbridges take the same form, this being a four-span structure supported by bank seats to each motorway embankment and piers to each verge and the central reserve. The eastbound merge consists of two lanes which reduce to one lane as it joins the M4, while the westbound diverge remains as two lanes throughout the junction.

7.4.3 The M4 rises gradually out of junction 10, and 500m after the slip road ends it reaches Bill Hill overbridge. Bill Hill overbridge carries the A321 over the M4 and takes the form of a four span. This structure will not be affected by the Scheme.

7.4.4 Following Bill Hill overbridge, the M4 gradually rises up before taking a downward gradient to Straight Mile overbridge. Straight Mile Road is carried over the M4 by this four span structure. No works are anticipated to this structure.

7.4.5 The M4 then follows a slight rise and crests prior to Billingbear Farm overbridge, which is situated on a slight downward gradient. This structure has three-spans. The Scheme will not affect this structure.
7.4.6 Hammonds Wood is situated on the same downward slope. This structure has four spans and carries the B3018 over the M4. It will not be affected by the Scheme.

7.4.7 Further along the M4, Beenhams overbridge is situated on a very slight downward gradient. This structure also has four spans and will not be affected by the Scheme.

7.4.8 The M4 then gradually rises before cresting at Littlefield Green overbridge. This structure carries the B3024 over the M4 and takes the form of a four-span deck. The Scheme will not affect this structure.

7.4.9 Paley Street Farm overbridge is situated on a slight downward slope. The structure has three-spans. No works are anticipated to this structure.

7.4.10 The M4 follows the same downward gradient to Stud Green Access overbridge. This structure takes the same form as the previous overbridge and carries Thrift Lane over the M4. The Scheme will not affect this structure.

7.4.11 The M4 then continues uninterrupted on a slight downward gradient to junction 8/9. The eastbound diverge has one lane which expands to three lanes on reaching the junction, while the westbound merge has two lanes which reduces to one lane as it joins the M4. junction 8/9 itself is a gyratory, elevated above the main carriageway of the motorway on two overbridges. These overbridges are described as part of the junction 8/9 to junction 7 link in chapter 4 of this EDR.

**J10- J8/9: Proposed works on the motorway**

*Lane configuration*

7.4.12 ALR will be provided for the entire length of this section, with the existing three lanes and the hard shoulder converted to create four running lanes with no hard shoulder. Four ERAs are to be provided on each carriageway. One ERA in each direction will incorporate a new POP. The existing POPs, one to each carriageway, will be removed.

7.4.13 TJR will be implemented at junction 8/9 (Holyport), but not at junction 10 (A329(M) Winnersh Interchange). The lane configuration for this section of motorway will be the same in all material respects to that for junction 12 to junction 11, i.e. lane gain/lane drop at the western end and four through lanes in each direction at the eastern end.
Offside and central reserve works

7.4.14 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11 except that no road lighting is proposed. It includes widening the existing carriageway of the M4 by 200mm to 500mm and in the central reserve: provision of a hard surface, construction of RCB and modifications to the drainage system.

Neasrside and verge works

7.4.15 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11.

Carriageway resurfacing

7.4.16 Low-noise surfacing will be provided throughout the Scheme as part of the works.

Gantries

7.4.17 There will be 30 gantries between junction 10 and junction 8/9. 27 of these will be various cantilever type structures and three will be super-span portals. Two of the super-span portals will display information to both eastbound and westbound carriageways. In total there will be 16 gantries facing the traffic on each carriageway. The location of the gantries is shown on the Scheme plans in Annex f of this EDR.

7.4.18 Gantries on the eastbound carriageway:

a) one gateway gantry positioned shortly after the junction 10 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

b) two intermediate gantries, similar to the gateway, but positioned at roughly equal intervals along the section;

c) ten additional VMSs (two MS3s and eight MS4s) positioned over the nearside lane at regular intervals;

d) two ADSs positioned at 1 mile (1.61km) and ½ mile (0.81km) in advance of junction 8/9 showing the exit destination of High Wycombe and Maidenhead; and

e) one final direction sign on approach to junction 8/9 showing exit destination as above and M4 through traffic destinations of Greater London and Slough (W). This gantry will also carry a set of four AMIs, one over each lane.

7.4.19 Gantries on the westbound carriageway:

a) one gateway gantry similar to eastbound gateway, but positioned downstream of the junction 8/9 entry slip road;
b) two intermediate gantries similar to the gateway, but positioned at roughly equal intervals along the section;

c) ten additional MS4s positioned over the nearside lane at regular intervals;

d) two ADSs positioned at 1 mile (1.61km) and ½ mile (0.81km) in advance of junction 10 showing the exit destinations of Reading (E), Bracknell and Wokingham; and

e) one final direction sign on approach to junction 10, showing exit destination as above and M4 through traffic destinations of the South West, Bristol and Reading (S, W & C).

### J10 – J8/9: Proposed land-take

**Table 15: Schedule of proposed land-take between junctions 10 and 8/9**

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity (ha)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary land-take</td>
<td>7.44</td>
<td>Land associated with Construction Compound 4 (see 8.2.11)</td>
</tr>
</tbody>
</table>

#### 7.5 Junction 8/9 to junction 7

**Existing**

7.5.1 The M4 between junction 8/9 (Holyport) and junction 7 (Huntercombe) has three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway, but each hard shoulder has intermittent breaks, or discontinuities, as described below. The main carriageway lighting columns are located in the central reserve. The general landform through this link is rural with isolated residential and industrial areas. A detailed description of the surrounding landscape, the settlements served by this link and any relevant local landscape designations is provided in chapter 4 of this EDR.

7.5.2 Junction 8/9 is formed as a gyratory, elevated above the main carriageway of the motorway. There is a two-lane slip road merging to a single lane slip on to the eastbound carriageway of the M4, and a similar slip off the carriageway up to junction 8/9 on the westbound carriageway.

7.5.3 Ascot Road overbridge (Figure 24) is located after the end of the slip road tapers on a slight upward gradient. Ascot Road overbridge is currently a four span overbridge which carries the A330 over the M4 and, in conjunction with the A308(M), connects junction 8/9 of the M4 with the villages and towns to the south of the M4. The hard shoulder of the M4 is discontinuous under the bridge therefore a replacement bridge needs to be constructed to enable ALR. To the north of the M4 at this location is industrial land which is slightly elevated above the line of the motorway. The land falls away to the south on which there is
residential housing. To the east, the motorway passes over the A308 Windsor Road on a three-span underbridge. Neither the structure of this bridge nor Windsor Road under the bridge is affected by the Scheme. The motorway then continues on an elevated section to The Cut underbridge which is unaffected by the Scheme. There is a POP on the westbound carriageway between the two underbridges.

7.5.4 The M4 continues to rise up before dipping down towards the next structure encountered, Monkey Island overbridge, which is currently a four-span bridge which is shown in Figure 25. The road over this bridge is a local unclassified road, connecting the village of Bray with a number of dwellings and several hotels and other businesses. The carriageways narrow at this point and the hard shoulder is discontinuous as the motorway passes under the bridge therefore a replacement bridge needs to be constructed to enable ALR. Immediately after the Monkey Island overbridge the hard shoulder resumes for some 300m, before ending again prior to the Thames Bray underbridge.

7.5.5 The Thames Bray underbridge has three-spans and also carries footways/cycleways over the river, one on each side of the motorway. This bridge needs widening to enable ALR. Close to the northern boundary at this location is a high pressure gas pipeline owned by National Grid Gas.

7.5.6 After Bray Bridge, the motorway level falls to the next major structure to the east which is Marsh Lane overbridge, see Figure 26. This is currently another four-span overbridge, again with a short discontinuity in the M4 hard shoulder therefore a replacement bridge needs to be constructed to enable ALR. Marsh Lane is an unclassified road linking Dorney and Dorney Reach to the south with the A4, Bath Road, to the north. The M4 then crosses over the Jubilee River (a hydraulic channel constructed to take overflow from the River Thames and so alleviate flooding to areas in and around the towns of Maidenhead, Windsor, and Eton). The bridge over the Jubilee River is not affected by the Scheme.

7.5.7 Continuing eastwards from the Jubilee River, the M4 reaches Lake End Road overbridge, currently another four-span bridge over the motorway with short discontinuities in the hard shoulder. The discontinuities necessitate construction of a replacement bridge to enable ALR. Lake End Road, or the B3026, is roughly parallel to Marsh Lane and also links Dorney to the A4. The M4, as it passes under Lake End Road overbridge, has arrived at the start of the slip roads to and from junction 7.
7.5.8 Junction 7, at Huntercombe, is a trumpet-shaped junction at the end of a 1km long dual two-lane road which links the M4 to the A4 Bath Road between Maidenhead and Slough. The link road, known as the Huntercombe Spur, starts at a roundabout on the A4, heads south, crosses over the M4 on the Huntercombe Spur overbridge, currently a four-span structure similar to those at Marsh Lane and Lake End Road and then swings all the way round to the west and then back north to form the “loop” of the trumpet shape. One lane of the westbound slip road onto the M4 is currently hatched over with white road markings so that the merge on to the motorway operates as a single lane merge. The eastbound slip road off the M4 has two lanes which curve to the north before merging into the link road to the A4.

7.5.9 The hard shoulder below the Huntercombe Spur overbridge is discontinuous therefore a replacement bridge needs to be constructed to enable ALR. The works associated with the bridge are described as part of the junction 7 to junction 6 link in chapter 4 of this EDR.

**Proposed works on the motorway**

*Lane configuration*

7.5.10 ALR will be provided for the entire length of this section, with the existing three lanes and the hard shoulder converted to create four running lanes with no hard shoulder. Two ERAs are to be provided on the eastbound carriageway and one on the westbound side. None of these are suitably located for a POP so the existing POP (westbound) will be removed and not replaced.

7.5.11 TJR will be implemented at junction 8/9 (Holyport) and junction 7 (Huntercombe). This will require reconfiguration of the slip roads at these junctions.

*Offside and central reserve works*

7.5.12 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11. It includes widening the existing carriageway by 200mm to 500mm and in the central reserve: provision of a hard surface, construction of RCB, modifications to the drainage system and replacement road lighting.

7.5.13 New lighting will be provided for the whole length of this section. Lighting columns will be mounted on top of the new concrete barrier to carry LED luminaires 12m above the carriageway.

*Nearside and verge works*

7.5.14 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11.

*Carriageway resurfacing*

7.5.15 Low-noise surfacing will be provided throughout the Scheme as part of the works.
**Gantries**

7.5.16 There will be 21 gantries between junction 8/9 and junction 7, ten on the eastbound carriageway and 11 on the westbound carriageway. These will all be cantilever type structures. The location of the gantries is shown on the Scheme plans in Annex F of this EDR.

7.5.17 Gantries on the eastbound carriageway:

- a) one gateway gantry positioned shortly after the junction 8/9 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;
- b) six additional MS4s positioned over the nearside lane at regular intervals;
- c) two ADSs positioned at 1 mile (1.61km) and ½ mile (0.81km) in advance of junction 7 showing the exit destination of Slough (W); and
- d) one final direction sign on approach to junction 7, showing exit destination as above and M4 through traffic destinations of Greater London and Slough (C).

7.5.18 Gantries on the westbound carriageway:

- a) one gateway gantry positioned downstream of the junction 7 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;
- b) seven additional VMSs (five MS4s and two MS3s) positioned over the nearside lane at regular intervals;
- c) two ADSs positioned at 1 mile (1.61km) and ½ mile (0.81km) in advance of junction 8/9 showing the exit destinations of High Wycombe and Maidenhead; and
- d) one final direction sign on approach to junction 8/9, showing exit destination as above and M4 through traffic destinations of South west, Reading and Bracknell.

**Proposed works on Ascot Road**

7.5.19 As evidenced by the discontinuities in the hard shoulder under Ascot Road (Figure 24), the existing bridge spans can only accommodate three lanes on each carriageway of the motorway and are not adequate for four-lane ALR. A longer span replacement bridge is therefore required.
7.5.20 An online replacement option for this bridge was considered. However, heavy traffic usage of the A330 Ascot Road and the unsuitability of the existing Holyport Road and Windsor Road mean that there is no suitable diversion for traffic on Ascot Road during construction works.

7.5.21 As such, the proposed structure will be constructed adjacent to the existing bridge. This will allow pedestrians and traffic to continue to use the existing bridge while the new bridge is being constructed. However, some occasional signal controlled, single-lane TM will be required during the works. On completion of the new bridge, traffic will be diverted onto it and the old bridge will then be demolished.

7.5.22 The side road in the vicinity of the existing bridge will be re-aligned to the east of its current position. The new alignment has been developed to provide a large horizontal curve on the southern side of the road to aid forward visibility. An alignment on the western side of Ascot Road would result in a tighter horizontal curve approaching the southern tie-in. Re-aligning the road on the western side would also impact on residential property and the communications masts on the southern side of the motorway. The eastern re-alignment requires the construction of a 170m long (approximately) retaining wall, up to 6m high, on the north-eastern side of the new bridge to minimise impact on adjacent industrial premises.

7.5.23 The proposed structure is a single-span bridge. The level of the finished carriageway over the proposed bridge will be approximately 1.4m higher than the existing overbridge, due to the change in form and span of the proposed structure. The carriageway widths of the new bridge will not change from those existing. An overbridge general arrangement drawing is included in Annex F of this EDR.
7.5.24 It is anticipated that the construction works for this bridge will take 18 months to complete. This includes a three month allowance to divert existing underground services from the old bridge to the new bridge.

**Proposed works at Monkey Island overbridge**

7.5.25 Monkey Island overbridge (Figure 25) is another of the existing bridges over the M4 which cannot accommodate four-lane ALR. A longer span replacement bridge is therefore required.

![Figure 25: View of the existing Monkey Island bridge](image)

7.5.26 Monkey Island Lane is a no through-road to vehicular traffic to the south with the road continuing as a bridleway. It provides the only vehicular access to a number of residential and business properties south of the M4. There is therefore no suitable diversion for Monkey Island Lane so the new bridge will be built to the western side of the existing bridge to enable the latter to remain in use until the new bridge has been completed. Realignment of Monkey Island Lane to the west is preferable to an eastward alignment because it moves the road away from adjacent residential properties.

7.5.27 The proposed structure is a single-span bridge. The level of the finished carriageway over the proposed bridge will be approximately 1.4m higher than the existing overbridge, due to the change in form and span of the proposed structure. The carriageway widths of the new bridge will not change from those existing. An overbridge general arrangement drawing is included in Annex F of this EDR.

7.5.28 Behind the abutments of the existing structure at this location, in the north and south verges of the M4, are flood relief culverts which provide alleviation of excessive retention of water by the approach embankments to Monkey Island overbridge in flood conditions. These culverts are likely to need extending as part of the works to replace the overbridge at this location.
7.5.29 It is anticipated that the construction works for this bridge will take 14 months to complete. This includes a three month allowance to divert existing underground services from the old bridge to the new bridge.

**Proposed work at Thames Bray underbridge**

7.5.30 The Thames Bray underbridge has insufficient width to accommodate ALR and therefore requires widening. Both symmetrical and asymmetrical widening have been considered, but asymmetrical widening to the north has been selected as the preferred solution as explained in chapter 5 of this EDR.

7.5.31 To accommodate the asymmetric widening to the north of the existing bridge, the central alignment of the M4 motorway over the bridge will be moved to the north by up to 4m. The route of the motorway will tie back into the existing alignment within 400m either side of the bridge. Embankment widening options depend on the findings of the geotechnical investigation and site constraints but, will be designed to avoid impact on the nearby gas main and to minimise land-take requirements.

7.5.32 The proposal includes the introduction of two additional girders on the north side of the bridge supporting an additional width of deck equal to 7.8m. The preferred installation option is to lift the girders in short lengths using a 200tonne crane positioned at carriageway level on the widened embankments. The first section would cantilever out from the abutment on both sides followed by a second intermediate section and third central section. An underbridge general arrangement drawing is included in Annex F of this EDR.

![Figure 26: View of Thames Bray underbridge from south-east embankment](image)

7.5.33 Initial access for construction works to the north-east side will be via Marsh Lane on the east bank of the River Thames. However, this access is not suitable for heavy construction plant so, the main construction access will be gained from the motorway by tracking down the embankment. Access will be gained to the north-west side of the bridge via the access track from Monkey Island Lane.
7.5.34 During construction works, there is sufficient width on the carriageway at this location to allow the introduction of a temporary vehicle restraint in conjunction with narrow running lanes and a safe working zone of 1.2m. Consequently, three lanes of traffic can be maintained in both directions for the duration of the works apart from during short closures for lifting operations.

7.5.35 The river will remain open to navigation for most of the construction period. However, it will need to be closed for the duration of the actual beam lifts. There are also three footpaths/cycleways to consider:

a) the footpath/cycleway over the river on the south side of the M4 is not affected by asymmetric widening and will be kept open;

b) the footpath/cycleway over the river on the north side of the M4 will be closed for the duration of the works. A signed diversion will be provided via Monkey Island Lane to the west and Marsh Lane to the east; and

c) the tow-path under the bridge on the east side of the river will be isolated from the works and kept open during construction. However, like the river navigation route, short-term closures will be required during the beam lifts.

7.5.36 It is anticipated that the construction works for this bridge will take 27 months to complete.

Proposed works at Marsh Lane and Lake End Road overbridges

7.5.37 The existing bridges carrying Marsh Lane and Lake End Road over the M4 can each only accommodate three lanes on each carriageway of the motorway and are not adequate for four-lane ALR. A longer span replacement bridge is therefore required.

Figure 27: View of the existing Marsh Lane bridge
7.5.38 The original proposals for Marsh Lane and Lake End Road overbridges were online replacement for both and this was based on the assumption that each of the side roads can be temporarily closed for the duration of the construction with one being the diversion for the other. Responses from local residents and Dorney rowing lake during the consultation period noted that the proposed diversion route for the closure of Lake End Road overbridge was not suitable for buses or boat trailers. An issue was also raised regarding pedestrian access to Dorney County Combined School from the north side of the M4 in the event of any closure of Marsh Lane overbridge. As a consequence of these consultation responses the proposals for these bridges have been amended to maintain suitable access for buses and boat trailers. The Agency is investigating the need to provide transport for pupils of Dorney School during the closure of Marsh Lane overbridge. The indicative construction sequence will be as follows:

a) build new Lake End Road overbridge to the west of the existing bridge;
b) demolish old Lake End Road overbridge;
c) divert traffic from Marsh Lane to Lake End Road;
d) demolish and re-build Marsh Lane Road overbridge; and
e) re-open Marsh Lane to traffic.

7.5.39 The proposed structures are both single-span bridges. The level of the finished carriageway over the proposed bridges will be approximately 1.2m higher than the existing overbridges, due to the change in form and span of the proposed structures. The carriageway widths of the new bridges will not change from those existing. For details see the overbridge general arrangement drawings in Annex F of this EDR.
7.5.40 The diversion route for vehicles during closure of Marsh Lane overbridge will be via the B3026 Lake End Road and the A4 Bath Road. The Agency is investigating the need to provide transport for pupils of Dorney School during the closure of Marsh Lane overbridge.

7.5.41 It is anticipated that the construction works for each bridge will take 12 months to complete. The indicative programme for the works (see Annex B) assumes that work at Lake End Road will be completed first and work at Marsh Lane will then follow.

**Proposed land-take**

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity (ha)</th>
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<td>Temporary land-take (6.01)</td>
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<td>Total quantity of temporary land-take required between junctions 8/9 and 7 aside from that associated with construction compounds and third party (other) land. Includes unoccupied building at the western extent of the Priors Way Industrial Estate and small parcels of agricultural land.</td>
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<td>Third party (other) (1.18)</td>
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</table>
7.6  Junction 7 to junction 6

**Existing**

7.6.1 The M4 between junction 7 (Huntercombe) and junction 6 (Chalvey) has three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway, but each hard shoulder has discontinuities, as described below. The main carriageway lighting columns are located in the central reserve. The general landform through this link is residential. A detailed description of the surrounding landscape, the settlements served by this link and any relevant local landscape designations is provided in chapter 4 of this EDR.

7.6.2 Junction 7, at Huntercombe, is a trumpet-shaped junction as described in section 7.5.8. The westbound diverge is contained to one lane as it loops off the M4 with the second lane of the slip road hatched out until the link road straightens out. The eastbound merge is formed of two lanes as it leaves the junction 7 link road but, then reduces to one lane as it joins the M4.

7.6.3 The surrounding landform to Huntercombe Spur overbridge is mainly rural with the exception of the area to the north-east, which is residential and the structure can be seen from these houses. The structure has four spans supported by buried abutments in the verge embankment and piers to each verge and the central reserve. Both hard shoulders are currently discontinuous under the structure therefore it will be replaced under the Scheme.

7.6.4 Further along the M4 situated on a very slight downward gradient is Oldway Lane overbridge. This structure carries an accommodation access track over the M4. The track is a bridleway connecting to another track parallel to the westbound carriageway. The surrounding landform is primarily rural with the exception of the area to the north-east corner which has residential properties within 100m. The structure also has four spans supported by buried abutments in the verge embankments and piers to the verges and central reserve. The verge piers force discontinuities in the M4 hard shoulder, meaning a longer span replacement bridge is required at this location.

7.6.5 There is an environmental bund to the eastbound verge located between Oldway Lane overbridge and the next structure, Wood Lane overbridge. The bund has a length of approximately 1,100m. This bund will be retained unaltered.

7.6.6 Wood Lane overbridge is situated on a very slight downward gradient. The structure carries Wood Lane, an unclassified local road, and provides the sole access for a number of residential properties and a water treatment works. The structure has four spans supported by buried abutments in the verge embankments and piers to the verges and central reserve. The piers force discontinuities in the M4 hard shoulder meaning a longer span replacement bridge is required at this location.
7.6.7 There is also an environmental bund located to the parkland to the north of the M4 between Wood Lane overbridge and junction 6. This bund will be retained unaltered.

7.6.8 Further along the M4 to the east and situated on a very slight downward gradient, is Chalvey culvert. This culvert carries a drainage channel through the motorway embankment below the M4 and the slip roads at junction 6. The structure is formed from a 3.5m span concrete box culvert with a height of approximately 2.5m.

7.6.9 Due to proposed slip road re-alignment and widening, the culvert will require extensions to both ends. This extension will take the form of the existing concrete box culvert.

7.6.10 The eastbound diverge to junction 6 has one lane which expands to three lanes on reaching the junction, while the westbound merge has two lanes which reduces to one lane as it joins the M4. There is environmental barrier along the full length of the verge on the eastbound diverge. Junction 6 is a gyratory, situated beneath the M4. The main carriageway of the motorway is carried over the junction by two underbridges. These underbridges are described as part of the junction 6 to junction 5 link in chapter 4 of this EDR.

**Proposed works on the motorway**

*Lane configuration*

7.6.11 Lane provision will be the same in all material respects to the link from junction 8/9 to junction 7 - ALR in each direction with TJR at the junction at each end of the link.

7.6.12 One ERA will be provided on each carriageway. There are no existing POPs on this link and no new ones are proposed.

*Offside and central reserve works*

7.6.13 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the link from junction 12 to junction 11.

*Nearside and verge works*

7.6.14 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the link from junction 12 to junction 11.

7.6.15 The one material difference is that there will be 790m of new 2m high noise barrier from Wood Lane overbridge to junction 6 to help shield the residential properties north of the motorway, such as those on Mitchel Close and Cooper Way.

*Carriageway resurfacing*

7.6.16 Low-noise surfacing will be provided throughout the Scheme as part of the works.
Gantries

7.6.17 There will be nine gantries between junction 7 and junction 6. Eight of these will be cantilever type structures and one will be a super-span portal. The super-span portal will display information to both eastbound and westbound carriageways. In total, there will be five gantries facing the traffic on each carriageway. There will also be a new gantry on the link road between junction 7 and the A4 Bath Road, this will be a cantilever structure over the southbound carriageway. The location of the gantries is shown on the Scheme plans in Annex f of this EDR.

7.6.18 Gantries on the eastbound carriageway:

a) one gateway gantry positioned shortly after the junction 7 entry slip road. This super-span portal gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits. This gantry will also carry the 2/3 mile (1.073km) ADS for junction 6;

b) two additional MS4s positioned over the nearside lane at regular intervals;

c) one ADS positioned at 1/3 mile (0.536km) in advance of junction 6 showing the exit destinations of Slough (C) and Windsor; and

d) one final direction sign on approach to junction 6, showing exit destination as above and M4 through traffic destinations of Greater London and Slough (E).

7.6.19 Gantries on the westbound carriageway:

a) one gateway gantry positioned downstream of junction 6 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

b) one additional MS4 positioned over the nearside lane on the super-span gantry;

c) two ADSs positioned at 2/3 mile (1.073km) and 1/3 mile (0.536km) in advance of junction 7 showing the exit destination of Slough (W); and

d) one final direction sign on approach to junction 7, showing the exit destination as above and M4 through traffic destinations of the South West, Reading and Maidenhead.

Proposed works on Huntercombe Spur overbridge (Junction 7)

7.6.20 As evidenced by the discontinuities in the hard shoulder under Huntercombe Spur (Figure 29), the existing bridge spans can only accommodate three lanes on each carriageway of the motorway and are not adequate for four-lane ALR. A longer span replacement bridge is therefore required.
7.6.21 Offline replacement has been selected for this bridge for the reasons explained in chapter 5 of this EDR. This allows the junction to remain open during construction. The new bridge will be built as two separate structures in the following sequence:

a) construct the new southbound bridge to the eastern side of the existing bridge;

b) divert northbound and southbound traffic onto the new bridge with one lane in each direction;

c) demolish the existing bridge;

d) construct the new northbound bridge on the site of the old bridge; and

e) open both new bridges to two lanes of traffic in each direction.

7.6.22 This will result in a realignment of the bridge to the east. The level of the finished carriageway over the proposed bridge will be approximately 1.2m higher than the existing overbridge, due to the form and span of the proposed structure. The link road and approach embankments will, therefore, need realigning. A short length of retaining wall will be constructed to ensure that this work does not encroach on the allotments or residential areas northeast of the junction.

7.6.23 The new bridges will each be three-span bridges as described in section 6.3. The new decks will be some 3m wider than the existing bridge so that each bridge will be able to carry two lanes and a hard shoulder for the spur in each direction. An overbridge general arrangement drawing is included in Annex F of this EDR.

7.6.24 It is anticipated that the construction works for the two bridges and the link road will take about 26 months.
Proposed works on Oldway Lane overbridge

7.6.25 Oldway Lane overbridge (Figure 30) is another of the existing bridges over M4 which cannot accommodate four-lane ALR. A longer span replacement bridge is therefore required.

Figure 30: View of the existing Oldway Lane bridge

7.6.26 Oldway Lane carries only the occasional motorised vehicle. It operates mainly as a bridleway. A power to close the bridleway temporarily to facilitate demolition and construction works will be included in the DCO. Diversion routes will need to be agreed with the local authority but there are possible routes over both Wood Lane and Lake End Road overbridges.

7.6.27 Once the diversion is in place, the existing bridge will be demolished and a new structure built in its place. The level of the finished route over the proposed bridge will be approximately 1.1m higher than the existing overbridge, due to the change in form and span of the proposed structure. The track or bridleway width will be approximately 0.5m narrower than the existing bridge. For details see the overbridge drawings in Annex F of the EDR.

7.6.28 It is anticipated that the construction works for this bridge will take eight months to complete.

Proposed works on Wood Lane overbridge

7.6.29 The existing bridge carrying Wood Lane over the M4 (Figure 31) can only accommodate three lanes on each carriageway of the motorway and is not adequate for four-lane ALR. A longer span replacement bridge is therefore required.
7.6.30 For the reasons explained in chapter 5 of this EDR, offline construction has been selected as the preferred option for this structure.

7.6.31 The new bridge will be built to the east of the existing bridge. This will move the road away from the residential properties near the southwest corner of the bridge and allows an improvement of the alignment of the tight 180 degree bend to the south of the M4. However, this will require the introduction of a 220m long (approximately) concrete-faced retaining wall on the north-eastern side of the new bridge approach embankment to avoid impact on adjacent retail premises (an Asda superstore).

7.6.32 The proposed new structure is a single-span bridge (see section 6.3). The level of the finished carriageway over the proposed bridge will be approximately 1.4m higher than the existing overbridge, due to the change in form and span of the proposed structure. An overbridge general arrangement drawing is included in Annex F of this EDR.

7.6.33 The construction works for this bridge are anticipated to take 20 months to complete. This includes five months to divert underground utilities from old bridge to new.

**Proposed works at Chalvey culvert**

7.6.34 The Chalvey culvert (Figure 32) carries the M4 over the Chalvey Ditch, which is to the west of junction 6. The culvert is a 3.66m span reinforced concrete box structure and has insufficient width to carry the widened junction 6 slip roads on both sides of the carriageway.

7.6.35 The proposed symmetrical 4m widening solution will match the form of the existing culvert with precast or in-situ reinforced concrete construction.
Figure 32: View of the southern of Chalvey culvert

Proposed land-take

Table 17: Schedule of proposed land-take between junctions 7 and 6

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<td>Temporary land-take</td>
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7.7 Junction 6 to junction 5

Existing

7.7.1 The M4 between junction 6 (Chalvey) and junction 5 (Langley) has three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway but each hard shoulder has discontinuities, as described below. The main carriageway lighting columns are located in the central reserve. The general landform through this link is residential with isolated areas of parkland.
7.7.2 Junction 6 is formed of a gyratory, situated beneath the M4. The main carriageway of the motorway is carried over the junction by two bridges: Chalvey Interchange West overbridge and Chalvey Interchange East overbridge. Both bridges take the same form; three-spans supported by bank seats to each verge embankment and piers to each verge. There is an environmental barrier to the eastbound verge within the junction. No work is anticipated to either of these bridges. The eastbound merge consists of two lanes which reduces to one lane as it joins the M4, while the westbound diverge has one lane which expands to three lanes on reaching the gyratory. There is an environmental barrier to the full length of verge to the eastbound merge and it continues along the main carriageway verge.

7.7.3 Windsor Branch Railway underbridge is located at the end of the slip roads to junction 6. The M4 slightly crests over the structure to allow sufficient clearance over the Slough to Windsor and Eton Branch railway line. The bridge comprises two separate but similar five-span structures; one carrying the eastbound carriageway and the other carrying the westbound carriageway. Over the structure there is an environmental barrier mounted on the north side and a pedestrian guardrail mounted on the south side. Both of these barriers are protected by high containment road restraint barriers to each verge. The bridge has insufficient width to accommodate the proposed alignment at junction 6 and will therefore require widening.

7.7.4 Further along the M4, situated on a slight downward gradient is the Prince of Wales underbridge. The structure has four spans and carries the M4 over the A332. The Scheme will not affect this structure.

7.7.5 The downward gradient continues through to Water and Gas Main subway. The subway has a cross-section of 2.5m$^2$ and provides a passage for utilities to cross beneath the M4. The subway is accessible to maintainers through access chamber lids that are located adjacent to the carriageway in the verge. The carriageway over this structure has three lanes in each direction and a discontinuous hard shoulder due to the proximity of the subway to Datchet Road overbridge. Due to the requirement for four lanes in each direction over this structure, the subway will require extending at both ends to move the access chamber lids away from the proposed alignment.

7.7.6 Datchet Road overbridge is the next bridge to the east. This structure carries the B376 Datchet Road, an all-purpose urban single carriageway, linking the towns of Slough to the north and Datchet to the south. The surrounding landform consists of residential properties to the north and to the south. The existing approaches to the overbridge on the B376 are at an incline to reach the necessary clearance over the M4. The structure has four spans supported by bank seats to the verge embankments and piers to the verges and central reserve. The verge piers force
discontinuities in the M4 hard shoulder meaning that a longer span replacement bridge is required at this location.

7.7.7 The M4 continues on a slight downward slope to the Recreation Ground overbridge. This four-span structure carries a single carriageway which connects Upton Court Road and the track to Upton Court Park with the main road between Datchet and Slough. The carriageway over the structure is gated and believed to be used occasionally by the park staff as well as being a public right of way used for access to the motocross club to the north of the structure. The surrounding landform is rural to the north and residential to the south-west. The verge bridge piers force discontinuities in the M4 hard shoulder meaning that a longer span replacement bridge is required at this location.

7.7.8 Beyond the Recreation Ground overbridge, Water Main subway is located on a section of level carriageway. This subway is of the same construction and diameter as Water and Gas Main subway, with the exception that the access chamber covers are located within the hard shoulders. This subway will, therefore, also require an extension to both ends to move the access chamber lids into the proposed verge.

7.7.9 The M4 remains level on the approach to Riding Court Road overbridge. This four-span structure carries Riding Court Road, an all-purpose urban single carriageway, linking the B470 London Road to the south with Slough via the A4 London Road to the north. The surrounding landform is a mixture of residential and rural. The verge piers force discontinuities in the M4 hard shoulder meaning that a longer span replacement bridge is required at this location.

7.7.10 Between Riding Court Road overbridge and junction 5, the M4 is constricted by the presence of Riding Court Road to the north and Major’s Farm Road to the south.

7.7.11 Further along the M4 from Riding Court Road overbridge is Ashley’s Arch culvert. This structure is a 1.5m diameter concrete pipe and allows a drainage channel to cross beneath the M4. There is a discontinuous hard shoulder to the eastbound carriageway over this structure, meaning that the structure will require extending to the north to allow sufficient space for the proposed road layout.

7.7.12 The M4 then continues under Hams Farm footbridge on an upward gradient through to junction 5. The eastbound diverge has one lane which expands to four lanes on reaching the junction, while the westbound merge has two lanes which reduces to one lane as it joins the M4. Junction 5 is a gyratory, situated beneath the M4. The main carriageway of the motorway is carried over the junction by two bridges and a subway. These bridges are described as part of the junction 5 to junction 4b link in section 7.8.
Proposed works on the motorway

Lane configuration

7.7.13 Lane provision will be similar to the previous links - ALR in each direction with TJR at the junction at each end of the link.

7.7.14 Four ERAs will be provided, two on each carriageway. The western-most ERA on the eastbound carriageway will incorporate a new POP which will replace the only existing POP on this link.

Offside and central reserve works

7.7.15 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the previous sections.

Nearside and verge works

7.7.16 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the previous sections.

7.7.17 The main differences are that:

a) a new 2m high noise barrier will be constructed in both verges over the widened Windsor Branch Railway underbridge. This will mitigate the noise impact to properties on Spackmans Way to the north and Willowbrook to the south; and

b) a further 150m length of 2.4m high noise barrier in the southern verge west of Datchet Road overbridge will provide shielding for properties on the Myrke.

Carriageway resurfacing

7.7.18 Low-noise surfacing will be provided throughout the Scheme as part of the works.

Gantries

7.7.19 There will be 17 gantries between junction 6 and junction 5. One will be a super-span portal and the others will all be various cantilever type structures. The super-span portal will display information to both eastbound and westbound carriageways. In total there will be nine gantries facing the traffic on each carriageway. The location of the gantries is shown on the Scheme plans in ES Volume 2.

7.7.20 Gantries on the eastbound carriageway:

a) one gateway gantry positioned shortly after the junction 6 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

b) five additional MS4s positioned over the nearside lane at regular intervals;
c) two ADSs positioned at 1 mile (1.61km) and 1/3 mile (0.54km) in advance of junction 5 showing the exit destinations of Langley, Colnbrook, Eton and Datchet; and

d) one final direction sign on the approach to junction 7, showing exit destination as above and M4 through traffic destinations of Greater London and Heathrow. This gantry will also carry a set of four AMIs.

7.7.21 Gantry on the westbound carriageway:

a) one gateway gantry positioned downstream of the junction 5 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

b) five additional MS4s positioned over the nearside lane at regular intervals;

c) two ADSs positioned at 2/3 mile (1.07km) and 1/3 mile (0.54km) in advance of junction 6 showing the exit destinations of Slough (C) and Windsor; and

d) one final direction sign on the approach to junction 6, showing exit destination as above and M4 through traffic destinations of the South West, Reading and Slough (W).

Proposed works at Windsor Branch railway bridge

Figure 33: View of Windsor Branch railway bridge from the south

7.7.22 The existing Windsor Branch railway bridge (Figure 33) has insufficient width to accommodate TJR at junction 6 and therefore requires widening. Asymmetric widening to the south by 8.85m is the preferred solution as explained in chapter 5 of this EDR.
7.7.23 To accommodate the asymmetric widening, the central alignment of the M4 motorway over the bridge will be moved to the south by almost 6m. The route of the motorway will tie back into the existing alignment within 400m either side of the bridge. Embankment widening options are currently under review, but may incorporate reinforced and steepened side slopes to minimise the requirement for permanent land-take.

7.7.24 The proposed form of bridge widening will match the existing bridge and will consist of five spans constructed from precast concrete beams supported on reinforced concrete piers and bank seats.

7.7.25 During construction works, a safe working zone of 1.2m and three narrow running lanes of traffic can be maintained in both directions for the duration of the works apart from during short closures for activities such as beam lifting.

7.7.26 It is anticipated that the construction works for this bridge will take 27 months to complete.

**Proposed works at Gas and Water Main culvert**

7.7.27 The Gas and Water Main subway carries a water main under the M4 immediately west of Datchet Road overbridge. The subway is a 3.35m span reinforced concrete box with access chambers at each end currently located in the existing hard shoulders. Consultation with National Grid has confirmed the gas main has been abandoned, although it is unclear whether the hazardous installation consent has been revoked. The water main remains in use.

7.7.28 Maintenance and inspection of the existing structure are difficult and require confined-spaces trained diving teams and night time lane closures. Subject to agreement with Thames Water, the preferred option is to infill the structure and eliminate the need for any further maintenance. Alternatively, the structure will require widening by approximately 3.1m at each end so that the access chambers can be moved into the verge and behind the safety barrier. This latter option is assessed by the EIA as a worst case scenario.

**Proposed works on Datchet Road**

7.7.29 As evidenced by the discontinuities in the hard shoulder under Datchet Road (Figure 34), the existing bridge spans can only accommodate three lanes on each carriageway of the motorway and is not adequate for four-lane ALR. A longer span replacement bridge is therefore required.
7.7.30 Offline replacement has been selected as explained in chapter 5 of this EDR. The proposed structure will be constructed adjacent to the existing bridge. This will allow pedestrians and traffic to continue to use the existing bridge while the new bridge is being constructed. However, some signal controlled single-lane TM will be required on occasion during the works. On completion of the new bridge, traffic will be diverted onto it and the old bridge will be demolished.

7.7.31 The side road in the vicinity of the existing bridge is re-aligned to the east of its current position as shown in the overbridge general arrangement drawings in Annex F of this EDR. This will move the road away from the residential properties south of the motorway, on The Myrke.

7.7.32 The proposed structure is a three-span bridge. The level of the finished carriageway over the proposed bridge will be approximately 1.4m higher than the existing overbridge, due to the change in form and span of the proposed structure. The carriageway and footway widths of the new bridge will be similar to those existing.

7.7.33 It is anticipated that the construction works for this bridge will take 22 months to complete. This includes a five month allowance to divert existing underground services from the old bridge to the new bridge.

**Proposed works on the Recreation Ground overbridge**

7.7.34 The existing Recreation Ground overbridge (Figure 35) can only accommodate three lanes on each carriageway of the motorway and is not adequate for four-lane ALR. A longer span replacement bridge is therefore required.
7.7.35 A power to close the road over the bridge temporarily for the duration of the construction will be included in the DCO. A possible vehicular diversion route for the bridge would be via Datchet Road and Upton Court Road but details will need to be agreed with the local authority.

7.7.36 The proposed structure is a single-span bridge. The level of the finished carriageway over the proposed bridge will be approximately 1.1m higher than the existing overbridge it replaces, due to the change in form and span of the proposed structure. The carriageway and footpath widths of the new bridges will not change from those existing. A 60m length (approximately) of retaining wall will be constructed to ensure that the raised approach embankment does not encroach on the adjacent allotments. An overbridge general arrangement drawing is included in Annex F of this EDR.

7.7.37 It is anticipated that the construction works will take eight months to complete.

Proposed works at Water Main culvert

7.7.38 The Water Main culvert carries a water main under the M4 about 250m east of Recreation Ground overbridge, close to the Slough Road allotments. The culvert is a 2.75m span reinforced concrete box with access chambers at each end currently located in the existing hard shoulders.

7.7.39 Maintenance and inspection of the existing structure are difficult and require confined-spaces trained diving teams and night time lane closures. Subject to agreement with Thames Water, the preferred option is to infill the structure and thereby eliminate the need for any further maintenance. Alternatively, the structure will require widening by approximately 2.1m at each end so that the access chambers can be moved into the verge and behind the safety barrier. Working space for this activity will require temporary land acquisition at each end.
of the structure. At the southern end this would encroach temporarily on the Slough Road allotments.

**Proposed works on Riding Court Road overbridge**

7.7.40 Riding Court Road overbridge (Figure 36) is another of the existing bridges over the M4 which cannot accommodate four-lane ALR. A longer span replacement bridge is therefore required.

![Figure 36: View of the existing Riding Court bridge](image)

7.7.41 An offline bridge replacement for Riding Court Bridge has been selected for the reasons provided in chapter 5. The side road will be re-aligned to the west of its current position to achieve an improved horizontal alignment and to minimise impact on residential properties south of the motorway on London Road.

7.7.42 The proposed structure is a single-span bridge. The level of the finished carriageway will be approximately 1.4m higher than the existing overbridge, due to the change in form and span of the proposed structure. The carriageway widths of the new bridge will not change from those existing. An overbridge general arrangement drawing is included in Annex F of this EDR.

7.7.43 It is anticipated that the construction works for this bridge will take 16 months to complete.

**Proposed works at Ashley’s Arch culvert**

7.7.44 Ashley’s Arch culvert consists of two structures: a 1.5m diameter concrete pipe and a 6.1m reinforced concrete box culvert. The concrete pipe section has insufficient length to carry the widened eastbound carriageway and will require lengthening by approximately 1.5m to the north. The reinforced concrete culvert is not affected by the Scheme.
Table 18: Schedule of proposed land-take between junctions 6 and 5

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<td>Permanent land-take</td>
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7.8 Junction 5 to junction 4b

Existing

7.8.1 The M4 between junction 5 (Langley) and junction 4b (M25) has four running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway but each hard shoulder has discontinuities, as described below. The main carriageway lighting columns are located in the central reserve. The general landform through this link is residential and industrial around junction 5 and rural towards junction 4b.

7.8.2 Junction 5 (Langley) is formed of a gyratory, situated beneath the M4. The main carriageway of the motorway is carried over the junction by two underbridges and a subway. Both underbridges take the same form; three-spans supported by bank seats to each verge embankment and piers to each verge. The subway provides a route for the pedestrians to pass over the gyratory, but under the M4. The structure takes the form of a 2.4m span reinforced concrete box. There are elevated walkways leading away from the subway in both directions to spiral ramps down to pavement level at both sides of the gyratory. Over the structures, the carriageway is three lanes wide with no hard shoulder. The Langley interchange underbridges and subway will therefore require widening in order to
provide four lanes of traffic in each direction through the junction. The eastbound merge consists of two lanes which reduces to one lane as it joins the M4, while the westbound diverge has one lane which expands to three lanes on reaching the gyratory.

7.8.3 The M4 follows a slight downward gradient away from junction. Sutton Lane overbridge is located immediately at the end of the junction 5 slip roads and carries Sutton Lane over the M4 on a four-span structure. This structure will not be affected by the Scheme.

7.8.4 The M4 levels out as it approaches Old Slade Lane overbridge. The structure is located at the start of the junction 4b slip road where the surrounding landform is mainly rural. The overbridge carries an accommodation track over the M4 to provide access for farm use, local pedestrians, dog walkers and cyclists as part of the Colne Valley Trail. The structure is formed from three-spans supported by bank seats to the verge embankments and piers to the verges. The piers force discontinuities in the M4 hard shoulder meaning that a longer span replacement bridge is required at this location.

7.8.5 The eastbound diverge to junction 4b has one lane which expands to two lanes, while the westbound merge remains as two lanes through the junction and as it joins the M4. The main carriageway of the M4 continues on a slight upward gradient through to junction 4b. Junction 4b itself is an interchange between the M4 and the M25. The overbridges through this junction are described as part of junction 4b to junction 4 in section 7.9.

Proposed works on the motorway

Lane configuration

7.8.6 In the eastbound direction, TJR is provided at junction 5. The eastbound entry slip road from junction 5 merges into the left hand lane so that, at Sutton Lane overbridge, immediately downstream of the merge, the M4 will have four driving lanes and no hard shoulder. After passing under Sutton Lane, the existing M4 carriageway widens to four lanes and a hard shoulder. At this point, the four new driving lanes will be slewed left so that the existing hard shoulder becomes the new near side lane. This will generate space on the right hand side of the carriageway to develop a fifth driving lane. This section of five-lane ALR will then continue eastwards to junction 4b, where the two left hand lanes will peel off to tie in with the existing two-lane slip road to the M25. The remaining three lanes will continue as currently existing through junction 4b. Junction 4b will not have TJR.
7.8.7 In the westbound direction, TJR will not be implemented at junction 4b. The westbound slip road from the M25 to M4 will be configured to create a lane gain so that there will be four driving lanes from junction 4b to junction 5. This link already has four lanes and a hard shoulder and the existing hard shoulder will be retained as far as the junction 5 exit slip road. TJR will be provided at junction 5.

7.8.8 One ERA will be provided on the eastbound carriageway. This ERA will incorporate a new POP which will replace the existing eastbound POP. The westbound carriageway on this section will retain its hard shoulder and its existing ERA.

**Offside and central reserve works**

7.8.9 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11.

**Nearside and verge works**

7.8.10 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11.

7.8.11 For 500m of the elevated section over junction 5 there will be new 2m high noise fencing in each verge of the motorway. This will benefit residential properties on both sides of the motorway, including those at Grampian Way, Ditton Road, Welland Close and Tweed Road.

**Carriageway resurfacing**

7.8.12 Low-noise surfacing will be provided throughout the Scheme as part of the works.

**Gantries**

7.8.13 There will be 11 gantries between junction 5 and junction 4b. Four will be super-span portals and the other seven will all be various cantilever type structures. Three of the super-span portals will display information to both eastbound and westbound carriageways. In total, there will be seven gantries facing the traffic on each carriageway. The location of the gantries is shown on the Scheme plans in Annex F of this EDR.

7.8.14 Gantries on the eastbound carriageway:

   a) one gateway gantry positioned shortly after the junction 5 entry slip road. This gantry will carry a single MS4 and a set of five AMIs, one positioned over each lane, to display lane availability and speed limits;

   b) two intermediate gantries similar to the gateway gantry, but positioned half-way along and at the end of the section. The second of these two gantries is an existing structure which also spans the junction 4b westbound slip road off the M4. This gantry will also carry route confirmation signs for the slip road;
c) one additional MS3 positioned over the nearside lane;

d) one ADS positioned in advance of junction 4b showing the exit destinations of M25, Watford, Oxford, Heathrow (Terminal 4, 5 & Cargo) and Gatwick; and

e) two further direction signs at 1/3 mile (0.54km) and on the approach to junction 4b, showing the exit destination as above and M4 through traffic destinations of Greater London and Heathrow.

7.8.15 Gantries on the westbound carriageway:

a) one gateway gantry positioned downstream of junction 4b entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

b) two additional MS4s positioned over the nearside lane at regular intervals;

c) two ADSs positioned at 2/3 mile (1.07km) and 1/3 mile (0.54km) in advance of junction 5 showing the exit destinations of Langley, Colnbrook and Datchet; and

d) one final direction sign on the approach to junction 5, showing the exit destination as above and M4 through traffic destinations of the South West, Reading and Slough (W & C).

Proposed works at Langley Interchange bridges

7.8.16 The bridges at Langley Interchange (junction 5) (see Figures 37 and 38) carry the M4 over the junction's roundabout on the A4. There are four existing structures, one for each carriageway over each side of the roundabout, with a narrow separation along the central reserve between each pair of eastbound and westbound bridges. Each bridge is only three lanes wide and will need to be widened by 4.5m to accommodate ALR through the junction.
The separation of the bridges along the central reserve and the proximity of the existing slip roads preclude the option of asymmetric widening of the motorway. The proposed solution is therefore to widen each of the four structures by 4.5m outward from the motorway, leaving the central reserve unchanged. An overbridge general arrangement drawing is included in Annex F of this EDR.

Each of the bridges has three-spans formed by concrete box girders. These box girders cannot easily be widened so the preferred solution is to widen the bridges using steel girders and a concrete deck slab.

During construction works, narrow lanes will be required on the M4 at this location to allow a safe working zone of 1.2m and three lanes of traffic to be maintained in both directions for the duration of the works (apart from during short closures for activities such as beam lifting).
7.8.20 Similarly, the three lanes of the roundabout and the footpaths under the bridge will be kept operational for the bulk of the construction period with only short-term closures anticipated.

7.8.21 It is anticipated that the construction works for this bridge will take 14 months to complete.

Proposed works at Langley Interchange subway

![Figure 39: Langley Interchange subway](image)

7.8.22 The Langley Interchange subway (Figure 39) will require symmetric widening by 3.2m at each end to accommodate ALR through to junction 5. Symmetric rather than asymmetric widening is forced by the chosen option for the Langley Interchange bridges. The length of widening is constrained by the proximity of the footbridges over the roundabout at each end of the subway.

7.8.23 It is proposed to construct a reinforced concrete frame enclosing the existing wing walls. The temporary works required to retain the existing carriageway during the works could be provided by sheet piling or soil nailing.

7.8.24 The footways would need to be closed for the duration of the widening works and a temporary diversion would be signed and fenced via the interchange underbridges.

Proposed works on Old Slade Lane overbridge

7.8.25 The existing Old Slade Lane bridge (Figure 40) over the M4 can only accommodate three lanes on each carriageway of the motorway and is not adequate for four-lane ALR. A longer span replacement bridge is therefore required.
7.8.26 A power to close the road and bridleway over the bridge temporarily for the duration of the construction will be required. A possible vehicular diversion route for the bridge would be via the A4 Colnbrook Bypass, Sutton Lane and North Park. Details will be agreed with the local authority.

Figure 40: View of the existing Old Slade Lane bridge

7.8.27 The proposed structure is a single-span bridge. The level of the finished carriageway will be approximately 1.1m higher than the existing overbridge, due to the change in form and span of the proposed structure. The carriageway widths of the new bridge will not change from those existing. An overbridge general arrangement drawing is included in Annex F of this EDR.

7.8.28 It is anticipated that the construction works will take 12 months to complete.

**Proposed land-take**

**Table 19: Schedule of proposed land-take between junctions 5 and 4b**

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<tr>
<th>Category</th>
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<th>Comments</th>
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<td>Associated with Construction Compound 9 (see 8.2.11)</td>
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<td>Temporary land-take</td>
<td>1.99</td>
<td>Total quantity of temporary land-take required between junctions 5 and 4b aside from that associated with construction compounds</td>
</tr>
</tbody>
</table>
7.9 Junction 4b to junction 4

Existing

7.9.1 The M4 between junction 4b (M25) and junction 4 (Heathrow) has four running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway and lighting to both the central reserve and the verge. The general landform through this link is residential.

7.9.2 Junction 4b is an interchange between the M4 and the M25. Two of the junction 4b link roads pass over the M4 on viaducts, whilst the M4 passes over the other two link roads and Staines Branch Railway Line via the use of three single-span underbridges: Staines Branch Line West underbridge, Staines Branch Line underbridge and Staines Branch Line East underbridge. None of these structures will be affected by the Scheme. The eastbound merge and westbound diverge take the same form, which is two lanes separated by a ghost island.

7.9.3 Wraysbury River underbridge and River Colne underbridge are located within junction 4b and carry the M4 over the Wraysbury River and River Colne respectively. These bridges will not be affected by the Scheme.

7.9.4 Towards the end of the junction 4b slip roads, the main carriageway separates, forming a wide central reserve that is covered by dense vegetation. An environmental barrier has also been placed on the central reserve and the eastbound verge.

7.9.5 The M4 then passes under Little Benty North and South footbridges, before arriving at Harmondsworth Road North and South overbridges. Harmondsworth Road North overbridge has three-spans and is supported by bank seats to the verge embankments and piers to the verges. There is environmental barrier to the eastbound verge adjacent to the abutment. Harmondsworth Road South overbridge is a single-span deck on full-height abutments. Both structures carry Harmondsworth Road over the M4 and neither will be affected by the Scheme.

7.9.6 Further along the M4 situated on a slight incline is Sipson Road subway. This subway takes the form of a 3m spanning concrete box and provides pedestrian access under the M4 junction 4 slip roads. 850m over the structure there is environmental barrier to the eastbound verge and a steel parapet to westbound verge. Due to the proposed realignment and widening of the junction 4 slip roads, the subway will need to be widened at both ends.

7.9.7 Holloway Lane underbridge is located further along the M4. The structure carries the M4 main carriageway and junction 4 slip roads over the A408. This structure has four spans. There are steel parapets to the motorway verges and an environmental barrier on the eastbound slip road verge. No works are proposed to this structure.
The eastbound diverge to junction 4 has two lanes which expand to four lanes on reaching the junction, while the westbound merge has three lanes which reduce to one lane as it joins the M4. There is also environmental barrier to the verge of the eastbound diverge. Junction 4 is a gyratory, situated beneath the M4. The main carriageway of the motorway is carried over the junction by two underbridges. These underbridges are described as part of the junction 4 to junction 3 link in section 7.10.

**Proposed works on the motorway**

**Lane configuration**

ALR, with five lanes in each direction, will be provided for the entire length of this link, with the existing four lanes and the hard shoulder converted to create five running lanes with no hard shoulder. Two ERAs are to be provided, one on each carriageway. The westbound ERA will incorporate a new POP. The existing POP, on the westbound carriageway, will be removed.

TJR will not be provided at junction 4b (M25); as the M4 passes through junction 4b it will consist of three lanes and a hard shoulder in each direction. The slip roads to and from junction 4b will be configured as a double lane gain (eastbound) and double lane drop (westbound) to create the five lanes described above.

At junction 4 (Heathrow) a single lane drop (eastbound) and lane gain (westbound) will reduce the motorway back to four lanes each direction to provide TJR.

**Offside and central reserve works**

Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 12 to junction 11.

**Near side and verge works**

Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section junction 12 to junction 11.

**Carriageway resurfacing**

Low-noise surfacing will be provided throughout the Scheme as part of the works.

**Gantries**

There will be 16 gantries between junction 4b and junction 4, eight on each carriageway. These will be a mix of six new cantilever structures, five new portal gantries and five re-used existing portal gantries. The location of the gantries is shown on the Scheme plans in Annex F of this EDR.
7.9.16 Gantries on the eastbound carriageway:

a) one gateway gantry positioned shortly after junction 4b entry slip road. This gantry will carry a single MS4 and a set of five AMIs, one positioned over each lane, to display lane availability and speed limits;

b) one intermediate signal gantry similar to the gateway gantry positioned roughly half-way along the section;

c) one additional MS4 positioned over the nearside lane within junction 4b;

d) three ADSs positioned at 1 mile (1.61km), ¾ mile (1.21km) and ¼ mile (0.40km) in advance of junction 4 showing the exit destinations of Heathrow (Terminals 1, 2 & 3) and Uxbridge. The ¾ mile (1.22km) sign will be located over the slip road from M25. The ¼ mile (0.40km) gantry will also include direction signs for M4 through traffic;

e) one final direction sign on the approach to junction 4, showing exit destinations as above and M4 through traffic destinations of Central London and Hounslow; and

f) one gantry with a route confirmation sign over the junction 4 slip road and an MS4 variable message sign over the M4.

7.9.17 Gantries on the westbound carriageway:

a) one gateway gantry positioned downstream of the junction 4 entry slip road. This gantry will carry a single MS4 and a set of five AMIs, one positioned over each lane, to display lane availability and speed limits;

b) two intermediate signal gantries similar to the gateway gantry positioned roughly half-way along the section and one over the junction 4b exit. The latter will include route confirmation signs for the slip road;

c) one additional MS3 positioned over the nearside lane within junction 4;

d) three ADSs positioned at 1 mile (1.61km), ¾ mile (1.21km) and ¼ mile (0.40km) in advance of junction 4 showing the exit destinations via M25(S) of Heathrow (Terminals 4 & 5) and Gatwick, and via M25(N) of Watford and Oxford. The ¾ mile (1.21km) sign will be located over the slip road from the Heathrow Spur at junction 4. The ¼ mile (0.40km) gantry will also include direction signs for M4 through traffic; and

e) one final direction sign on approach to junction 4b, showing exit destinations as above and M4 through traffic destinations of the South West, Reading and Slough.
7.9.18 On the Heathrow spur road, to the south of junction 4, there will be a further three gantries. Two of these will re-use the existing gantries over the northbound carriageway to display appropriate lane destinations. A new MS3 cantilever gantry will be positioned over the northbound carriageway to inform drivers of conditions on the smart motorway ahead.

**Proposed works at Sipson subway**

7.9.19 Sipson Road subway (Figure 41) creates a pedestrian route under the M4. It requires extending by approximately 5m to accommodate ALR through junction 4.

![Figure 41: Sipson Road subway from the south](image)

7.9.20 Asymmetric widening to the south side has been selected as the preferred option for the reasons explained in chapter 5 of this EDR.

7.9.21 The extension will be designed to span the existing reinforced concrete approach walls. The extended deck slab would be cast continuous with the existing deck and will be constructed at a level to match the headroom of the existing structure. The extension will be designed to avoid impact on the adjacent gas supply facility.

7.9.22 Some footway closures are anticipated to construct the widening and a diversion is available via Holloway Lane to the east.
Proposed land-take

Table 20: Schedule of proposed land-take between junctions 4b and 4

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity (ha)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Temporary land-take</td>
<td>0.27</td>
<td>Total quantity of temporary land-take required between junctions 4b and 4.</td>
</tr>
</tbody>
</table>

7.10 Junction 4 to junction 3

Existing

7.10.1 The M4 between junction 4 (Heathrow) and junction 3 (Hayes) is 3,000m long with three running lanes in each direction. There is also a hard shoulder on the nearside of each carriageway and lighting columns to the central reserve. The general landform through this link is residential.

7.10.2 Junction 4 is formed of a gyratory situated beneath the M4. The main carriageway of the motorway is carried over the junction by two underbridges: Airport Interchange West overbridge and Airport Interchange East overbridge. Both underbridges take the same form; three-spans supported by bank seats to each verge embankment and piers to each verge. The carriageways over the structures are three lanes wide with a hard shoulder. There is no work anticipated to either of these structures. The eastbound merge consists of two lanes which reduces to one lane as it joins the M4, while the westbound diverge has one lane which expands to three lanes on reaching the gyratory.

7.10.3 The M4 follows a downward gradient away from junction 4. After 1,400m the gradient almost levels out as it traverses over St. Peters subway. No works are anticipated to this structure.

7.10.4 Harlington overbridge is located a further 325m along the M4 at a similar gradient to the previous structure. This structure is supported by piers to both verges and carries the A437 High Street over the M4. The Scheme will not affect this structure.

7.10.5 Further along the M4, Fuller subway is situated on a similar gradient to the previous two structures. No works are anticipated to this structure.

7.10.6 St. Dunstan’s subway is located 525m from the previous subway on a slightly upward gradient. This structure will not be affected by the Scheme.
7.10.7 The eastbound diverge to junction 3 has one lane which expands to three lanes on reaching the junction, while the westbound merge has two lanes which reduce to one lane as it joins the M4. Junction 3 is a gyratory, situated beneath the M4. The main carriageway of the motorway is carried over the junction by Cranford Park Avenue underbridge. This structure will not be affected by the Scheme.

**Proposed works on the motorway**

*Lane configuration*

7.10.8 TJR will be implemented at junction 4 (Heathrow). This will require reconfiguration of the slip roads at the junction.

7.10.9 ALR will be provided for the entire length of this link, with the existing three lanes and the hard shoulder converted to create four running lanes with no hard shoulder. Two ERAs are to be provided, one on each carriageway. There are two existing POPs on this section both of which will be removed. No new POPs are proposed.

7.10.10 Junction 3 (Hayes) is at the western end of the Scheme. Lane provision on the M4 through the junction is not affected by the Scheme. It will remain as three lanes and a hard shoulder in each direction. The westbound entry slip road merges with the M4 in a lane gain configuration to create a fourth lane on the motorway. Similarly, but in the opposite direction, the eastbound exit slip road results in a lane drop.

*Offside and central reserve works*

7.10.11 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 11 to junction 12.

*Nearside and verge works*

7.10.12 Work in the central reserve and offside lanes in this link is the same in all material respects to the work proposed for the section from junction 11 to junction 12.

*Carriageway resurfacing*

7.10.13 Low-noise surfacing will be provided throughout the Scheme as part of the works.

*Gantries*

7.10.14 There will be 11 gantries between junction 4 and junction 3. Ten will be cantilever structures and one a super-span portal. The super-span portal will carry information for traffic on both carriageways giving a total of six gantries facing the traffic on each carriageway. The location of the gantries is shown on the Scheme plans in ES Volume 2. Gantry provision on this section is summarised below.
7.10.15 Gantries on the eastbound carriageway:

a) one gateway gantry positioned shortly after the junction 4 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

b) two additional MS4s positioned over the nearside lane within junctions 4b and 3;

c) two ADSs positioned at ½ mile (0.81km) and ¼ mile (0.40km) in advance of junction 3 showing the exit destinations of Heathrow, Harrow and Hounslow. The ¼ mile (0.40km) gantry will also include a set of four AMIs; and

d) one final direction sign on the approach to junction 3, showing exit destinations as above, and M4 through traffic destinations of Central London and Ealing.

7.10.16 Gantries on the westbound carriageway:

a) two additional MS4s positioned over the nearside lane within junctions 4b and 3;

b) one gateway gantry positioned downstream of the junction 4 entry slip road. This gantry will carry a single MS4 and a set of four AMIs, one positioned over each lane, to display lane availability and speed limits;

c) two additional MS4s positioned over the nearside lane within junctions 3 and 4b;

d) two ADSs positioned at ½ mile (0.81km) and ¼ mile (0.40km) in advance of junction 4 showing the exit destinations of Heathrow (Terminals 1, 2 & 3) and Uxbridge. The ¼ mile (0.40km) gantry will also a set of four AMIs; and

e) one final direction sign on the approach to junction 4, showing exit destinations as above and M4 through traffic destinations of the South West, Reading and Heathrow (Terminals 4 & 5).

Proposed land-take

Table 21: Schedule of proposed land-take between junctions 4 and 3

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<tr>
<th>Category</th>
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<td>Temporary land-take</td>
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7.11  Visual appearance

**General**

7.11.1  As the Scheme is the improvement of an existing road, with no verge widening or installation of types of infrastructure that are not already present along the Scheme, the visual appearance of the motorway will not change significantly from the existing appearance. It is considered that the replacement bridges, number of gantries and changes to vegetation will be the main alterations to the visual appearance for both the road users and adjacent residents.

7.11.2  The replacement bridges will be of standard form as used elsewhere on the SRN but, will be up to 1.5m higher than existing with thicker decks for single-span bridges. Oldway Lane overbridge will be replaced by a footbridge rather than a vehicular bridge. None of the replacement bridges will be of elaborate visual appearance.

7.11.3  There will be more gantries along the Scheme. Currently there are 33 gantries between junction 12 and junction 3, equivalent to one gantry every c.1515m. The Preliminary Design requires a total of 162 gantries, this equates to a gantry every c.310m.

7.11.4  Vegetation clearance will be required around areas of bridgeworks and drainage works in the verge. This may involve removing mature vegetation and although there will be replacement planting, it will take some time for the vegetation to reach the same level of maturity.

**Landscape and visual impact assessment**

7.11.5  The landscape and visual implications of the Scheme are assessed in the ES. The assessment considers how the Scheme will alter the character of the landscape, as well as the views of the landscape afforded to people - visual amenity considerations. These two separate but related issues form the basis of landscape and visual impact assessment ("LVIA").

7.11.6  The receptors affected by the visual impacts of the Scheme are properties and public vantage points with the North Wessex AONB and the Thames Valley landscape. They will be impacted by both temporary and permanent effects.

7.11.7  Temporary disruption to landscape character and views will primarily result from activities such as use of plant and vehicles, creation of compounds, and material stockpiles, during construction. This will be mitigated by construction best practice to minimise disruption, e.g. protection of existing vegetation to be retained and targeted use of hoarding to screen construction sites. This will be secured in the CEMP.
7.11.8 Permanent impacts may include deterioration in landscape character and views, primarily resulting from vegetation clearance and the introduction of new operational infrastructure. This will be mitigated as far as possible by replacement planting.

7.12 **Environmental Masterplan**

7.12.1 The vegetation clearance and Environmental Masterplan drawings for the Scheme are included in Annex F of this EDR. These provide an indication of how the land cleared of vegetation for temporary construction works will be replanted following construction, and incorporates mitigation measures identified as part of the EIA process. Environmental enhancement is also incorporated in appropriate circumstances. Proposed planting will mainly consist of native tree and shrub species appropriate to the nature of the soil and the pre-existing vegetation composition. In the medium to long-term, this planting will mature to provide habitats and visual screening which will replace the vegetation removed.

7.12.2 The Environmental Masterplan will be developed further during the detailed design phase of the scheme. It currently includes the elements described below.

**Nature conservation mitigation areas**

7.12.3 The Environmental Masterplan incorporates replacement habitat for affected protected and notable species where required, including:

a) appropriate receptor sites for amphibians and reptiles;
b) reinstatement of the affected verges includes reseeding with a wildflower seed mix;
c) native tree planting (particularly on the borders of any Local Wildlife Sites and Local Nature Reserves), with an emphasis on fruit bearing varieties in areas identified as supporting badgers;
d) installation of otter ledges on culverts or under bridges where no ledge is currently present;
e) provision of bat boxes; and
f) otter and badger resistant fencing.

**Landscape planting**

7.12.4 The planting design would take into account Highways Agency required minimum planting distances from the carriageway, with shrubs not less than 3m, and trees not less than 5m. The planting areas would maintain safe sightlines at road bends and junctions, and would avoid obscuring signs and signals. Tall growing species would not be planted under power lines, and tree and shrub planting would generally avoid underground services. Planting would perform visual screening, landscape integration, nature conservation/biodiversity, public amenity
and noise screening. Plant stock would be preferably of local or regional provenance. As a minimum, plant stock would be from the UK.

7.12.5 Landscape mitigation would restore lost vegetation where practicable and link with remaining hedges and trees on the highway boundary, screening the traffic from nearby properties but also leaving open countryside views from the road at appropriate locations.

**Vertical noise barriers**

7.12.6 Vertical barriers are proposed in several areas to mitigate noise impacts as set out in the Environmental Statement. The locations of these are indicated in the Environmental Masterplan.

### Access

#### Overview

7.13.1 No new motorway junctions are created or existing junctions decommissioned as part of the Scheme. No restrictions, that might limit the direction of travel, are being introduced at any of the junctions.

7.13.2 Traffic on the local road network using the overbridges may be disrupted during construction works. Disruption would include the need to adhere to diversion routes. This disruption will only be temporary until the construction work for each particular bridge is complete.

**During construction**

*Traffic management on the motorway*

7.13.3 TM will be required along the Scheme to provide the necessary work space required for the contractor, while maintaining safe conditions for drivers and construction workers. A Contractor has not been appointed to the Scheme yet so precise TM measures are not known. A draft TM Plan is included as an appendix to the ES.

7.13.4 Typically, TM would comprise narrow lanes with a speed restriction of 50mph separated from the working areas by a temporary barrier and a safety zone. For most of the construction period for each link, three lanes in each direction will be kept open for traffic. During the verge work phase (see chapter 8 and Construction: Programme in Annex B) the three lanes will be positioned over existing lanes 3, 2 and part of lane 1. During the central reserve works phase, the three lanes will be positioned over the existing hard-shoulder, lane 1 and part of lane 2. Similar arrangements will be used to maintain four lanes during works between junction 4b and junction 4.
7.13.5 Further short-term TM measures and lane closures will be required for some operations. Bridge demolition and gantry erection will require full overnight road closures. Construction of bridge piers in the central reserve will require additional working space typically leaving only two lanes in each direction open for traffic. Periods of two lane operation will be limited to weekends and nights wherever practicable.

7.13.6 Where motorway closures are required, diversions will be signed along the existing strategic diversion routes utilising adjacent local authority roads.

7.13.7 It is anticipated that speed enforcement measures will be required to ensure road user and road worker safety. This is likely to be in the form of temporary CCTV and average speed check (“SPECS”). The SPECS cameras will be required in each TM section, whilst temporary CCTV cameras will be installed approximately every 500m to ensure the efficient identification of breakdowns and management of incidents.

*Traffic management on side roads*

7.13.8 TM on side roads will depend on the alignment of the new overbridge being constructed. For online reconstructions, the side road will be closed for the duration of the bridge and side road construction, and a temporary diversion route will be in place. For offline reconstructions, localised TM, such as signal controlled one way working and speed restrictions, will be required for defined periods during construction. See Tables 22 and 23 for further detail.

**Table 22: Temporary diversions for online overbridge construction**

<table>
<thead>
<tr>
<th>Overbridge</th>
<th>Location</th>
<th>Indicative programme</th>
<th>Diversion route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marsh Lane</td>
<td>J8/9 – J7</td>
<td>Mar. 2019 to Mar. 2020</td>
<td>Bath Road (A4) and Lake End Road</td>
</tr>
<tr>
<td>Oldway Lane</td>
<td>J7 – J6</td>
<td>May 2019 to Feb. 2020</td>
<td>Using existing public rights of way and Wood Lane bridge to cross M4</td>
</tr>
<tr>
<td>Recreation Ground</td>
<td>J6 – J5</td>
<td>July 2018 to Feb. 2019</td>
<td>Datchet Road and Upton Court Road</td>
</tr>
<tr>
<td>Old Slade Lane</td>
<td>J5 – J4b</td>
<td>July 2018 to Apr. 2019</td>
<td>Colnbrook Bypass/Sutton Lane and North Park</td>
</tr>
</tbody>
</table>
Table 23: Traffic management for offline overbridge construction

<table>
<thead>
<tr>
<th>Overbridge</th>
<th>Location</th>
<th>Indicative programme</th>
<th>Traffic management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monkey Island Lane</td>
<td>J8/9 – J7</td>
<td>Feb. 2018 to Aug. 2019</td>
<td>Shuttle way working using signal control for tie-in and overlapping works</td>
</tr>
<tr>
<td>Huntercombe Spur</td>
<td>J7</td>
<td>Feb. 2018 to Mar. 2020</td>
<td>Shuttle way working and phased construction</td>
</tr>
<tr>
<td>Wood Lane</td>
<td>J7 – J6</td>
<td>Feb. 2018 to Jan. 2020</td>
<td>Shuttle way working using signal control for tie-in and overlapping works</td>
</tr>
<tr>
<td>Datchet Road</td>
<td>J6 – J5</td>
<td>July 2018 to July 2020</td>
<td>Shuttle way working using signal control for tie-in and overlapping works</td>
</tr>
<tr>
<td>Riding Court Road</td>
<td>J6 – J5</td>
<td>Mar. 2019 to Aug. 2020</td>
<td>Shuttle way working using signal control for tie-in and overlapping works</td>
</tr>
</tbody>
</table>

**Non-motorway users**

7.13.9 Severance issues caused by the Scheme for non-motorway users are outlined below and discussed in chapter 13 Effects on all Travellers of the ES.

7.13.10 Users of walking and cycling routes in the vicinity of the Scheme may experience adverse effects as a result of the construction works although appropriate mitigation measures (e.g. diversion routes, signage and information to be provided to nearby residents prior to rebuilding) will be implemented by the Contractor.
Junction 8/9 to junction 7

7.13.11 Reconstruction of Ascot Road overbridge will have an impact on movements between communities to the north and south of the M4 and vice versa. Communities to the south are likely to experience a greater impact given that Maidenhead is an important centre of employment and service centre. The bridge is proposed to be constructed offline, allowing traffic and pedestrians to continue to use the existing bridge whilst the new bridge is constructed. Some TM measures will be required during some sections of the works, which may result in slight delays for traffic using the bridge. The Priors Way Industrial Estate is accessed from Windsor Road. Reconstruction of the overbridge is likely to involve temporary land-take comprising part of the Industrial Estate nearest the A330. Other occupiers of the Industrial Estate are unlikely to be subject to significant effects. This is fully assessed in the ES.

7.13.12 Monkey Island overbridge provides access from the village of Bray to the north of the M4 to residential properties and facilities to the south of the M4 including the Monkey Island Hotel. Monkey Island Lane is a no-through-road with a section to the south of the M4 comprising a bridleway; this forms part of the route of National Cycle Route 4. Online construction of the overbridge would not be practical as both local residents and users of the Monkey Island Hotel would be unable to access premises south of the M4, meaning that an offline construction solution is required. As such, the new bridge will be built offline to the western side of the existing bridge to enable the latter to remain in use until the new bridge is completed.

7.13.13 Marsh Lane overbridge connects Bath Road to the north with the villages of Dorney, Eton Wick and Eton to the south of the M4. The route also provides access to Eton Dorney Lake. Users of this route may experience slightly lengthened journey times during the construction period. Lake End Road to the east provides an alternative route. Marsh Lane overbridge is proposed to be constructed online, with Lake End Road overbridge providing a suitable diversion during the construction period.

7.13.14 Lake End Road provides an alternative route to that of Marsh Lane, connecting Bath Road to the north of the M4 with the villages of Dorney, Eton Wick and Eton to the south of the motorway. Lake End Road overbridge is proposed to be constructed offline to maintain suitable access to Dorney rowing lake and Dorney School.

7.13.15 The Thames Bray underbridge will be widened. This may have implications for walkers, cyclists and boat users along this stretch of the River Thames during the widening works. Cycle routes pass on either side of the M4 in this location prior to heading north/south along the riverbank. Users of the Thames Path may experience an impact should the bridge widening works require any temporary diversion of the footpath. Businesses that may experience an effect as a result of
the widening of the Thames Bray underbridge include the Amerden Caravan Park to the east of the Thames – the site may experience a reduction in visitor numbers during the course of the construction period. Ongoing consultation with landowners and occupiers, for example owners of the Amerden Caravan Park, is being undertaken; potential mitigation measures may include the phasing of construction to avoid peak holiday periods. There will also be a need to for a number of closures of the waterway to river traffic to allow beam lifts.

7.13.16 Alterations are proposed to the Huntercombe Spur overbridge at junction 7 of the M4. Proposals for the westbound slip lane have been realigned to avoid land-take of residential properties in this area.

Junction 7 to junction 6

7.13.17 Possible temporary community severance impacts may occur as a result of the rebuilding of the Oldway Lane and Wood Lane overbridges. With appropriate diversion routes, signage and information to be provided prior to rebuilding taking place, the severance is not considered to be significant.

7.13.18 Alterations are proposed to the Huntercombe Spur overbridge eastbound. There is not anticipated to be any effect on local residents in terms of land-take; principal effects therefore relate to loss of amenity as described earlier.

7.13.19 The Oldway Lane overbridge is used by pedestrians, cyclists and equestrians to link residential areas on the outskirts of Slough (notably the Cippenham area) with recreational activities along the Jubilee River. The Jubilee River Cycle Path and walking routes pass along the towpath of the river from where links can be made with Eton Dorney rowing lake, NCN4 and the Thames Path. The rebuilding of the Oldway Lane overbridge could therefore have an adverse effect on recreational users in the short-term as the crossing would be temporarily severed during reconstruction of the pedestrian bridge. Alternative access could be provided for the residents of Cippenham to the Jubilee River via the Wood Lane overbridge; however this requires a considerable increase in length of journey and the use of on-road sections for cyclists in particular.

7.13.20 Wood Lane overbridge provides a link across the M4 for 16 properties on Wood Lane, together with access to the Thames Water’s Slough sewage treatment plant. The route to the south of Wood Lane connects with a walking/cycling path along the banks of the Jubilee River. The overbridge is proposed to be reconstructed offline, to the east of the existing bridge to enable the latter to remain open during the construction period.
**Junction 6 to junction 5**

7.13.21 Datchet Road overbridge is proposed to be rebuilt offline to the east of its current location. The Order limits pass in the immediate vicinity of properties in Datchet Meadows and continue through an area of greenfield land to the west of Upton Park. There is a motocross site to the north of the M4 in this location, which may experience impacts as a result of the construction works, although these would be temporary in nature. Due to the overbridge being constructed offline, there are no community severance issues.

7.13.22 The Recreation Ground overbridge provides a pedestrian and cycle link from Datchet Road to the Upton Park area. It provides properties in the Upton Court Road area with the opportunity to link in with the wider Jubilee River walking and cycling network. The motocross site located in the immediate vicinity of the Recreation Ground overbridge to the north of the M4. As the overbridge will be rebuilt online, use of the motocross site and the walking/cycling route north to Upton Park Road may be affected by construction works. The Myrke allotment site is to the east of the Recreation Ground overbridge and part of the allotment site is within the Order limits as part of the temporary land-take required for the purposes of motorway relocating Thames Water’s access chambers. The access road to the allotment sites is also within the Order limits. There may be a temporary adverse impact on users of the allotments as a result of the construction of the Scheme in terms of access to the site, general amenity of the area and notably for users of those allotments whose plots may be required as part of temporary land-take for the Scheme.

7.13.23 Riding Court Road overbridge provides a link between the town of Datchet and the area of Langley on the outskirts of Slough. It provides access, in particular, for employees from the Datchet area and other residential areas to the south of the M4 travelling to businesses in either the Riding Court Farm development or the Computer Associates Technologies business to the north of the M4. Employees from the Datchet area travelling to either of these locations (and vice versa) would experience a longer journey times travelling along alternative routes such as Slough Road and London Road to the west; or the B470 and London Road to the east. Access into the Riding Court farm development itself may be improved as a result of the Scheme. A planning application currently with Royal Borough of Windsor and Maidenhead to develop a sand and gravel extraction site in the vicinity of Riding Court Farm has been identified; the form of replacement of Riding Court Road overbridge has been altered in line with this development and also to eliminate the need for a long vehicular diversion and to make the diversion of statutory undertakers’ apparatus easier.
7.13.24 Between junction 6 and the Windsor Branch Railway underbridge, the Order limits for the Scheme include the Jubilee River towpath and cycle route on the northern bank. There may therefore be a slight adverse effect on users of this route during the construction period.

7.13.25 The Windsor Branch Railway underbridge is proposed to be widened. Cycle and walking routes pass along either side of the railway line in this location, under the M4. The Order limits for the Scheme include the Jubilee River towpath and cycle route on the northern bank. There is likely to be a slight adverse impact on users of these routes at certain times as the underbridge widening work takes place.

**Junction 5 to junction 4b**

7.13.26 Within this link, the Old Slade Lane overbridge is proposed to be rebuilt. During the course of construction an alternative access could be provided from the Colnbrook Bypass to the south, although this may result in lengthened journey times. From the south of the M4 there is a walking and cycling route that passes to the west of the lakes in the vicinity of the Lakeside Business Park, connecting with the village of Colnbrook. There is also a fishing business to the south of the M4. Users of this route would experience a minor adverse effect.

**During operation and maintenance**

7.13.27 No new junctions are created nor are existing junctions decommissioned as part of the Scheme. No restrictions, that may limit the direction of travel, are being introduced at any of the junctions.

7.13.28 Access to the motorway will be improved at junctions 12, 10, 4b and 3 through the implementation of a dedicated on-slip, i.e. the slip road becomes lane 1. This will eliminate the need for traffic to filter into a running lane to join the motorway, which reduces the need for traffic to change lanes and thereby reduces potential delay on approach roads and improves traffic flow on the motorway.

**Emergency services**

7.13.29 The Contractor will ensure that access for emergency vehicles in maintained throughout the construction period. Prior to carriageway closures for bridge works the Contractor will liaise with the emergency services, the Agency and relevant local authorities so appropriate diversion routes, or alternative arrangements, for emergency vehicles can be agreed. This will be secured in the CEMP.

7.13.30 Access for emergency services during incident management is discussed in section 9.4.
8 CONSTRUCTION

8.1 Context

8.1.1 Preliminary design of the scheme is complete but a Contractor to construct the works has not yet been appointed by the Agency. As such, detailed aspects of construction methodology, which will be determined by the Contractor in due course, cannot yet be fixed. Consequently, the description below is based on current best practice and the most likely arrangements. For assessment purposes it is considered to represent a reasonable worst case environmentally.

8.2 Mainline construction activities

Overview

8.2.1 Construction of smart motorway schemes is fundamentally different to new build or road widening schemes. The works are substantially contained within the existing highway boundary and involve a sequence of operations that progress along the length of any carriageway. In any one location the operations pass through at a rate of 50m to 200m per day and otherwise the location will be inactive, standing available. The operations are carried out in disciplines, e.g. excavation gang, concreting gang, etc., or by subcontractor activity sequentially to ensure some reasonable continuity of work for each discipline in one or other carriageway to minimise costly stoppages. Slower activities will proceed for some time and length along the road before a quicker activity follows on and catches up with it. A 50m per day activity like pipework and chamber installation takes four weeks to prepare 1km. A 200m per day activity like slip-forming completes 1km in just one week. The final resurfacing of a full 3.7m lane over the same 1km takes six hours.

8.2.2 Within each work area there is a primary sequence where the verge works and lane widening is carried out, then the central reserve works are carried out and finally any unfinished road resurfacing, finishes and communications works are done. Then there is a period of commissioning and testing of the technology systems.

Construction compounds

8.2.3 Construction of the Scheme will require the establishment of a main office compound (c.5ha) and several smaller section compounds (c.1ha each) to accept material deliveries, provide distribution of plant and equipment and provide office and welfare facilities for workers and a base for vehicle recovery. These locations will need to be adjacent to the motorway or motorway junctions to allow easy access and egress from site. Initially 13 possible areas along the Scheme were identified through desktop study and preliminary site visits. Four compounds were then regarded as unsuitable as follows:
a) compound 1 (Bardon Theale Depot at the junction off Wigmore Lane, near junction 12. Access via A4) on the basis that the proposed area required the removal of screening to adjacent residences, significant earthworks and increased risk of the presence of ecological receptors;
b) compound 10 (existing London Concrete (Bardon) site adjacent to the M25 (northbound) and to the M4 (westbound slip road)) on the basis that further investigations identified the area as more significantly developed than expected and insufficient area was available for a suitable compound without affecting existing businesses;
c) compound 12 (Shepiston Lane, Hayes near junction 4) on the basis of potential disturbance to an immediately adjacent hotel; and
d) compound 13 (Agency Depot at Heston Motorway Service Area at junction 3) on the basis of potential disturbance to an immediately adjacent traveller park.

8.2.4 Also, during the consultation process, an additional potential compound area adjacent to junction 3 (compound 14) was suggested by London Borough of Hounslow. After consideration by Environmental and Construction specialists, it was decided that this location was not suitable for a compound and is therefore not included in the Order land as part of the Application.

8.2.5 The remaining potential compound areas are described below, and are included within the Order limits (compound numbers refer to the original numbering criterion):

a) compound 2: existing farmland, off A4 Dorking Way, near junction 12;
b) compound 3: existing farmland at the end of A33 Old Basingstoke Road, adjacent to junction 11;
c) compound 4: within looped slip roads at junction 10;
d) compound 5: previous compound area off A308(M) adjacent to junction 8/9;
e) compound 6: within looped slip roads at junction 7;
f) compound 7: previous compound off A355, near junction 6;
g) compound 8: triangle of land between the M4, Datchet Road and Recreation Ground access road;
h) compound 9: Colnbrook Landfill site at Sutton Lane, near junction 5; and
i) compound 11: Prologis Park off A408 adjacent to junction 4.
Construction traffic and working hours

8.2.6 The number of communities or individual households in the immediate vicinity of the M4 corridor is relatively high in some places. However, the works traffic in relation to the prevailing high volumes of traffic and HGVs on the M4 is assessed as not being significant.

8.2.7 To provide context; the existing motorway between junctions 3 and 12 carries about 130,000 vehicles per day ("vpd") of which 10% are HGVs. The Scheme involves about 1,500,000 tonnes of old and new materials and temporary works. Typical 32 tonne lorries carry 20 tonnes per load with two lorry movements per load (one full one empty) is 150,000 HGV movements to bring in all works materials and remove all waste or surplus. Over four years, or 1,000 working days, this equates to an average of 150 vpd due to the works compared to the existing HGV traffic of about 13,000 vpd.

8.2.8 The working hours will be Monday to Friday and some Saturday work on specific tasks. Winter and summer working hours will vary to suit the daylight time available.

8.2.9 Night time working is to be expected on activities that require full or significant occupation of the existing M4 carriageways. This means not being able to maintain three lanes open on both M4 carriageways. These activities will include: setting out TM, alterations and removals; bridge works, demolitions and bridge beam erection for new bridges and gantries; carriageway re-surfacing and white-lining. For these types of activities the Agency has extensive experience in necessary TM and programming, which would be applied as necessary.

8.2.10 A CEMP will be in place and it will address all matters pertaining to dust noise and disturbance. The basis of the CEMP is included in the Outline EMP in the ES.

8.2.11 TM is put in place to safeguard the travelling public and for the safety of the work force doing the works. Three lanes of traffic will be maintained at all times during daytimes and peak flows. At night, as necessary, single lane running will occur and motorway closures will be necessary for bridge and gantry erection. The initial phase in any length of works will move the traffic towards the central reserve in narrow lane running. This gives a working area and safety zone, for the verge works. When the verge works and lane widening are complete in both carriageways, the traffic is moved to give working access and a safety zone on both sides of the central reserve.

8.2.12 The Contractor’s working areas and the live running lanes will be delineated with temporary safety barriers with clearly signed access and egress points for Contractor’s vehicles.
Site clearance

8.2.13 This will include some removal of vegetation where necessary at bridges and areas of widening for ERAs. The operation is not unlike the maintenance activity when managing landscaped area, with most of the greenery and branches being chipped on site and left on the verge slopes. Larger branches or trunks of trees will be removed from site and taken to a timber yard of the subcontractor’s choice.

8.2.14 Other works will involve the removal of existing steel crash barrier, lighting poles, ducting and cabling, and communications equipment. They will be removed and taken to store for re-use or taken for recycling. Fencing and environmental barriers may need to be taken down and these would be replaced at a later date in the works process on a like-for-like basis, unless replacements are needed immediately to mitigate the environmental impacts of any works.

Demolition

8.2.15 There are two types of demolition activity. The major demolition of bridges will be a specialist subcontract with an established and competent demolition contractor. These works will usually be at night and, if time requires, at the weekend during off-peak traffic flow they may require a motorway closure. It can be expected that a large number of 360 excavators with hydraulic concrete shears and breakers will be used. Also there will be large cranes to lift out steelwork and 32 tonne lorries with wheeled loaders. Generators and lighting will also be required. The Contractor will produce a detailed demolition plan and conduct liaison with adjacent residents and businesses prior to the operation.

8.2.16 There will also be minor demolition work to remove old concrete bases and footings to barriers and posts. This will be carried out in normal working hours with small breakers on mini excavators and the arisings removed to a compound for separation and recycling.

Earthworks

8.2.17 Earthworks are fairly limited on construction of smart motorways and will mainly involve necessary widening for road realignment and ERAs. The topsoil will initially be stripped and set aside for re-use as near to the earthworks area as is possible, this may involve haulage on lorries to a suitable compound or storage area.

8.2.18 Following this excavation, filling will be carried out using wheeled 360 degree excavators, moving earth by lorry and compacting with rollers. It is expected that the Contractor will carry out detailed mass haul assessments and programming of the works to endeavour to balance the earthworks arising and fill requirements, minimising off-site disposal and the cost of the operations. The large operating lengths in the outline planning are designed to facilitate this.
8.2.19 Retaining walls

In conjunction with earthworks, there are retaining walls to be constructed. Smaller walls are built by traditional concrete construction or gabion walling. In some areas, steel sheet piles are required. Initially a piling platform is formed using imported stone and roller compaction. The piles will then be installed using specialist rigs and vibratory drivers. Where there is close proximity of sensitive locations adjoining the motorway, low-noise, vibrationless installers can be used.

8.2.20 Piling for structures

Where piling is required, a piling platform will be created and specialist rotary or flight auger rigs used to install the piles. The rigs will be matched in size to suit the piles being installed. The rigs can install approximately 80m length of typical bridge pile in one day, i.e. eight 10m piles per day. Thus, for the bridges affected by the Scheme, the piling operations can be expected to be present for a matter of days at each bridge location.

8.2.21 Drainage and ducting

Alterations to the drainage and new communications ducting will be carried out with wheeled 360 degree excavators for any deeper drains and, more generally, with mini excavators or JCB-type loader backhoes. Materials will be brought to the work area just-in-time for installation having been previously stored in the nearest suitable construction compound. Chambers and pits are generally pre-formed rings or plastic units and are installed with the pipework. Trench filling is done with a small roller and plate compactors.

For some drainage or ducting works, the size of verge slot drain or concrete channel will suit a slip-form process. The specialist slip-forming machine to be used is the same as the one for central reserve stepped concrete barrier. This can achieve 200m to 300m per day. On this basis, whilst this is a large and potentially noisy operation, it is transient and should only affect any adjacent receptors for no more than a day.

8.2.23 Gantry construction

The concrete foundations will be constructed using traditional methods for reinforced concrete: shuttering, scaffolding, reinforcement fixing and casting of concrete. The superstructures will have masts erected with a small crane or crane-lorry in normal working hours. Cantilever gantries will be similarly erected, but this will be at night with TM confining the traffic to single-lane running. For larger and full-span gantries the motorway will be closed and the gantries erected by larger hydraulic cranes. The gantries will be erected in batches between junctions to minimise the number of closures required.
8.2.24 Following on from the drainage and ducting, and reinforced concrete base construction operations, the verges will be filled to level and compacted using material previously set aside for re-use and/or material brought in on small lorries. Sign installation, walkway paving, barrier installation and, topsoil and seeding will then be carried out.

8.2.25 Following on from the verge or central reserve works at lower levels, the existing pavement will be planed out using large rotary planers and 32 tonne lorries transporting the arising aggregate mix directly off-site to the subcontractor’s recycling yard. Any local widening and strengthening for the sub-base stone layers will then be carried out using imported stone and rollers. This latter operation may be carried out in conjunction with the drainage and ducting works.

8.2.26 The final resurfacing of the new lane 1 and 2 (previously the hard shoulder and lane 1 respectively) will be carried out as a night time operation with the traffic in single lane running in lane 4 (previously lane 3). The old surface will be planed off and the new surface re-laid in a continuous process. A single team of planer, lorries and pavers can complete 1 lane-km per shift.

8.2.27 A similar set of operations will occur for the re-surfacing of lanes 3 and 4 (previously lanes 2 and 3 respectively) following on from completion of the central reserve works.

8.2.28 Road finishes, white lining and any loop cutting for communications are carried out in the same night shift as the paving operation.

Central reserve works

8.2.29 When the verge works are complete the TM is switched over to have the traffic running in narrow lanes adjacent to the verge with the temporary safety barriers moved to provide lane 4 and the central reserve on both carriageways as a safe working area. Similarly to verge operations the central reserve is cleared of existing redundant materials and then excavated out to formation layer. Stone formation layers and road subbase is laid with materials brought in just-in-time. Slip-forming operations for channels and slot drains will be carried out with the base of the RCB. The road construction widening is then carried out and then the RCB formed. Finally, the surfacing is laid.

Communications installation

8.2.30 Laying of the communications cabling, equipment boxes wiring, etc. will be carried out sequentially as the Contractor’s works make ducting, bases and gantries available. Cabling requires 1km to 2km sections of the works to be available. This is why the works will be conducted as long sections - to provide completed lengths of works for the communications teams to work in. Sections of
the communications will be completed and tested, however, full commissioning and testing can only be carried out following the completion of the verge and central reserve works. This is the final activity within each phase and during this the TM is removed and the motorway traffic will run in the new completed layout.

8.3 Construction programme sequence

Overview

8.3.1 The works programme over five years has been planned to balance the cost and time taken to carry out the works with the length of TM and associated 50mph speed restrictions in place at any time. It has been established from similar highway schemes that regularly implementing TM and then removing it with speed variance 50mph to 70mph creates driver frustration and is less safe to the travelling public and the road construction workers.

8.3.2 TM arrangements of up to 32km (20 miles) have been found to be the maximum optimum distance to balance time, cost and safety.

8.3.3 The philosophy behind the programme allows the work required to be carried out in a safe and efficient manner with the minimum amount of disruption to the travelling public. TM would be kept to a minimum and clear signs and diversions would be provided.

8.3.4 The proposed design and construction works are integrated to maximise the re-use of existing infrastructure and available materials and to minimise the impact on local roads and adjacent landowners and households.

8.3.5 The Contractor will establish proactive processes to minimise the effects on the local community and to engage in good public liaison. This will be secured in the CEMP.

8.3.6 The works of 51km length have been split into two lengths. The first is from junction 12 (Theale) to junction 8/9 (Holyport) a length of 27km and, the second is from junction 8/9 to junction 3 (Hayes) a length of 24km.

Overall construction sequence

8.3.7 The outline construction programme included as Annex B shows the basic overriding plan for carrying out the works. The boxes shaded yellow or green show when and where the main works with TM are happening. Works are programmed to start in late 2016, however until early 2019, receptors near junction 8/9 to junction 3 have no disturbance; similarly there is no disturbance for receptors near junction 12 to junction 8/9 from late 2018 onwards as those works are complete.
An advantage of this broad split is that the first section of the Scheme (junction 12 to junction 8/9) can be completed and opened as smart motorway in about two years thereby giving early benefits to road users and minimising the length of time for potential disturbance to adjacent stakeholders. Also during this period, road users and adjacent stakeholders between junction 8/9 and junction 3 will not be adversely affected.

The broad split allows time for the construction of new, modified and replacement structures that are required between junction 8/9 and junction 4b, in advance of the road works in this section. During construction of the bridges, there will only be isolated pockets of activity on the bridge sites, with construction traffic predominantly using the M4 for access and egress. This then enables the road works for junction 8/9 to junction 3 to be carried out in Years 3 and 4 of the programme.

The following sections provide an outline construction sequence. The dates given are based on the outline construction programme in Annex B of this EDR and show the dates from establishing TM to removing the TM. These dates are purely indicative as a Contractor has not been appointed to the Scheme and they do not include the mobilisation and demobilisation periods.

**Junction 12 to junction 11 (note - timings are indicative)**

Work in this section will be undertaken in four phases. The majority of the smart motorway infrastructure is installed in the verge during the first phase.

**Phase 1 Verge Works (January 2017 to July 2017)**

a) initial site establishment;

b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve providing sufficient space to construction the new works in the verge;

c) following TM installation, the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;

d) installation of new drainage infrastructure;

e) installation of new communications ducting and chambers;

f) gantry construction;

g) retaining wall construction;

h) construction of ERAs;

i) installation of any required replacement fencing / screening;

j) installation of new safety barriers;

k) installation of new communications cabling and equipment;
l) verge furniture and finishings; and
m) surfacing and lining works.

**Phase 2 Central Reserve Works (July 2017 to December 2017)**

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;
b) site clearance;
c) drainage;
d) installation of RCB;
e) installation of new lighting columns;
f) lighting commissioning; and
g) surfacing and lining works.

**Phase 3 Local Commissioning (January 2018 to March 2018)**

a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new technology equipment; and
c) partial removal of TM.

**Phase 4 Full Commissioning (June 2018 to September 2018)**

a) full commissioning of smart motorway system (in parallel with the works to junction 11 to junction 10 and junction 10 to junction 8/9); and
b) removal of remaining TM and full implementation of the Scheme from junction 12 to junction 8/9.

**Junction 11 to junction 10 (note - timings are indicative)**

8.3.12 Work in this section will be undertaken in three phases. The majority of the smart motorway infrastructure is installed in the verge during the first phase.

**Phase 1 Verge Works (January 2017 to December 2017)**

a) initial site establishment;
b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve providing sufficient space to construction the new works in the verge;
c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;
d) installation of new drainage infrastructure;
e) installation of new communications ducting and chambers;
f) gantry construction;
g) retaining wall construction;
h) construction of ERAs;
i) installation of any required replacement fencing / screening;
j) installation of new safety barriers;
k) installation of new communications cabling and equipment;
l) verge furniture and finishings; and
m) surfacing and lining works.

Phase 2 Central Reserve Works (December 2017 to June 2018)
a) traffic switch to move motorway traffic next to verge constructed in Phase 1;
b) site clearance;
c) drainage;
d) installation of RCB;
e) installation of new lighting columns;
f) lighting commissioning; and
g) surfacing and lining works.

Phase 3 Commissioning (June 2018 to September 2018)
a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new Technology Equipment;
c) full commissioning of smart motorway system (in parallel with the works to junction 12 to junction 11 and junction 10 to junction 8/9); and
d) removal of TM and full implementation of the scheme from junction 12 to junction 8/9.

Junction 10 to junction 8/9 (note - timings are indicative)

Work in this section will be undertaken in three phases. The majority of the smart motorway infrastructure is installed in the verge during the first phase.

Phase 1 Verge Works (March 2017 to November 2017)
a) initial site establishment;
b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve providing sufficient space to construction the new works in the verge;
c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;
d) installation of new drainage infrastructure;
e) installation of new communications ducting and chambers;
f) gantry construction;
g) retaining wall construction;
h) construction of ERAs;
i) installation of any required replacement fencing / screening;
j) installation of new safety barriers;
k) installation of new communications cabling and equipment;
l) verge furniture and finishings; and
m) surfacing and lining works.

Phase 2 Central Reserve Works (November 2017 to June 2018)

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;
b) site clearance;
c) drainage;
d) installation of RCB;
e) installation of new lighting columns;
f) lighting commissioning; and
g) surfacing and lining works.

Phase 3 Commissioning (June 2018 to September 2018)

a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new technology equipment;
c) full commissioning of smart motorway system (in parallel with the works to junction 12 to junction 11 and junction 11 to junction 10); and
d) removal of TM and full implementation of the scheme from junction 12 to junction 8/9.

Junction 8/9 to junction 7 (note - timings are indicative)

8.3.14 Work in this section will be undertaken in four phases. The initial phase involves works to allow the replacement / extension of the existing bridges where there is currently insufficient width to deliver a smart motorway ALR scheme.
Phase 1 Structures Works (January 2018 to May 2020)

a) Ascot Road overbridge:
   i. construction of new Ascot Road overbridge offline maintaining vehicular and pedestrian access across Ascot Road during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   ii. diversion of traffic and utilities over new structure;
   iii. demolition of original Ascot Road bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   iv. completion of new side road alignment over new structure.

b) Monkey Island overbridge:
   i. construction of new Monkey Island overbridge offline maintaining vehicular and pedestrian access across Ascot Road during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   ii. diversion of traffic and utilities over new structure;
   iii. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   iv. completion of new side road alignment over new structure.

c) Thames Bray underbridge:
   i. Thames Bray bridge will be widened asymmetrically to the north of the M4;
   ii. existing footpath to the north of Thames Bray underbridge will be closed for the duration of the works; and
   iii. construction of extended bridge requiring preparation of abutment piling area, piling works, construction of substructure and then installation of new bridge beams, deck and approach embankments.
d) Marsh Lane overbridge:
   i. closure of Marsh Lane and diversion of services;
   ii. construction of new Marsh Lane overbridge online. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   iii. diversion of traffic and utilities over new structure;
   iv. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   v. completion of new side road alignment either side of new structure.

e) Lake End Road overbridge:
   i. construction of new Lake End Road overbridge offline maintaining vehicular and pedestrian access across Ascot Road during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   ii. diversion of traffic and utilities over new structure;
   iii. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   iv. completion of new side road alignment over new structure.

Phase 2 Verge Works (January 2020 to November 2020)

a) initial site establishment;

b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve provided sufficient space to construction the new works in the verge;

c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;

d) installation of new drainage infrastructure;

e) installation of new communications ducting and chambers;

f) gantry construction;
g) retaining walls;
h) construction of ERAs;
i) installation of any required replacement fencing / screening;
j) installation of new safety barriers;
k) installation of new communications cabling and equipment;
l) verge furniture and finishing; and
m) surfacing and lining works.

Phase 3 Central Reserve Works (November 2020 to June 2021)

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;
b) site clearance;
c) drainage;
d) installation of RCB;
e) installation of new lighting columns;
f) lighting commissioning; and
g) surfacing works.

Phase 4 Commissioning (June 2021 to September 2021)

a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new technology equipment; and
c) full commissioning of smart motorway system (in parallel with the works to junction 6 to junction 3).

Junction 7 to junction 6 (note - timings are indicative)

8.3.15 Work in this section will be undertaken in four phases. The initial phase involves works to allow the replacement / extension of the existing bridges where there is currently insufficient width to deliver a smart motorway ALR scheme.

Phase 1 Structures Works (January 2018 to March 2020)

a) Huntercombe Spur overbridge (junction 7):
   i. construction of new Huntercombe Spur overbridge off line maintaining vehicular during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   ii. diversion of traffic and utilities over new structure;
iii. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and

iv. completion of new side road alignment over new structure.

b) Oldway Lane overbridge:

i. closure of Oldway Lane and diversion of services;

ii. construction of new overbridge on line. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;

iii. diversion of traffic and utilities over new structure;

iv. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and

v. completion of new side road alignment either side of new structure.

c) Wood Lane overbridge:

i. construction of Wood Lane overbridge off line maintaining vehicular and pedestrian access across Ascot Road during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;

ii. diversion of traffic and utilities over new structure;

iii. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and

iv. completion of new side road alignment over new structure.

Phase 2 Verge Works (January 2020 to November 2020)

a) initial site establishment;

b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve provided sufficient space to construction the new works in the verge;
c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;

d) installation of new drainage infrastructure;

e) installation of new communications ducting and chambers;

f) gantry construction;

g) retaining walls;

h) construction of ERAs;

i) installation of any required replacement fencing / screening;

j) installation of new safety barriers;

k) installation of new communications cabling and equipment;

l) verge furniture and finishings; and

m) surfacing and lining works.

Phase 3 Central Reserve Works (November 2020 to June 2021)

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;

b) site clearance;

c) drainage;

d) installation of RCB;

e) installation of new lighting columns;

f) lighting commissioning; and

g) surfacing works.

Phase 4 Commissioning (June 2021 to September 2021)

a) traffic switch to move motorway onto permanent outside three lanes;

b) local commissioning of new Technology Equipment; and

c) full commissioning of smart motorway system (in parallel with the works to junction 8/9 to junction 7 and junction 6 to junction 3).

Junction 6 to junction 5 (note - timings are indicative)

8.3.16 Work in this section will be undertaken in four phases. The initial phase involves works to allow the replacement / extension of the existing bridges where there is currently insufficient width to deliver a smart motorway ALR scheme.
Phase 1 Structures Works (June 2018 to July 2020)

a) Windsor Branch Railway underbridge:
   i. Windsor Branch Railway underbridge will be widened asymmetrically to the south of the M4; and
   ii. construction of extended bridge requiring preparation of abutment piling area, piling works, construction of substructure and then installation of new bridge beams, deck and approach embankments.

b) Datchet Road overbridge:
   i. construction of new Datchet Road overbridge off line maintaining vehicular during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   ii. diversion of traffic and utilities over new structure;
   iii. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   iv. completion of new side road alignment over new structure.

c) Recreation Ground overbridge:
   i. closure of Recreation Ground bridge access and diversion of services;
   ii. construction of new overbridge on line. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   iii. diversion of traffic and utilities over new structure;
   iv. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   v. completion of new side road alignment either side of new structure.
d) Riding Court Road overbridge:
   i. construction of Riding Court Road overbridge off line maintaining vehicular and pedestrian access during the construction period. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   ii. diversion of traffic and utilities over new structure;
   iii. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and
   iv. completion of new side road alignment over new structure.

**Phase 2 Verge Works (January 2020 to November 2020)**

a) initial site establishment;

b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve provided sufficient space to construction the new works in the verge;

c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;

d) installation of new drainage infrastructure;

e) installation of new communications ducting and chambers;

f) gantry construction;

h) construction of ERAs;

i) installation of any required replacement fencing/screening;

ej) installation of new safety barriers;

k) installation of new communications cabling and equipment;

l) verge furniture and finishings; and

m) surfacing and lining works.

**Phase 3 Central Reserve Works (November 2020 to June 2021)**

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;

b) site clearance;

c) drainage;
d) installation of RCB;

e) installation of new lighting columns;

f) lighting commissioning; and

g) surfacing works.

Phase 4 Commissioning (June 2021 to September 2021)

a) traffic switch to move motorway onto permanent outside three lanes;

b) local commissioning of new technology equipment; and

c) full commissioning of smart motorway system (in parallel with the works to junction 8/9 to junction 6 and junction 5 to junction 3).

Junction 5 to junction 4b (note - timings are indicative)

8.3.17 Work in this section will be undertaken in four phases. The initial phase involves works to allow the replacement / extension of the existing bridges where there is currently insufficient width to deliver a smart motorway ALR scheme.

Phase 1 Structures Works (June 2018 to July 2019)

a) Langley Interchange overbridges:
   
i. Langley Interchange underbridges will be widened symmetrically to the north and south of the M4; and

   ii. construction of extended bridge requiring preparation of abutment piling area, piling works, construction of substructure and then installation of new bridge beams, deck and approach embankments.

b) Langley Interchange Pedestrian subway:
   
i. Langley Interchange Pedestrian subway widened symmetrically to the north and south of the M4 with pedestrians diverted during the construction works.

c) Old Slade Lane overbridge:
   
i. closure of Old Slade Lane and diversion of services;
   
ii. construction of new overbridge on line. Works commence with abutment construction then continue with deck construction, diversion of services and surfacing work;
   
iii. diversion of traffic and utilities over new structure;
iv. demolition of original bridge structure. Whilst the proposed method of demolition will be decided following the appointment of the Contractor and specialist demolition subcontractor, the intention is that the bridge will be demolished using large 360 degree excavators with hydraulic concrete shears and breakers; and

v. completion of new access alignment either side of new structure.

**Phase 2 Verge Works (July 2019 to July 2020)**

a) initial site establishment;

b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve provided sufficient space to construction the new works in the verge;

c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;

d) installation of new drainage infrastructure;

e) installation of new communications ducting and chambers;

f) gantry construction;

g) retaining walls;

h) construction of ERAs;

i) installation of any required replacement fencing / screening;

j) installation of new safety barriers;

k) installation of new communications cabling and equipment;

l) verge Furniture and finishings; and

m) new Road Surfacing and lining works.

**Phase 3 Central Reserve Works (July 2020 to June 2021)**

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;

b) site clearance;

c) drainage;

d) installation of RCB;

e) installation of new lighting columns;

f) lighting commissioning; and

g) surfacing works.
Phase 4 Commissioning (June 2021 to September 2021)

a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new technology equipment; and
c) full commissioning of smart motorway system (in parallel with the works to junction 6 to junction 3).

Junction 4b to junction 4 (note - timings are indicative)

8.3.18 Work in this section will be undertaken in three phases.

Phase 1 Verge Works (July 2019 to July 2020)

a) initial site establishment;
b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve provided sufficient space to construction the new works in the verge;
c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;
d) installation of new drainage infrastructure;
e) installation of new communications ducting and chambers;
f) gantry construction;
g) retaining walls;
h) construction of ERAs;
i) installation of any required replacement fencing / screening;
j) installation of new safety barriers;
k) installation of new communications cabling and equipment;
l) verge furniture and finishings; and
m) surfacing and lining works.

Phase 2 Central Reserve Works (July 2020 to June 2021)

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;
b) site clearance;
c) drainage;
d) installation of RCB;
e) installation of new lighting columns;
f) lighting commissioning; and
g) surfacing works.

**Phase 3 Commissioning (June 2021 to September 2021)**

a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new technology equipment; and
c) full commissioning of smart motorway system (in parallel with the works to junction 8/9 to junction 4b and junction 4 to junction 3).

**Junction 4 to junction 3 (note - timings are indicative)**

8.3.19 Work in this section will be undertaken in three phases.

**Phase 1 Verge Works (July 2019 to July 2020)**

a) initial site establishment;
b) install TM. During this phase the traffic will be moved over to three narrow lanes positioned next to the central reserve provided sufficient space to construction the new works in the verge;
c) following TM installation the site will be cleared of vegetation and existing infrastructure in the verge not required to be retained by the Scheme;
d) installation of new drainage infrastructure;
e) installation of new communications ducting and chambers;
f) gantry construction;
g) retaining walls;
h) construction of ERAs;
i) installation of any required replacement fencing/screening;
j) installation of new safety barriers;
k) installation of new communications cabling and equipment;
l) verge furniture and finishings; and
m) surfacing and lining works.

**Phase 2 Central Reserve Works (July 2020 to June 2021)**

a) traffic switch to move motorway traffic next to verge constructed in Phase 1;
b) site clearance;
c) drainage;
d) installation of RCB;
e) installation of new lighting columns;
f) lighting commissioning; and
g) surfacing works.

Phase 3 Commissioning (June 2021 to September 2021)

a) traffic switch to move motorway onto permanent outside three lanes;
b) local commissioning of new technology equipment; and
c) full commissioning of smart motorway system (in parallel with the works to junction 8/9 to junction 4).
9 OPERATION OF THE SCHEME

9.1 Why and when do the variable speed limits apply?

9.1.1 Approximately 130,000 vehicles use junctions 3 to 12 of the M4 on a daily basis. The motorway currently experiences significant congestion during peak times, which causes significant delay. The introduction of VMSL will improve journey time reliability and safety, and reduce congestion.

9.1.2 When the traffic flows on the links increase to a level likely to cause congestion, the VMSL will be implemented.

9.2 How do the variable speed limits work?

9.2.1 During normal motorway operation, the AMI and VMS will remain blank in respect of speed limits and the motorway will operate as shown in Figure 42. When no speed limits are displayed, the national speed limit will apply.

Figure 42: Blank signals in normal traffic conditions

9.2.2 When VMSL are operational, clear instructions will be given to drivers via speed limit signs. These will be displayed on post mounted AMI signals (where provided), via speed limit signs displayed on the AMI signals above the main carriageway and on the verge mounted variable message signs. This is illustrated in Figure 43. The speed limit displayed will take account of prevailing traffic conditions and will be automatically calculated through a radar detection system or alternatively set by the RCC at South Mimms. The VMS located on gantries or on the verge will provide further information to drivers.
9.3 How will speed enforcement work?

9.3.1 Enforcement of VMSL will be carried out using a combination of gantry-mounted and verge mounted speed enforcement equipment, and traditional enforcement by the Police. The speed limits can vary due to traffic conditions, and the cameras are activated when they detect a vehicle travelling in excess of the speed limit.

9.4 What happens in the event of an accident or breakdown?

9.4.1 During incident management the AMI and VMS will be set to protect the scene of an incident and assist the access of emergency services and other core responders such as the Traffic Officer Service.

9.4.2 On the AMI, speed limits and lane availability will be indicated through the use of VMSL and lane divert arrow signals (with flashing amber lanterns) and Red ‘X’ signals (with flashing red lanterns) as shown in Figure 44.

9.4.3 Appropriate supporting information will be displayed on the VMS to further encourage compliant driver behaviour. Modifications to the signal control software will enable a single VMS 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 in Figure 45.
Evidence from the M42 pilot scheme demonstrates that using the hard shoulder as a running lane has not compromised safety. It is expected that the frequency of breakdowns in live lanes will be substantially less (The M42 pilot found breakdowns approximately halved (Ref 18)) than the existing frequency of breakdowns on the hard shoulder, as a significant proportion of breakdowns will be able to get to an ERA.

However, some broken down vehicles will not be capable of travelling to an ERA and will come to a stop in a live running lane. The extra controls provided through smart motorway features will mitigate this risk, by being able to detect vehicles through the queue protection system, use of full CCTV coverage to find vehicles and the ability to set lane closures to protect vehicles.

What is Ramp Metering and how does it work?

Ramp Metering ("RM") is a form of traffic control that utilises traffic signals on the motorway merges to restrict the flow of vehicles entering the motorway to a prescribed rate, so as to reduce congestion and turbulence at merge points. There are six existing RM sites within the Scheme; these are located at:

a) M4 J5 westbound;
b) M4 J6 westbound;
c) M4 J6 eastbound;
d) M4 J7 eastbound;
e) M4 J8/9 eastbound; and
f) M4 J12 eastbound.

All of the existing RM sites (with the exception of junction 12 eastbound) currently pass the operational criteria and they will be retained. Junction 12 eastbound is at the end of the Scheme and operates with a lane gain. This RM site will be further reviewed during Detailed Design before a decision is made whether to retain or remove the system.
10 SAFETY

10.1 Approach to safety for smart motorways

10.1.1 The Agency’s road network currently has high performance in terms of safety and it is an objective of this Scheme to maintain that high standard. During the pre-application phase, the Scheme design has been the subject of a Road Safety Audit and an assessment of operational safety.

10.2 Road safety audit

10.2.1 A Stage 1 Road Safety Audit, in accordance with the DMRB (Ref 17), was carried out on the Preliminary Design and the resultant report is included as Annex D.

10.2.2 The Alliance’s response to the Road Safety Audit is included as Annex E.

10.3 Operational safety

10.3.1 Due to the inherent nature of smart motorways, the Agency has developed bespoke procedures for dealing with incidents and undertaking operational and maintenance activities where there is no hard shoulder. This is supplemented by a media campaign to educate drivers (Ref 19).

10.3.2 Incident management for the Scheme is outlined above at 9.4.

Hazard log

10.3.3 When initially assessing the feasibility of ALR prior to the implementation of any scheme it was not possible to rely on past accident statistics. Instead the Agency performed a risk assessment to determine the expected safety performance. This used hazard analysis to take account of road users and road workers and is a proven technique used in many industries such as nuclear, oil and gas, automotive, railways, aviation and defence. The outcome of this work was a generic hazard log which is reviewed for each individual scheme.

10.3.4 A hazard log is a database that contains a list of operational hazards, the associated risk from each hazard, and mitigations to reduce the risk to an acceptable level. The Agency’s generic hazard log contains 135 hazards that specifically relate to smart motorways. Each hazard is assessed to understand how often it occurs, how likely it will be to lead to an accident, how severe a typical accident is likely to be and how the risk can be managed. A hazard log approach was first used for the M42 pilot scheme that introduced the successful use of the hard shoulder as a running lane in the UK.
10.3.5 The 20 highest scoring hazards account for around 90% of the total risk and include: driver fatigue, driving too fast, rapid change of general vehicle speed, tailgating, vehicle stopping in a running lane, pedestrians in running lanes and vehicle recovered from refuge area. After analysis, the top nine scoring hazards were (in descending order of magnitude):

a) driver fatigued – unable to perceive hazards effectively;
b) individual vehicle is driven too fast;
c) vehicle stops in running lane – off-peak;
d) pedestrian in running lane – live traffic;
e) tailgating;
f) vehicle stops in running lane – peak;
g) rapid change of general vehicle speed;
h) maintenance workers setting up and taking down work site; and
i) vehicle recovered from ERA.

10.3.6 Some of the hazards can be mitigated, and the design and use of technology to create a controlled environment where drivers comply with signs and speeds, allows the Agency to manage these risks to an acceptable level. For instance, the hazards of a vehicle being driven too fast or the occurrence of tailgating are mitigated through the use of VMSL and enforcement.

10.3.7 The Agency consider that drivers also have a major role to play in helping to reduce the risk of incidents on ALR schemes by:

a) leaving enough space between vehicles, and complying with all signs, especially speed limits and lane closure signs, e.g. Red X;
b) only stopping in an emergency if absolutely necessary and using motorway service areas, on-slips, off-slips or ERAs whenever possible; and

c) preparing the vehicle and themselves prior to undertaking a journey e.g. having enough fuel, regularly serviced vehicle, etc.

10.3.8 The hazard log developed for the M42 has been updated for the Scheme to reflect the different operation of ALR and the hazard log report is included in Annex F. The hazard log shows that for most of the highest scoring hazards of the Scheme, the risk score for the baseline and the change in risk for the implementation of the smart motorway is the same as that in the generic ALR hazard log. However there are four hazards where the risk score for the Scheme differs from the generic risk score.
a) for H37 ‘Individual vehicle is driven too fast’ the risk reduction for the Scheme is slightly greater than for a generic ALR scheme because of higher peak traffic volume when the benefit of mandatory speed limits and the provision of a controlled motorway are greatest;

b) for H138 ‘Driver fatigued - unable to perceive hazards effectively’ the ‘before’ score is slightly lower than the generic score due to the presence of a MSA between junction 11 and junction 12, which should help decrease driver fatigue;

c) for H135 ‘Vehicle stops in running lane - off peak’ the risk score for the Scheme is lower than the score in the generic ALR hazard log as a result of lower off peak traffic flows; and

d) for H52 ‘Maintenance workers setting up and taking down work site’ the risk score is also slightly lower. The hazard score is from applying the Agency’s road worker safety assessment tool, which shows that with mitigation such as RCB and remote control TM signing the risk from this hazard remains broadly unchanged from the level before implementation of the smart motorway.

10.3.9 The risk score for the Scheme is slightly higher for H149 ‘Vehicle drifts off carriageway (i.e. leaving the carriageway as a result of road environment)’. The increase in risk for this hazard (compared to ‘no change’ in the generic ALR case) was endorsed at the 12 September 2013 Project Safety Control Review Group (“PSCRG”). PSCRG proposed that the same change to the risk score should be considered for the generic ALR hazard log. As the current design for the M4 junction 5 to junction 4b link is for four lanes plus a hard shoulder, the increase in risk for this hazard could be slightly lower than the revised generic score.

10.3.10 The change score for H11 ‘Driver ignores closed lane(s) signals that are protecting an incident’ has been changed from a ‘-0.2’ to a ‘0’ since the publication of the SGAR2 (previous Options phase of the scheme development) version of this hazard log report in line with changes to the generic ALR hazard log. The change in score reflects results from monitoring of the M25 ALR sections, which show that, at times, significant number of drivers ignore Red X lane closure signals. The score change was endorsed by the PSCRG on 11 December 2014.

10.3.11 The risk reduction for H154 ‘Vehicle stopped on hard shoulder (D3M) or verge (ALR)’ is lower for the proposed Scheme compared to the generic ALR hazard log as a hard shoulder is retained through junctions 3, 4b, 10, 12, whereas the generic design assumes the provision of TJR throughout.
10.3.12 Hazard H62 ‘On road resources work unprotected’ (S06) has been eliminated from the hazard log. On road resources always work under protection from either the Traffic Officer Vehicle (“TOV”) or Emergency Traffic Management (“ETM”). This applies to both the current motorway and after ALR implementation. It is noted that the Agency was recently issued with a Crown Censure – the equivalent of a criminal prosecution – for safety failings after the fatality of a Traffic Officer who was struck by a vehicle on the M25. The Health and Safety Executive (“HSE”), which investigated, took the decision to deliver a Censure after identifying failures in the Agency’s quarterly supervision checks at the Dartford outstation. This has been taken into account within the hazard log but it is noted that this incident was due to correct safety procedures not being followed.

10.3.13 Hazard H95 ‘TO/maintainer in running lane’ covers situations where a traffic officer (“TO”) or maintainer crosses one or several running lanes (e.g. to retrieve debris), which historically would have involved using the hard shoulder as a starting point. The generic ‘before’ risk score for this hazard was originally assessed as an E8.0. Since the original assessment, operational practices have changed and rolling road blocks are now used more regularly, rather than starting from stopping on the hard shoulder. Therefore, the generic ALR ‘before’ risk score for H95 has been reduced from an E8.0 to an E6.5 whilst the ‘before’ risk score for H34 ‘Incident management - rolling block’ has increased from E5.0 to E6.0.

10.3.14 For H95 the generic hazard log assumes that with the introduction of ALR no areas of hard shoulder remain from which to start work. The risk from H95 has therefore been eliminated from the generic hazard log. However, the proposed Scheme will retain some areas of hard shoulder through junctions 3, 4b, 10 and 12. Therefore, the risk from this hazard, although significantly reduced, is not completely eliminated and a residual risk remains, which is reflected by the risk reduction score of ‘-1.5’ and the ‘after’ score of E5.0.

**Incident management**

10.3.15 Approximately half of vehicles that breakdown on a motorway will be capable of reaching an ERA. Drivers are then required to contact the RCC for assistance using the emergency telephone.

10.3.16 During incident management the advanced motorway indicators and variable message signs will be set to protect the scene of an incident and assist the access of emergency services, core responders and the Traffic Officer Service. On the advanced motorway indicators, speed limits and lane availability will be indicated through the use of VMSL and lane divert arrow signals (with flashing amber lanterns) and Red ‘X’ signals (with flashing red lanterns) as shown in Figure 46.
Appropriate supporting information will be displayed on the VMS 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 shown in Figure 45.

Evidence from the M42 pilot (Ref 18) demonstrates that using the hard shoulder as a running lane has not compromised safety. It is expected that the frequency of stoppages in live lanes will be substantially less (approximately half) than the existing frequency of stoppages on the hard shoulder, as a significant proportion of breakdowns will be able to get to a refuge area.

However some broken down vehicles will not be capable of ‘limping’ to a refuge area and will come to a stop in a live running lane. The extra controls provided through smart motorway features will mitigate this risk, by being able to detect vehicles through the queue protection system, use of full CCTV coverage to find vehicles and the ability to set lane closures to protect vehicles.

**Maintenance**

As part of the development of the Scheme, the Agency has prepared a Maintenance and Repair Strategy Statement (“MRSS”) which provides a strategy and guidance for the post implementation maintenance and repair of the Scheme.

The MRSS was prepared for preliminary design and will be developed further as the Scheme progresses to detailed design and subsequently construction. To develop this strategy, consultation has and will continue to take place with relevant organisations to assure appropriate standards are met to comply with the Construction (Design and Management) Regulations 2007 (Ref 20). The Maintenance Service Providers (“MSPs”) have been appraised of the operational concept and design as it has developed and have helped shape the final design solution.
10.3.22 There are two fundamental maintenance considerations that result from the implementation of smart motorways, namely:

a) the impact on existing maintenance access and maintenance operations resulting from removal of the hard shoulder; and

b) the impact of the increased technology equipment and associated infrastructure that is required to operate a smart motorway.

10.3.23 The removal of the hard shoulder presents the greatest challenge (noted within IAN 161/13’s supporting document - the Demonstration of Meeting the Safety Objective report), as it changes the existing procedures used by MSPs to set out and take down TM. It also means that access to the verge will almost always require the closure of a live lane. This, in conjunction with the increased technology and its maintenance, could result in an increase in volume of relaxed (when traffic flows are low and weather is good) TTM works, unless carefully managed.

Traffic management strategy

10.3.24 The strategy for the deployment of TTM incorporates the use of permanently located remote control TTM signs in the verge and central reserve in conjunction with fixed taper locations. This will provide flexible advance TTM signing coverage for all relaxed works lane closures. To further support these signs, relevant lane closure information will be shown by the MS4s and AMIs during the setting up and taking down of the TTM work site.

Meeting the road worker (maintenance) safety objective

10.3.25 To meet the road worker safety objective of the Agency’s Policy ‘Aiming for Zero’ and critically the Health and Safety legislative requirements for road workers, the scheme will:

a) remove the need to implement TTM so far as is reasonably practicable;

b) consider off network access where feasible;

c) incorporate a design for safe TTM deployment (described in 10.3.24);

d) replace the existing steel barrier in the central reserve with RCB to reduce maintenance requirements;

e) use remote interrogation and resetting of MS4s and AMIs;

f) provide a maintenance environment that allows the MSP to use increased programme rationalisation of maintenance works; and

g) implement a mandatory 40mph speed limit while TTM is being established or removed.
10.3.26 The safety assessment work that has been undertaken suggests that if the proposed mitigation measures are implemented, the safety objective for maintenance workers is expected to be met. These proposed mitigation measures have been drafted on the basis of a worst case assessment, as it should be noted that actual data is unavailable on the benefits or risks associated with smart motorways, as no on-road trials have been conducted. Results from the monitoring of the first ALR schemes on the M25 will be reviewed in due course and any learning points incorporated into the Scheme design and MRSS.

**Project Safety Control Review Group**

10.3.27 The PSCRG comprises stakeholders from the Agency’s Designers, the Agency’s project team, the Agency’s internal stakeholders including: Customer Operations, Network Services Directorate and Network Delivery and Development Directorate; and the Agency’s MSPs for Areas 3 and 5. Meetings are held to discuss Scheme-specific issues which may impact on operational safety of the Scheme. This ensures that road safety is properly considered in accordance with the Agency’s procedures.
# REFERENCES

<table>
<thead>
<tr>
<th>Ref</th>
<th>Title</th>
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<tbody>
<tr>
<td>1</td>
<td>The Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009.</td>
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<tr>
<td>3</td>
<td>Infrastructure Planning (Environmental Impact Assessment) Regulations 2009</td>
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<tr>
<td>6</td>
<td>OECD Global Competitiveness Report 2011/12.</td>
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<td>7</td>
<td>Thames Valley Multi Modal Study (2003)</td>
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<td>8</td>
<td>London Orbital multi modal study</td>
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<td>9</td>
<td>London to South West and South Wales multi-modal study</td>
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<tr>
<td>11</td>
<td>Advanced Motorway Signalling and Traffic Management Feasibility Study</td>
</tr>
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<td>12</td>
<td>Roads – Delivering Choice and Reliability</td>
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<tr>
<td>13</td>
<td>Britain’s Transport Infrastructure Motorways and Major Trunk Roads</td>
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<td>14</td>
<td>National Infrastructure Plan (2014)</td>
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<td>15</td>
<td>Chancellor’s Autumn Statement (2014)</td>
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<td>16</td>
<td>Roads Investment Strategy (2014)</td>
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<td>17</td>
<td>Design Manual for Roads and Bridges</td>
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<td>18</td>
<td>M42 MM Monitoring and Evaluation: Three Year safety Review</td>
</tr>
<tr>
<td>20</td>
<td>The Construction (Design and Management) Regulations 2007</td>
</tr>
<tr>
<td>Terminology</td>
<td>Description</td>
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<td>--------------------------</td>
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<tr>
<td>Abutment</td>
<td>The sub-structure at the end of a bridge. Abutments provide vertical and lateral support for the super-structure.</td>
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<tr>
<td>ADS</td>
<td>Advance Direction Sign</td>
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<td>ALR</td>
<td>All Lane Running</td>
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<td>AMI</td>
<td>Advance Motorway Indicator</td>
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<td>AMSTMFS</td>
<td>Advanced Motorway Signalling and Traffic Management Feasibility Study</td>
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<tr>
<td>AONB</td>
<td>Area of Outstanding Natural Beauty</td>
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<tr>
<td>Bank seat abutment</td>
<td>Smaller than a full height abutment. It sits at the top of the approach embankment and results in a bridge with a more open aspect, but with a longer deck.</td>
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<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
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<td>CEMP</td>
<td>Construction Environmental Management Plan</td>
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<td>DCO</td>
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<td>ERA</td>
<td>Emergency Refuge Area</td>
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<td>ES</td>
<td>Environmental Statement</td>
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<tr>
<td>Full height abutment</td>
<td>An abutment that sits at the back of the under-road verge and acts as a retaining wall to hold back the earthworks fill material of the bridge approach embankments.</td>
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<tr>
<td>HGV</td>
<td>Heavy Goods Vehicle</td>
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<td>HIB</td>
<td>Highways Investment Board</td>
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<td>IAN</td>
<td>Interim Advice Note</td>
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<tr>
<td>IDM</td>
<td>Integrated Demand Management</td>
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<td>ITS</td>
<td>Intelligent Transport System</td>
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<td>Lane drop</td>
<td>From outside the Scheme, the left hand lane of the entry slip road becomes lane 1 of the motorway.</td>
</tr>
<tr>
<td>Lane gain</td>
<td>Lane 1 would diverges from the motorway into the exit slip road.</td>
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<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
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<td>MRSS</td>
<td>Maintenance and Repair Strategy Statement</td>
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<td>MS3</td>
<td>Message Sign Mark 3</td>
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<td>MS4</td>
<td>Message Sign Mark 4</td>
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<td>MSA</td>
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<td>MSP</td>
<td>Maintenance Service Provider</td>
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<td>NDD</td>
<td>Network Delivery and Development Directorate</td>
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<td>NN NPS</td>
<td>National Networks National Policy Statement</td>
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<td>NSIP</td>
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<td>NTM</td>
<td>National Transport Model</td>
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<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>ORBIT</td>
<td>London Orbital multi modal study</td>
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<td>Pier</td>
<td>An intermediate element of the sub-structure required on multi-span bridges. A pier usually consists of a column, a group of columns or a wall.</td>
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<tr>
<td>POP</td>
<td>Police Observation Platform</td>
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<td>PSCRG</td>
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<td>PTZ</td>
<td>Pan, Tilt and Zoom</td>
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<td>RCB</td>
<td>Rigid Concrete Barrier</td>
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<td>RCC</td>
<td>Regional Control Centre</td>
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<td>RSA</td>
<td>Road Safety Audit</td>
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<td>SRN</td>
<td>Strategic Road Network</td>
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<td>Description</td>
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<tr>
<td>SSSI</td>
<td>Site of Special Scientific Interest</td>
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<tr>
<td>Super structure</td>
<td>The deck and parapets of a bridge.</td>
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<tr>
<td>Sub structure</td>
<td>The columns and other supports on which the super-structure rests.</td>
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<tr>
<td>SWARMMS</td>
<td>London to South West and South Wales multi-modal study</td>
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<tr>
<td>TJR</td>
<td>Through Junction Running</td>
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<td>TM</td>
<td>Traffic Management (in the context of this report, this is the traffic management associated with the construction work for the Scheme)</td>
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<tr>
<td>TTM</td>
<td>Temporary Traffic Management (in the context of this report, this is the temporary traffic management associated with the future maintenance and operation of the motorway)</td>
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<td>TVMMS</td>
<td>Thames Valley Multi Modal Study</td>
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<td>VMS</td>
<td>Variable Message Sign</td>
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<td>VMSL</td>
<td>Variable Mandatory Speed Limit</td>
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<td>VPD</td>
<td>Vehicles per day</td>
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</tbody>
</table>
Annex A: Vegetation Clearance and Environmental Masterplan
Annex B: Outline construction programme
Annex C: Road Safety Audit
Annex D: Designer’s response to RSA
Annex E: Hazard Log
Annex F: General Arrangement Drawings