High Speed Two Phase 2a: West Midlands to Crewe

Working Draft Environmental Impact Assessment Report

Volume 1: Introduction and methodology

September 2016

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Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

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A report prepared for High Speed Two (HS2) Limited:

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Foreword

Background

High Speed Two (HS2) is a new high speed railway proposed by the Government to connect major cities in Britain. Stations in London, Birmingham, Leeds, Manchester, East Midlands and South Yorkshire will be served by high speed trains running at speeds of up to 360kph (225mph).

HS2 will be built in phases. Phase One comprises the first section of the HS2 network of approximately 230km (143 miles) between London and Birmingham and the West Midlands that will become operational in 2026. It was the subject of an Environmental Statement (ES) deposited with the High Speed Two (London – West Midlands) Bill in 2013 and ES deposited with Additional Provisions to that Bill in 2014 and 2015. The Bill is currently proceeding through Parliament with the aim of achieving Royal Assent by the end of 2016 and commencing construction in 2017.

Phase Two of HS2 would extend the line to the north-west and north-east, to Manchester with connections to the West Coast Main Line (WCML) at Crewe and Golborne, and to Leeds with a connection to the East Coast Main Line approaching York, completing what is known as the 'Y network'.

Phase 2a (the Proposed Scheme), the subject of this working draft Environmental Impact Assessment (EIA) Report[1], comprises the first approximately 60 kilometres (37 miles) of the western leg of Phase Two from the West Midlands to Crewe. It would connect with Phase One at Fradley, to the north-east of Lichfield, and connect to the WCML south of Crewe, to provide onward services beyond the HS2 network, to the north-west of England and to Scotland.

The delivery of this section of the route has been brought forward by six years to open in 2027, one year after the opening of Phase One, as set out in the Command paper High Speed Two: East and West, The next steps to Crewe and beyond (November 2015)[2]. This will deliver faster journeys from London to Crewe, Manchester, Liverpool, Preston, Warrington, Wigan and Glasgow more quickly. Accelerating delivery of the route to Crewe means that the North West and Scotland will see more of the benefits of HS2 more quickly, and this will bring economic benefits sooner.

Purpose of the working draft Environmental Impact Assessment Report

The purpose of the working draft EIA Report is to provide the public and other stakeholders with an opportunity to review and comment on preliminary environmental information for Phase 2a of HS2. Whilst there is no statutory requirement to provide such a working draft EIA Report, comments received at this stage will be considered during the ongoing process of assessment and design of the Proposed Scheme, and will be reflected in the formal EIA Report that will accompany the Bill for Phase 2a. The Bill is due to be deposited in Parliament by the end of 2017.

[1] Note that Parliament's Standing Order 27A makes reference to production of an environmental statement (ES). Under the EIA Directive 2014/52/EU, the output of the environmental assessment is an Environmental Impact Assessment (EIA) Report. This report uses the term EIA Report where referring to the output of the EIA. This 'working draft' EIA report provides an initial environmental assessment of the current stage of design.

[2] HS2 Ltd (2015), High Speed Two: East and West, The next steps to Crewe and beyond. November 2015. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480712/hs2-east-and-west.pdf

Public consultation will also be undertaken on the formal EIA Report during the passage of the Bill through Parliament.

Scope and methodology

The scope of the assessment and the methodology followed by each topic in the working draft EIA Report is set out in the draft EIA Scope and Methodology Report (SMR) for Phase 2a[3] (unless otherwise stated).

The draft SMR was subject to consultation from 8 March 2016 to 13 May 2016. It was amended in response to that consultation, and the final (post-consultation) SMR is being published alongside this working draft EIA Report (available on the website www.gov.uk/hs2). The assessment reported in the formal EIA Report will be based on the revised SMR.

Work in progress

The consultation on the working draft EIA Report is being carried out early in the development of the Phase 2a proposals. This is to assist the early engagement with those potentially affected by the Proposed Scheme and to help inform the design of the Proposed Scheme and assessment.

The approach adopted for this working draft EIA Report is to identify:

- the current environmental baseline (i.e. the environment as it is at the moment);
- the impacts of the Proposed Scheme (and where possible, the significant environmental effects); and
- the proposed means of avoiding, reducing or managing the likely significant adverse effects.

The understanding of the current environmental baseline for the working draft EIA Report is based on literature reviews, consultation with relevant bodies, and measurement, monitoring and surveys of environmental parameters in the field where timely access has been permitted. Computer modelling is required for a number of environmental topics (such as noise, traffic and air quality) to determine impacts and effects. As this is a working draft EIA Report, each of these activities is ongoing and will inform the assessment reported in the formal EIA Report.

Professional judgement and reasonable worst case assumptions have been used, where appropriate, to provide an indication of likely impacts to inform consultation and engagement on the Proposed Scheme. The approach to this is described as appropriate in the relevant environmental topic sections. The working draft EIA Report also identifies where it is currently expected that further fieldwork (subject to access to the land being granted) or modelling will be undertaken.

[3] Arup/ERM (2016) HS2 Phase Two: West Midlands to Crewe EIA Scope and Methodology Report – draft for consultation, March 2016. Available on-line at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506111/HS2_Phase_2a_EIA_Scope_and_Methodology_Report_Final_for_Comms_08-03-2016_WEB_1400.pdf.

Development of the design and mitigation

The public consultation on the working draft EIA Report may raise issues that result in changes being made to the design, construction arrangements or mitigation currently proposed, which in turn may alter the outcome of the assessment of environmental impacts reported in the working draft EIA Report.

The design of the Proposed Scheme will also continue to develop in advance of deposit of the Bill. Assumptions about how the Proposed Scheme would be built and operated may also be refined. Reasonable and practicable measures will be identified to address the significant effects of the Proposed Scheme and incorporated into the design. Such changes and their effect on the outcome of the environmental assessment will be reflected in the formal EIA Report. The formal EIA Report will also include further and/or fuller details on the following:

- future baseline conditions (i.e. the prediction of future environmental conditions without the Proposed Scheme);
- the reasonable alternatives that have been studied;
- technical details and supporting data for each topic;
- in-combination effects on community resources and local residents;
- likely significant environmental effects of the Proposed Scheme when acting cumulatively with other projects, with Phase One and, where appropriate, with Phase 2b; and likely significant environmental effects on the wider transport network due to road vehicle, train and passenger movements associated with the Proposed Scheme.

Structure of the working draft Environmental Impact Assessment Report

This document is part of the working draft EIA Report for Phase 2a of the proposed HS2 rail network between the West Midlands and Crewe. The working draft EIA Report sets out the current design of the Proposed Scheme, the likely environmental impacts (and, where possible, the likely significant environmental effects) of the construction and operation of the Proposed Scheme and proposed mitigation measures. The assessment will be updated for the formal EIA Report to reflect further work on the design and assessment between now and when the hybrid Bill is deposited.

The working draft EIA Report comprises the following documents:

Non-technical summary

This provides a summary in non-technical language of:

- the Proposed Scheme and reasonable alternatives considered;
- the impacts of the Proposed Scheme (and where possible, the likely significant environmental effects), both beneficial and adverse; and
- the proposed means of avoiding, reducing or managing the likely significant adverse effects.

Volume 1: Introduction and methodology

This provides:

- a description of HS2, the EIA process and the approach to consultation and engagement;
- details of the permanent features of the Proposed Scheme and generic construction techniques, based on the current level of design;
- a summary of the scope and methodology for the environmental topics; and
- a summary of the strategic, route-wide and route corridor alternatives to the scheme and local alternatives considered prior to November 2015.

Volume 1 also comprises a glossary of terms and list of abbreviations and two appendices which are listed below.

Volume 2: Community area reports and map books

These cover the following community areas: 1 Fradley to Colton; 2 Colwich to Yarlet; 3 Stone and Swynnerton; 4 Whitmore Heath to Madeley; and 5 South Cheshire. The reports provide the following for each area:

- an overview of the area;
- a description of the construction and operation of the Proposed Scheme within the area, based on the current level of design;

- a summary of local alternatives considered since November 2015;
- a description of the environmental baseline;
- a description of the environmental impacts of the Proposed Scheme (and, where possible, the likely significant environmental effects), both beneficial and adverse; and
- the proposed means of avoiding, reducing or managing the likely significant adverse effects.

The maps relevant to each community area are provided in separate Volume 2 map books. These maps include the location of the key environmental features (Map Series CT-10), key construction features (Map Series CT-05) and operation features (Map Series CT-06) of the Proposed Scheme. There are also specific maps showing proposed viewpoint and photomontage locations (Map Series LV, to be read in conjunction with Section 11, Landscape and visual), noise contour maps (Map Series SV, to be read in conjunction with Section 13, Sound, noise and vibration) and maps showing key features (Map Series WR, to be read in conjunction with Section 15, Water resources and flood risk).

Volume 3: Route-wide effects

This describes the impacts and effects that are likely to occur at a geographical scale greater than the community areas described in Volume 2.

Glossary of terms and list of abbreviations

This contains terms and abbreviations, including units of measurement, used throughout the working draft EIA Report.

Appendix: Alternatives report

This describes the evolution of the Proposed Scheme and the reasonable alternatives considered.

Appendix: Draft Code of Construction Practice (CoCP)

This sets out the measures and standards to provide effective planning, management and control of potential impacts on individuals, communities and the environment during construction.

Structure of this report

Volume 1, this report, comprises the following sections:

- Introduction: introduces the Proposed Scheme and its associated consent process, including the Bill and EIA;
- Background to HS2: explains the Government's case for HS2 and how the Proposed Scheme has evolved;
- Approach to consultation and engagement: describes the approach to consultation and engagement for the EIA Report and the process going forward;
- The Proposed Scheme: provides a summary of the Proposed Scheme's objectives, describes the route, the service pattern and other operational characteristics;
- Permanent features of the Proposed Scheme: describes the main features of the Proposed Scheme;
- Construction of the Proposed Scheme: describes the generic construction methods likely to be used;
- Environmental impact assessment: explains how the EIA has been carried out and the scope of the assessment;
- Scope and methodology: provides an outline of the approach adopted for each environmental topic;
- Mitigation: describes the proposed mitigation approach for each environmental topic;
- Strategic and route-wide alternatives: provides a summary of the various alternatives that have been considered at a strategic and route-wide level; and
- Local alternatives: explains what local alternatives have been considered prior to November 2015. Local alternatives considered after November 2015 are reported in the Volume 2, community area reports.

1 Introduction

1.1 Overview of High Speed Two

1.1.1 High Speed Two (HS2) is a new high speed railway proposed by the Government to connect major cities in Britain. Stations in London, Birmingham, Leeds, Manchester, East Midlands and South Yorkshire will be served by high speed trains running at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph))[4].

1.1.2 In January 2012, the Government announced its intention to develop a Y-shaped high speed rail network. The network will be brought forward in phases, with powers sought initially for a high speed line from London to West Midlands, called Phase One. The 2012 decision also confirmed the Government's preferred route for Phase One following a consultation exercise. In November 2013, HS2 Ltd deposited a Bill in Parliament to seek powers for the construction and operation of Phase One. The Bill is currently proceeding through Parliament with the aim of achieving Royal Assent by the end of 2016 and construction beginning in 2017.

1.1.3 In January 2013, the Government announced its initially preferred route for Phase Two between the West Midlands, Leeds and Manchester. Following some minor amendments in July 2013, the proposed route was subject to a seven-month public consultation until January 2014.

1.1.4 Sir David Higgins, in his reports in 2014 (HS2 Plus[5] and Rebalancing Britain[6]) recommended accelerating the West Midlands to Crewe section of the Phase Two route to deliver some of the benefits that HS2 will bring to the region sooner. In the November 2015 Command Paper, the Government, having considered a number of options for accelerating part of the route, announced its intention to bring forward the route to Crewe, and set out the preferred line of route for what is known as Phase 2a.

1.1.5 Accelerating delivery of the Phase 2a route will:

- provide faster journeys from London to Crewe, Manchester, Liverpool, Preston, Warrington, Wigan and Glasgow sooner – improving journey times by up to 13 minutes in addition to journey time savings already delivered by Phase One;
- mean that the North West and Scotland will see more of the benefits of HS2 more quickly, and this will bring economic benefits sooner;
- relieve pressure on bottlenecks on the existing WCML at Colwich Junction and around Stafford, which should improve the reliability and performance on the existing main line and it could also open up more capacity, including for freight; and

[4] Note that the alignment of the route has been designed to allow for train speeds of up to 400kph (248mph) in the future, should there be a commercial justification for doing so. Operation at up to 400kph will require demonstration that improved train design enables services to operate at that higher speed without giving rise to additional significant environmental effects.
[5] HS2 Ltd (2014), HS2 Plus – A report by David Higgins. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374695/HS2_Plus__A_report_by_David_Higgins.pdf
[6] HS2 Ltd (2014), Rebalancing Britain – From HS2 towards a national transport strategy. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374709/Rebalancing_Britain__From_HS2_towards_a_national_transport_strategy.pdf

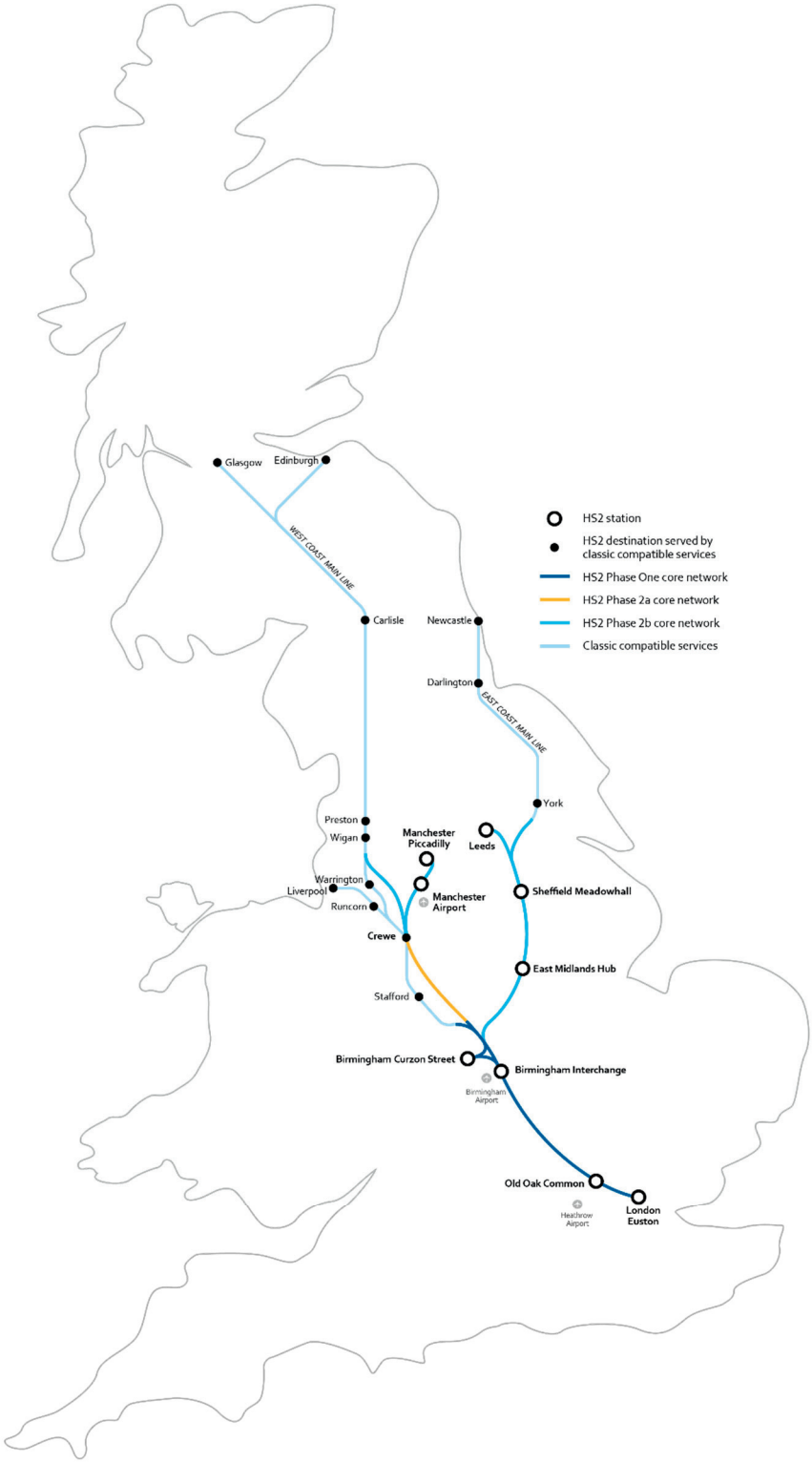
- allow passengers travelling to or from a wide range of places to connect onto HS2 services given that Crewe is already a major hub on the rail network with regional and long distance connections to the wider North West, East Midlands, and North and South Wales.

1.1.6 Phase 2a (the Proposed Scheme), the subject of this working draft EIA Report, comprises the first section of the western leg of Phase Two, from the West Midlands to Crewe (approximately 60km (37 miles) in length). It would connect with Phase One near Fradley, to the north-east of Lichfield, and connect to the West Coast Main Line (WCML) south of Crewe, to provide onward services beyond the HS2 network, to the north-west of England and to Scotland. The proposed HS2 route highlighting the route to Crewe is shown in Figure 1.

1.1.7 The powers for Phase 2a will be sought through a separate hybrid Bill, with the aim of achieving Royal Assent by the end of 2019. Construction would commence in 2020, ahead of the rest of Phase Two, and the section is anticipated to be operational in 2027, six years earlier than originally planned.

1.1.8 An announcement on the Phase Two route from Crewe to Manchester and from the West Midlands to Leeds, referred to as Phase 2b, is expected in Autumn 2016. Construction of Phase 2b would commence in approximately 2023, with operation planned to start around 2033.

Figure 1: The HS2 Core Network[7]



[7] On 7 July 2016, Sir David Higgins's report Sheffield and South Yorkshire Report 2016 was published and indicated that a different route through South and West Yorkshire should be considered, which would remove the previously proposed Meadowhall station. This is currently being considered by the Secretary of State.

1.2 Hybrid Bill procedure

1.2.1 The Government occasionally uses hybrid Bills to promote major infrastructure projects of national importance. They have been used most recently for Phase One of HS2[8] and for other rail schemes, such as the Channel Tunnel Rail Link Act 1996[9] (known as HS1) and the Crossrail Act 2008[10]. Use of primary legislation rather than promoting a development consent order under the Planning Act 2008[11] allows the Government to seek the full range of statutory powers and authorisations that a project of this size and complexity requires. This may include revisions to the rail regulatory regime and the planning regime, as well as provisions to enable the making of subsequent orders and regulations by way of statutory instrument.

1.2.2 A hybrid Bill is draft legislation that affects public and private interests, and the procedures followed in Parliament in considering such a Bill incorporate aspects of both public and private Bill procedures before it can be enacted.

1.2.3 Private Business Standing Orders of the Houses of Parliament require that the hybrid Bill, when submitted to Parliament, must be accompanied by a set of supporting documents. These documents include Plans and Sections of the Works, a Book of Reference detailing the land interests affected, an estimate of expense and an EIA Report[12] describing the likely significant effects of the Proposed Scheme on the environment.

1.2.4 Following First Reading of the hybrid Bill ('the Bill') and the deposit of supporting documents, the Standing Orders require a public consultation on the EIA Report. This formal consultation will be held over a period of at least 56 days (eight weeks) in accordance with Standing Order 224A. A summary of comments on the EIA Report will be provided by Parliament's independent assessor to inform the Second Reading of the Bill.

1.2.5 At Second Reading, the principles of the Bill are agreed, including the justification for a high speed railway, and a Select Committee is then set up[13].

1.2.6 This is followed by a petitioning period during which those specially and directly affected by the Bill can petition[14]. These petitions are then considered by the Select Committee, which may result in amendments to the Bill. A Public Bill Committee of Members of Parliament then reviews the Bill, and may make amendments to the public elements of the Bill, after which the Bill undergoes its Report and Third Reading stage in the House of Commons.

[8] *The High Speed Rail (London – West Midlands) Bill* as amended in the House of Commons Select Committee, March 2016. Available online at: http://www.publications.parliament.uk/pa/bills/cbill/2015-2016/0137/cbill_2015-20160137_en_1.htm
[9] *Channel Tunnel Rail Link Act 1996*. Her Majesty's Stationery Office, London.
[10] *Crossrail Act 2008*. Her Majesty's Stationery Office, London.
[11] *Planning Act 2008*. Her Majesty's Stationery Office, London.
[12] Note that Parliament's Standing Order 27A makes reference to production of an environmental statement (ES). Under the EIA Directive 2014/52/EU, the output of the environmental assessment is an Environmental Impact Assessment (EIA) Report. This report uses the term EIA Report where referring to the output of the EIA.
[13] In the House of Commons, Select Committee members are Members of Parliament who have no constituency interest in the Bill.
[14] The petitioning period will be determined during the Second Reading.

1.2.7 The Bill then transfers to the House of Lords, where a similar process is followed. The Bill returns to the Commons for consideration of any amendments made in the Lords, after which it can then receive Royal Assent, becoming an Act of Parliament[15].

1.2.8 The Act of Parliament will grant deemed planning permission for the proposed works and provide powers to:

- build, operate and maintain the railway and associated works;
- compulsorily acquire interests in the land required;
- interfere with rights of way, including the realignment of highways and waterways (permanently or temporarily);
- modify infrastructure belonging to statutory undertakers (e.g. utility companies);
- carry out works to listed buildings and buildings in conservation areas; and
- carry out protective works to buildings and third party infrastructure.

1.2.9 The Parliamentary Plans and Sections accompanying the Bill will show, amongst other things, the land required, both permanently and temporarily, the 'limits of deviation' and 'limits of land to be acquired or used'[16] for the construction of the Proposed Scheme, as described in section 1.3.

1.3 The need for EIA and the role of an EIA Report

1.3.1 Under the Standing Orders of Parliament, an EIA Report (previously known as an Environmental Statement) must be deposited at the same time as the Bill is introduced. The EIA must fulfil the requirements of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (SI 2011/1824) (the 'EIA Regulations') which reflect European Union (EU) Directive requirements for assessment of the effects of certain public and private projects on the environment[17].

1.3.2 A new EIA Directive 2014/52/EU[18] entered into force in May 2014, with the requirement that Member States transpose this into national legislation by 16 May 2017. The UK Government had not confirmed a date for the issue of new regulations for implementation of this new Directive during preparation of this working draft EIA Report.

1.3.3 On 23 June 2016, the UK voted to leave the EU. The Department for Exiting the European Union will now lead work across Government on the process that will make that happen and to consider what it will mean for the UK. In due course the Government will need to take initial decisions on how to proceed with the UK's withdrawal from the EU and on the negotiation for the UK's future relationship with

[15] Parliamentary procedure is determined by Parliament and so is liable to change.
[16] The Parliamentary plans and sections will show the centreline of works, the Limits of Deviation (LOD) and the Limits of Land to be Acquired or Used (LLAU). The LOD are used to show the limits of the works in the Bill. These limits will show the extent of the proposed works based on the design developed to the stage necessary for the preparation of the Bill. The LOD provide allowances for contingencies, working spaces and similar factors.
[17] Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
[18] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014

the EU. Until exit negotiations are concluded, the UK remains a full member of the EU and all the rights and obligations of EU membership apply. In any case, environmental assessment has been and will continue to be integral to the development of the Proposed Scheme.

1.3.4 HS2 Ltd has therefore adopted the principles of the new EIA Directive for Phase 2a in advance of new UK regulations and guidance, liaising with the Department for Transport (DfT) and the Department for Communities and Local Government (DCLG) on the implications for the EIA of Phase 2a, where possible.

1.3.5 Phase 2a will be subject to authorisation through the hybrid Bill process. The objectives of EIA will, therefore, be pursued through the Parliamentary process. This working draft EIA Report has been prepared in accordance with the requirements of Standing Order 27A as well as any additional requirements of the new EIA Directive 2014/52/EU (with any differing or revised requirements of the new EIA Directive superseding those in Part II Schedule 4). It has been based on the information available and the assessment undertaken to date.

1.3.6 Standing Order 27A states that the environmental statement (i.e. the formal EIA Report) should include:

- information set out in Part II of Schedule 4 of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, since revoked and replaced by the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (the EIA Regulations)[19]; and
- as much of the information in Part I of Schedule 4 of the EIA Regulations as is reasonably required to assess the environmental effect of the works.

1.3.7 The information required under Part II of Schedule 4 comprises (in summary):

- a description of the development including information on its site, design and size;
- a description of the measures envisaged to avoid, reduce, and if possible, remedy significant adverse effects;
- the data required to identify and assess the main effects that the development is likely to have on the environment;
- an outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for the choice made, taking into account the environmental effects; and
- a non-technical summary of the information.

1.3.8 The 2014 Directive recognises that environmental issues, such as resource efficiency, sustainability, biodiversity protection and the risks of major accidents and natural disasters should be included in assessment and decision making processes.

[19] *Town and Country Planning (Environmental Impact Assessment) Regulations 2011* (SI 2011 No. 1824). Her Majesty's Stationery Office, London.

1.3.9 There are a number of changes in the 2014 Directive. These include:

- the sustainable use of soil and the need to address the 'land take' of projects (the term 'Land' is introduced in Article 3 of the Directive, which lists the factors to be addressed by environmental impact assessment);
- the need to address the significant effects of projects on biodiversity, to avoid or minimise such effects (Article 3 refers to 'Biodiversity with particular reference to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC');
- a revised requirement to assess the impacts of projects on climate (for example, greenhouse gas emissions) and the vulnerability of projects to climate change;
- the need to consider the vulnerability of major infrastructure projects to major accidents and/or natural disasters and consequential significant adverse effects on the environment;
- in relation to historical and cultural heritage and landscape – the need to address the visual impacts of projects, in relation to the built or natural landscape and urban areas;
- a specific reference to assessment of human health is introduced (Article 3 uses the terms 'Population and human health' instead of 'human beings' in the 2011 Directive);
- developers are required to provide a description of the 'reasonable alternatives' studied of relevance to the project (for example in terms of project design, technology, location, size and scale) and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects; previously the 2011 Directive referred to the 'main alternatives'; and
- provision for post-EIA monitoring of significant adverse effects on the environment in appropriate cases.

1.3.10 The Parliamentary Plans that will accompany the Bill will show the vertical and horizontal alignment of the Proposed Scheme and the scheduled works required to construct it. The powers that will be acquired through the Bill process include 'limits of deviation' from the alignments shown on the Parliamentary Plans. These limits allow those who are appointed to implement the powers (known as the nominated undertaker) to deviate when constructing or maintaining the Proposed Scheme, in the following directions:

- laterally to any extent within the limits of deviation for that work, as identified on the Parliamentary Plans;
- vertically downwards to any extent from the level shown on the sections included in the Parliamentary Plans; and
- vertically upwards to any extent not exceeding three metres from the level shown for that work on the sections, except for stations, depots or ventilation (intervention) shafts.

1.3.11 The formal EIA Report will include a description of any differences to the likely significant effects that will arise and any further mitigation that will be provided were the Proposed Scheme to be built along a different alignment within these limits. Changes that are considered unlikely or impossible will not be assessed.

1.3.12 Detailed technical appendices supporting the assessment will be published as part of, or alongside, the formal EIA Report.

1.4 Meeting environmental commitments after consent

1.4.1 The Secretary of State is expected to establish a set of controls known as Environmental Minimum Requirements (EMRs). The EMRs will be contained in a suite of documents that will sit alongside the provisions set out in the Bill itself. The nominated undertaker will be required to comply with the EMRs and other controls contained within the Bill and other existing legislation.

1.4.2 During the passage of the Bill, the Secretary of State will confirm to Parliament the scope of, and the documents forming, the EMRs; and will make a commitment to Parliament to take whatever steps he/she considers reasonable and necessary to secure compliance with them.

1.4.3 The EMRs, together with the controls in the Bill, will ensure that the impacts assessed in the formal EIA Report will not be exceeded, unless this results from a change in circumstances that was not foreseeable at the time the formal EIA Report was prepared; or any such changes will be unlikely to have significant adverse environmental effects; or will be subject to a separate consent process and further EIA.

1.4.4 The EMRs will also impose requirements on the nominated undertaker to use reasonable endeavours to adopt measures to reduce the adverse environmental effects reported in the formal EIA Report, provided that this does not add unreasonable cost or delay to the construction or operation of the Proposed Scheme.

1.4.5 The EMRs will be set out in the formal EIA Report and are expected to include:

- general principles, in which the Secretary of State commits that the environmental effects reported in the formal EIA Report are not exceeded by application of the environmental mitigation assessed in the formal EIA Report;
- a Code of Construction Practice (CoCP), which will set out measures to provide effective planning, management and control during construction;
- an Environmental Memorandum, which is a framework for HS2 Ltd and its contractors and stakeholders, such as the Environment Agency and Natural England, to work together to ensure that the design and construction of Phase 2a is carried out with due regard for environmental considerations;
- a Planning Memorandum, which will set out an agreement between the Government and the local planning authorities relating to the processing of detailed planning approvals under the provisions of the Bill, including the design and appearance of bridges, viaducts, tunnel portals, noise barriers and earthworks;

- a Heritage Memorandum, which will set out a commitment to limit the impact on the historic environment and will address the elements of the design and construction works that have a direct impact on heritage assets; and
- undertakings and assurances given during the passage of the Bill.

1.5 HS2 and sustainability

1.5.1 The Government's High Speed Rail Strategy and the overall policy framework for the development of the Proposed Scheme are set out in the Command paper *High Speed Two: East and West, The next steps to Crewe and beyond (November 2015)* [20].

1.5.2 Development of the Proposed Scheme has been influenced by the Government's commitment to sustainable development. International and national bodies have set out broad principles of sustainable development. Resolution 42/187 of the United Nations General Assembly[21] defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

1.5.3 The Government's commitment to sustainable development builds on Securing the Future[22], which set out five 'guiding principles' of sustainable development, namely:

- living within the planet's environmental limits;
- ensuring a strong, healthy and just society;
- achieving a sustainable economy;
- promoting good governance; and
- using sound science responsibly.

1.5.4 The National Planning Policy Framework (NPPF)[23] sets out the Government's strategic guidance on development planning in England and Wales. The principles of sustainable development underpin the NPPF and its associated technical guidance. It identifies three dimensions to sustainable development, namely:

- economic: contributing to building a strong, responsive and competitive economy;
- social: supporting strong, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and
- environmental: contributing to protecting and enhancing our natural, built and historic environment, and as part of this, helping to improve biodiversity, use natural resources prudently, reduce waste and pollution, and mitigate and

[20] HS2 Ltd (2015), High Speed Two: East and West, The next steps to Crewe and beyond. November 2015. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480712/hs2-east-and-west.pdf
[21] UN General Assembly (1989), Implementation of General Assembly resolutions 42/186 and 42/187: resolution / adopted by the General Assembly, 22 December 1989, A/RES/44/227.
[22] Defra (2005), Securing the future – delivering UK sustainable development strategy (PB10589).
[23] Department for Communities and Local Government (2012), National Planning Policy Framework.

adapt to climate change (including moving to a low carbon economy).

1.5.5 The NPPF indicates that these factors should not be considered in isolation, because they are mutually dependent. Economic growth can secure higher social and environmental standards, whilst well-designed buildings and places can improve the lives of people and communities. Therefore, to achieve sustainable development, the NPPF requires economic, social and environmental gains to be sought jointly and simultaneously.

1.5.6 These principles have been, and remain, an important influence on the development of the Proposed Scheme. An appraisal of sustainability (AoS) has been used to appraise and report on the sustainability performance of the Phase 2a and 2b proposals throughout their development.

1.5.7 In July 2013, the previous Government published the HS2 Phase Two Sustainability Statement[24] as part of a public consultation on Phase Two and to inform the Government's decision on the preferred route for Phase Two. The Sustainability Statement described the extent to which the Government's proposed route for Phase Two (including Phase 2a) supported objectives for sustainable development, following the AoS. Four sustainable development priorities were used for the assessment:

- reducing greenhouse gas emissions and combating climate change;
- protecting natural and cultural resources and providing environmental enhancement;
- creating sustainable communities; and
- sustainable consumption and production.

1.5.8 The Phase Two Sustainability Statement 2013 provided a systematic review of the scheme proposals using 18 sustainability topics, each under one of the four headings described above. This informed both the Proposed Scheme designs and the selection of alternative options for Phase Two as a whole, taking into account wider transport and economic objectives, operational requirements, cost and practicality. This was incorporated into decision-making on the development of the route, which helped refine the number of options down to a single preferred route.

1.5.9 Consultation on the proposed route of HS2 Phase Two took place between July 2013 and January 2014. Question 7 of the consultation asked for feedback on the AoS of the proposed Phase Two route, including the alternatives. HS2 Ltd produced the 'Response to HS2 Phase Two Consultation: Appraisal of Sustainability (Question 7) Report[25] for Government to respond to the issues raised. The report was published by Government in December 2015 as part of the decision to proceed with the Proposed

[24] HS2 Ltd, 2013, Sustainability Statement - Volume 1: main report of the Appraisal of Sustainability. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401154/pc205_vol_1_sustainability_statement_180713.pdf

[25] HS2 Ltd, December 2015, HS2 Phase Two Response to HS2 Phase Two Consultation: Appraisal of Sustainability (Question 7), HS2 Ltd. December 2015. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/481570/Response_to_HS2_Phase_Two_consultation_-_Appraisal_of_Sustainability.pdf....pdf

Scheme. An updated Sustainability Report[26] was also published, documenting the post-consultation changes to the Phase 2a route. As well as outlining the preferred scheme and the associated sustainability impacts, it also summarised the key changes from the 2013 consultation route.

1.5.10 The potential significant effects identified in the Sustainability Statement and the post-consultation Sustainability Report will be reviewed during the EIA and assessed in the context of the Proposed Scheme.

1.5.11 HS2 Ltd's Sustainability Policy[27] sets out its priority for sustainable design, which will help to reduce adverse environmental effects. The policy stresses HS2 Ltd's commitment to develop "an exemplar project", and to "limit [the scheme's] negative impacts through design, mitigation and by challenging industry standards, [while looking] for environmental enhancements and benefits". The themes used by an earlier version of the policy[28] as a basis for realising HS2 Ltd's ambitions were addressed by the Phase Two Sustainability Statement 2013, as described in Section 1.3 of the Phase Two Sustainability Statement. The policy sets out the role of HS2 in delivering sustainable economic growth and the commitment to balance community, economic and environmental issues in taking the project forward.

1.5.12 Practicable measures will be considered further to avoid or reduce the adverse environmental effects of the Proposed Scheme as part of a continuing effort to improve the sustainability performance of the new railway during construction and operation.

1.6 The acquisition, use and return or disposal of land

1.6.1 The Bill for Phase 2a will seek powers for the compulsory acquisition of land for the Proposed Scheme. Payment of compensation for land compulsorily acquired will be in accordance with the general statutory framework set out under the National Compensation Code[29].

1.6.2 The Parliamentary Plans and Book of Reference will show the extent of land that the nominated undertaker may acquire permanently for the works and any additional land to be acquired or used, either temporarily or permanently, for the construction and operation of the Proposed Scheme. The nominated undertaker will notify the owners and occupiers of such land. Generally the Bill will authorise the permanent acquisition of land required for construction sites, because of the length of time for which that land will be required, but unless the land is required for additional permanent use it will be offered back to the previous owners on completion of the works.

[26] Temple-RSK (2015). Sustainability Report – Phase Two Post-Consultation Update: West Midlands to Crewe. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480667/Sustainability_Report_Phase_Two_Post-Consultation_Update_West_Midlands_Crewe.pdf

[27] HS2 Ltd, November 2015, Sustainability Policy. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/475766/HS2_Sustainability_Policy_P04_Nov15.pdf

[28] See Appendix B.4 of HS2 Ltd, 2013, Sustainability Statement - Appendix B - AoS Method, Alternatives and Supporting Documents. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/400835/p2c11_appendix_b_-_aos_method_and_alternatives_050713.pdf

[29] The compensation code is not a single document but a collective term used for the principles set out in Acts of Parliament, principally the Land Compensation Act 1961, the Compulsory Purchase Act 1965, the Land Compensation Act 1973, the Planning & Compulsory Purchase Act 1991 and the Planning & Compulsory Purchase Act 2004.This is supplemented by case law, relating to compensation for compulsory acquisition.

1.6.3 The limits of deviation enable the Proposed Scheme to deviate slightly from the centre line of the works shown on the Parliamentary Plans as may be required following detailed design, but the scheme must remain within the land shown on the Parliamentary Plans. The nominated undertaker will acquire or use less than the full extent within the limits if, following detailed design, not all of the land is required for permanent works or their construction.

2 Background to High Speed Two

2.1 The need for high speed rail

2.1.1 The case for high speed rail was set out in January 2012, in *Investing in Britain's Future – Decisions and Next Steps*[30]. It was reiterated in the November 2015 Command Paper[31].

2.1.2 The case for taking action and for HS2 in particular revolves around four key elements:

- extra capacity;
- improved connectivity;
- local growth; and
- direct opportunities for people and businesses.

2.1.3 This identified that over the next 20 to 30 years, additional capacity would be required to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. The Government considers that the rail network will play a key role in delivering this new capacity and that a clear case exists for a new high speed rail network.

2.1.4 The Government does not consider that more rounds of incremental enhancements to existing lines will be sufficient to meet long-term capacity needs for passengers or freight. Analysis by Network Rail has indicated that even very major enhancement packages cannot resolve the pressures on capacity anticipated on the WCML over the coming decades. The strong likelihood is that even by pushing the WCML to the absolute limit, as the alternatives that have been considered do, it would only delay rather than eliminate the need for new lines in the future. In the meantime, substantial disruption would have been imposed on passengers over a number of years as works were carried out and the additional strategic, economic and connectivity benefits that high speed rail is particularly capable of delivering, would have been foregone.

2.1.5 Given the opinion that upgrading the existing north-south lines is not a viable long-term solution, Government considers that the real choice, therefore, is not between high speed rail and further incremental upgrades; rather between high speed rail and a new conventional rail line capable of providing the capacity that is required. Building new conventional rail lines would not be significantly cheaper, nor would their impacts on the environment and communities be significantly less than those of new high speed rail lines. Moreover, new conventional rail lines would deliver far fewer benefits in terms of enhanced connectivity and support for long-term economic growth. The additional benefits generated by designing a new line to accommodate high speed services, compared with a new conventional speed line, would outweigh the additional costs by a factor of more than four to one. These matters are described in

[30] Department for Transport (2012), *High Speed Rail: Investing in Britain's Future – Decisions and Next Steps*. Her Majesty's Stationery Office, London.
[31] HS2 Ltd (2015), High Speed Two: East and West, The next steps to Crewe and beyond. November 2015. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480712/hs2-east-and-west.pdf

more detail within the report High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed 'Y' Network.

2.1.6 The Government's view is that high speed rail will create a better transport experience for passengers, bypassing existing congested railways and delivering extra capacity for people and freight, while improving connectivity that will help unlock growth and regeneration for cities throughout the country. The Government also considers that high speed rail would have greater potential to attract travellers from air and road transport, reducing the environmental impacts of these journeys.

2.1.7 By comparison, upgrading the existing north-south rail network would be insufficient to provide the necessary capacity and improved performance required to meet the country's long-term economic needs. It would also cause significant disruption on the existing railway network. There is a need for a better transport system for the 21st century and incremental upgrades are not enough to meet the long-term growth in demand.

2.1.8 Phase One of HS2 will link London, Birmingham and the West Midlands, and through the connection to the WCML at Handsacre, destinations in the North West and up to Scotland, greatly improving capacity and connectivity and reducing journey times. The interchange at Old Oak Common will also offer the opportunity to link to Crossrail and the Great Western Main Line. Phase One will resolve some of the most pressing challenges around capacity south of Birmingham, but it will not deliver the transformation in connectivity that is required to meet the objective of supporting economic growth in the North. To do this it will be necessary to continue with Phase Two.

2.1.9 Phase Two of HS2 would extend the high speed railway between Birmingham and Leeds and between Birmingham and Manchester, with connections onto the WCML at Crewe and Golborne and to the ECML south of York. The Government is committed to completing the full Y network to Manchester and Leeds.

Acceleration

2.1.10 In November 2015, the Government made a decision on the Phase 2a route and set out the case for accelerating the delivery of Phase 2a. Accelerating the delivery of this section of Phase Two will improve journey times to northern cities sooner, support growth and jobs in the local areas, and help to create the conditions for both the Northern Powerhouse[32] and the Midlands Engine[33]. It will also have a positive financial impact, as set out in the November 2015 HS2 West Midlands to Crewe Strategic Outline Business Case: Economic Case[34].

[32] The Northern Powerhouse is a proposal launched in a speech by the Chancellor of the Exchequer in Manchester in June 2014. Its aim is to boost economic growth in the north of England, especially the 'core cities' of Manchester, Liverpool, Leeds, Sheffield and Newcastle. Better transport connections between the northern cities and better links to London underpin the proposal. The transport strategy for the Northern Powerhouse which includes Phase Two of HS2 was set out in 'The Northern Powerhouse: One Agenda, One Economy, One North; Transport for the North, March 2015, HMSO.

[33] The Midlands Engine is a proposal by Government to improve and grow the Midlands' economy by £34 billion by 2030 and create a further 300,000 jobs. The prospectus for the Midlands Engine for Growth which refers to the need to exploit and build on the connectivity provided by Phase One and Phase Two of HS2 was launched by the Secretary of State for Business, Innovation and Skills in December 2015.

[34] Department for Transport (2015), HS2 West Midlands to Crewe – Strategic Outline Business Case: Economic Case, November 2015. Available on-line at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480718/hs2-west-midlands-to-crewe-sobc-economic-case.pdf

2.2 Evolution of High Speed Two

2.2.1 The 2015 Command Paper followed many years of analysis and development, which is described more fully in the Alternatives Report as an appendix to the Volume 1 and summarised within section 10 of this report.

2.2.2 A summary of the development of the strategic case for a high speed rail network and for the HS2 Phase One route can be viewed in Volume 1 of the HS2 Phase One main ES. The main milestones informing the development of Phase 2a are summarised in Table 1.

Table 1: Main milestones in the development of Phase 2a

Date	Activity
March 2010	The Government published its Command Paper High Speed Rail[35], which confirmed its support for a high speed Y network, and for initial development of a route between London and the West Midlands. HS2 Ltd was instructed to take this work forward, whilst options for connections to Heathrow Airport were to be the subject of a separate report by Lord Mawhinney.
March 2010	A review of the strategic alternatives to high speed rail, reported in High Speed 2 Strategic Alternatives Study – Strategic Outline Case[36].
January 2012	The Secretary of State published the Command Paper High Speed Rail: Investing in Britain's Future – Decisions and Next Steps, together with supporting documents. The Command Paper confirmed the Government's intention to develop a Y-shaped high speed rail network, including direct links to Heathrow Airport and HS1. The network was to be brought forward in two phases, with powers sought initially for a London-West Midlands high speed line based on a refined version of the consultation route.
January 2013	Publication of High speed rail: investing in Britain's future phase two - the route to Leeds, Manchester and beyond[37]. The Secretary of State announced the Government's intention to proceed with the planning and design of Phase Two, and published initial preferred routes for Leeds and Manchester, whilst work on the Heathrow spur was put on hold pending the report of the Davies Commission. Published alongside this was the initial preferred scheme sustainability summary and initial preferred route plan and profile maps Also published were HS2 Ltd's March 2012 advice to Government[38]: • Options for Phase Two of the High Speed Network; • Options for Phase Two of the High Speed Network appraisal of sustainability; • Record of stakeholder engagement for phase two of the high speed rail network; • HS2 cost and risk model report;

[35] Department for Transport (2010), *High Speed Rail – Command Paper.* Her Majesty's Stationery Office, London.
[36] Atkins (2010), *High Speed 2 Strategic Alternatives Study, Strategic Outline Case*, London.
[37] Department for Transport (2013), *High speed rail: investing in Britain's future phase two - the route to Leeds, Manchester and beyond*, https://www.gov.uk/government/publications/high-speed-rail-investing-in-britains-future-phase-two-the-route-to-leeds-manchester-and-beyond, Accessed July 2016.
[38] Department for Transport (2013), *HS2 Phase Two initial preferences* https://www.gov.uk/government/collections/hs2-phase-two-initial-preferred-route, Accessed July 2016.

Date	Activity
	• Options for phase two of the high speed rail network approach to design; • three Phase Two engineering options reports (West Midlands to Manchester, West Midlands to Leeds and Heathrow); • Selecting an initial preferred scheme for HS2 phase two refinement work since March 2012.
July 2013	Launch of public consultation on the proposed route for Phase Two detailing the route from the West Midlands to Manchester, Leeds and beyond. Consultation documents included supporting technical information (including maps) the Sustainability Statement and quick reference factsheets[39].
September 2013	HS2 Ltd published an analysis of the potential scale, range and distribution of regional economic impacts associated with the substantial improvements to the rail network brought about by HS2 (both Phase One and Phase Two) and the use of freed-up capacity on the classic rail network[40].
October 2013	Publication of the Economic Case for HS2 and Strategic Case for HS2.
November 2013	The Secretary of State for Transport announced that Sir David Higgins had been tasked with reporting on how to reduce the cost of HS2; how its benefits could be delivered earlier and at a lower cost; and how to ensure that HS2 delivers benefits like jobs and growth.[41]
March 2014	Publication of HS2 Plus – a report by David Higgins, which recommended the accelerated delivery of the Phase 2a route to Crewe[42].
October 2014	Publication of Rebalancing Britain: From HS2 towards a national transport strategy, a second report by the Chairman of HS2 Ltd Sir David Higgins[43]. This highlighted the need for greater consideration of transport connectivity across the north of England. It described HS2 as a new spine for the national rail network, and as an important catalyst for a national transport strategy.
November 2015	Publication of the Strategic Case and Economic Case for HS2 Phase 2a, as part of the Strategic Outline Business Case.
November 2015	Publication of High Speed Two: East and West, The next steps to Crewe and beyond paper. This included the decision on the Phase 2a route, following consideration by Government of the responses to consultation. Publication of the HS2 Phase 2a Strategic Outline Business Case documents Strategic Case, Economic Case and Rail Alternatives to Phase 2a[44]. Publication of the "High Speed Rail: Investing in Britain's future. Consultation on the route from the West Midlands to Manchester, Leeds and beyond"[45] consultation response analysis report by Ipsos MORI. This reported on the outcome of the consultation on the proposed route for Phase Two.

[39] HS2 Ltd (2013), Phase Two Route Consultation, http://webarchive.nationalarchives.gov.uk/20141027142236/http://www.hs2.org.uk/phase-two/route-consultation/document-library, Accessed: April 2016.
[40] Hs2 Ltd (2013), *HS2 Regional Economic Impacts.*
[41] Department for Transport (2013) https://www.gov.uk/government/news/sir-david-higgins-to-drive-down-cost-of-hs2
[42] HS2 Ltd (2014), HS2 Plus – A report by David Higgins. https://www.gov.uk/government/publications/hs2-plus-a-report-by-david-higgins
[43] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374709/Rebalancing_Britain_-_From_HS2_towards_a_national_transport_strategy.pdf
[44] Department for Transport (2015), Phase 2a publications. https://www.gov.uk/government/collections/hs2-phase-two-from-the-west-midlands-to-leeds-and-manchester#department-for-transport-phase-2a-publications
[45] Ipsos MORI (2014), *High Speed Rail: Investing in Britain's future. Consultation on the route from the West Midlands to Manchester, Leeds and beyond.* https://www.gov.uk/government/consultations/hs2-phase-two-proposed-line-of-route-from-west-midlands-to-manchester-and-leeds; Accessed April 2016

Date	Activity
	Publication of the "HS2 Phase Two Response to HS2 Phase Two Consultation: Appraisal of Sustainability (Question 7)". This report provided an HS2 Ltd response to feedback from question 7 of the Phase Two consultation, regarding the Appraisal of Sustainability. Publication of High Speed Rail: Preferred Route to Crewe. Sustainability Report. Phase Two Post-Consultation Update: West Midlands to Crewe.
January 2016	Publication of the remaining documents that form part of the Phase 2a Strategic Outline Business Case: Financial Case, Management Case and Commercial Case.
March 2016	Publication of the draft HS2 Phase Two: West Midlands to Crewe EIA Scope and Methodology Report for consultation.

2.3 Enhancing capacity and connectivity

2.3.1 The Government's case for a new north-south high speed rail network is primarily to ensure that the intercity rail network supports the economic development of the country by providing sufficient capacity and improved connectivity between urban centres. The need for additional capacity will become increasingly pressing on Britain's key north-south inter-urban rail routes, particularly on the WCML, from the mid-2020s.

2.3.2 Demand for inter-regional travel within the UK, including levels of rail patronage, has been increasing in recent years. The Strategic Case for HS2 published in October 2013[46] reported that the number of passenger miles travelled on the national rail network had increased from 20 billion in 1992/93, to 36 billion in 2012/13. In terms of the number of rail passenger journeys, there had been an increase from 976 million in 2002/03 to 1,502 million in 2012/13. This represented a 54% increase in demand in a 10-year period and is equivalent to an annual year-on-year growth rate of 4.4%. Intercity journeys increased by 65% over the same period, with journeys increasing from 77 million to 128 million. This was a 5.2% annual year-on-year growth rate. Over the same period, gross domestic products grew by 43% or 3.6% per year. This trend in passenger growth had been evident since the 1980s, reflecting rising levels of population and economic activity, and is predicted to continue despite advances in information and communications technology.

2.3.3 Since the Strategic Case was published, demand for rail travel has continued to grow at a rate that is well above the long-term forecast that underpins DfT's Economic Case for HS2[47]. From 2013 to 2015 (years ending 31 March), the number of rail journeys in Great Britain grew by 10.2% from 1,501 million to 1,654 million. This is an annual growth rate of 5% – more than double the growth of around 2% assumed in the Economic Case for HS2.

2.3.4 The 2007 White Paper: Delivering a Sustainable Railway predicted that rail patronage would double by 2030, and identified London-Birmingham-Manchester as one of the

[46] Department for Transport (2013), *The Strategic Case for HS2*.
[47] Department for Transport (2015), *Supplement to the October 2013 Strategic Case for HS2*.

first routes likely to require interventions beyond the WCML upgrade underway at that time.

2.3.5 Network Rail's New Lines Study tested the assumptions about future demand and set out the strategic business case for new high speed lines. This work predicted that the demand for travel between London, Birmingham, Manchester and Edinburgh would increase by more than 90% between 2007 and 2030.

2.3.6 The report 'Britain's Transport Infrastructure – High Speed Two' confirmed that between 1997/8 and 2007/8 rail passenger miles increased by an average of 3.5% per annum and rail passenger journeys by an average of 3.8%, with the annual rate of increase becoming steeper over time. The report indicated that whilst macro-economic influences are important, this demand continues to be driven by underlying factors such as improvements to journey times and reliability, coupled with the disbenefits of using other modes of transport.

2.3.7 The Network Rail work in 2008/9 concluded that the WCML, Midland Main Line (MML), ECML and Chiltern Main Line (CML) would be at or near capacity by 2020. The most critical constraints would be reached initially on the WCML, despite its recent upgrade, followed by the MML and ECML (taking account of planned incremental upgrades). Recent work has confirmed the likelihood of critical capacity constraints developing on the WCML.

2.3.8 The critical prognosis for the WCML is a key influence both on the overall case for HS2 and on the more immediate benefits of Phase 2a. As well as carrying passengers between the major cities, the WCML is a very significant carrier of commuters into the capital and other major cities, and handles over 40% of the country's rail freight, making it the busiest mixed use railway line in Europe. Despite a major upgrade over the last 10 years, and partly because of the success of the service improvements that have followed, it is rapidly reaching its capacity.

2.3.9 The WCML carries passenger services of every type, including long distance intercity, inter-regional and commuter passenger services and freight. Congestion on the WCML has a noticeably detrimental effect on the reliability of intercity and commuter services, which regularly fail to meet their performance target and are below the national average.

2.3.10 Extra capacity provided in recent years has filled up more quickly than expected. Some £9 billion was invested in upgrading the WCML between 1998 and 2008. The upgrade increased peak service levels on the fast lines into Euston from 9 tph to 13-14tph and reduced journey times, such as those between London and Manchester, by around 20%. However, despite the considerable cost and disruption involved, within seven years of completion of the works:

- over 60% of the additional peak inter-city seats provided by the upgrade are already being filled;
- more trains are being operated on the WCML's fast lines in the peak hour (up to 15-16tph) than was envisaged when the upgrade was planned; and
- reliability of the services on the WCML is poor, partly due to this intensity of

operation.[48]

2.3.11 Pressures to run more services on the WCML will inevitably arise as rail demand continues to grow, for the following reasons:

- the existing peak trains, some of which are crowded now, will become severely overcrowded – even if they are all run at maximum length;
- today's WCML timetable is a compromise. Lack of capacity means that opportunities to improve frequency of commuter services around Birmingham and Manchester are constrained. It also limits the ability to run more long-distance services to link London directly with other cities across the West Midlands, North West, Scotland and Wales; and
- as international trade expands, there is an urgent demand for more freight paths on the WCML, which links the nation's major ports with inland freight terminals. Rail freight brings annual benefits of around £1.5 billion to Britain's economy. [49]

2.3.12 Britain's second major strategic rail route, the ECML, is about to see a significant increase in capacity via the new Intercity Express Programme (IEP) trains and a number of line improvements to be carried out by Network Rail. However, despite this, forecasts suggest that by the 2030s, more capacity will be needed.[50]

2.3.13 Network Rail's 2011 report[51] demonstrated that even very major enhancement packages on the WCML would not meet the expected demand over the coming decades. This would delay, rather than eliminate, both the need for new lines and their associated strategic, economic and connectivity benefits, at the cost of significant disruption to passengers.

2.3.14 Journey time is a key influence on the ability of rail to compete with other modes. This has been demonstrated; for example, by the Paris and Brussels THALYS service and the East Japan 'Shinkansen' network; and by HS1, which has captured around 80% of the travel market between London and Paris through a combination of high speed and the convenience of a city-centre to city-centre service.

2.3.15 The work carried out by Network Rail concluded that a new line serving the London-Birmingham-Manchester corridor should be capable of high speed operation rather than the maximum speeds typically achieved on classic lines. Speed has less impact on the construction and operating costs of a railway than on its economic benefits, as measured by time saved. Whilst the cost profile for a new high speed line is about 9% higher than that for a new classic speed line, the economic benefits achieved by the reduced journey times are substantially greater.

2.3.16 As a result, the Government concluded that the additional benefits generated by a high speed line, compared to a classic speed line, would outweigh the additional costs by a factor of more than four to one. As well as providing substantial additional

[48] Department for Transport (2015), *Supplement to the October 2013 Strategic Case for HS2*.
[49] Department for Transport (2015), *Supplement to the October 2013 Strategic Case for HS2*.
[50] Department for Transport (2015), *Supplement to the October 2013 Strategic Case for HS2*.
[51] Network Rail (2011), Review of Strategic Alternatives to HS2.

capacity in its own right, a new dedicated high speed line would release capacity on existing routes, which could be redeployed to the benefit of services such as commuters and freight. This released capacity, on top of the enhanced capacity provided by the HS2 network, represents a significant additional benefit, since the costs of congestion are felt most keenly by existing passengers and businesses.

2.3.17 HS2 will enable passengers to travel from London to Birmingham in 49 minutes rather than one hour 24 minutes today, and from London to Manchester in one hour, eight minutes rather than the two hours, eight minutes it takes today, once the full Y network is in operation. HS2 is a crucial part of plans to transform transport in the North, and will dramatically improve north-south connectivity.

2.3.18 HS2 will provide new links between regional cities, and will directly connect eight of the 10 largest cities in Britain: London; Manchester; Liverpool; Glasgow; Edinburgh; Newcastle; Sheffield and Leeds. At the heart of the rail network north of London, Birmingham will also have the potential to connect Bristol, Wales and the South West to the other core cities.

2.3.19 People will be able to meet their work commitments, make new contacts, find new jobs, and spend their time more productively when travelling. The evidence shows that people place a premium on being able to get to places quickly[52]. HS2 will broaden the options available to people in terms of where to live, where to locate their business and how to travel.

2.3.20 The sooner that HS2 is built, the sooner it will be possible to deliver the improved connectivity and associated economic benefits. This provides the rationale for bringing forward the programme for Phase 2a of HS2 by six years to open in 2027. Phase 2a would deliver faster journey times from London to Manchester, Crewe, Liverpool, Preston, Warrington, Wigan and Glasgow – improving journey times by up to 13 minutes in addition to journey time savings to be delivered by Phase One.

2.3.21 Once completed, Phase 2a would deliver a step change in capacity. It would relieve pressure on bottlenecks, improve reliability and performance, and create extra capacity on the WCML and at stations between Handsacre and immediately south of Crewe. In particular, any released capacity could be used to run additional freight services to Basford Hall yard, a major freight interchange immediately south of Crewe. This would unlock some of the substantial freight benefits from HS2 earlier, contributing to economic growth.

2.4 Generating growth

2.4.1 The efficient movement of people and goods is fundamental to the productive potential of an economy. Improvements in transport infrastructure enable the economy to grow by increasing the efficiency of labour and business markets through a reduction in the barriers to trade created by distance and congestion.

2.4.2 Improved connectivity can deliver benefits by making an area more accessible, resulting in a greater concentration of workers and firms. These benefits can help to re-balance the economy by stimulating growth in the regions. Rail is a particularly

[52] Wardman M, Batley R et al (2013), *Valuation of Travel time Savings for Business Passengers*, ITS Leeds.

effective means of moving large numbers of people over a range of distances. This is because of its high inherent capacity, its ability to provide centre-to-centre routes and the wide range of connections it offers with other modes of transport.

2.4.3 The potential for high speed rail to facilitate improved economic growth, through benefits to agglomeration, competition and labour markets, is an important consideration for the Government. The extension of the high speed rail network to the north of England reflects the Government's intention that the regional benefits of high speed rail travel are distributed as widely as possible. HS2 will link the majority of Britain's biggest cities, including its second and third cities, Birmingham and Manchester, increasing the productive potential of regional economies and providing an opportunity to increase their contribution to the UK economy.

2.4.4 HS2 will be the biggest infrastructure project in Europe and will have a significant impact on jobs, both directly and through its supply chain, particularly in engineering and construction. The new high speed rail stations have the potential to boost local economic growth in the short-term and to facilitate longer-term benefits by acting as a catalyst for local regeneration, as is the case with HS1.

2.4.5 The Y network reflects the Government's objective of ensuring that the regional economic benefits of high speed rail travel are distributed as widely as possible. Recent analysis presented in the Economic Case indicates that the economic benefits of HS2 to the regions, particularly the Midlands and the North, will be greater than those to London.

2.4.6 Phase Two of HS2 would deliver the transformation in connectivity that is required to meet the objective of supporting economic growth in the North. HS2 would drive growth by acting as a catalyst for major regeneration and development schemes (for example, around Crewe), delivering better connectivity and providing opportunities for the UK's businesses and workforce, such as the creation of high skilled construction jobs. It would generate economic opportunities and development beyond the direct impacts of building a new railway.

2.4.7 Accelerating the delivery of Phase 2a means that people would benefit from faster journey times and enhanced connectivity much sooner than the planned opening of the full Phase Two in 2033. As set out in the November 2015 HS2 West Midlands to Crewe Strategic Outline Business Case: Economic Case, accelerating the delivery of Phase 2a would also have a positive financial impact.

2.5 Climate change

2.5.1 The Proposed Scheme has been developed against a background of concern and strengthening policy regarding climate change. This includes consideration of both the need to mitigate climate change through reductions in greenhouse gas emissions, and the need for critical infrastructure and environments to be resilient to climate change impacts and risks.

2.5.2 The Kyoto Protocol of 1997 took the lead in converting this concern into action at an international level. More recently, negotiations in December 2015 on the future of international cooperation on climate change at the 21st Conference of the Parties (CoP21) of the United Nations Framework Convention on Climate Change (UNFCCC)

in Paris[53] resulted in a legally binding treaty on climate action. The central aims of the agreement is to strengthen the global response to climate change by keeping global temperature rise this century below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

2.5.3 At a UK level the Climate Change Act 2008[54] established a framework for the UK to achieve its long-term goals of reducing GHG emissions by at least 80% from 1990 levels by 2050. The Climate Change Act 2008 includes an interim target of at least a 34% reduction from 1990 levels by 2020. To ensure that regular progress is made towards the target, the Climate Change Act 2008 also established a system of carbon budgets.

2.5.4 The first four carbon budgets, leading to 2027, have been set in law. Meeting the fourth carbon budget (2023-27) will require that GHG emissions are reduced by 50% on 1990 levels in 2025. Draft legislation for the fifth carbon budget (2028-2032), which – as recommended by the Committee on Climate Change (CCC)[55] – would limit annual GHG emissions to an average 57% below 1990 levels, is expected to be proposed by government by the end of 2016. The CCC, in its annual progress report to Parliament in June 2016[56], provided a review of recent progress and identified areas where policy should be developed and strengthened if it is to succeed in meeting the fourth and fifth carbon budgets. The CCC identified a need for development and strengthening of "national and local policies to reduce demand for car travel, sufficient to deliver car-km reductions of around 5% below the baseline trajectory, including through shifts to public transport, cycling and walking".

2.5.5 The Carbon Plan (2011)[57] sets out the government's plans for achieving the GHG emissions reductions committed to in the Climate Change Act and the first four carbon budgets. Transport is a significant source of UK GHG emissions and is therefore an essential part of the Carbon Plan. However, rail represents a very small proportion of total UK transport emissions. Latest UK GHG emission figures published by the Department of Energy and Climate Change in 2016 indicate that transport accounted for 23% of overall UK GHG emissions in 2014[58] of which 21% came from road transport and 0.5% came from railways. The Carbon Plan states that rail travel will become substantially decarbonised through increasing electrification and the use of more efficient trains and lower carbon fuels. The Carbon Plan mentions that the proposed high speed rail network, now being developed by HS2 Ltd, "will transform rail capacity and connectivity to promote long-term and sustainable economic growth."

[53] UNFCCC (2015), Conference of the Parties, Adoption of the Paris Agreement; http://unfccc.int/resource/docs/2015/cop21/eng/log01.pdf; Accessed: 20 April 2016.
[54] Her Majesty's Stationery Office, (2008), Climate Change Act 2008, London. Available online at: http://www.legislation.gov.uk/ukpga/2008/27/contents; Accessed: 20 April 2016.
[55] CCC (2015), The Fifth Carbon Budget – The next step towards a low-carbon economy, November 2015. Available online at: https://documents.theccc.org.uk/wp-content/uploads/2015/11/Committee-on-Climate-Change-Fifth-Carbon-Budget-Report.pdf
[56] Committee on Climate Change, (2016), Meeting Carbon Budgets – 2016 Progress Report to Parliament; https://www.theccc.org.uk/publication/meeting-carbon-budgets-2016-progress-report-to-parliament/; Accessed: 27 July 2016.
[57] HM Government, (2011), The Carbon Plan: Delivering our Low Carbon Future. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47613/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf; Accessed: 20 April 2016.
[58] Department of Energy & Climate Change (2016), Final UK greenhouse gas emissions national statistics: 1990-2014. Available online from https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2014

Furthermore, the Carbon Plan notes that further electrification of the rail network will support low carbon modal shift in the future.

2.5.6 The fifth carbon budget (2028-32) target would reduce UK greenhouse gas emissions in 2030 by 57% relative to 1990 levels. In order to meet this target, key priorities for the transport sector are ensuring that carbon efficiency of conventional road vehicles continues into the 2020s, as well as increasing the deployment of electrical vehicles and encouraging a behavioural change towards 'smarter choices' such as the use of more public transport.

2.5.7 The construction of a new high speed rail line would result in substantial greenhouse gas emissions. However, in terms of enhancing inter-urban connectivity, high speed rail is one of the most carbon efficient means of transporting large numbers of people, measured in terms of emissions per passenger kilometre. High speed rail is considered to draw an optimum balance between carbon reduction and economic benefits. Furthermore, the carbon emissions of high speed rail are likely to reduce in future as the energy supply is decarbonised, i.e. as Britain moves away from using gas, oil and coal-fired power stations and towards renewable and low carbon sources of energy. There is a large carbon benefit associated with the operation of Phase One of HS2. There are expected to be further carbon benefits associated with the operation of Phase 2a.

2.5.8 Encouraging a shift to lower-carbon modes was one of the considerations in rejecting modal alternatives such as increasing domestic aviation capacity. While the Government is encouraging the development of low emission road vehicles, building new motorways would still lead to significantly more transport emissions in the short to medium term. A high speed line is likely to be one of the most carbon efficient solutions and is also considered to draw an optimum balance between carbon reduction and economic benefits. Furthermore, the carbon footprint of high speed rail is likely to be reduced in future as the energy supply is decarbonised (i.e. as Britain moves away from using gas, oil and coal-fired power stations).

2.5.9 The Climate Change Act 2008 also created a framework for building the UK's ability to adapt to climate change. The Act gives the Secretary of State for the Environment the power to direct Government Departments and reporting authorities, (i.e. organisations with functions of a public nature and statutory undertakers, which include major transport infrastructure companies), to produce reports on the current and future predicted impacts of climate change on their organisation and to set out proposals for adapting to this change.

2.5.10 The Act requires Government to develop and implement a National Adaptation Programme (NAP)[59], following the publication of a Climate Change Risk Assessment[60], to help build this resilience. The current NAP will be reviewed every five years and will continue to set the framework for how government, businesses, communities and civil society should prepare for and adapt to climate change. As described in the NAP, the design and EIA processes are required to incorporate consideration of climate change

[59] Her Majesty's Government (2013), *The National Adaptation Programme, Making the country resilient to a changing climate*, Her Majesty's Stationery Office.
[60] Her Majesty's Government (2012), UK Climate Change Risk Assessment: Government Report, Her Majesty's Stationery Office.

implications. More specifically, the NAP states that "DfT is the sponsor for the High Speed 2 (HS2) rail route and has required HS2 Ltd to incorporate consideration of climate change implications in its design and Environmental Impact Assessment processes".

2.5.11 The Cabinet Office guidance on 'Keeping the country running'[61] is a key document used in the development of HS2's approach to climate change resilience. There is a resilience objective within the HS2 Sustainability Policy and Environment Agency guidance on climate change allowances to be used in flood risk assessments as set out in the NPPF[62] has informed the assessment.

2.5.12 Further information is provided in sections 8.4 and 9.6 below and in Volume 3: Route-wide effects.

2.6 Managing local impacts and effects

2.6.1 The Government acknowledges that constructing a new railway in the UK will inevitably lead to a range of adverse local impacts and effects. However, in developing the route between the West Midlands and Crewe, impacts have been reduced as far as reasonably practicable. Environmental assessment has been integral to route development and design, initially by way of the AoS and subsequently through preparation of the working draft EIA Report.

2.6.2 Options for mitigating adverse effects will continue to be identified during development of the Proposed Scheme prior to the submission of the Bill. Mitigation measures that are considered to be effective, reasonably practicable and affordable will continue to be incorporated into the design and management of the Proposed Scheme. A structured approach has been adopted towards mitigation, whereby priority is given to avoiding significant adverse effects. Where that is not achievable, such effects will be reduced or abated, or compensation provided. The approach to mitigation is described further in section 9.

2.6.3 Local impacts are also being identified through the consultation process. Options for addressing these issues are being considered as the alignment and design of the Proposed Scheme evolves. Further details of the consultation process are set out in Section 3.

[61] Cabinet Office; Keeping the country running: natural hazards and infrastructure, 2011. Available online at: https://www.gov.uk/government/publications/keeping-the-country-running-natural-hazards-and-infrastructure
[62] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances; Accessed 9 June 2016

3 Stakeholder engagement and consultation

3.1 Background

3.1.1 Stakeholder engagement has been an integral and ongoing part of the process of designing and assessing the Proposed Scheme from inception. It is enabling the general public, local authorities, statutory bodies and technical and specialist stakeholders to respond to, and inform:

- the development of the design;
- the collection of relevant baseline environmental information and data;
- the scope and methodology of the assessment;
- the assessment of the significant environmental effects arising from construction and operation of the Proposed Scheme;
- the enhancement of the beneficial effects of the project; and
- the measures identified to avoid or mitigate significant adverse effects.

3.1.2 This section sets out:

- the range of stakeholders involved;
- how and when engagement and consultation has been undertaken to date; and
- future opportunities for stakeholder engagement.

3.1.3 Details of how stakeholder feedback has been considered in the development of the design and assessment of the Proposed Scheme are set out in Section 3 (Stakeholder engagement and consultation) of the Volume 2, community area reports

3.2 Stakeholders

Introduction

3.2.1 HS2 Ltd is using a variety of mechanisms to ensure an open and inclusive approach to consultation and engagement. Mapping of stakeholders is being used to help identify the most appropriate ways in which to consult and engage with stakeholders and communities, and with key sections or groups within such communities. This has been and will continue to be reviewed and updated throughout the process of design development and assessment.

Directly affected individuals and landowners

3.2.2 The engagement and consultation has a strong focus on directly affected individuals. This group comprises farmers, growers and those whose property would be directly affected by the Proposed Scheme whether permanently or temporarily. A wider range of property owners has also been engaged, including residential and commercial

owners, and those who own land used for charitable purposes. There is a specific programme of ongoing direct consultation with these stakeholders. This stakeholder group also forms a key part of the baseline and assessment of the Proposed Scheme.

Communities

3.2.3 Communities that may be directly affected by the Proposed Scheme have been identified and are a key focus of the engagement and formal consultation. Engagement is occurring directly with communities, with key community representatives and with a broad range of interest groups within the respective areas.

3.2.4 Communities are being consulted during the design and assessment process to ensure they have the opportunity to input to and influence the development of the Proposed Scheme.

Local authorities and parish councils

3.2.5 Engagement with local authorities has been, and will continue to be, ongoing throughout the design and assessment of the Proposed Scheme. The aim is to maximise the opportunity for local authorities to engage positively in the development of the Proposed Scheme both in the context of technical input to the assessment and local knowledge and issues. The local authorities provide valuable technical information to aid the design development and environmental assessment process and influence local area mitigation proposals. The local authorities also provide information on communities and other stakeholders within their area, which is helping to inform the assessment and design of the Proposed Scheme.

Technical and specialist groups/stakeholders

3.2.6 This group comprises stakeholders with specific technical knowledge or particular interest in the Proposed Scheme, many of whom will have a high level of influence on the design and assessment process, particularly in relation to technical feasibility and likely environmental impacts. This group includes national representatives of environmental statutory authorities and government departments, as well as non-statutory technical/specialist organisations. These stakeholders are helping to influence project-wide mitigation strategies and principles.

3.2.7 Designated statutory consultees (such as the Environment Agency) for the process of undertaking an EIA have been, and will continue to be, engaged with throughout the assessment. Specific, dedicated engagement on health will also be undertaken, including with health and wellbeing boards run by local authorities, local Directors of Public Health and Public Health England.

3.3 Key stages and mechanisms for engaging with stakeholders

Introduction

3.3.1 The process of direct engagement with the stakeholders began in 2009. A variety of mechanisms are being used to ensure an open and inclusive approach to engagement and consultation, reflecting the differing requirements and expectations of stakeholders.

3.3.2 Key engagement undertaken to date is summarised in Table 2 and described below. This has included consultation on the draft SMR, property consultation and a series of meetings with national and local environmental stakeholders, local authorities, parish councils, individual landowners and organisations.

Table 2: Engagement, consultation and decision points to date for HS2 Phase Two (incorporating Phase 2a)

Date	Engagement, consultation and decision points
2009-2012	Development of the Phase Two route and consideration of route-wide alternatives input: • engagement with limited number of key stakeholders to help identify locations for stations and depots; • engagement on information generated by desk-based studies, including environmental studies; and • stakeholders also involved in reviewing alternative options, which included consideration of relevant environmental information.
2010-to-date – ongoing	HS2 National Environment Forum and HS2 Ministerial Environmental Roundtable: • attended by members of key statutory and non-governmental organisations to represent the interests of local people and the wider society in respect to specific environmental issues; • managed at national representative level and carried out bilateral meetings on specific issues on a case by case basis; and • regular engagement with organisations including Natural England and the Environment Agency.
January 2013	Announcement of initial preferred route: • allowed an early opportunity to engage with key stakeholders on potential key issues and concerns about the route and its impacts ahead of consultation; and • publication of background material used to inform the initial preferred route, including an AoS options report setting out the environmental performance of alternative route options.
July 2013 - January 2014	Consultation on Phase Two proposed route: • consultation of the proposed route, stations and depots; and • sought comments on the approach to the environmental appraisal carried out by HS2 Ltd.
30 November 2015	Route Decision on Phase 2a: • consultation response for Phase 2a, including feedback on the AoS of the proposed Phase Two route via question 7 of the consultation (December 2015); • confirmation of the preferred route and decision to accelerate construction; • publication of a summary change document reflecting changes made since the consultation; and • publication of a Sustainability Report for the Phase 2a route highlighting differences in environmental performance as a result of changes made.
30 November 2015-February 2016	Phase 2a property consultation: consultation with property owners along the route of the Proposed Scheme.

8 March-13 May 2016	Consultation on the draft SMR, which sets out: • the proposed approach to environmental assessment; and • the approach to considering and reporting on alternatives.
March 2016 (ongoing)	Public participation – initial direct engagement with Phase 2a landowners and other stakeholders: • covering potential impacts and giving affected landowners and wider stakeholders the opportunity to raise issues and opportunities in relation to the Proposed Scheme; and • HS2 Ltd provides information and discusses the potential environmental impacts of the current draft design and opportunities for mitigation.

Route development and consideration of route-wide alternatives

3.3.3 Engagement with specialist and technical stakeholders was undertaken to inform development of the Phase Two route and the consideration of alternatives. Specialist stakeholders also provided input into desk studies, and specifically into environmental studies.

3.3.4 Stakeholders assisted in reviewing the sifting of alternative options, drawing upon the environmental studies, to help inform the identification of what would be the initial preferred route.

Engagement on the initial preferred route and consultation on the Appraisal of Sustainability

3.3.5 The announcement of the initial preferred route for Phase Two in January 2013 provided an early opportunity to engage with stakeholders on potential key issues and concerns about the route and its impacts ahead of public consultation.

3.3.6 This engagement fed into the analysis of a substantial number of route-wide alternatives to the proposed Phase Two alignment, which was informed by the AoS process. The AoS was used to appraise and report on the sustainability performance of the Phase Two (including Phase 2a) proposals throughout their development, as described in section 1.5 and section 2.2.

Refinement of the route

3.3.7 Since the Government published the preferred line of route for Phase 2a in November 2015, work has continued to refine the scheme to reduce its environmental effects, to resolve some previously unexplored engineering issues and to improve value for money. This has resulted in some design changes that have been incorporated into the scheme that are being consulted on before deciding whether to incorporate them into the hybrid Bill scheme.

3.3.8 That consultation is taking place in parallel with consultation on the working draft EIA Report. Each of the proposed changes to the design are described in the Design Refinement Consultation document and in the working draft EIA Report. In the event that following public consultation the Secretary of State decides not to include one or more of the proposed changes in the hybrid Bill scheme, his decision will be reflected in the formal EIA Report.

Property consultation

3.3.9 A formal property consultation took place for Phase 2a between 30 November 2015 and 25 February 2016. The purpose of the consultation was to inform the Government's decision on whether the compensation and assistance schemes in place for Phase One need to be amended for Phase 2a, based on the views of those individuals and organisations who expressed their opinions on the proposals. The outcome of this consultation are summarised in HS2 Phase Two: West Midlands to Crewe Property Consultation 2015[63].

3.3.10 A programme of property consultation events has also been undertaken route-wide since November 2015. The purpose of the property consultation was to give stakeholders the opportunity to speak with HS2 Ltd property, environment and engineering specialists about the details of the Government's proposals for compensation and assistance for property owners.

Consultation on the draft Scope and Methodology Report

3.3.11 The scope and methodology of the assessment reported in the working draft EIA Report is set out in the draft SMR[64] (unless otherwise stated). The draft SMR was subject to consultation from 8 March 2016 to 13 May 2016. It was issued, as part of the consultation process, to statutory bodies, non-government organisations (NGOs) and local authorities (including parish councils). It was available on the Government's website, allowing comment by local interest groups and the public. The draft SMR was amended in response to the consultation. The revised SMR, and a consultation summary report, is published alongside the working draft EIA Report. The assessment reported in the formal EIA Report will be based on the revised SMR.

National Environment Forum and Ministerial roundtable

3.3.12 The National Environment Forum is attended by members of key statutory and non-governmental organisations to represent the interests of local people and the wider society in respect to specific environmental issues. The forum includes representatives of government departments and relevant statutory authorities such as Historic England, Natural England and the Environment Agency.

3.3.13 The forum meets quarterly and provides advice on environmental policy, including project-wide mitigation strategies and principles. Bilateral meetings are also conducted with stakeholders on specific issues on a case by case basis.

3.3.14 The Minister of State for Transport also holds a quarterly Ministerial roundtable meeting, with environmental NGOs. This forum is held by the DfT and provides a regular opportunity for organisations with appropriate expertise and knowledge and

[63] Dialogue by Design (2016), HS2 Phase Two: West Midlands to Crewe Property Consultation 2015, a report to HS2 Ltd and the Department for Transport, April 2016. Available on-line at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/526063/HS2_Phase_2a_Property_Consultation_2015_Response_Summary_Report.pdf.

[64] Arup/ERM (2016) HS2 Phase Two: West Midlands to Crewe EIA Scope and Methodology Report – draft for consultation, March 2016. Available on-line at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506111/HS2_Phase_2a_EIA_Scope_and_Methodology_Report_Final_for_Comms_08-03-2016_WEB_1400.pdf.

the Secretary of State for Transport (or representative Minister) to discuss national level environmental issues relating to HS2.

3.3.15 Members of the forum include the Campaign to Protect Rural England, the Campaign for Better Transport, the National Trust, the Wildlife Trusts, Woodland Trust and the Ramblers. The forum provides the opportunity for open discussion about environmental and sustainability issues and considers how the Proposed Scheme could contribute to or enhance the environment it passes through.

Engagement with wider technical and specialist stakeholders

3.3.16 Engagement is ongoing with wider technical and specialist stakeholders, beyond the national and statutory stakeholders engaged through the National Environment Forum and Ministerial roundtable.

3.3.17 These stakeholders include regional or community interest groups, such as the Staffordshire Wildlife Trust and the Cheshire Wildlife Trust, and organisations such as the Canal & River Trust and the Cannock Chase Area of Outstanding Natural Beauty (AONB) Unit.

3.3.18 Specific engagement has been sought with relevant specialist practitioners to inform specific technical assessments. This has included a collective meeting of environmental health practitioners and a meeting with local planning authority archaeologists. Engagement with public health representatives is also underway.

3.3.19 Engagement is also ongoing with utility companies and statutory stakeholders such as National Grid, Severn Trent, Network Rail, and the Oil and Pipelines Agency.

3.3.20 This engagement has focused on ensuring that technical and specialist stakeholders inform all stages of the design and assessment of the Proposed Scheme, from alternatives assessment to identification of specific technical impacts and mitigation.

Engagement with local authorities and parish councils

3.3.21 Direct engagement has been undertaken with local authorities and parish councils to collate appropriate local baseline information, identify and understand issues and concerns, and provide a mechanism for ongoing dialogue and discussion on the emerging assessment.

3.3.22 Engagement has focused on the technical areas that inform the assessment, including traffic and transport, cultural heritage, water resources and flood risk, ecology and biodiversity, landscape and visual, sound, noise and vibration, amongst others topics.

3.3.23 This engagement will continue to be undertaken to inform the evolving design and the assessment that will be reported in the formal EIA Report.

Engagement with farmers and growers

3.3.24 Engagement is ongoing with farmers and growers whose land or property would be directly affected by the Proposed Scheme both permanently and temporarily. The purpose of this engagement has been to provide each farmer and grower with the opportunity to raise issues and opportunities in relation to the Proposed Scheme.

3.3.25 Engagement has also enabled farmers and growers to understand potential impacts on the basis of the current draft design and opportunities for mitigation to be incorporated into the development of the Proposed Scheme. For example, the location of environmental mitigation has been refined to reduce the loss of agricultural land and the location of accommodation overbridges across the route have been refined to better reflect the need of farmers. Eighty four site visits to potentially affected farmers and growers have been undertaken since January 2016. These visits will continue, as appropriate.

3.3.26 Engagement is also continuing with key representatives for the farmers and growers industry, in particular with the National Farmers Union and Country Land and Business Association.

Engagement with wider property owners and directly affected individuals

3.3.27 In addition to formal property consultation, direct engagement has been undertaken with individual businesses and charities who may be affected. These include businesses such as the Staffordshire County Showground and charitable organisations such as the Combined Handicapped and Disabled Society (CHADS) at Handsacre.

3.3.28 The purpose of this engagement has been to provide such owners with the opportunity to raise issues, understand the nature of potential impact and discuss mitigation, in relation to the Proposed Scheme. This engagement is ongoing.

Engagement with communities and community representatives

3.3.29 Community stakeholders in the area include a range of local interest groups, local facility and service providers, schools and educational establishments.

3.3.30 The purpose of this engagement has been to give affected communities the opportunity to raise issues and opportunities in relation to the Proposed Scheme. Community stakeholders have been provided information on the development of the Proposed Scheme, as a basis to identify potential impacts and opportunities for mitigation within the local area, reflecting local conditions and identified issues.

3.3.31 Engagement has and will continue to be undertaken with schools and educational establishments such as Yarlet School, and in particular, those close to the Proposed Scheme and those with specialist interests or catering to the needs of vulnerable people within the community such as Rugeley School. This has informed the assessment of community and health in the working draft EIA Report.

3.3.32 Engagement with local communities is co-ordinated by HS2 Ltd's stakeholder engagement and community representatives. It is being supplemented where necessary by meetings and engagement with organisations and individuals, particularly in relation to specially affected groups.

Consultation on the working draft EIA Report

3.3.33 Consultation on the working draft EIA Report is taking place over an eight-week period from September to November 2016. Copies of the working draft EIA Report have been made available in public libraries and on the HS2 Ltd website

(www.gov.uk/hs2). Public events are being held in communities across the Proposed Scheme as part of the consultation. Feedback from communities attending these events will be used to consider the further development of the Proposed Scheme and its environmental assessment, and will be reflected in the formal EIA Report that will accompany the Bill for Phase 2a. A summary of these changes will be provided in a Consultation Summary Report, which will be published when the Bill is deposited. The Bill is due to be deposited in Parliament by the end of 2017.

Other consultations

3.3.34 A consultation is also taking place on the Design Refinements Consultation and a working draft Equality Impact Assessment Report in parallel with the consultation on the working draft EIA Report. Details of the closing date for comments, and the address to which comments should be sent are available online at www.gov.uk/hs2.

3.4 Future consultation and engagement

Introduction

3.4.1 HS2 Ltd will continue to engage with the public and other stakeholders following the consultations. Feedback from ongoing engagement will continue to be considered during the design and assessment of the Proposed Scheme.

Planning forum

3.4.2 The planning forum will be the main mechanism for discussion on planning matters between HS2 Ltd and the local authorities affected by the Proposed Scheme. It will focus on matters of route-wide interest.

3.4.3 It is anticipated that the planning forum and its sub-groups will commence in early 2017 and will focus on matters associated with powers contained in the Bill. Specific technical disciplines have been meeting with local authorities to discuss technical matters outside of these forums.

Parliamentary consultation and petitioning

3.4.4 Parliament will be undertaking public consultation on the formal EIA Report. Consultees will have at least 56 days (eight weeks) to respond to the consultation following the deposit of the Bill documents in Parliament and the first publication of the necessary newspaper notices that follows. Parliamentary officials will appoint an independent assessor who will summarise responses and provide a report to Parliament before Second Reading of the Bill.

3.4.5 There will also be a petitioning period. This petitioning period will provide an opportunity for individuals or organisations specially and directly affected by the Proposed Scheme to petition against the Bill. More information on who may petition against the Bill, and how to do so, is available on Parliament's website (http://www.parliament.uk).

4 The Proposed Scheme

4.1 Introduction

4.1.1 This section provides a summary description of the Proposed Scheme, which is shown in Figure 2. Detailed route descriptions at a local level are contained in Section 2.2 of the Volume 2, community area reports. The community areas that have formed the basis for the EIA are:

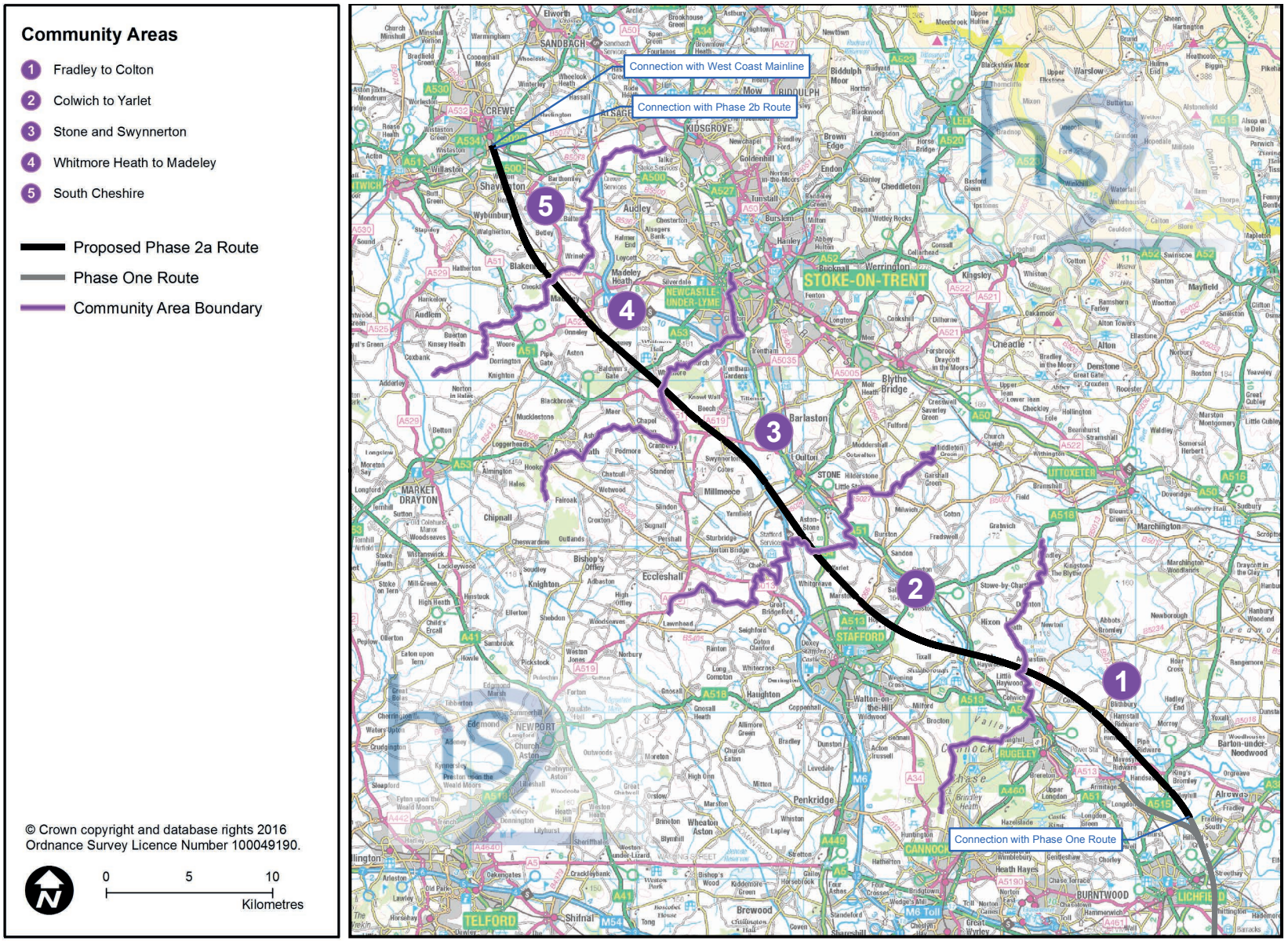
- community area 1: Fradley to Colton;
- community area 2: Colwich to Yarlet;
- community area 3: Stone and Swynnerton;
- community area 4: Whitmore Heath to Madeley; and
- community area 5: South Cheshire.

4.1.2 This section also provides a description of:

- the interfaces with Phase One and the proposed Phase 2b scheme;
- the background to the proposals for the new 'Crewe Hub' railway station (although this does not form part of the Proposed Scheme); and
- the anticipated services and operating characteristics of the Proposed Scheme.

4.1.3 Please refer to section 5 for more information on the main permanent features described below.

Figure 2: Community areas



4.2 Description of the Proposed Scheme

4.2.1 The Phase 2a route comprises a high speed railway line from the Phase One route at Fradley, to Crewe. It would run north-east of Stafford and south-west of Stone, crossing a mainly rural area with small settlements in Staffordshire and Cheshire East.

4.2.2 Phase 2a would connect with the Manchester spur that forms part of Phase One at Fradley, to the north-east of Lichfield. It would continue northwards across the River Trent floodplain, over a distance of approximately 3km, on a series of embankments and viaducts. Maintenance loop sidings would be located to the north of Pipe Ridware.

4.2.3 The route would pass between the villages of Stockwell Heath and Colton on embankment, before crossing Moreton Brook on viaduct. It would continue into a cutting with a retaining wall past Moreton House, a Grade II listed building used as a residential home for Rugeley School (The Mayfield Children's Home), emerging onto embankment. The route would cross the Colwich to Manchester railway, run adjacent to the Great Haywood Marina, cross the Trent and Mersey Canal and then cross the River Trent for the second time. The route would then cross Lionlodge Covert, an area of deciduous woodland and designated Local Wildlife Site, on an embankment. At this point, the route would be approximately 1km to the south of Pasturefields Salt Marsh Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI).

4.2.4 The route would enter a cutting through Ingestre Park Golf Club then pass through a section of Staffordshire County Showground. It would pass through Hopton in a false cutting behind a landscaped retaining wall, and south-west of Hopton Heath registered battlefield at a distance of approximately 500m or more. It would then pass Marston on embankment and continue on a series of embankments and cuttings, following the M6 corridor and crossing Filly Brook and the Norton Bridge to Stone Railway on a viaduct. The route would cross the M6 near Stone and Yarnfield. A construction railhead would be located adjacent to the M6 to the west of Stone, utilising land both north and south of the Norton Bridge to Stone Railway.

4.2.5 The route would pass to the north of Swynnerton on an embankment close to an area of historic landscape that includes Swynnerton Historic Parkland. Continuing north, the route would pass Swynnerton Old Park in a cutting. It would continue into the Meece valley on an embankment and then cross Meece Brook on a viaduct, before passing through the higher ground west of Whitmore.

4.2.6 The route would cross the A53 Newcastle Road to the south-east of Whitmore Heath, in a cut-and-cover tunnel of approximately 250m in length. This would be followed by twin bored tunnels of approximately 750m in length under the settlement of Whitmore Heath. The route would emerge and pass through Whitmore Wood ancient woodland in a cutting with a retaining wall. The route would enter the River Lea valley on an embankment, passing several historical landscape features, including Hey House, a Grade II listed building, and Old Madeley Manor Scheduled Monument. It would continue on a viaduct over the River Lea, WCML and the out of use Silverdale line of the Stoke to Market Drayton Railway.

4.2.7 Extending northwards towards Crewe, the route would continue in a cutting before entering a bored tunnel, approximately 670m in length, to the west of Madeley close to Barhill Ancient Woodland. The route would continue in a shallow cutting before

continuing onto embankment and crossing Checkley Brook and the River Lea floodplain on a viaduct.

4.2.8 The route of the Proposed Scheme would then run on embankment before transitioning into a shallow cutting, passing under an overbridge and towards Den Lane.

4.2.9 Continuing northwards, the route of the Proposed Scheme would pass under a viaduct, which would carry two spurs over the route to connect with the WCML to the east of the Proposed Scheme. For the Proposed Scheme to integrate with the existing WCML, modifications would be required including a new section of WCML and modifications to the southern and northern parts.

4.2.10 The route of the Proposed Scheme would continue in a retained cut for approximately 1.5km before reaching a headwall[65]. This would form the boundary between the Phase 2a route and Phase 2b, and be the point from which tunnelling works for a tunnel under Crewe would be constructed as part of the Phase 2b route to Manchester.

4.2.11 Access tracks to connect the route of the Proposed Scheme with an infrastructure maintenance depot would run along the western side of the route of the Proposed Scheme. It is currently anticipated that permanent maintenance facilities, in the form of an Infrastructure Maintenance Depot (IMD), would be located at the northern end of the Phase 2a area, on an area of approximately 37 hectares and extending for three kilometres to the west of the route of the Proposed Scheme. The IMD would provide a central store and help maintain high speed trains on the Phase 2a route, as well as the full western leg of Phase Two (to Manchester) once the full Y network is operational. The IMD would be supported by maintenance loop facilities at Pipe Ridware, in the Fradley to Colton area (community area 1).

4.2.12 As part of the developing design, an alternative option to relocate the permanent maintenance facilities in the Stone and Swynnerton area (community area 3) at the site identified for the temporary Stone railway main compound is being considered. This is being evaluated and should it be selected as the preferred location for the depot, the impacts of this would be assessed and reported in the formal EIA Report.

4.3 Phase 2a interfaces

Interface between Phase One and Phase 2a

4.3.1 The Phase 2a route would connect with the Manchester spur that forms part of Phase One at Fradley. This interface has been located and designed to enable the Proposed Scheme to be constructed without adversely affecting the operation of Phase One.

4.3.2 As part of Phase One, a junction with the existing WCML will be developed near Handsacre. The proposed spur provided in Phase One for the Phase Two route commences alongside Fradley Park. The spur passes over the HS2 line connecting to the WCML at Handsacre (the Handsacre link). The spur will include the junction off the Phase One line and an embankment approximately 1.3km in length, with an

[65] A wall built at the end of the retained cut.

underpass for the realigned Wood End Lane and a viaduct over the Trent and Mersey Canal. The construction of the spur will end just to the north of the Trent and Mersey Canal at Fradley. Landscape mitigation planting proposed, as part of Phase One, for the area at the end of the spur will be modified to enable the connection to the Phase 2a scheme.

4.3.3 The cumulative effects of Phase One and Phase 2a will be assessed and reported in the formal EIA Report.

Interface between Phase 2a and Phase 2b

4.3.4 A new junction would be constructed with the WCML, which would allow classic compatible trains using the Proposed Scheme to access Crewe Station and onward connections to the existing network towards Manchester, Liverpool, Warrington and North Wales.

4.3.5 Provision is made in the design for the HS2 mainline tracks to later continue northwards to Manchester using a tunnel under Crewe, as part of the Phase 2b route. The Phase 2a route terminates at a headwall which would form the southern end of this tunnel.

4.4 Crewe Hub

4.4.1 Network Rail is developing options for a Crewe Hub scheme, which is separate to the Phase 2a Proposed Scheme.

4.4.2 The Command paper High Speed Two: East and West can be taken as national policy support for Crewe Hub. It sets out, in paragraphs 6.14 and 6.15, the emerging options for a Crewe Hub station, noting that options work being undertaken by Network Rail and HS2 Ltd (with CEC) is now focused on two locations (the existing Crewe station and Basford sidings) and that the Government is 'working towards reaching a preferred approach in autumn 2016'.

4.4.3 An appraisal of the cumulative effects of constructing and operating the Proposed Scheme and Crewe Hub, insofar as information is available at the time of the assessment, will be reported in the formal EIA Report.

4.5 Services and operating characteristics

Overview

4.5.1 Making the most of the additional capacity created by HS2 will be crucial if its full benefits are to be realised. Railway timetables are always evolving in response to demand, and at this stage in the project it is too early to make detailed commitments about how HS2 will operate. However, a provisional service pattern has been identified in order to test the Economic Case and to provide an operational specification for the Proposed Scheme.

4.5.2 It is envisaged that passenger services would operate between 05:00 and 24:00 from Monday to Saturday and 08:00 and 24:00 on a Sunday. Maintenance would occur outside these hours, unless it can take place in such a way that allows trains to operate at the same time. Passenger services will start at or after 05:00 from the terminal stations and will progressively increase to the number of trains per hour in each

direction on the main lines as discussed below and as detailed within the Volume 2, community area reports. The number of services is assumed to operate every hour from 07:00 to 21:00. The number of services will progressively decrease after 21:00 and the last service will arrive at terminal stations by 24:00.

4.5.3 HS2 would be used by two types of service:

- services operating on high speed infrastructure only would use standard European-sized high speed trains (referred to as 'captive' trains); and
- services running on high speed and existing rail infrastructure would use specially designed high speed trains that are also capable of running on the existing UK rail network (referred to as 'classic compatible' trains).

4.5.4 It is assumed that classic compatible high speed trains operating between London, Manchester, Liverpool and Glasgow will, when the full Phase Two route is operational, comprise two 200m-long trains coupled together or single 200m long trains. Trains are expected to be 400m long during peak hours and a mix of 200m and 400m-long trains at other times. Up to 550 passengers will be accommodated on each 200m-long high speed train (i.e. up to 1,100 passengers for each two-unit train). To enable these trains to operate on the classic network, they will be equipped with a suitable train control system and will be of a reduced width and height.

4.5.5 The forecasted minimum journey times from London are set out in Table 3.

Table 3: Assumed journey times with Phase 2a[66]

Destination from London Euston	Journey time (hours: minutes)
Crewe	0:55
Manchester Piccadilly	1:27
Preston	1:28
Liverpool	1:32
Glasgow	3:43

4.5.6 The figures below show the peak hour train flow in each direction across the Proposed Scheme that have been assumed for the purpose of the sound, noise and vibration assessment reported in the working draft EIA Report.

4.5.7 There are three scenarios shown:

- Proposed Scheme – peak hour one-way train flow by route section (Phase One year of opening 2026) (see Figure 3);
- Proposed Scheme – peak hour one-way train flow by route section (Phase 2a

[66] As defined in the November 2015 Command Paper High Speed Two: East and West, The Next Steps to Crewe and Beyond.

year of opening 2027) (see Figure 4); and

- Proposed Scheme – peak hour one-way train flow by route section (with the whole of Phase Two operating) (see Figure 5).

4.5.8 Each scenario shows the number of high speed trains operating in each direction. The scenarios are based on each train consisting of two 200m-long trains coupled together. Note that the numbers of trains shown do not necessarily add up to form the number in the next section. This is because the values shown are the number of trains that represent a reasonably foreseeable worst case for the sound, noise and vibration assessment.

4.5.9 The currently assumed initial flows on the main section of Phase 2a is for 6tph in each direction during peak hours upon opening in 2027 (refer to Figure 4) rising to 12tph in the long term with the full Phase Two scheme open (refer to Figure 5). The flows principally used for the sound, noise and vibration assessment are those shown in Figure 5 (i.e. with the whole of Phase Two operating).

Figure 3: Proposed Scheme – peak hour one-way train flow (Phase One year of opening 2026)

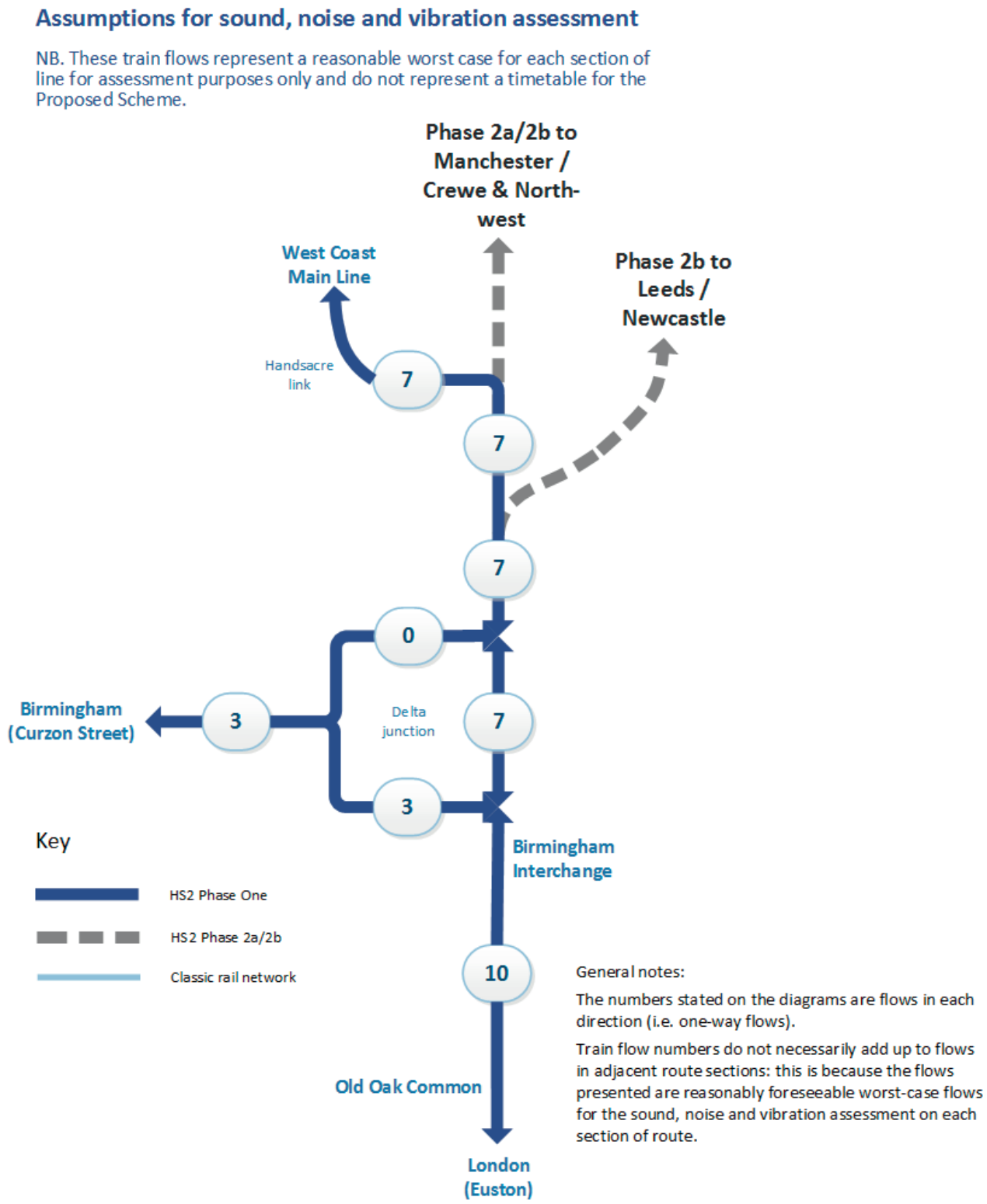


Figure 4: Proposed Scheme – peak hour one-way train flow (Phase 2a year of opening 2027)

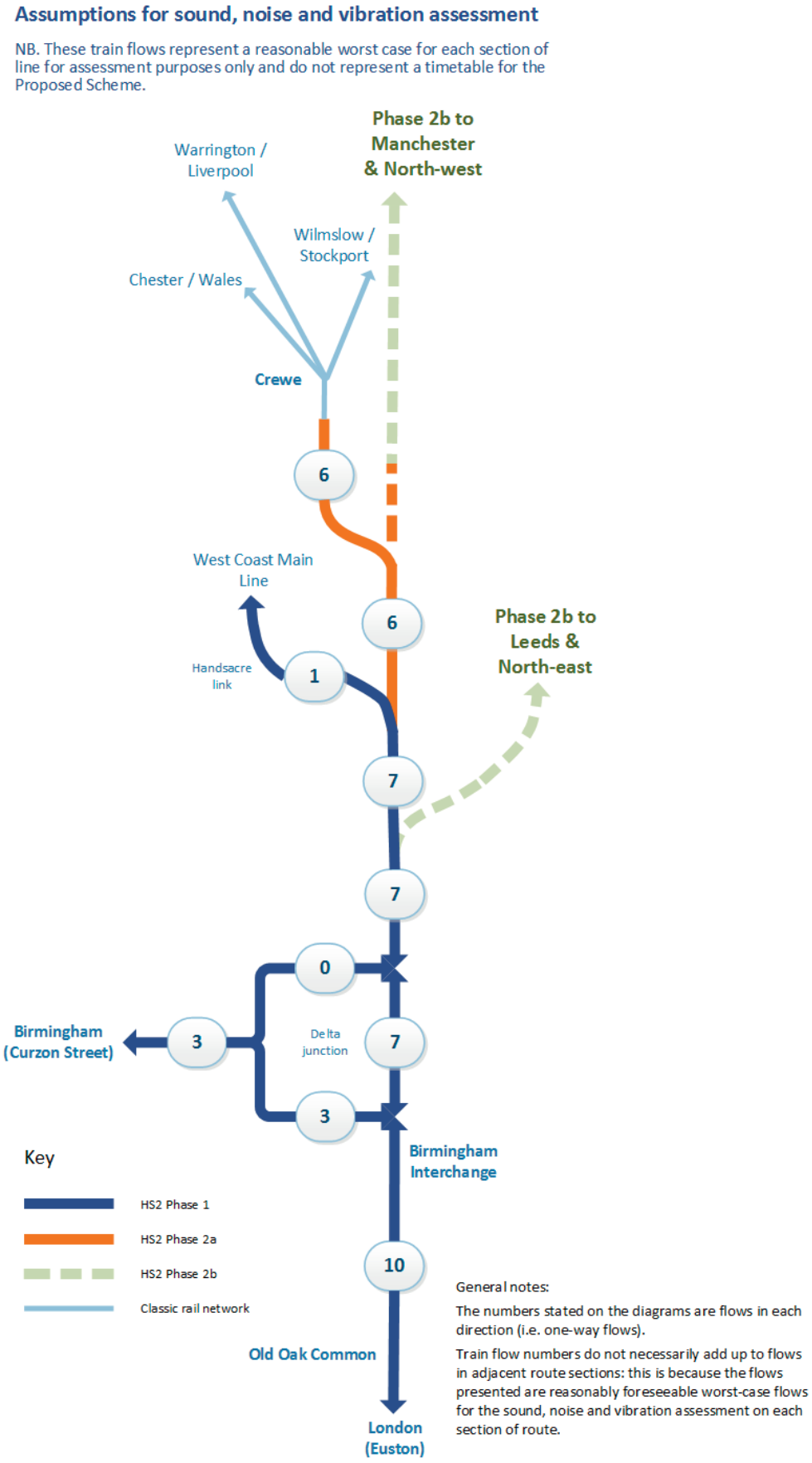
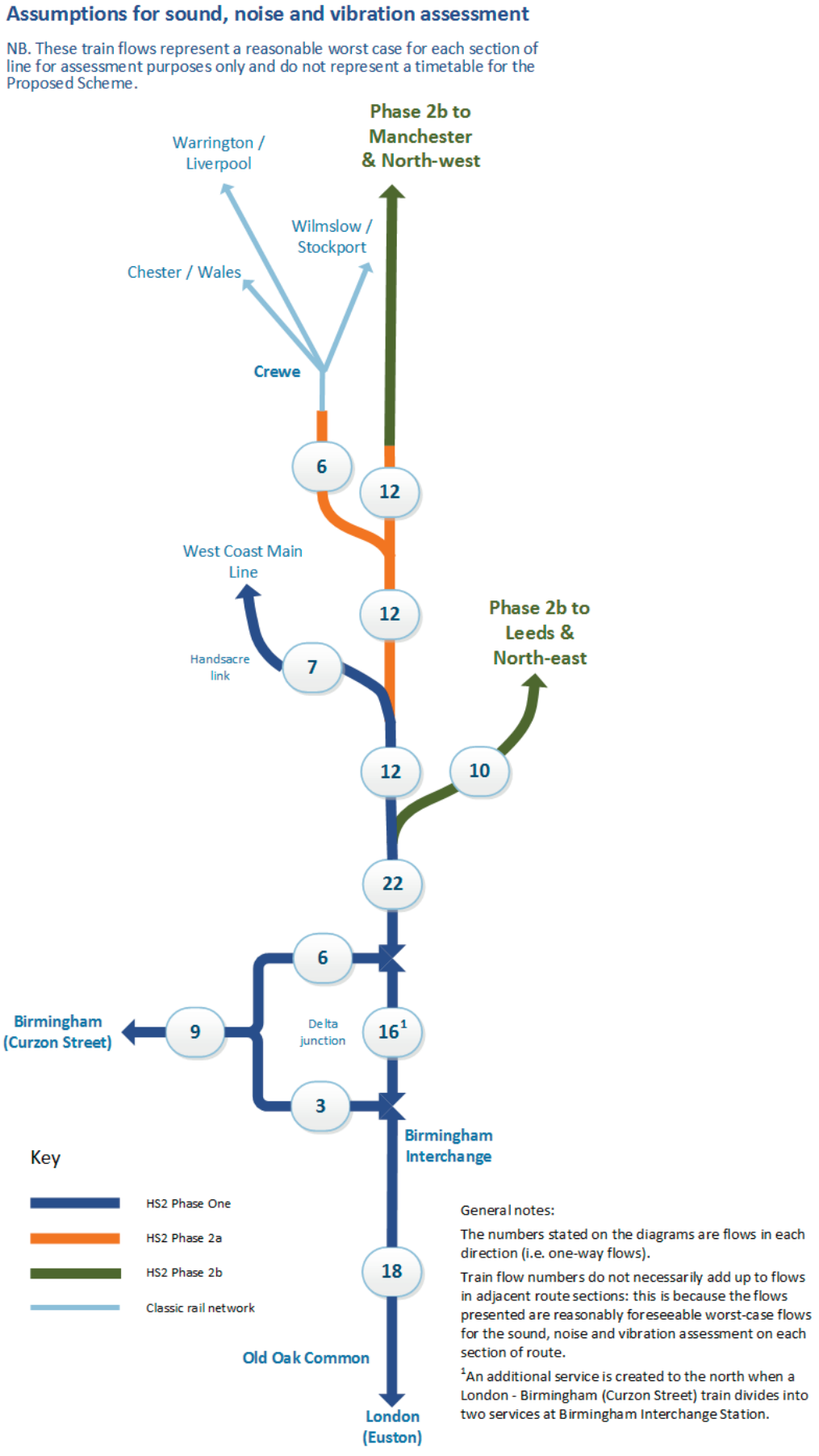


Figure 5: Proposed Scheme – peak hour one-way train flow by route section (with the whole of Phase Two operating)



4.5.10 Trains on the Proposed Scheme will operate at up to 360kph (225mph)[67]. However, the alignment of the route has been designed to allow for train speeds of up to 400kph (248mph) in the future where there is a commercial justification for doing so. Operation at up to 400kph will require demonstration that improved train design enables services to operate at that higher speed without giving rise to additional significant environmental effects.

4.5.11 The operating speeds over each section of the route are anticipated to be as follows:

- up to 360kph on the HS2 mainline between the interface with Phase One (the Handsacre junction) and Crewe; and
- up to 230kph on the spurs that will connect HS2 to the WCML at Crewe.

4.5.12 The technical and operational specification for the Proposed Scheme is derived from the European Union's Technical Specifications for Interoperability (TSI)[68], which defines the requirements for all new high speed railways and their connections to classic rail networks.

Maintenance of operational infrastructure

4.5.13 The maintenance regime will include inspection and monitoring to predict and prevent changes to the condition and performance of infrastructure that might affect operation of the Proposed Scheme. This will be achieved through:

- remote condition monitoring of assets;
- measurement systems fitted to passenger rolling stock that monitor that physical interaction between train and rail system assets; and
- the frequent operation of infrastructure measurement trains which record the condition of infrastructure assets.

4.5.14 Viaducts and tunnels will be examined from rail-mounted vehicles equipped with appropriate lifts and access platforms. Civil engineering assets will be monitored using condition sensors.

4.5.15 Other elements of the maintenance regime will include:

- inspection and maintenance of electrical and mechanical equipment such as auto-transformers, including lineside locations;
- preventative maintenance of the track systems using dedicated works trains for track alignment corrections, grinding of rails and other heavy-duty operations;
- preventative maintenance for other equipment 'maintenance by replacement' whereby components are exchanged, to be serviced offline in a depot or factory;

[67] Timetables are likely to use 330kph as a basis for most trains (assumed 90% of services), and 360kph for 10% of services.
[68] European Railway Agency. Multiple Technical Specifications for Interoperability (TSI). Available online at: http://www.era.europa.eu/Core-Activities/Interoperability/Pages/TechnicalSpecifications.aspx

- planned periodic refurbishment and replacement of assets;
- during the life of the railway, elements of the railway system will need to be replaced on the basis of condition criteria, although civil infrastructure such as tunnels and viaducts will be maintained in perpetuity through servicing and repair of structural elements to avoid the need for replacement; and
- update or replacement of control and telecommunication systems and other software-based elements, depending on technological developments and obsolescence.

4.5.16 The assumptions underpinning the maintenance regime include:

- maintenance within the operational rail corridor will take place between the hours of 24:00-04:59 on Monday to Saturday and 24:00-07:59 on Sunday, outside passenger train operating hours;
- design, system and process will separate maintenance activity and staff from operating passenger trains;
- safe compounds will be established by isolating traction power supply from the control centre, with coordination between power and traffic control to allow quick and efficient access;
- where reasonably practicable, mechanical and electrical equipment will be located to allow servicing from a safe and secure location and without affecting operations;
- maintenance affecting services will be largely mechanised and undertaken from rail-based vehicles, including the use of mobile factory trains[69]; and
- maintenance trains will be of a hybrid type, with diesel engines.

Maintenance depots and operational staff

4.5.17 Infrastructure maintenance operations will be managed and resourced from maintenance and operational facilities along the HS2 route.

4.5.18 Infrastructure maintenance activities will occur when train services are not operating. Any exception to this would be during a serious occurrence that has a major effect on commercial service. Maintenance facilities will be operational 24 hours a day, 365 days a year.

4.5.19 Other maintenance and repair activities for systems such as traction power distribution or train control will largely be carried out away from the operational railway.

[69] A train that carries all necessary equipment and supplies to carry out the required maintenance activities of the track and rail corridor. The trains may be stationed at depots, or on maintenance loop sidings (allowing maintenance at night at more remote locations). It can also carry workers required for maintenance. The use of mobile factory trains avoids the need to have equipment and materials being delivered to the trackside via HGVs.

4.5.20 Infrastructure maintenance operations, including routine line checks and replacement of track and overhead line equipment (OLE), will be managed and resourced from the proposed IMD that forms part of the Proposed Scheme south of Crewe.

4.5.21 Activities managed and resourced from the IMD will include: support of rail maintenance vehicles that will carry out track inspections; rail grinding; ballast track alignment geometry correction and cleaning; overhead line maintenance; and inspection of structures and earthworks.

4.5.22 These activities, which also routinely take place on the classic network, will generally occur when train services are not operating. Associated plant and material will also be stored and transported to site by rail, supported by maintenance loop facilities, (refer to section 5.10), located near Pipe Ridware. The IMD will be operational 24 hours a day, 365 days a year and up to 300 maintenance staff will be required to undertake these works.

4.5.23 Other maintenance and repair activities for systems such as traction power distribution or train control will largely be carried out away from the operational railway.

5 Permanent features of the Proposed Scheme

5.1 Design

5.1.1 The design of Proposed Scheme will be developed in line with the HS2 Design Vision[70], which was published in June 2015. In addition, the Secretary of State has established an independent Design Panel, so as to ensure that designs of structures and other related aspects of the new railway will complement local aspirations and contribute to the natural and built environment. The Design Panel will assist HS2 Ltd through advice, and HS2 Ltd will work in partnership with a range of organisations, including planning authorities. The aim will be to deliver a high standard of design that is also cost-effective and sustainable.

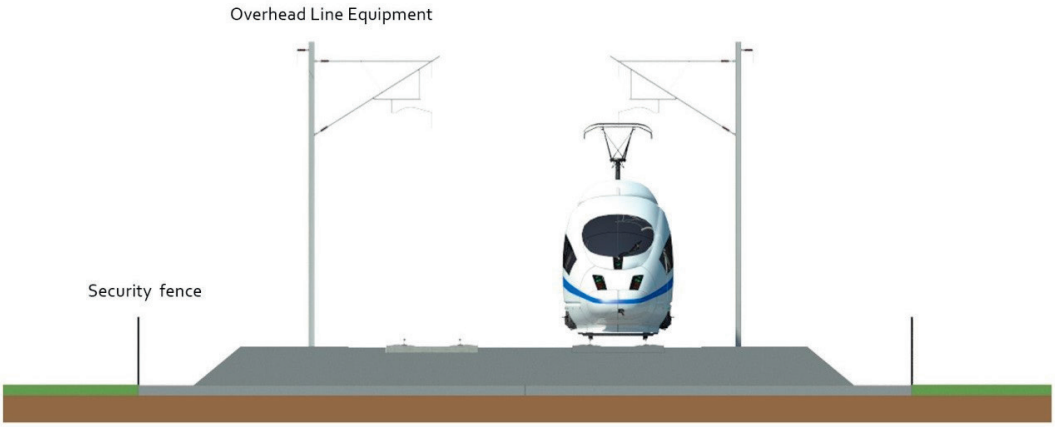
5.2 Rail corridor

5.2.1 In most locations the route will comprise two railway tracks, one for northbound and one for southbound services. The width of the rail corridor may vary along its length to accommodate the topography and cuttings and embankments. The rail corridor will, in general, encompass the two tracks, associated OLE, track drainage, electricity cables, cable ducting, line-side walkways and noise fence barriers, where required. The rail corridor will be continuously fenced, with the type of fencing used at each location dependent on the functional requirements and its context (e.g. whether in an urban or rural setting).

5.2.2 An indicative cross section through a two-track rail corridor at ground level is shown in Figure 6.

[70] HS2 Ltd (2015), HS2 Design Vision – Preview Publication, June 2015. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/475052/HS2_Desgn_Vision_2015.pdf

Figure 6: Indicative two-track rail corridor



5.2.3 In some locations the railway corridor will be wider to accommodate four tracks. This will be necessary:

- for sections of the route where different lines converge;
- where maintenance loops are required at Pipe Ridware in community area 1; and
- on the approach to the IMD, where additional track work will be provided for trains to enter/exit the depot facilities.

5.3 Cuttings and embankments

5.3.1 Cuttings will be formed by excavation in areas where the local topography is at a higher level than the desired route alignment. Embankments will be formed by placing fill material where the local topography is lower than the desired route alignment. Embankments will also be used where the route crosses valleys and is not otherwise on bridges or viaducts.

5.3.2 An illustration of a cutting is shown in Figure 7 and an illustration of an embankment is shown in Figure 8.

Figure 7: Illustration of a generic cutting and cross-section of cutting

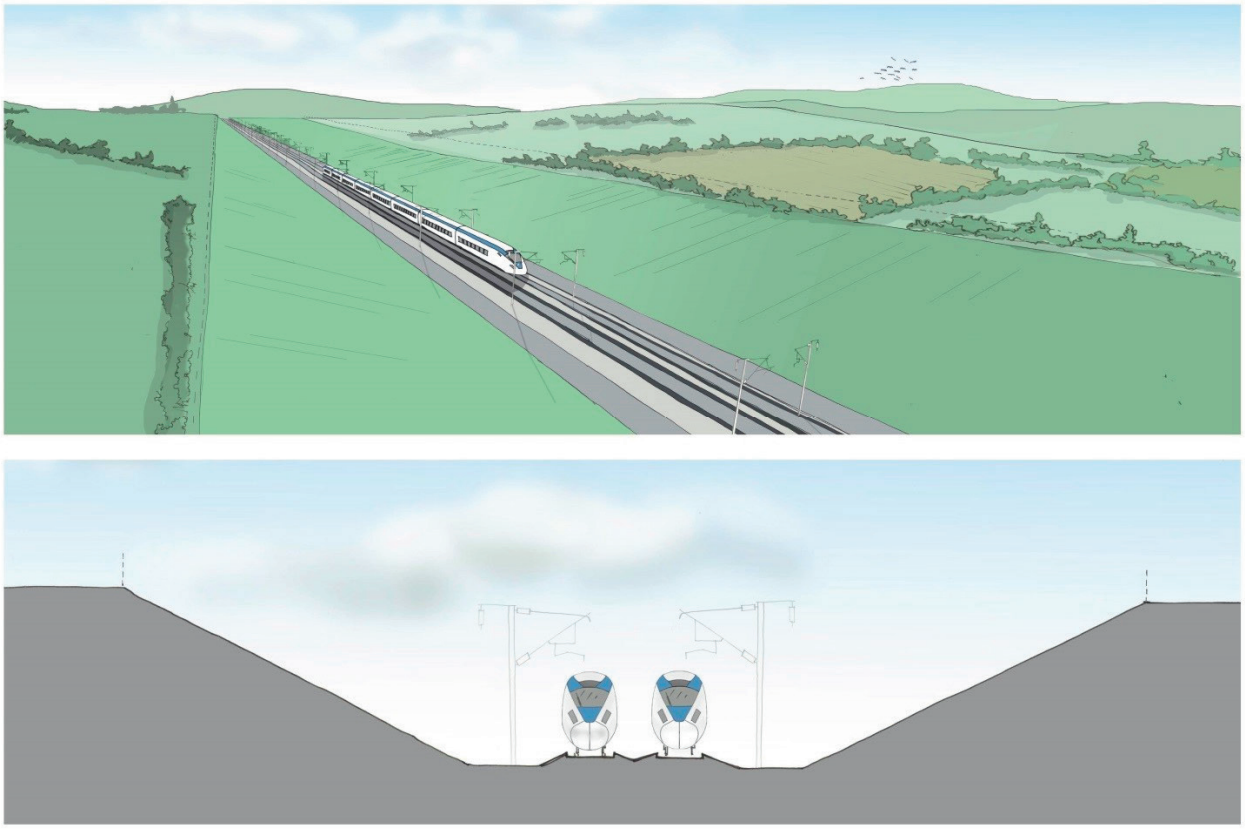
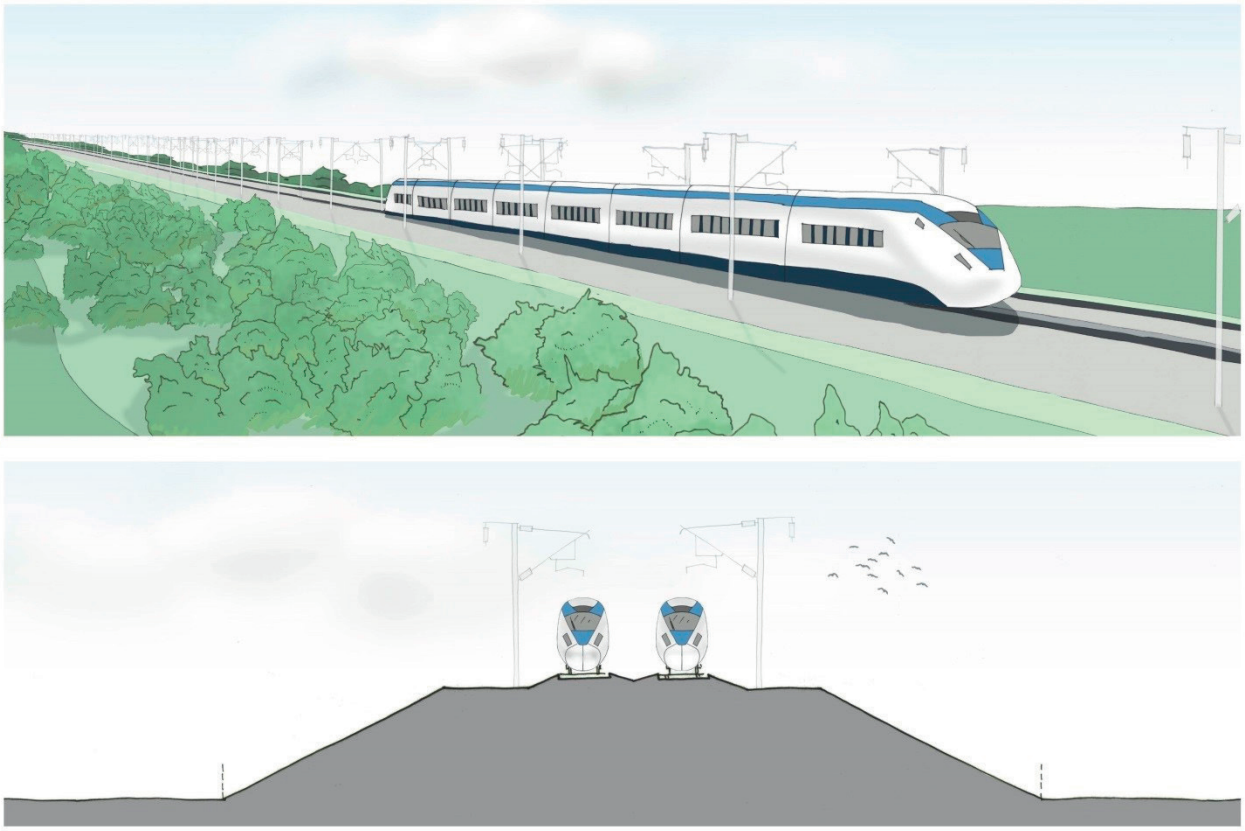
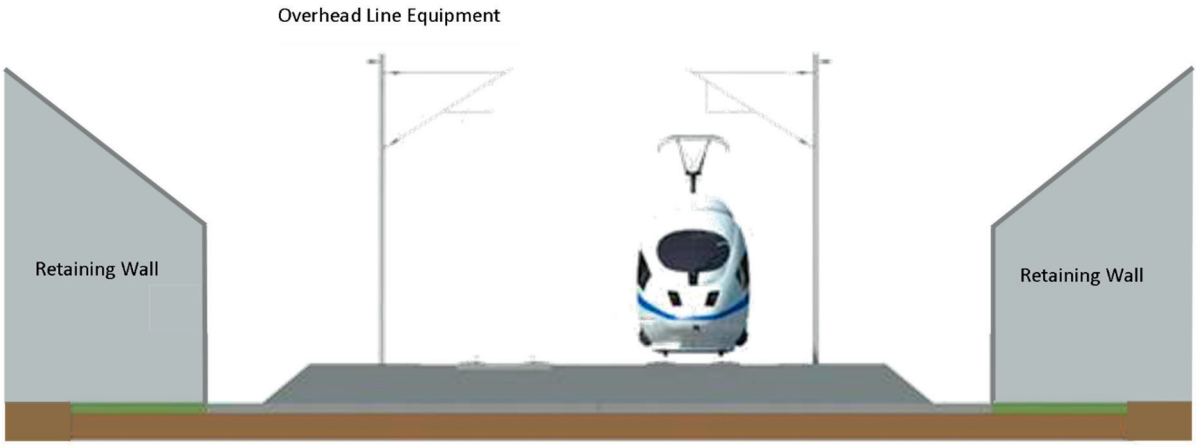


Figure 8: Illustration of a generic embankment and environmental mitigation earthworks and cross-section of embankment



5.3.3 The angle of side slopes for cuttings and embankments, and therefore the overall width of the works, will depend on local ground conditions and topography, and on the quality of excavated material. In general, embankment slopes will be 1:2.5, that is for each metre of depth or height, the width of each slope will be 2.5 times larger. Slopes may be steepened or retaining walls may be used where space is limited; for example, where the area of land required needs to be reduced. An illustration of retaining walls is shown in Figure 9.

Figure 9: Illustration of retaining walls



5.3.4 Slopes will generally be top-soiled and seeded. In unfavourable geological conditions, stabilising elements and/or drainage may be incorporated within slopes. Where mitigation earthworks are proposed to be returned to agricultural use, arable slopes will be re-graded to no steeper than 1:8, although steeper grades may be adopted for pastoral use.

5.3.5 Priority will be given to reusing material excavated from the Proposed Scheme in the engineering earthworks to form embankments and environmental mitigation earthworks along the route. This will help to reduce the need to dispose of surplus excavated material[71] off-site, which has associated environmental effects. This approach will also reduce the impact of the Proposed Scheme by making best use of the excavated material to significantly reduce the need to import material.

5.4 Drainage and watercourse realignments

Railway drainage

5.4.1 Drainage parallel to the railway will generally comprise filter drains feeding balancing ponds at intervals along the route. These ponds are of three types: attenuation ponds, infiltration ponds and hybrid ponds. Attenuation ponds will attenuate peak flows so

[71] Excavated material will become surplus if its irrecoverable physical, chemical or bio-chemical quality precludes its use in the Proposed Scheme, if there is more material available than fulfils the requirements of the Proposed Scheme, or if the requirement for a type of material is too far away from the point of arising to make its use practicable.

that run-off generated from the railway track discharges at an agreed rate to a nearby watercourse, thereby reducing the risk of localised flooding. Infiltration ponds will allow runoff to be absorbed into the ground where conditions are suitable. Many of the ponds will be a hybrid combining features of both types.

5.4.2 Balancing ponds will typically be unlined and have banks with a varying profile. Their size will depend on drainage requirements. The majority will not be designed to hold water permanently, but will be dry most of the time, except following intense rainfall events. They will be designed to accommodate a one in 100 year annual rainfall probability event, with an allowance for climate change.

5.4.3 Surface water runoff within built-up areas may need to be discharged to the urban drainage system (usually a surface water or combined sewer) at a controlled rate.

Buildings and facilities drainage

5.4.4 Sewage from the IMD and other manned facilities will be discharged into adjacent sewers, where available with appropriate capacity. On-site treatment or collection of foul effluent may be necessary in specific cases.

5.4.5 Surface water runoff from buildings and areas of hardstanding (e.g. accesses and parking) will be infiltrated to ground or will be attenuated and discharged, at a rate agreed with the relevant authority, to a nearby watercourse or a sewer. The design will employ sustainable drainage systems to manage surface water runoff and improve discharge water quality. The drainage system will also incorporate pollution control devices such as oil and silt traps where necessary.

Land drainage

5.4.6 In some locations, structural and landscape earthworks will affect existing drainage systems of agricultural and other land adjacent to the new railway. Elsewhere, they will alter the existing overland flow routes helping to drain surface water runoff from fields and areas of woodland, or change the slope of the land. The design will therefore include land drainage measures to address these changes in an appropriate way.

Watercourse crossings

5.4.7 New structures will be required to carry the railway over existing watercourses, ranging from box culverts[72] to underbridges[73]. The length of culverts will be kept to a practicable minimum. Culverts will be designed for a one in 100 year annual rainfall probability event, including an allowance for climate change. Bridge soffits[74] will be raised above the one in 100 year annual rainfall probability event, including allowances for climate change and freeboard[75].

[72] A tunnel (pipe or box shaped) that carries a stream or open drain under a road or railway.
[73] A bridge carrying the Proposed Scheme over other features.
[74] The underside of a bridge.
[75] The height from the maximum design level of a watercourse to: a) the adjacent banks of an open channel, to provide a factor of safety against flooding; or b) the soffit (underside) of any culvert or bridge above, to minimise the risk of blockage by floating debris, etc.

Watercourse realignment

5.4.8 Watercourses will need to be realigned in some cases. Channel flows will be designed and maintained in consultation with the relevant drainage authority. The methods to divert watercourses are described in more detail in section 6.9.

5.4.9 Rivers and streams will be reinstated, where reasonably practicable, with a natural-looking appearance, having consideration for the requirements of the Water Framework Directive (WFD). Appropriate access will be provided to watercourses to allow for maintenance.

5.5 Highways (roads and public rights of way)

5.5.1 New, diverted or realigned roads and public rights of way (PRoW, i.e. footpaths, bridleways and byways), will be constructed to the appropriate standard for each location. All alterations to major rural roads will be designed using the UK's national standards given in the Design Manual for Roads and Bridges (DMRB)[76]. However, country lanes are very different to the main road network, and it is important to retain the existing character of these minor rural routes where reasonably practicable. Since most published standards do not cater adequately for this type of road, HS2 Ltd has developed a set of design criteria which is based on experience from the Channel Tunnel Rail Link (HS1) project and industry good practice. These will be applied where new, realigned or diverted routes are required, helping them to retain a similar 'feel' as other roads in the locality. Local authority design standards will also be used, where appropriate, together with national guidance including the Manual for Streets[77]. The shortest practicable route for realignment consistent with design and safety requirements will normally be used.

5.5.2 New or enhanced vehicular access will be required at various points to allow access to the Proposed Scheme. Facilities such as the IMD will require access at all times. Emergency access will be required to tunnel portals, whilst occasional access will be required for maintenance purposes to features such as balancing ponds, structures, landscaped areas and line-side equipment.

5.6 Tunnels

Introduction

5.6.1 Tunnels would be constructed at a number of locations along the route, as described in the Volume 2 community area reports, Section 2.2. Two methods of construction will be used:

- bored, which leaves the original surface features intact (apart from at the locations where ventilation and intervention shafts are constructed); and
- cut-and-cover, which requires temporary disruption at the surface whilst the tunnel is constructed, followed by the reinstatement of surface conditions.

[76] Department for Transport (2012), Design manual for roads and bridges. Highways Agency. UK.
[77] Department for Transport (2007), Manual for Streets. Thomas Telford publishing. London.

5.6.2 All tunnels will have portals (i.e. exit/entrance structures). The different tunnel types and features are described below.

Bored tunnels

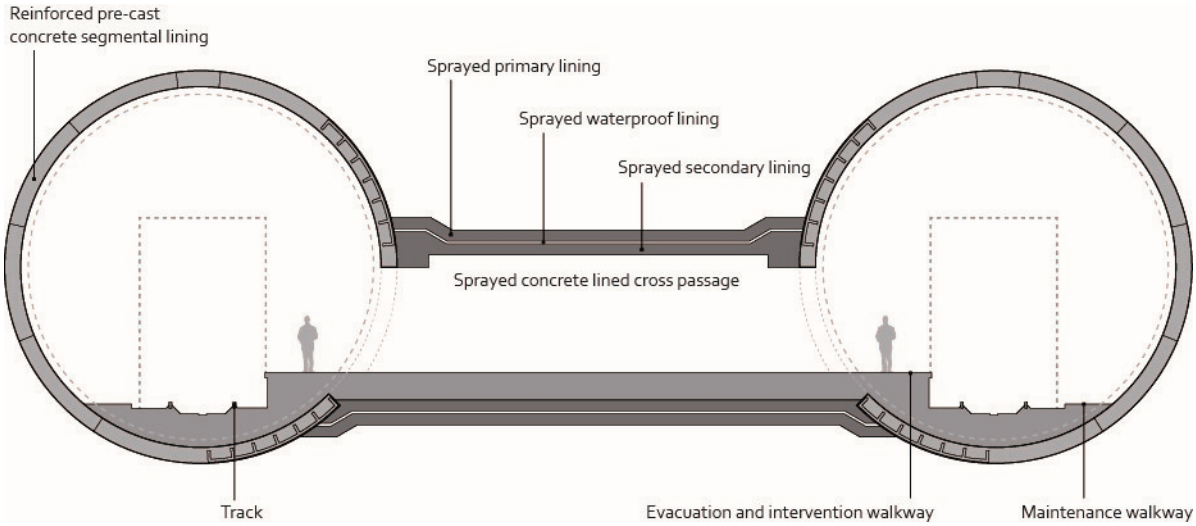
5.6.3 Bored tunnels will generally be constructed where the depth between the railway and existing ground is such that open excavation is not practicable, and where the tunnel length is sufficient to make the use of tunnelling equipment viable. Bored tunnels are currently proposed for under the settlement of Whitmore Heath, and to the west of Madeley (in community area 4, Whitmore Heath to Madeley). These will be twin-bore tunnels comprising two parallel bores, each containing a single rail track.

5.6.4 Tunnel bores will usually have an internal diameter of 8.8m. They will be approximately one tunnel diameter apart, except where they approach the portals, and will be connected by cross passages at intervals.

5.6.5 It is currently anticipated that bored tunnels will be constructed using a tunnel boring machine (TBM). Further detail about the nature and operation of TBM is provided in section 6.12. However, there is the potential for these tunnels to be constructed by mining. If this option is selected, it will be assessed and any significant environmental effects will be reported in the formal EIA Report.

5.6.6 A cross-section of a typical twin-bore tunnel is shown in Figure 10.

Figure 10: Cross-section of typical twin-bore tunnel



5.7 Portals

5.7.1 All tunnels will have portals at each entry/exit. Portals will take different forms, depending on ground conditions, local topography, train speeds and whether they need to accommodate a TBM during construction.

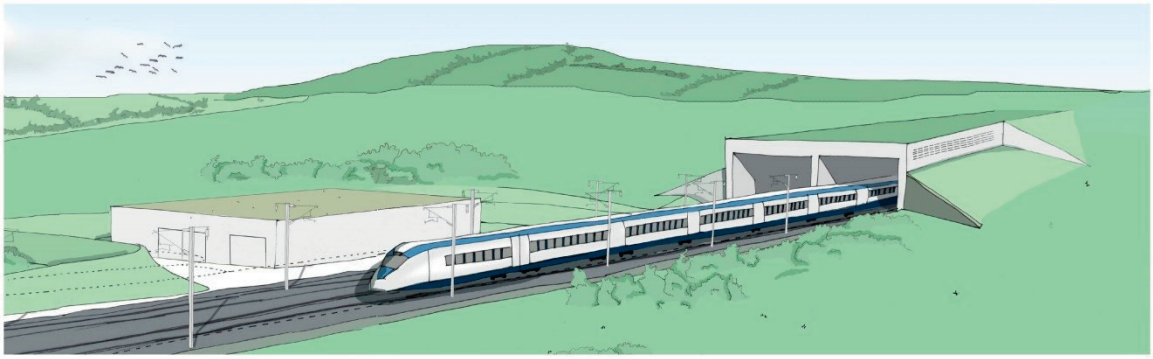
5.7.2 Tunnel portals may incorporate some or all of the following features:

- porous portal (i.e. tapered, perforated, reinforced concrete structures, to reduce air pressure effects created as trains enter a tunnel);

- mechanical ventilation[78];
- surface buildings housing services such as power, telecommunications, water supply, fire safety, drainage and ventilation equipment;
- storage tanks;
- road access for emergency services;
- escape routes;
- a 550m² area for passengers in the event of an emergency; and
- parking and hardstanding for service vehicles.

5.7.3 A generic tunnel portal in a rural location is shown in Figure 11.

Figure 11: Illustration of a generic tunnel portal



5.8 Bridges

5.8.1 Bridges are required where the route would pass over or under a feature such as a PRoW, road, river, floodplain or existing railway. The height of the bridge will be determined by the route alignment, the topography and the feature being crossed.

5.8.2 Overbridges (i.e. bridges over the Proposed Scheme) will typically be constructed of concrete or weathering steel. Typical height clearances will be 7.15m (i.e. from rail level to the underside of the bridge).

5.8.3 Intermediate piers are likely to be of reinforced concrete construction on pad or piled foundations[79], subject to ground conditions.

5.8.4 Parapets will be solid, with a height of 1.8m where above the railway lines and 1.5m on side spans in the case of multi-span structures.

5.8.5 Underbridges (i.e. bridges carrying the Proposed Scheme over other features) are likely to be constructed of reinforced concrete and/or steel. Clearances will vary as required by the type of feature being crossed. For watercourses, underbridges will be

[78] Ventilation fans will be switched off under normal conditions, but will be activated in the event of a stalled train or a fire, and for maintenance purposes. It is likely that this equipment will only operate for limited testing periods during the daytime.
[79] Pad foundation – A foundation structure that spreads the imposed loads over a sufficient area to reduce stress on foundation material. Often described as shallow foundations. Piled foundation – Deeper foundations such as piles, and diaphragm walls, where loads are distributed through the ground at depth by drilled or driven structures. Often described as embedded or deep foundations.

designed for a one in 100 annual rainfall probability event, including allowances for climate change and freeboard.

5.8.6 Figure 12 is an illustration of a single-span overbridge. Figure 13 is an illustration of a pedestrian underpass.

Figure 12: Illustration of a generic single-span bridge

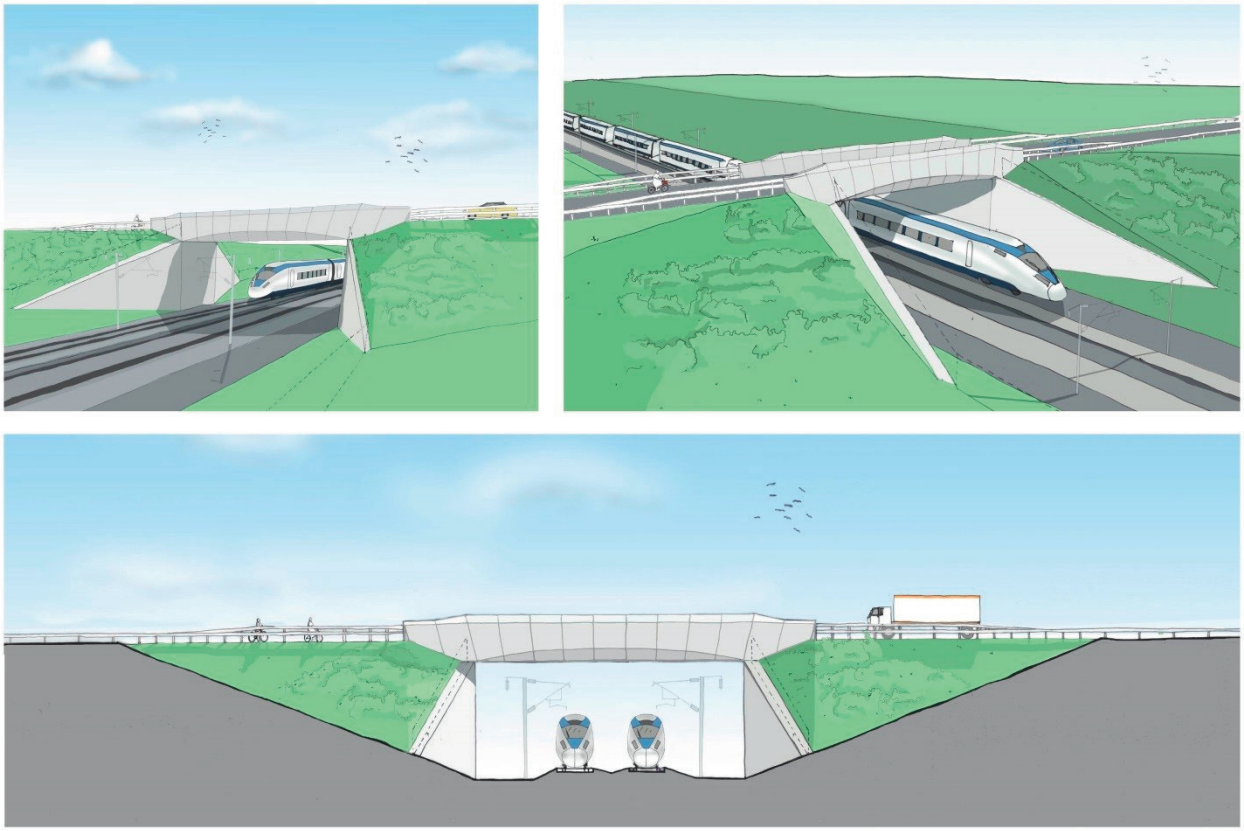
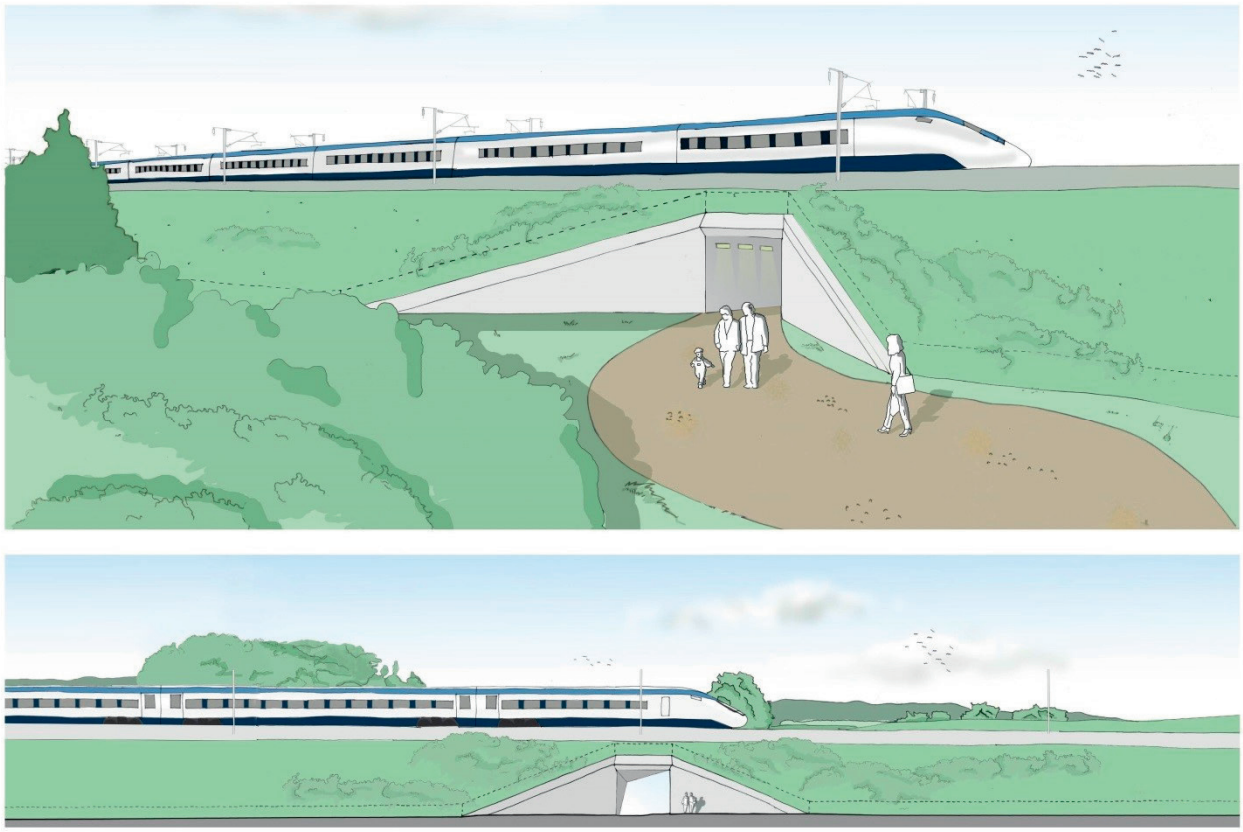


Figure 13: Illustration of a generic pedestrian underpass



5.9 Viaducts

5.9.1 Viaducts are constructed where embankments would not be a practicable or effective solution. Viaducts will generally be built where a multi-span structure is needed to provide a continuous elevated route across undulating terrain, existing roads or floodplains.

5.9.2 The height of the viaduct will be determined by the route alignment, the topography and the feature being crossed. Intermediate piers are likely to be of reinforced concrete construction on pad or piled foundations, subject to ground conditions or the construction methodology. Abutments will be constructed of reinforced concrete on pad or piled foundations. Viaducts over waterways will be designed for a one in 100 annual rainfall probability event, including allowances for climate change and freeboard.

5.9.3 Figure 14 and Figure 15 are illustrations of high and low-level viaducts.

Figure 14: Illustration of a generic high viaduct

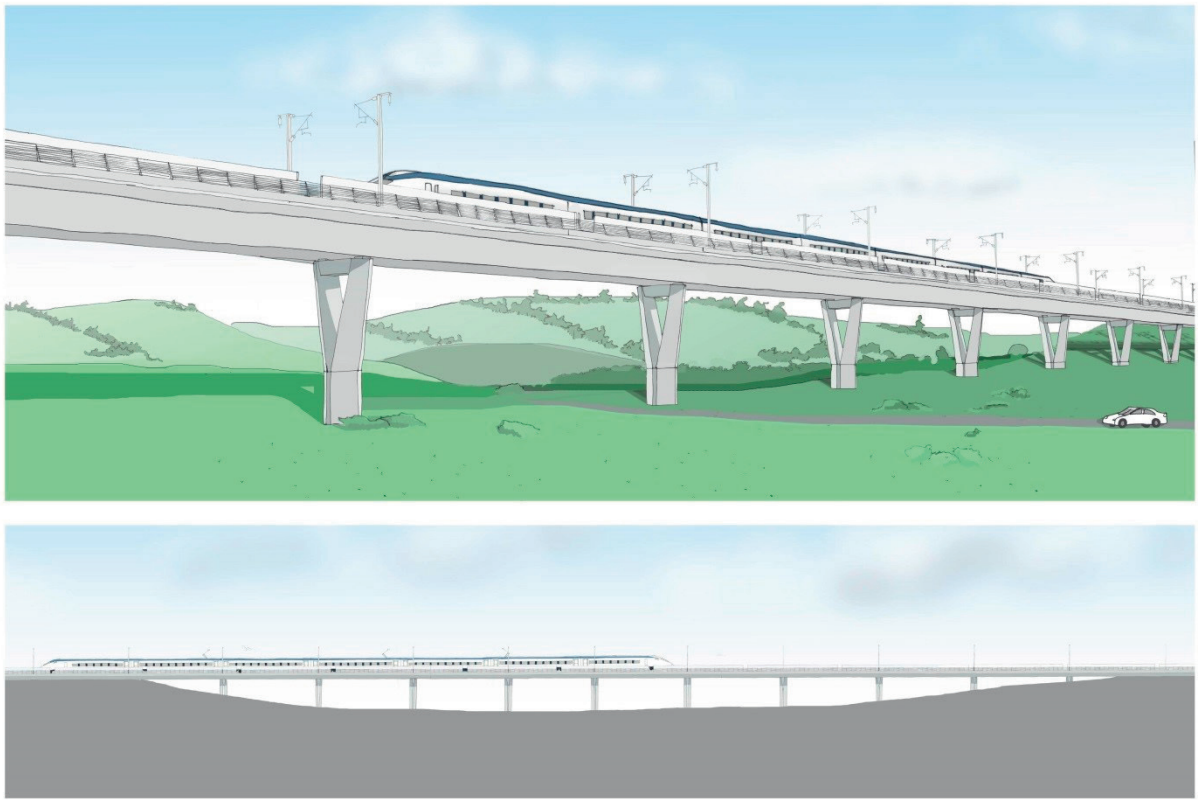
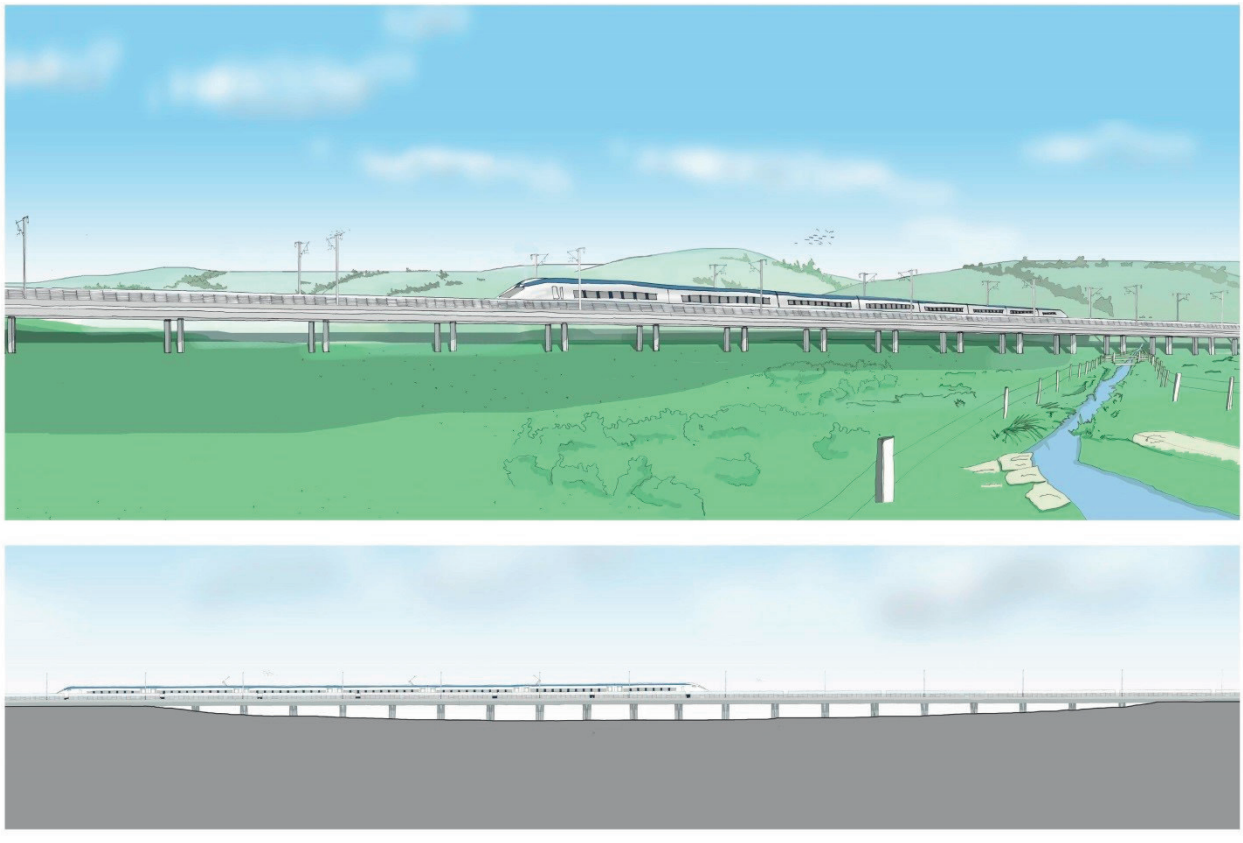


Figure 15: Illustration of a generic low viaduct



5.10 Maintenance loop sidings

5.10.1 Maintenance loop sidings will be located near Pipe Ridware.

5.10.2 Two additional tracks will be provided at this location alongside the main track, extending for approximately 1.4km. The loop sidings enable maintenance trains to be stabled temporarily without returning to the IMD to the south of Crewe. Maintenance trains may be stabled on the loop sidings during the day when maintenance activities are being undertaken over a number of nights.

5.11 Infrastructure maintenance depot

5.11.1 The IMD is described in Volume 2, Community Area Report, CA5, South Cheshire.

5.11.2 Further information on the operational maintenance regime and staffing is provided in section 4.5.

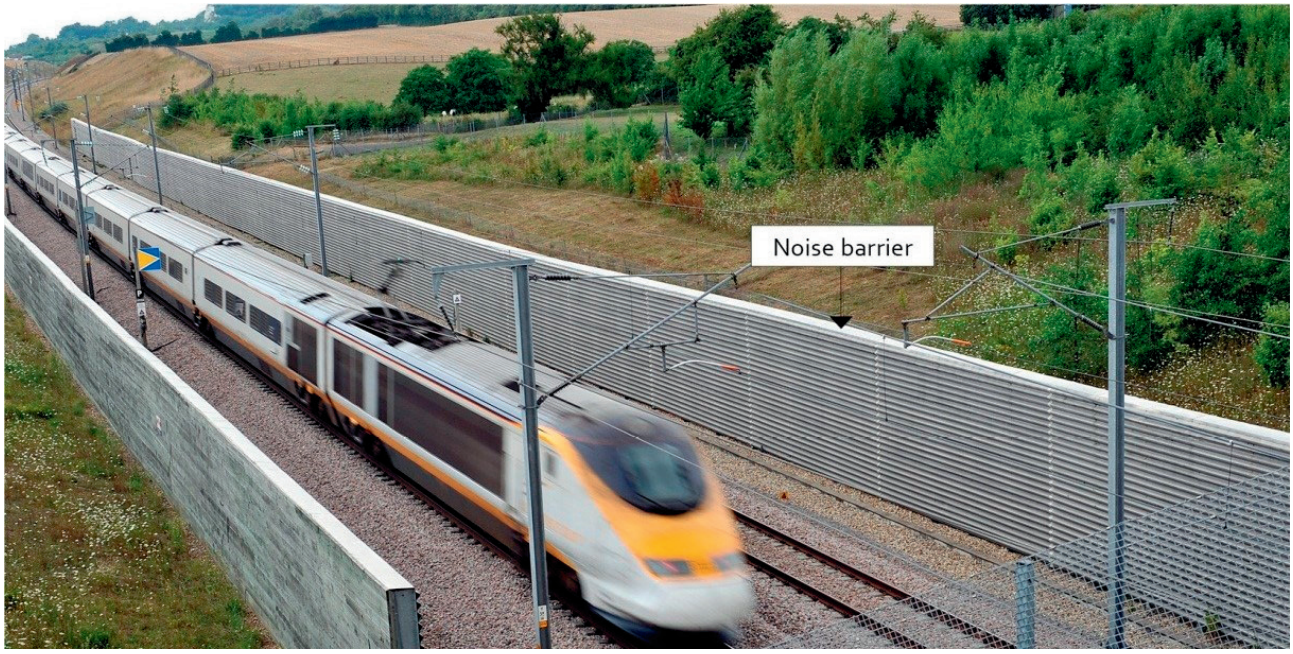
5.12 Noise barriers

5.12.1 The Proposed Scheme will include noise barriers to avoid or reduce significant airborne noise effects. The barriers will generally take the form of landscape earthworks or noise fence barriers. The locations of noise barriers are shown in the Volume 2, community area map books.

5.12.2 The extents and heights of noise barriers are designed to minimise noise effects taking into account considerations such as the benefit of the barrier, its cost; engineering practicability; and other potential impacts such as visual intrusion.

5.12.3 Noise effects will be reduced at many locations along the route by engineering structures, such as cuttings, and by landscape earthworks provided to avoid or reduce significant visual effects. An example of a noise fence barrier is shown in Figure 16.

Figure 16: Photograph of a noise fence barrier



Source: © Troika

5.13 Site restoration and landscape treatment

5.13.1 All temporary plant, materials, equipment, buildings, access roads and vehicles will be removed from the site when construction is complete. This will allow the land to be restored. Land will generally be returned to its previous use, where this is reasonably practicable and in agreement with the landowner.

5.13.2 Land will be restored to agriculture or forestry where those were the land uses immediately prior to construction, or to a condition agreed by the owner of the land and relevant planning authority. Mitigation design will be developed to respond to the appropriate landscape strategies and design objectives set out in HS2 Ltd's Landscape Design Approach[80] (e.g. to conserve, enhance, restore or transform landscapes). The following may be provided within restored areas, to compensate for, or replace, resources adversely affected during construction:

- habitat for wildlife species/habitats; and
- areas of valued landscape character.

5.13.3 Any areas of replacement habitat will be established and monitored to maintain the long-term conservation status of the species/habitat in each case.

5.13.4 Landscaped design solutions, as set out in the Landscape Design Approach, can provide multiple benefits, including visual screening, noise mitigation, habitat creation, and the protection and enhancement of heritage assets. The provision of woodland, for example, can provide:

[80] HS2 Ltd's emergingapproach to the development of landscape design along the route. The Landscape Design Approach is being produced to guide and direct professionals in the development of all landscape areas with the aim to achieve an integrated and contextually driven landscape design.

- screening and visual integration of the Proposed Scheme; and
- an interconnected and multi-functional green infrastructure network (providing enhanced resilience and biodiversity connectivity).

5.13.5 Landscape design can assist biodiversity enhancement by linking existing features such as ponds, streams or waterways with woodlands, copses or hedgerows.

5.13.6 Trees and shrubs planted within restored areas will be of local provenance. Section 9 provides further information on the approach to mitigation.

5.14 Track

5.14.1 The railway tracks will be either ballasted and/or slab track. Ballasted tracks are fastened to concrete sleepers supported by stone ballast. Slab tracks are supported on a continuous concrete structure.

5.14.2 The track and track-bed will be designed to avoid or reduce significant ground-borne noise or vibration effects from tunnels and surface sections of the route.

5.14.3 The choice of track form at different locations will be informed by further modelling and investigation of the ground conditions along the route. It has been assumed, for the purpose of the assessment (e.g. in relation to construction methods and noise and vibration), that slab track will be used in bored tunnels. Noise mitigation would be integrated into the design of surface sections of slab track to avoid or reduce significant adverse noise effects.

5.15 Power supply

5.15.1 Figure 17 indicates the process of supplying power to high speed trains.

5.15.2 Power will be supplied from the National Grid 400kV network and 132 kV distribution network via feeder stations, which will be located in Community Area 1 (Fradley and Colton) at Newlands Lane and Community Area 5 (South Cheshire) in south Crewe. These feeder stations will require dedicated areas of land.

5.15.3 Each feeder station will comprise two distinct and separate compounds: a National Grid or distribution network substation – denoted Grid Supply Points (GSPs); and an HS2 auto-transformer feeder station.

5.15.4 The Grid Supply Points will contain 400 or 132 kV switchgear[81], power transformers as required and ancillary equipment. The compound will require road access, will be fenced and may need at least one large electrical pylon depending on its connection to the existing network,, although most structures and buildings within the compound will otherwise be of modest height. The GSP compounds will typically require approximately 3.9ha of land, however it may be possible to utilise existing infrastructure to avoid the need to provide new standalone GSPs.

5.15.5 The auto-transformer feeder stations are expected to contain 25kV switchgear, traction transformers, load balancers[82] and ancillary equipment. They will be located

[81] Switchgear is electrical equipment used to control and isolate the flow of electricity to a circuit.
[82] Electrical equipment used to balance the electrical loads so that the unbalance is kept within acceptable limits set by the supply authority.

adjacent to the route and will be incorporated within the overall railway corridor. Each auto-transformer feeder station will occupy approximately 2.75ha of land, and will require road access.

5.15.6 Connections from the GSPs to the auto-transformer feeder stations will require new transmission lines which will either be buried or overhead lines, or a combination of both. It is currently anticipated that the transmission lines to connect to the distribution network could extend for up to 6km at Colton and up to 18km in the South Cheshire area between the network and the auto-transformer feeder station. Further studies to consider the route and design of these transmission lines is ongoing, informed by continued engagement with the statutory provider, and will be reported in the formal EIA Report.

5.15.7 Auto-transformer stations will be provided along the route at approximately 5km intervals. They will accommodate switchgear and associated equipment, including cabinets for the communications system, and will require road access. They will occupy approximately 0.1-0.2ha of land.

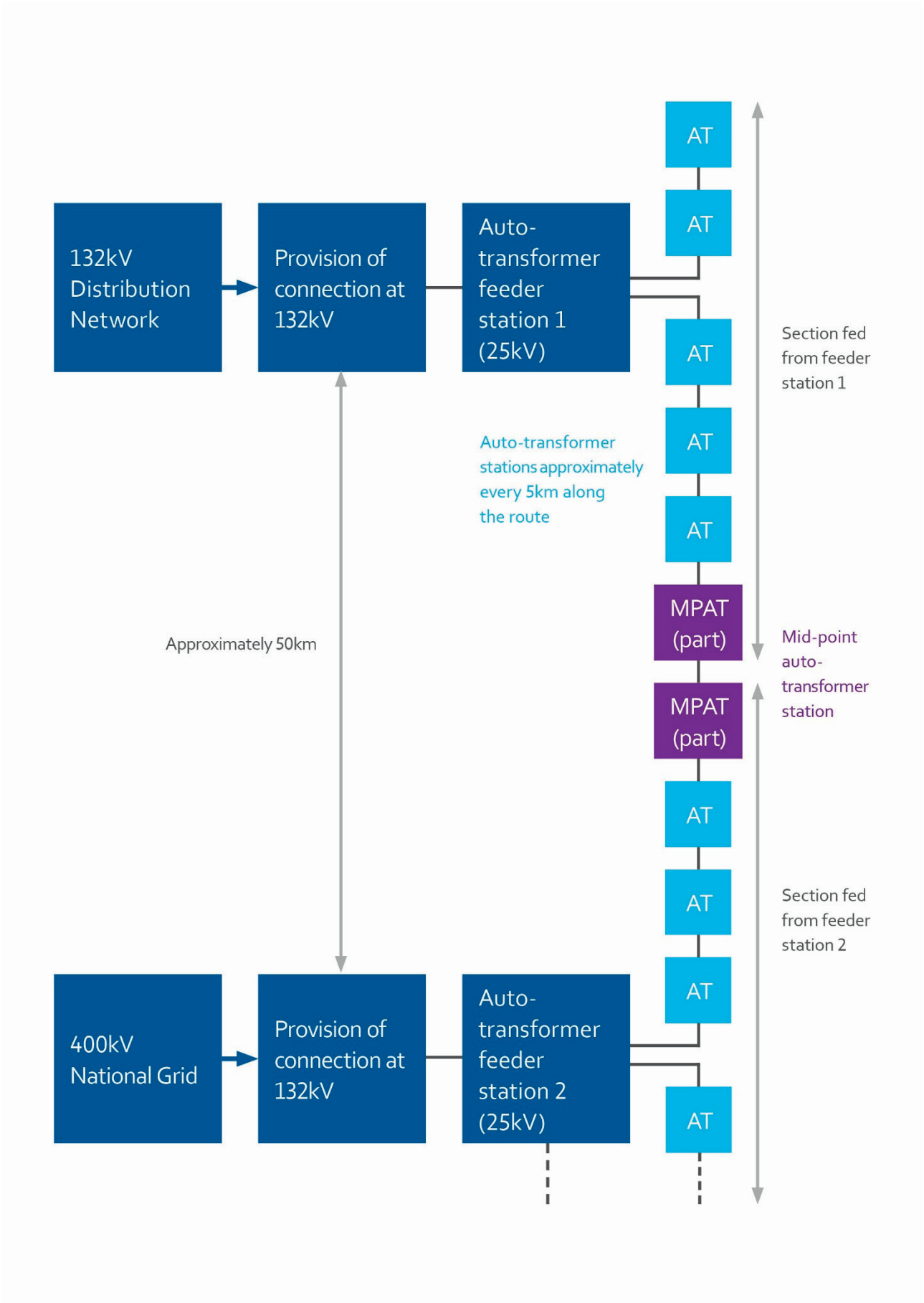
5.15.8 One other type of traction power[83] substation is required in addition to the auto-transformer stations along the route: mid-point auto-transformer. These will be located approximately halfway between autotransformer feeder stations at a point where the overhead line is sectioned to create two supply areas. A mid-point auto-transformer station is effectively two auto-transformer stations located on the same site, with each auto-transformer station connected to each supply section. They will generally require approximately 0.2ha of land.

5.15.9 Power will be transmitted to the trains through an OLE contact system. The OLE will comprise steel masts and cantilever supports, portal frames where appropriate and contact wires to transmit the current to the train pantographs[84] and catenary support wires[85]. The masts and frames will usually be around 8.5m high and will be spaced at 45-65m intervals along the track.

5.15.10 Electrical power will be required for other purposes in addition to the traction power supply, including lighting and the operation of equipment in tunnels, shafts and depots. Arrangements will be made with the local power distribution company, or district network operator, for auxiliary power supplies at each location where they are required.

[83] Power provided primarily for the purpose of moving trains.
[84] A device mounted on the roof of train to provide an electrical connection between the train and the overhead contact wire.
[85] A system of wires used to support the contact wire at the correct height above the track.

Figure 17: Diagram showing the indicative process of supplying power to the trains



5.16 Train control and telecommunications

5.16.1 The train control system will be a computer-based interlocking system, controlled from a route-wide network control centre at the Washwood Heath depot (as described in Volume 2: Washwood Heath to Curzon Street report (Community Forum Area 26) of the Phase One main ES[86]). It will not require traditional trackside signals for its operation. The associated line-side equipment will include cable troughs, marker boards and cabinets, generally no more than 1-3m high.

5.16.2 The route will use radio communications as part of its railway operations and train control systems. This will require radio antennae to be mounted on short extension poles fixed to the OLE masts, approximately every 2km. The antennae will typically be up to 10m from track level. The associated radio transmission equipment will be mounted at the base of the poles. A communications backbone will be provided by a network of optical fibre cables. These cables will be laid in troughs beside the track, and will connect all line-side equipment to the control centre.

[86] HS2 Ltd (2013), London-West Midlands Environmental Statement, Volume 2 Community Forum Area Report, CFA26, Washwood Heath to Curzon Street, November 2013. Available on-line at http://webarchive.nationalarchives.gov.uk/20140806172102/http://assets.dft.gov.uk/hs2-environmental-statement/volume-2/Volume_2_CFA26_Washwood_Heath_to_Curzon_Street.pdf

6 Construction of the Proposed Scheme

6.1 Introduction

6.1.1 This section provides an overview of the typical activities and methods that are anticipated to be used during construction. Construction of the Proposed Scheme would commence in 2020, with operation planned to start in 2027. A construction programme for each community area is included within the Volume 2 community area reports.

6.2 Construction land requirements

6.2.1 Land will be required temporarily during the construction period for:

- construction compounds and their access/egress;
- the diversion and realignment of roads, PRoW and private accesses, and/or the provision of temporary alternative routes;
- the diversion and realignment of railways, watercourses and utilities;
- the temporary storage of soils and excavated material; and
- transfer nodes, and railheads[87] for the movement of excavated material and delivery of construction materials and plant.

6.2.2 Land for the temporary storage of excavated material will be required during the earthworks stage, mainly at locations where large volumes of excavated material arise, such as tunnel portals and deep excavations. Temporary material stockpiles will be required at certain sections of the route to limit the distances over which such materials need to be transported. Land will be returned to its pre-construction use, wherever appropriate, or to a condition agreed by the owner of the land and the relevant planning authority.

6.3 Environmental controls during construction

Overview

6.3.1 The nominated undertaker and all construction contractors will be subject to existing legislation and the protective legislative provisions set out in the Bill. As described in section 1.4, environmental controls and processes contained in the EMRs will provide the mechanisms for meeting environmental commitments following Royal Assent. The nominated undertaker and all construction contractors will be required to comply with the CoCP and a series of local environmental management plans (LEMPs).

6.3.2 Site-specific control measures at a local level will be included within the LEMPs, which will be developed during the Parliamentary process and detailed design stage in consultation with the relevant stakeholders. The Proposed Scheme extends across

[87] A transfer node is a location where bulk deliveries or excavated materials leave or enter the construction worksites from public roads. A railhead is a site at a strategic location along the route with connections to the National Rail network. Railheads will be used as the delivery location for bulk rail-borne materials, such as ballast, rails and sleepers.

five local authorities, necessitating engagement with a wide range of stakeholders. The CoCP is, therefore, intended to provide a framework to ensure a consistent approach.

6.3.3 The draft CoCP is presented as an appendix to the Volume 1. This section summarises its key elements.

Purpose of the Code of Construction Practice

6.3.4 The draft CoCP sets out a series of proposed measures and standards of work, which will be applied by the nominated undertaker and its contractors throughout the construction period to provide:

- effective planning, management and control during construction to control potential impacts upon people, businesses and the natural and historic environment; and
- the mechanisms to engage with the local community and their representatives throughout the construction period.

6.3.5 The nominated undertaker and its contractors will comply as a minimum with applicable environmental legislation at the time of construction, together with any additional environmental controls imposed by the Bill. For this reason the applicable statutory requirements are not repeated within the draft CoCP. Further guidance on specific areas, such as soil handling and dust management, will be considered from industry best practice guidance documents as set out in the draft CoCP.

Environmental management system

6.3.6 The nominated undertaker will develop an environmental management system (EMS) in accordance with BS EN ISO 14001[88]. The EMS will provide the process by which environmental management both within its organisation and in relation to its operations is undertaken to ensure that the relevant findings of the formal EIA Report are addressed throughout the construction phase. The EMS will set out:

- the procedures to be implemented to plan and monitor compliance with environmental legislation and other relevant requirements;
- the key environmental aspects of the work and how they will be managed;
- staff competence and awareness requirements and how these are to be achieved and maintained;
- record keeping arrangements;
- the procedures to be implemented to monitor compliance with the environmental provisions in the Bill; and
- the procedure to monitor compliance and the effectiveness of the measures included within the draft CoCP.

[88] British Standards Institute (2004), *BS EN ISO 14001:2004 Environmental management systems*.

Lead contractors' environmental management systems

6.3.7 The nominated undertaker will require each of its lead contractors[89] to have an EMS certified to BS EN ISO 14001. Their EMSs will include roles and responsibilities, together with appropriate control measures and monitoring systems to be employed during planning and construction of the works for all relevant topic areas. Where the lead contractor is a joint venture, their EMS will be certified to cover the activities of the joint venture.

6.3.8 Lead contractors will be required, as part of their EMSs, to plan their works in advance to ensure that, as far as is reasonably practicable, measures to reduce environmental effects are integrated into the construction methods and that commitments from the formal EIA Report and Bill are complied with. The works will also be subject to approval processes set out in the draft CoCP by the nominated undertaker (e.g. suitability of construction phase plans) and by any statutory consents required.

6.3.9 The lead contractors' EMSs will cover the activities of all their contractors. The lead contractors will also be required to coordinate with other contractors and relevant parties relevant to their works. This will be documented in their EMSs, as appropriate.

6.3.10 The lead contractors' EMSs will include procedures to monitor and report on compliance with the project's environmental requirements, together with provisions for any corrective actions required. The detailed provisions of the lead contractors' EMSs will be subject to review and acceptance as being suitable by the nominated undertaker.

Enforcement and local environmental management plans

6.3.11 The requirements set out in the CoCP will be applicable to the whole of the Proposed Scheme. They will apply to each construction contract let by the nominated undertaker. These requirements will be supplemented by a LEMP for each relevant local authority area.

6.3.12 The LEMPs will set out how the Proposed Scheme will adapt and deliver the required environmental and community protection measures within each local authority area, through a series of topic-specific measures that reflect the general requirements of the CoCP.

Monitoring

6.3.13 The lead contractors will undertake the necessary monitoring for each environmental topic to comply with the requirements of the CoCP, the relevant LEMP, any additional consent requirements and their EMSs. Aspects to be monitored will include the impact of the works and the effectiveness of mitigation measures. Any actions that may be necessary for compliance will be identified.

[89] A lead contractor is a construction company that is directly contracted for the works by the nominated undertaker.

Considerate Constructors Scheme

6.3.14 Lead contractors will be required to sign up and adhere to the Considerate Constructors Scheme[90]. The Considerate Constructors Scheme is a UK-wide initiative that promotes good practice on construction sites through its codes of considerate practice. These commit the users of registered sites to be considerate and good neighbours, as well as being respectful, environmentally conscious, responsible and accountable.

Community relations

6.3.15 The nominated undertaker and its contractors will produce and implement a community engagement framework and provide appropriately experienced community relations personnel to implement it. The role of the personnel will be to provide appropriate information and to be the first point of contact to resolve community issues. The nominated undertaker will take reasonable steps to engage with the community, particularly focusing on:

- those who may be affected by construction impacts, including local residents, businesses, landowners and community resources; and
- the specific needs of protected groups (as defined in the Equality Act 2010)[91].

6.3.16 Regular meetings will be held between the lead contractor, the nominated undertaker, local authority and representatives of the local community or other stakeholders to discuss construction issues and the forthcoming programme of works. The nominated undertaker and its contractors will:

- provide support for local businesses, landowners, voluntary and community organisations that may be affected by the works; and
- consider local employment, apprenticeships and educational initiatives when recruiting staff.

Advance notice of works

6.3.17 The nominated undertaker and its contractors will ensure that local residents, occupiers, businesses, local authorities and parish councils affected by the proposed construction works, as outlined in the formal EIA Report, will be informed in advance of work taking place using the methods identified in the community engagement framework. The notifications will detail the estimated duration of the works, the working hours and the nature of the works. In the case of works required in response to an emergency, the local authority, parish council, local residents, businesses and community resources will be advised as soon as reasonably practicable. All notifications will include the community helpline number.

6.3.18 Information on the works will also be available on the HS2 website and at appropriate locations along the route. These locations will be identified in the LEMPs.

[90] Considerate Constructors Scheme, www.ccscheme.org.uk, Accessed: 8 April 2016.
[91] *Equality Act 2010*. Her Majesty's Stationery Office, London.

Core working hours

6.3.19 The contractors will seek to obtain consents for the proposed works from the relevant local authority under Section 61 of the Control of Pollution Act 1974[92]. Applications will include details on proposed working hours.

6.3.20 The draft CoCP outlines the anticipated working hours. Core working hours will be from 08:00-18:00 on weekdays (excluding bank holidays) and from 08:00-13:00 on Saturdays. The nominated undertaker will require its contractors to adhere to these core working hours for each site as far as reasonably practicable, unless otherwise permitted by the relevant local authority under Section 61 of the Control of Pollution Act.

6.3.21 Guidance on site-specific variations to core hours and/or additional hours likely to be required will be included within the LEMPs following consultation with the relevant local authority.

6.3.22 The Section 61 process will also be used to agree, in advance, any work required to be undertaken outside core hours, except in the case of emergency and not including repairs or maintenance.

Start up and close down periods

6.3.23 The nominated undertaker's contractors will require start-up and closedown periods to help maximise productivity during the core hours. A period of up to one hour before and up to one hour after core working hours will be required. Activities within these periods will include (but not be limited to) deliveries, movement to place of work, unloading, maintenance and general preparation works. Activities within these periods will not include operation of plant or machinery likely to cause a disturbance to local residents or businesses. These periods will not be considered an extension of core working hours.

Additional working hours

6.3.24 Tunnelling and activities directly associated with it (such as removal of excavated material, supply of materials and maintenance of tunnelling equipment) will be carried out on a 24 hour a day, seven days a week basis. Where reasonably practicable, material will be stockpiled within the compound boundary for removal during normal working hours.

6.3.25 Track laying activities and work requiring possession of major transport infrastructure may be undertaken during night-time, Saturday afternoons, Sundays and/or bank holidays, for reasons of safety or operational necessity. Such activities will often involve consecutive nights of work over weekend possessions, and on occasion involve longer durations. Activities outside core working hours that could give rise to disturbance will be kept to a reasonably practicable minimum.

6.3.26 Certain operations such as earthworks are season- and weather-dependent. In these instances the nominated undertaker's contractors will seek to extend the core

[92] *Control of Pollution Act 1974*. Her Majesty's Stationery Office, London.

working hours and/or days for such operations to take advantage of daylight hours, with the consent of the relevant local authority.

6.3.27 Certain other specific construction activities will require extended working hours for reasons of engineering practicability. These activities include, but are not limited to, major concrete pours and piling/diaphragm wall works. Surveys, such as for wildlife or engineering purposes, may also need to be carried out outside core working hours.

6.3.28 The relevant local authority will be informed as soon as reasonably practicable of the reasons for, and likely duration of, any works required in response to an emergency or which, if not completed, would be unsafe or harmful to the works, staff, the public or the local environment. This information will also be made available via the HS2 Ltd helpline. Examples of the type of work envisaged include: where pouring concrete takes longer than planned due to equipment failure, or where unexpectedly poor ground conditions, encountered whilst excavating, require immediate stabilisation.

Abnormal deliveries

6.3.29 Abnormal loads or those that require a police escort may be delivered outside core working hours subject to the requirements and approval of the relevant authorities.

Management of construction traffic

6.3.30 Vehicles accessing the construction compounds can be divided into three broad categories:

- heavy goods vehicles (HGV): articulated lorries for plant and materials, concrete trucks, bulk tipper trucks, abnormal/oversize loads;
- light goods vehicles: pickups and small tipper trucks, vans and cars; and
- rail vehicles: used in the construction of works immediately adjacent to or over the existing rail network, or used to deliver material to or from the site.

6.3.31 Construction vehicles carrying materials, plant, other equipment or workforce, or that are empty, will travel on public roads and via the rail network, as well as within the construction area between compounds. Wherever reasonably practicable, the rail network will be used in preference to public roads. The construction compounds will provide the interface between construction areas and the public roads or rail network. Movements between the construction compounds and the working areas will be on designated haul roads within the construction area, often along the line of the new railway or parallel to it.

6.3.32 The transport assessment assesses the impact of construction traffic on the transport network at a local and regional level. Its findings will inform the traffic management plans that will be implemented during construction in consultation with the local traffic and highway authorities and the emergency services. Measures to be considered in these plans include the following, as appropriate:

- site boundaries and the main access/egress points for compounds;
- temporary and permanent closures, diversions or realignments of highways (i.e. roads and PRoW); and

- the proposed traffic management and logistics strategies.

6.3.33 Lead contractors will be required to ensure that impacts on the local community from construction traffic are reduced to a practicable minimum and that public access is maintained where reasonably practicable. Traffic impacts will be reduced by identifying clear controls on vehicle types and hours of operation, and agreed routes for large goods vehicles. Highway works required to accommodate construction traffic will be identified. The number of private car trips to and from each site (both workforce and visitors) will be reduced by encouraging alternative sustainable modes of transport or vehicle sharing.

6.3.34 The measures in the CoCP will include clear controls on vehicle types, hours of site operation and routes for HGV, to reduce the impact of road based construction traffic. Construction workforce travel plans will be prepared by the lead contractors with the aim of encouraging the use of sustainable modes of transport and discouraging workforce commuting by private car, to reduce the impact of workforce travel on local residents and businesses. Generic and site-specific traffic management measures will be implemented on relevant roads, PRoW and other points of access as necessary.

Handling of construction material and surplus excavated material

6.3.35 Construction of the Proposed Scheme will generate significant quantities of excavated material. The nominated undertaker will use excavated material in the construction of the Proposed Scheme, wherever feasible (as described in section 5.2), thereby reducing the need for imported materials and the off-site disposal of surplus excavated material.

6.3.36 The majority of excavated material that will be generated across the Proposed Scheme will be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme.

6.3.37 The nominated undertaker will seek to provide any surplus excavated material that arises and which cannot be beneficially reused for the earthworks of the Proposed Scheme for:

- use in other local construction projects where opportunities arise at the time of construction; and/or
- use for restoration of mineral sites, where the transportation of that material does not result in significant environmental effects.

6.3.38 Only if excavated material is not required or is unsuitable for the construction of the Proposed Scheme will it be considered waste.

Waste management

6.3.39 The main waste streams likely to arise during the construction phases will include:

- surplus excavated material from earthworks and tunnelling activities;
- demolition waste;
- construction waste; and

- waste generated by occupants of worker accommodation sites.

6.3.40 Waste management will be based on the principles of the waste hierarchy, whereby priority is given to the prevention of waste generation, followed (where this is not possible) by reuse, recycling and recovery respectively. Disposal to landfill will be undertaken only as a last resort[93].

6.3.41 The principal objectives of sustainable resource and waste management are to use material resources more efficiently, to reduce waste at source and to reduce the quantity of waste that requires final disposal to landfill. 'Designing-out waste' principles will be applied to reduce the quantity of waste generated. An integrated earthworks design approach has been developed in order to minimise the quantity of excavated material generated and use that which is generated to satisfy the necessary engineering and environmental mitigation requirements for the Proposed Scheme.

6.3.42 A site waste management plan will be prepared and maintained by the nominated undertaker's lead contractors in order to identify the specific types and quantities of waste likely to arise during the construction process.

6.3.43 Further information regarding excavated material and waste management is given in the draft CoCP.

Noise and vibration strategy

6.3.44 Construction noise and vibration will be controlled and managed in accordance with the draft CoCP. The principles of these control and management processes are as follows:

- Best Practicable Means (BPM), as defined by the Control of Pollution Act and Environmental Protection Act 1990[94], will be applied during construction activities to minimise noise (including vibration) at neighbouring residential properties.
- mitigation measures will be applied, as part of BPM, in the following order:
  - noise and vibration control at source: for example, the selection of quiet and low-vibration equipment, review of construction methodology to consider quieter methods, location of equipment on-site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings; and then
  - screening: for example, local screening of equipment or perimeter hoarding.
- where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary rehousing will be offered.
- lead contractors will seek to obtain prior consent from the relevant local

[93] Unacceptable material Class U2 material will be disposed of directly to hazardous landfill. Class U2 'hazardous waste', is described in the Specification for Highway Works, Series 601 Classification, Definitions and Uses of Earthworks Materials sub-Clause 3(i); http://www.standardsforhighways.co.uk/ha/standards/mchw/vol1/; accessed 8 April 2016.
[94] *Environmental Protection Act 1990*. Her Majesty's Stationery Office, London.

authority under Section 61 of the Control of Pollution Act for the proposed construction works. The consent application will set out BPM measures to minimise construction noise, including control of working hours, and provide a further assessment of construction noise and vibration including confirmation of noise insulation or ultimately temporary re-housing provision.

- contractors will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to, and be reviewed by, the nominated undertaker and will be made available to the local authorities.
- contractors will be required to comply with the terms of the draft CoCP and appropriate action will be taken by the nominated undertaker as required to ensure compliance.

6.3.45 Taller screening will also be used if required to avoid or further reduce significant effects along the edge of the construction site boundary. This is described in the draft CoCP[95].

6.3.46 Noise insulation or ultimately temporary rehousing will enable residents to avoid being significantly affected[96] by levels of construction noise inside their dwellings.

6.3.47 Qualifying buildings will be identified early enough so that noise insulation can be installed, or temporary re-housing provided, before the start of the works predicted to exceed noise insulation or temporary re-housing criteria. Noise insulation, where required, will be installed as early as practicable to reduce internal sound levels from construction activities and from the Proposed Scheme in operation.

Ground settlement

6.3.48 Excavation for the tunnels and other below ground structures will potentially lead to small ground movements at the surface and below ground. The amount of ground movement will depend on a number of factors including depth and volume of works below ground, soil and groundwater conditions and the presence and nature of building foundations/third party assets. In most cases this will have no visible impact on property/third party assets. Very rarely these ground movements may affect properties/third party assets. Techniques for controlling settlement of buildings and protecting buildings from irreparable damage are well developed, based on other tunnelling projects such as the Jubilee line extension, HS1 and Crossrail. Appropriate techniques will be implemented to control and limit, as far as reasonably practicable, the effects of settlement.

6.3.49 The nominated undertaker will assess potential settlement along the route of the railway and include the risk of damage to all buildings within the zone affected by settlement. Depending on the level of risk, either no action will be required, buildings

[95] As described in the draft CoCP, provided as necessary by solid temporary hoarding, temporary earth stockpiles, screening close to the activities or other means to provide equivalent noise reduction.
[96] Information is provided in the National Planning Practice Guidance – Noise.
http://planningguidance.communities.gov.uk/blog/guidance/noise/noise-guidance/ e.g. the table summarising the noise exposure hierarchy.

will be monitored during construction, or special measures will be implemented where required to protect the buildings.

6.3.50 Measures to reduce settlement will form part of the EMRs, as will survey and monitoring requirements.

Extreme weather events

6.3.51 The nominated undertaker's contractors will pay due consideration to the impacts of extreme weather events and related conditions during construction. The contractors will use a short- to medium-range weather forecasting service from the Met Office or other approved provider of meteorological data and weather forecast provider to inform short- to medium-term programme management, environmental control and impact mitigation measures. The contractors will register with the Environment Agency's Floodline Warnings Direct service in areas of flood risk.

6.3.52 The lead contractors will ensure that appropriate measures within the draft CoCP are implemented, and as appropriate, additional measures to ensure the resilience of the proposed mitigation of impacts during extreme weather events.

6.3.53 The lead contractors' EMSs should consider all measures deemed necessary and appropriate to manage extreme weather events and should specifically cover training of personnel and prevention and monitoring arrangements. As appropriate, method statements should also consider extreme weather events where risks have been identified.

6.4 Advance works

Introduction

6.4.1 Works required in advance of the main construction programme will generally include:

- further detailed site investigations and surveys;
- further detailed environmental surveys;
- advance mitigation works including, where appropriate, the remediation of contamination, the translocation and creation of habitats, and surveys and investigation of archaeology and built heritage;
- site establishment and construction of temporary fences; and
- utility diversions.

6.4.2 Utility diversions have not been assessed for the working draft EIA Report. The likely significant effects of these works will be identified in the formal EIA Report.

Further detailed site investigations and surveys

6.4.3 Additional detailed investigations and surveys will be required before construction to gather further information about the land required for construction. This will include the location of construction compounds in order to plan their layout and access and egress arrangements. Investigations and surveys are likely to include:

- ground investigations, such as drilling boreholes, performing in-situ tests, and taking samples for testing to establish geotechnical parameters; and
- topographical surveys to map ground contours and existing surface features.

Further detailed environmental surveys

6.4.4 Further detailed, site-specific environmental surveys will also be undertaken. These will include:

- ecological surveys to confirm the baseline in areas where no access had been possible to date, and to inform licence applications and proposed works to translocate habitat/species;
- historic building, geophysical and/or trial trenching surveys to confirm the character of archaeological and built heritage assets and to inform the design of detailed mitigation strategies;
- hydrological and hydrogeological surveys to confirm flooding potential, surface water hydromorphological, quality and groundwater conditions; and
- geotechnical investigations to confirm ground and groundwater conditions; and contaminated land surveys, including boreholes, probe holes and trial pits, supported by soil and groundwater sampling and testing for a suite of relevant chemicals, to confirm any possible contamination sources and pathways, and support the design of any remediation works that may be required.

Advance mitigation works

Remediation of contamination

6.4.5 The following further works may be required where surveys identify that soil contamination is present:

- monitoring of groundwater;
- monitoring and sampling of ground gas where contamination from landfill gases is occurring;
- remediation works, including:
  - excavation;
  - soil treatment using methods such as soil-washing
  - bioremediation and stabilisation;
  - provision of capping layers or ground barriers to prevent the migration of contaminants or ground gases;
  - installation of venting systems for ground gases; and
- off-site disposal of unsuitable soils.

Creation of habitat and translocation of species/habitat

6.4.6 Most of the areas that will be identified for the provision of ecological compensation will be outside the extent of the construction works. Some areas identified for the translocation of protected or notable species will need to be created in advance, while others may already be suitable as receptor sites.

6.4.7 These works include, but are not limited to:

- the planting of new grassland or woodland habitats;
- the creation of new ponds, hibernacula[97] or basking features[98]; and
- the construction of artificial badger setts.

6.4.8 It may take up to two years to translocate or relocate protected species, where this is required. Translocation/relocation will occur before the start of construction in that area.

6.4.9 In some locations, notably where ancient woodlands are unavoidably affected, the woodland soils that would otherwise be lost will be translocated to identified receptor sites.

Archaeological and built heritage works

6.4.10 A programme of investigation works will be developed as set out in Section 8 of the draft CoCP. Investigation and recording may include historic building recording, archaeological excavation, palaeo-environmental boreholes and the in-situ preservation of assets.

Site establishment and temporary fencing / hoardings

6.4.11 Temporary security fencing or hoardings (as appropriate) will be erected on land required for construction, including at construction compounds (as discussed in section 6.6). Fencing could also be used to protect trees and to temporarily delineate field boundaries. Further information relating to site establishment is provided in section 6.7.

Utility diversions

6.4.12 A number of utility diversions will be required before construction commences. Utilities that will need to be diverted include water, gas mains, sewers, telecommunications equipment, electricity and fuel pipelines. The major utility diversions will be described in the formal EIA Report.

6.4.13 Condition surveys are likely to be undertaken prior to diversion. Some utilities may require additional strengthening or replacement.

6.4.14 Discussions with utility providers are underway to confirm whether utility infrastructure will need to be: positioned away from the area of work; protected from

[97] A hibernaculum is the winter den of a hibernating animal or insect.
[98] Many species habitually seek out external sources of heat or shelter from heat. For example, many reptiles regulate their body temperature by basking in the sun, or seeking shade when necessary.

the works by means of a concrete slab or similar; or have sufficient clearance from the works that they will not be affected.

6.4.15 An appropriate approach will be agreed with the relevant statutory undertaker (i.e. the utility company) where excavation or piling is required within the exclusion zones for high pressure mains, high voltage cables or fuel mains. The approach will include appropriate protective measures.

6.4.16 Ground-penetrating radar surveys[99] will be undertaken and trial holes excavated to identify if underground utilities are in their expected locations (subject to the agreement of the statutory undertaker and local authorities).

6.4.17 Some utility works will require PRoW to be temporarily realigned. This will be managed using a traffic management plan, as detailed in section 6.3.

6.4.18 The height and/or location of pylon towers for overhead line electricity cables will need to be changed in some locations. This will require the erection of temporary towers to carry the cables whilst the new or amended towers are being built. It will also require new power cables to be installed and tensioned, and these cabling works will require works at a number of towers either side of those to be amended. The cabling works are unlikely to necessitate works at ground level in between towers. However, access will be required, and the CT-05 and CT-06 map series in the Volume 2, community area map books will show the access routes. There may also be some restrictions to access at ground level between towers where re-cabling is being undertaken, as a precaution (other than at residential properties).

6.5 Overview of the construction works

6.5.1 The construction works along and adjoining the route will be of two broad types:

- civil engineering works, including:
  - establishment of construction compounds;
  - site preparation and enabling works;
  - main earthworks and structural works;
  - site restoration; and
  - removal of construction compounds;
- railway installation works, including:
  - infrastructure installation;
  - connections to utilities;
  - changes to the existing rail network; and
  - removal of construction compounds.

[99] A non-destructive survey technique used to identify underground features (often utilities services) using radio waves.

6.5.2 There are also locations where the existing railway network will need to be modified, which could involve a combination of civil engineering and/or railway installation works.

6.6 Construction compounds

6.6.1 Construction compounds will be required in various locations along the route, and will generally be sited alongside or adjacent to the relevant works. Each Volume 2 community area report identifies the location and use of the compounds for construction works and railway installation activities within its area.

6.6.2 There will be two types of construction compounds: main and satellite construction compounds. Main construction compounds will act as strategic hubs for core project management activities (i.e. engineering, planning and construction delivery) and for office-based construction personnel. They will include offices, storage for materials (such as aggregates, structural steel, and steel reinforcement) and laydown areas, and maintenance and parking facilities (for site plant, lorries and staff cars), together with the main welfare facilities for construction personnel. Workers' sleeping accommodation could be provided at Stone railhead main compound, as described in Volume 2, Community Area Report 3, Stone and Swynnerton. Main sites will typically require approximately 4ha of land (although this may vary depending on site conditions) and will support up to 300 construction personnel. There would be four main construction compounds along the route. Satellite construction compounds will generally be smaller, providing office accommodation for a limited number of construction personnel. Depending on the nature and extent of works to be managed from these compounds they may include local storage for plant and materials, welfare facilities, and limited car parking for construction personnel. The satellite construction compounds may require between approximately 0.7 and 3ha of land and will support between approximately 25 and 300 construction personnel. There will be 48 satellite construction compounds along the route (including civil engineering and railway installation).

6.6.3 Some construction compounds may act as points of entry to working areas from the public highway. Some will also act as interfaces with the existing rail network for receipt and/or disposal of materials by rail.

6.6.4 Construction compounds will also serve areas used for major stockpiling of materials such as topsoil, for transfer nodes or railheads and to enable materials to be transferred to and from the site via public highway. In other places, the compound may contain construction works, such as bridge/viaduct piers. In these situations the Volume 2 community area reports describe the use of the compound and associated area, and where sufficient environmental information is available, any resulting impacts and significant environmental effects.

6.6.5 Buildings within compounds will generally be temporary modular units that will be positioned to maximise construction space and limit the area of land required. In urban areas, or elsewhere where there is limited space, it may be necessary to stack these units.

6.6.6 The siting of construction compounds has been influenced by a number of factors, including:

- proximity to major construction activities;
- proximity to local A roads and rail/bus routes;
- avoiding proximity to sensitive receptors;
- easy accessibility for the local workforce;
- suitable existing topography with minimal requirement for site preparation works;
- proximity to existing utilities for ease of establishing temporary services;
- ease of establishing and maintaining security;
- adequate space; and
- the existing use of the site.

6.6.7 Construction compounds will be connected to existing local utility services (i.e. electricity, water, data, foul sewers and surface water drainage), where reasonably practicable. This will reduce the need for generators, storage tanks and associated traffic movements.

6.6.8 Security fencing or hoardings will be provided around the perimeter of each construction compound. Areas for offices, welfare and storage within compounds will generally be demarcated and secured with fences and gates. The type and construction of fences will depend on factors such as the level of security required, the likelihood of intruders, and the degree of visual impact. Lighting of construction compounds will be designed to reduce light pollution to the surrounding area, in accordance with the requirements of the draft CoCP. Construction compounds, including any areas used for access, will be returned to the most appropriate use as soon as reasonably practicable after completion of the works.

6.6.9 Some of the construction compounds will be used to manage demobilisation/testing and commissioning of the railway after 2027.

6.7 Site clearance, enabling works and site mobilisation

6.7.1 All areas of land required permanently and temporarily for the works will be cleared.

6.7.2 Vegetation will be removed and structures demolished, as necessary, before any excavation works. Any resulting waste material will be removed from site for reuse, recycling, recovery or disposal. Topsoil will be stripped down to the top of the subsoil layer and stored appropriately. Subsoil will also be stored appropriately, if it needs to be removed. The surfaces of stockpiled material will be formed to prevent degradation of the material and will be managed to control weed growth. Stockpiles will be kept away from sensitive features (including natural and historic features), watercourses and surface drains, as far as reasonably practicable. Elsewhere, stockpiles may be located near the site boundary, where they can help to provide temporary screening.

6.7.3 Trees and hedgerows will not be removed during the bird nesting season, with site clearance for non-critical design elements phased accordingly.

6.7.4 Conventional methods will be used for demolitions (e.g. boom-mounted hydraulic breakers[100] and cutters). The best practicable means will be used to recover materials for reuse and recycling. Asbestos and any other hazardous materials identified during surveys will be removed by a specialist contractor prior to demolition, as described in the draft CoCP. A condition survey of building foundations/third party assets will also be undertaken before and after the relevant works where it is agreed with the local authority that there is no best practicable means to reduce predicted or measured vibration.

6.7.5 Activities described as 'advance works' may also be undertaken during this stage of construction.

6.8 Cuttings and embankments

Cuttings

6.8.1 Cuttings will be excavated using excavators, graders and scrapers.

6.8.2 Material excavated from cuttings will be used, where reasonably practicable, to construct embankments, landscape earthworks and noise bunds. The construction of cuttings and embankments will therefore be interdependent, in most cases. This is reflected in the sequencing described below.

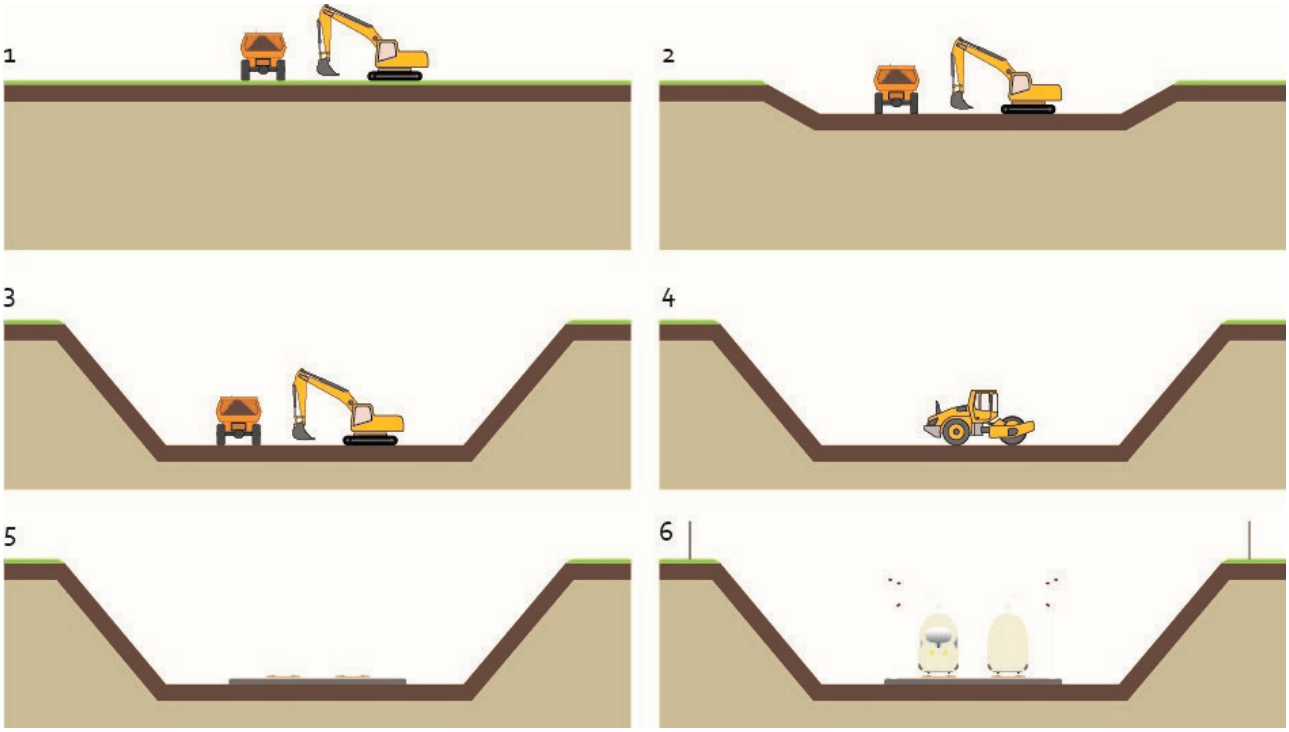
6.8.3 Cuttings will generally be constructed in the following sequence:

- vegetation will be removed, and surface water drainage installed where required;
- topsoil and subsoil will be stripped, with temporary material stockpiles being appropriately located and sloped to enable surface water runoff and subsequent re-soiling work;
- the cutting will be excavated sequentially, in layers;
- excavated material will be transported to embankment compound(s), where practicable, or to temporary stockpiles, with the material processed, where necessary, to improve its suitability for use; and
- re-soiling and seeding of the final slope profile – if the slope angle is steeper than that which would normally be adopted to ensure stability, additional measures will be required prior to re-soiling and seeding; for example the construction of retaining structures, soil nailing or slope drainage, either alone or in combination.

6.8.4 Figure 18 shows a generic construction sequence for a cutting.

[100] Demolition hammers or shears fitted to hydraulic excavator plant. The hammers/shears are often on long-reach booms to increase the demolition reach.

Figure 18: Illustration of a generic construction sequence for a cutting



6.8.5 Temporary stockpiling of excavated material may be required where it cannot be placed directly into its permanent location. Granular materials such as gravels produced from excavations may need to be processed through crushing and/or screening, to ensure that the material is acceptable for use as drainage, structural fill, backfill or capping material.

Embankments

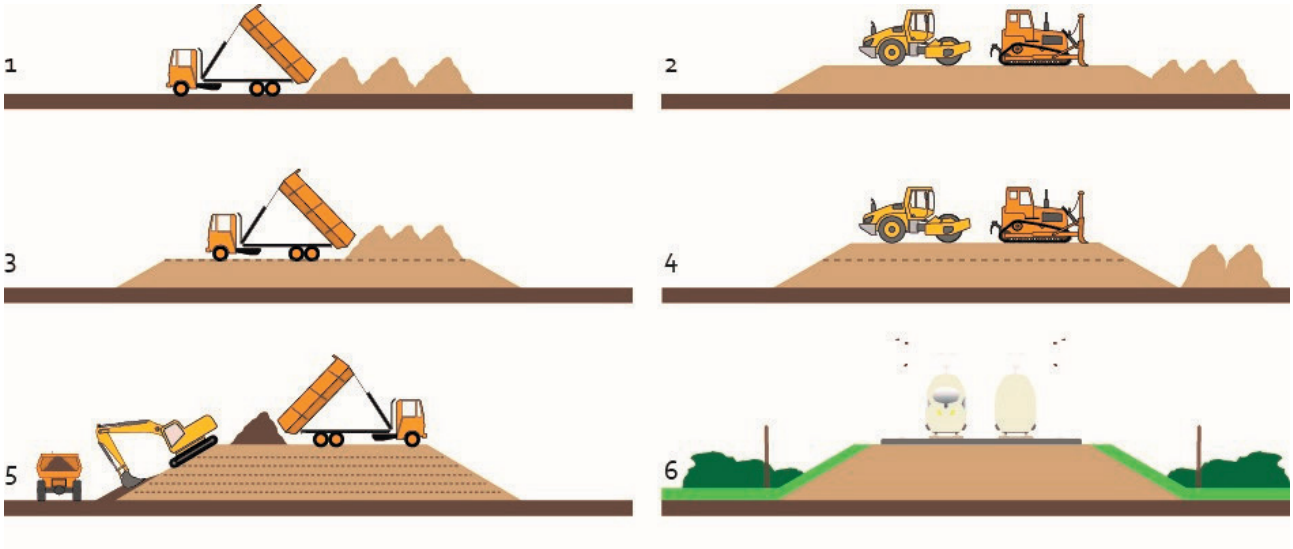
6.8.6 Earthworks will include the bulk excavation of material and placing of that material to create the route alignment. Embankments may be built in stages, commencing early in the construction programme, to allow settlement to occur. Binders (e.g. lime and/or cement) may be used selectively to improve the quality of the fill.

6.8.7 Embankments will typically be constructed in the following sequence:

- spreading, levelling and compacting of excavated material in layers over the area required;
- installation of slope drainage, where necessary, to manage runoff and prevent siltation of waterways or water-bodies;
- trimming and re-soiling of slopes to the required profile; and
- the placing of subsoil and topsoil to the required depth, which will be determined by the proposed use (e.g. as grassland, planted with trees and shrubs or returned to agriculture).

6.8.8 Figure 19 shows a generic construction sequence for an embankment.

Figure 19: Illustration of a generic construction sequence for an embankment



6.9 Drainage and watercourse realignment

6.9.1 Construction will require both temporary and permanent drainage works, including track drainage, culverts, balancing ponds and watercourse realignments. These will involve standard earthmoving techniques and equipment (e.g. backhoe excavators), and may use materials such as pre-cast concrete chambers, plastic pipes and filter drains.

6.9.2 Smaller culverts are likely to be constructed using pre-cast concrete units, lifted into place by a crane onto a prepared bed of granular material, and then sealed. Headwalls (i.e. the walls around the mouth of the culvert) may be constructed in-situ from reinforced concrete. Larger culverts may be constructed in-situ in reinforced concrete or from prefabricated units.

6.9.3 Where watercourse realignments are required, soft engineering techniques (such as the use of pre-seeded geotextile mats and vegetation rolls) will be used, where reasonably practicable. However, techniques such as piling may be required in certain situations.

6.9.4 Watercourses will generally be realigned to avoid impacts from the Proposed Scheme. A single realigned channel could represent a more sustainable solution where the route would otherwise need to cross a watercourse several times. Minor realignment will be required in many cases to reduce the length of watercourses that need to be culverted or bridged.

6.9.5 Watercourses that require horizontal realignment will generally be constructed by:

- temporarily fencing around the route of the realignment;
- excavating the realigned channel to the required level, leaving existing ground at each end (a 'plug'), or installing sheet pile walling[101], sufficient to prevent

[101] Embedded retaining wall utilising standard steel profiles. Used in temporary or permanent conditions. Installed by vibration, impact or push/jack techniques.

inflow from the existing watercourse;

- stabilising the side slopes and channel;
- lining the channel invert, if required;
- sealing with clay or constructing a concrete base and walls, if required;
- removing plugs or sheet pile walls, allowing water to flow into the realigned channel;
- sealing up the ends of the original watercourse and backfilling the channel with suitable material; and
- landscaping or finishing as required.

6.9.6 A crossing and a horizontal realignment of the flow path may be required where areas of surface water are affected by the Proposed Scheme. Vertical and horizontal realignment below existing bed level may be undertaken using drop inlet culverts[102] and inverted siphons[103]. Pumping may also be necessary in some situations. The choice of method will reflect the sensitivity and size of the flood risk, the availability of land and other physical or environmental constraints.

6.9.7 Site activities and working methods will be managed so as to protect the quality of surface water and groundwater from adverse effects. The quality, rate and volume of runoff will be controlled. Monitoring systems will be used during the construction works. Emergency procedures will be implemented in the case of any pollution incidents.

6.10 Highways (roads and public rights of way)

6.10.1 Existing roads or PRoW that cannot be used because they are crossed by the works will either be stopped up and the traffic diverted onto other existing highways, or new crossings will be built. New crossings will either be built on the line of the existing road or PRoW (termed 'online'), thereby requiring its closure or temporary realignment during construction, or alongside or nearby (termed 'offline').

6.10.2 The choice between whether new crossings will be online or offline will depend on factors such as safety, traffic flows, physical or environmental constraints and the presence (or otherwise) of public utilities.

6.10.3 Online crossings will usually be constructed by:

- constructing the temporary layout, if needed;
- temporarily realigning traffic and utilities (if they cannot be retained in their original location) and closing the existing route;

[102] A form of culvert used on sloping ground where the water level has to be lowered to pass under the Proposed Scheme, other railways or road access. Drop inlet culverts will be constructed using either an open cascade (a series of steps down the side of a cutting between an adjacent watercourse) or an enclosed chamber on the upstream side only.
[103] A form of culvert used on level ground where the water level has to be lowered to pass under the Proposed Scheme, other railways or a road access. Inverted siphons will be constructed using enclosed chambers on both sides of the route.

- constructing the new road or PRoW (and associated underbridge or overbridge, where applicable) and installing associated utilities; and
- re-directing traffic back onto the existing alignment.

6.10.4 Offline diversions will generally be constructed by:

- constructing the new permanent road or PRoW (and associated underbridge or overbridge, where applicable);
- diverting utilities onto the new alignment; and
- switching traffic onto the new alignment and stopping up the existing route.

6.10.5 Works to existing roads, including temporary diversions, will be carried out in consultation with the relevant highway authority.

6.10.6 Highway works will involve standard drainage and earthworks techniques, the laying of capping and sub-base materials and paving. Generally, plant will include excavators, dump trucks, bulldozers, rollers, graders and paving machines.

6.10.7 Smaller-scale works to existing PRoW will also be carried out in consultation with the relevant highway authority.

6.11 Piling

6.11.1 Deep foundations will be required where ground conditions are not suitable for the necessary loading or settlement requirements. They are usually required for:

- the piers and abutments of viaducts and bridges;
- retaining walls; and
- other large structures, such as the IMD.

6.11.2 Piles and diaphragm walls[104]are the most common form of deep foundation.

6.11.3 A piling mat of suitable material will be used as a working platform to ensure the stability of the heavy plant used for piling and diaphragm walling. A piling mat typically consists of compacted crushed or granular material laid on a geotextile membrane[105]. The existing ground surface will be levelled and the material placed in layers of suitable thickness before being compacted.

6.11.4 A number of techniques will be used to form deep foundations. The choice of pile type and installation method will generally be dictated by factors such as design loads, ground conditions, proximity of sensitive receptors and speed of installation. Precautions will be taken to prevent soil contamination migrating downwards into

[104] A rectangular (in plan) foundation structure used to carry horizontal and vertical loads. Can be installed by excavation using a grab or hydromill. The excavated trench is supported using a bentonite support fluid.
[105] Synthetic (generally) fabric used in conjunction with earthworks. Can be used to provide filter or reinforcement properties.

aquifers where piling takes place in areas of contaminated soil, in accordance with guidance from the National Groundwater and Contaminated Land Centre[106].

6.11.5 Diaphragm walling involves the construction of reinforced concrete walls within the ground using bentonite slurry as a temporary support medium.

6.11.6 Vibratory or silent piling systems will be preferred where displacement piles are used (i.e. steel sheet piling driven into the ground).

6.11.7 Continuous flight auger piles are constructed using a hollow stemmed piling auger. The auger is rotated into the ground to the required depth, then concrete is pumped down the hollow stem as the auger is extracted. The required steel reinforcement cage is then craned into the bore using a vibrating tool, if required. The use of continuous flight auger piles can be restricted by factors such as diameter, depth or by the design of the steel cage.

6.11.8 Bored piles are used to produce larger diameter and deeper piles with more complex steel reinforcement cages. The pile is formed by progressively boring, with the soil being 'spun off' the auger when it is extracted. The stability of the bore in the upper sections is usually maintained by a casing. The material lower down the pile may be self-supporting (e.g. clay) or may require a bentonite support fluid. Once the bore is complete, the steel reinforcement cage is fixed and lowered into the bore and concrete is then placed inside.

6.11.9 Figure 20 shows an example piling rig.

[106] National Groundwater & Contaminated Land Centre (2001), Piling and penetrative ground improvement methods on land affected by contamination – guidance on pollution prevention. NGCLC Report NC/99/73

Figure 20: Photograph of an example of a piling rig

6.12 Tunnels

Tunnel boring machines

6.12.1 Tunnels are generally excavated using a TBM. Figure 21 shows a typical TBM.

Figure 21: Photograph of a typical tunnel boring machine

6.12.2 A modern TBM consists of a rotating head called a cutter head, followed by a main bearing, a thrust system and trailing support mechanisms. The type of machine used depends on ground conditions and the amount of groundwater present. Three main types of TBM can be used in soft ground:

- earth pressure balance machine (EPBM);
- slurry shield; or
- open face.

6.12.3 A slurry shield TBM is used where the groundwater table and pressure are higher and there is very wet ground. An EPBM can be used in a wider range of ground types. Both systems use mixing and backfilling systems to maintain optimal pressure and to ensure a stable face in soft ground. Open face TBM are used when the ground is more stable and self-supporting.

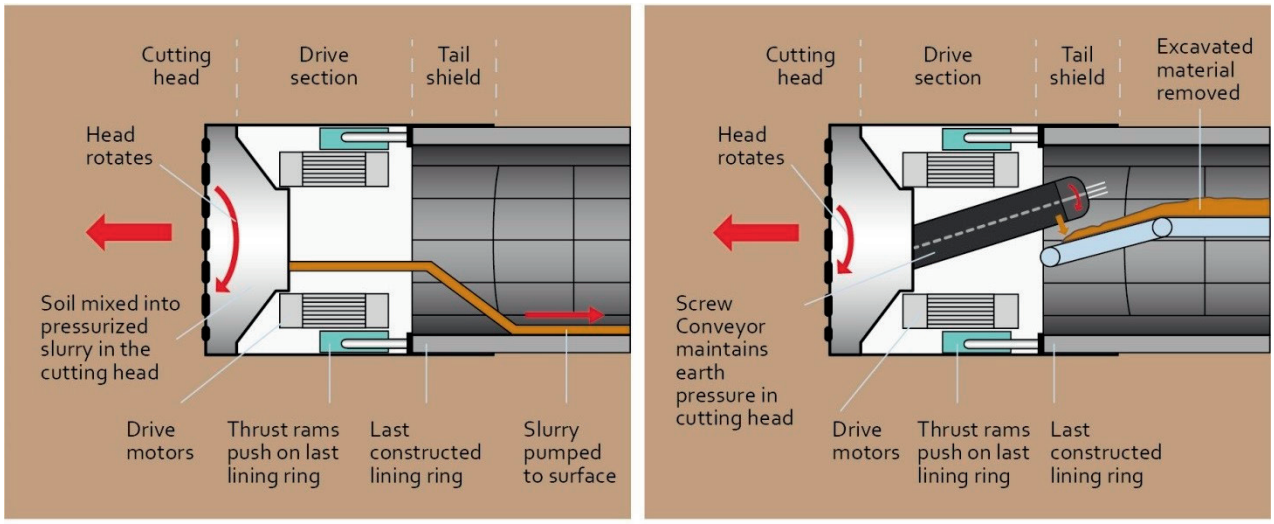
6.12.4 All of these types of TBM work by using thrust cylinders to advance forward by pushing off against concrete segments and support the ground by maintaining a balance between the earth and the pressure of the machine. The rate of material removed is determined by the rate of machine advance, thereby maintaining a stable environment.

6.12.5 The tunnel lining is erected and back grouted as the TBM is moved forward. A temporary construction railway may be laid in sequence behind the TBM to supply the

machines with tunnel lining segments and personnel, using rail-mounted vehicles. This railway will generally be twin-tracked to enable two-way traffic and servicing of cross passage construction.

6.12.6 Figure 22 shows a cross-section of a slurry shield and EPBM TBM.

Figure 22: Cross-section of a slurry shield and earth pressure balance machine



Bored tunnels

6.12.7 The linings of bored tunnels will typically comprise pre-cast reinforced concrete segments, back-grouted and sealed with gaskets to limit the ingress of groundwater. Ground treatment works, for example dewatering or grouting, may be required prior to and during excavation.

6.12.8 Possible construction methods for particular tunnel features, such as junctions with cross passages, include special cast iron or pre-cast concrete segments. These may be excavated using small machinery and lined with cast iron segments, pre-cast concrete segments or sprayed concrete.

6.12.9 The sequence of a twin-bored tunnel constructed using a single TBM, including the construction of tunnel portals, will be as follows:

- site clearance, enabling works and compound establishment;
- excavation, commencing with stripping of topsoil, followed by removal of any hardstanding;
- one portal will act as the drive portal at the start of the tunnel, from where the TBM will be launched, whilst the other portal will act as a reception portal from where the TBM will be recovered once boring is complete;
- the TBM and associated support plant and equipment, such as conveyors and grout plant, will be delivered and erected on-site;
- a concrete batching plant and pre-cast concrete facility may also be installed at the drive portal or at a supporting construction compound;

- the TBM will be moved into position, once it is assembled, and the portal headwall will be broken out;
- tunnelling will be continuous, with excavated material removed by conveyor (or by slurry pipes) to a local stockpile, and the pre-cast concrete tunnel segments delivered as the TBM advances;
- materials, such as tunnel lining segments, are usually transported from the portal or supporting construction compound to the TBM by a temporary, low speed construction railway[107];
- the portal headwall will be broken out, as the TBM approaches the reception portal, ready for the TBM to break through, for which de-watering may be required;
- once the first tunnel drive is completed, the TBM and associated tunnelling train will be dismantled, lifted out of the reception portal, loaded onto trucks, taken via the road network to the drive portal and then reassembled to commence the second drive;
- the process detailed above will be repeated for the second drive;
- as the second bore progresses, cross passages between the bores will be constructed;
- once the second tunnel drive is completed, the TBM, tunnelling train and other associated plant will be dismantled and removed from site; and
- on completion of the tunnelling works, the remaining in-situ concrete works to the base slab, together with the tunnel headhouse slab over the tunnel portal, will be constructed, and the headhouse building will be erected and fitted out.

Cut-and-cover tunnels

6.12.10 Construction of cut-and-cover tunnels will involve excavation, construction of a box structure and backfilling with fill material and soil. The land surface above will be graded to match the natural terrain and landscaped or restored to the original or an alternative use, in agreement with the landowner and the local planning authority.

6.12.11 Two main construction methods are likely to be used. For the first option an excavation is created from the surface in a conventional manner and may include installation of a temporary retaining wall. Once the final depth is reached, the tunnel floor is built, followed by the walls and roof. Finally, the entire structure is buried and the surface restored. Reinstatement will be carried out, where possible, using stored material from the cut or excavation stage.

6.12.12 Option one will be constructed by:

- site clearance, enabling works and compound establishment;

[107] Ground-borne noise and vibration will be controlled by the design and maintenance.

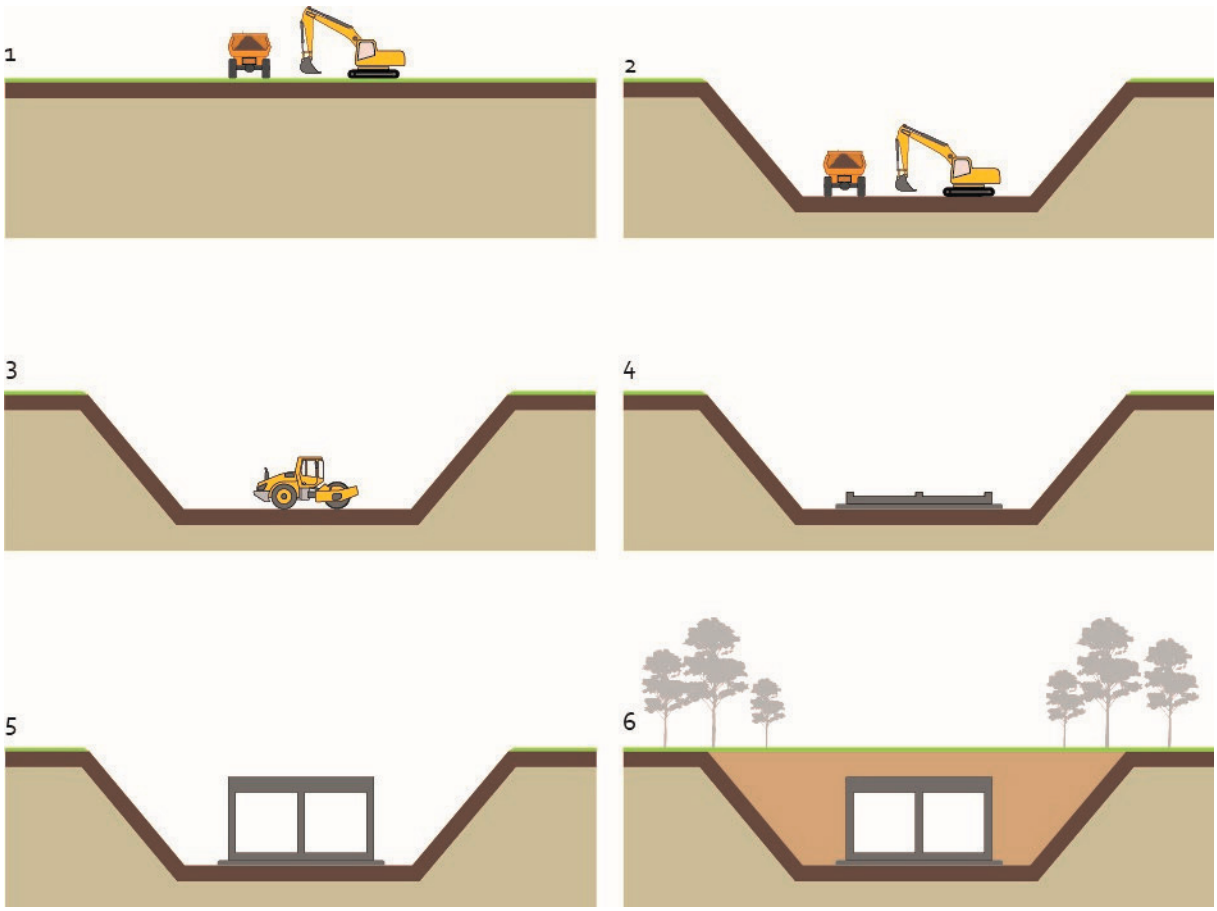
- excavating to the required depth;
- constructing a 'box' structure from reinforced concrete;
- backfilling around the sides and across the top of the structure, to suit the intended land use, and completing the landscaping works;
- diverting and installing utilities and laying road surfaces, as required; and
- removing temporary works, including any diversion/ realignments of roads and PRoW.

6.12.13 Side slopes may be strengthened during excavation to allow them to be cut at steeper gradients, reducing the area of land required and the potential import and export of materials. Alternatively, temporary retaining structures may be designed to further reduce the extent of excavation and the area of land required for construction and/or operation. Scaffolding, falsework[108], formwork[109], steel reinforcement and other materials will be placed using cranes before the reinforced box structure is constructed. Concrete delivered by mixer trucks will be placed either directly within the excavation or by concrete pumps located at ground level.

6.12.14 An illustration of this construction sequence is shown in Figure 23.

[108] Temporary structures such as scaffolding used to support the permanent works.
[109] Temporary or permanent moulds into which concrete or similar materials are poured.

Figure 23: Cut-and-cover construction method – option one



6.12.15 For the second option, the walls will be constructed first using diaphragm walling[110] or bored piling, followed by excavation and construction of the roof. Excavation of the tunnel is then undertaken beneath the roof slab from the open ends of the box.

6.12.16 This method is likely to be adopted where space limitations restrict the width of an open excavation with side slopes.

6.12.17 Option two will be constructed by:

- constructing the walls, with vertical retaining panels (i.e. piles or diaphragm walls) installed along the perimeter of the intended excavation from the surface downwards;
- excavating down to the level of the roof slab of the intended structure, which may require the propping of retaining walls, if installed;
- constructing the tunnel roof, whereby the roof slab is put in place and connected to the perimeter retaining wall, followed by backfilling and reinstatement of the surface;
- excavating and constructing the floors below roof level;

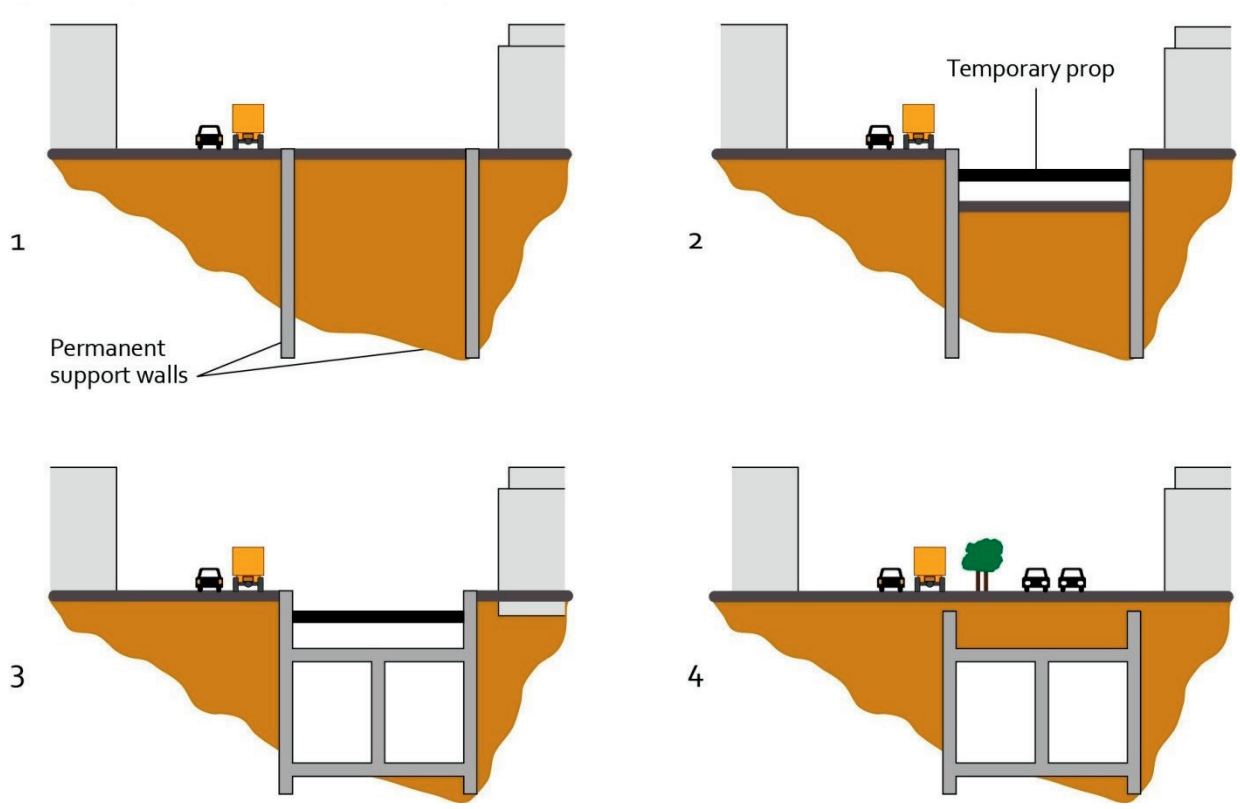
[110] Embedded walls inserted into the ground which can be used as foundation walls, groundwater barriers or to isolate portions of contaminated ground.

- excavating beneath the roof slab by means of a ramp formed at the portal end;
- casting the permanent base slab;
- removing any temporary props;
- diverting and installing utilities and laying road surfaces as required; and
- removing temporary works, including any diversion/realignments of roads and PRoW.

6.12.18 The excavation beneath the roof slab will be executed in stages if temporary props are required, with these being installed progressively.

6.12.19 An illustration of this construction sequence is shown in Figure 24.

Figure 24: Cut-and-cover construction method – option two



6.13 Portals

6.13.1 Portals in rural locations will typically be constructed by open excavation, with soil and rock slopes benched (i.e. cut in steps) and reinforced as necessary. Reinforced concrete headwalls and wing walls[111] will be formed around the tunnel entrances.

6.13.2 Portals will be constructed by open cut where the excavation is relatively shallow. Diaphragm wall or contiguous bored pile[112] techniques will be used for deeper excavations, requiring support by propping beams or a cover slab for the deepest

[111] A smaller wall attached or next to a larger wall or structure.
[112] Closely spaced, bored piles used to form an underground wall, for the construction of a deep basement or cut-and-cover tunnel.

excavations. A slab up to 120m long will also be required where portals are required to accommodate a TBM, to allow the back-up equipment or the TBM to be established.

6.14 Viaducts

6.14.1 The following methods of constructing viaduct decks are likely to be used:

- launched construction, in which a reinforced concrete deck is constructed in sections then launched over the piers, before the next section of deck is constructed behind and the process repeated;
- in-situ construction, in which the entire deck is constructed in reinforced concrete on temporary falsework, which is then removed; and
- beam and deck construction, where deck or portions of the deck are built off-site and placed in position by a crane.

6.14.2 The deck in beam and deck construction is made of either structural steel beams/girders or pre-stressed concrete beams, with a concrete deck acting compositely with the primary beams to enhance structural efficiency.

6.14.3 The choice between these options will depend on the geometry of the structure, the opportunity to construct falsework, which will vary depending on ground conditions, the type of feature being crossed, and the time available to undertake the work.

6.14.4 Launched construction may be used for longer viaducts. This method is made more economic by the incorporation of regular geometry (span arrangements and horizontal alignment).

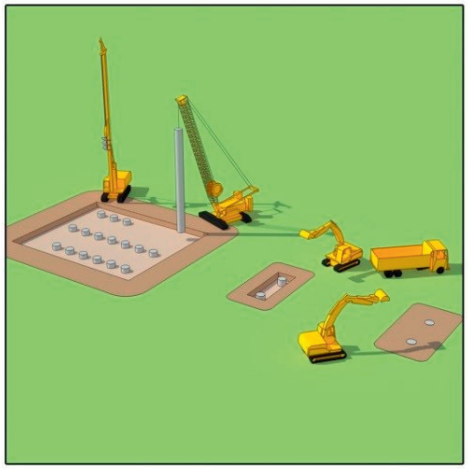
6.14.5 In-situ construction is more economic for low, bespoke, shorter span structures with high degrees of geometric complexity. The beam and deck solution is convenient for bridging over obstructions, for example railways or rivers, especially where construction headroom is restricted.

6.14.6 Viaducts will generally be constructed by:

- installing the construction access and working platform;
- constructing foundations and piers from the platform, installing concrete piles, excavating pile caps and constructing pile caps and support piers, followed by backfilling of excavations;
- constructing abutments, including excavating and constructing the pile mat, installing piles, constructing the abutment base and wall, and backfilling; and
- constructing the deck using either launched, in-situ construction or beam and deck solution.

6.14.7 An illustration of this construction sequence is shown in Figure 25.

Figure 25: Generic sequence for constructing a viaduct



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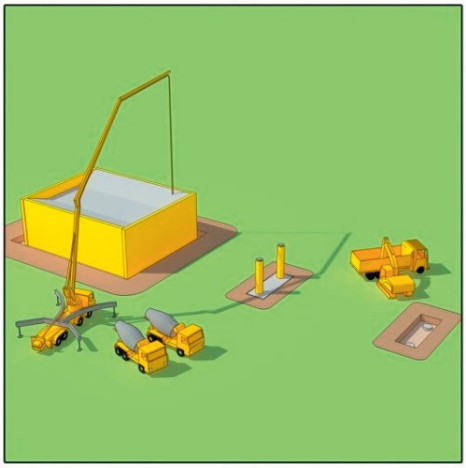

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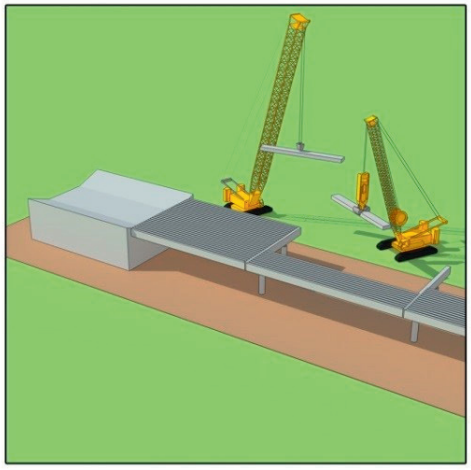

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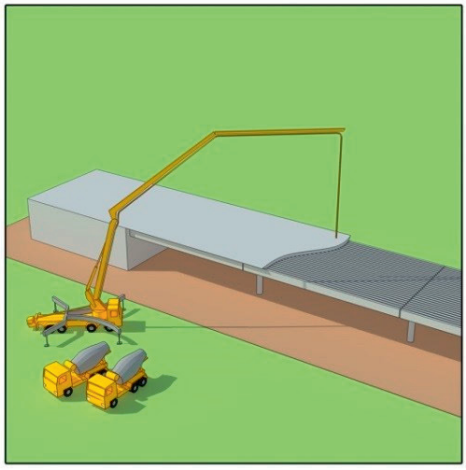

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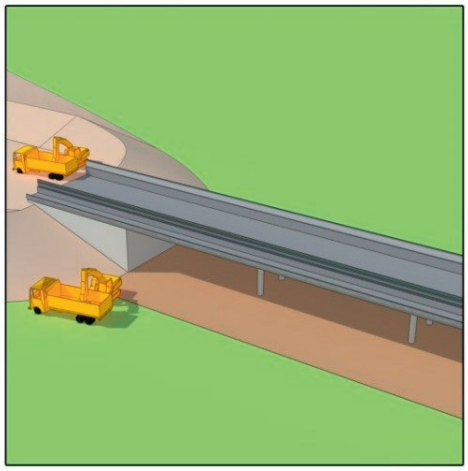

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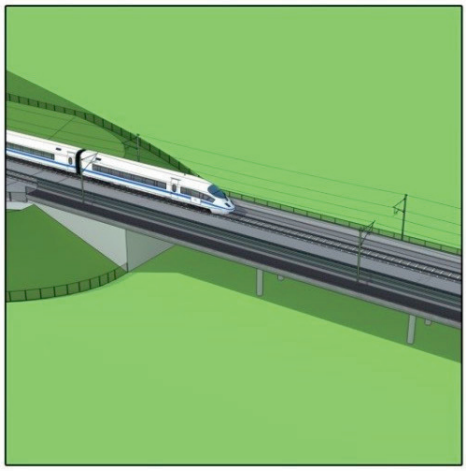

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6.14.8 The following sequence will be repeated, for in-situ construction, until the viaduct deck is completed:

- installing falsework and formwork, reinforcement and stressing tendons[113];
- casting the concrete deck;
- post-tensioning the structure; and
- removing formwork and falsework.

6.14.9 The launch formwork for launched construction will be manufactured off-site and delivered to site in 10-30m components The following sequence will then be repeated until the viaduct deck is completed:

- installing a temporary intermediate pier in some instances (e.g. where the permanent spans exceed 40m);
- establishing a concrete casting yard behind the abutment wall at each end of the viaduct;
- setting up the formwork in the casting yard;
- assembling the launching nose for the deck section;
- installing the superstructure formwork with an antifriction layer on supports;
- fixing the sliding equipment on the pier heads;
- fixing the section of deck reinforcement, placing the tendons, pouring the concrete, and attaching the launching nose to the front of the deck section; and
- forward launching of the deck section using hydraulic jacks.

6.14.10 Final post-tensioning will be installed to the deck on completion of deck launching, and the temporary supports removed.

6.14.11 The following sequence will be repeated, for the beam and deck solution, until the viaduct deck is completed:

- placing the precast/steel beams using cranes;
- placing the precast permanent soffit slabs, reinforcement and tendons;
- concreting the top slab; and
- post-tensioning connections between beams.

[113] High yield steel bar used to apply a compressive force to concrete such that under service conditions there is no net tension within the element.

6.15 Bridges

6.15.1 Bridges to carry the railway over rivers or other features (underbridges), or to carry those features over the railway (overbridges), will generally be constructed in advance of the main earthworks.

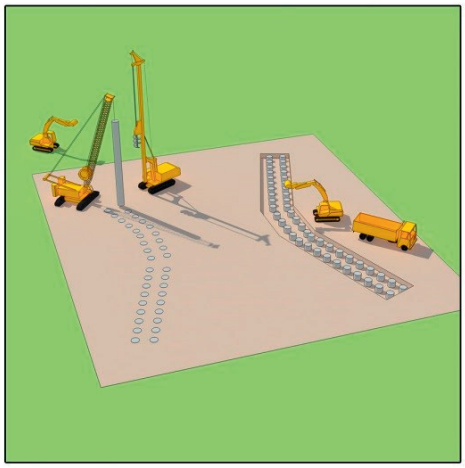
6.15.2 The construction sequence for overbridges and underbridges is generally the same. It consists of the following steps:

- excavating and installing foundations;
- constructing piers, abutments and wing walls;
- backfilling of abutments and wing walls;
- installing bearings and deck beams;
- casting of the deck slab; and
- installing parapets, expansion joints and finishes.

6.15.3 The backfilling operation for integral bridges will generally take place after the deck is constructed.

6.15.4 Figure 26 shows a generic sequence for constructing an overbridge. Figure 27 shows a generic sequence for construction an underbridge.

Figure 26: Generic sequence for constructing an overbridge



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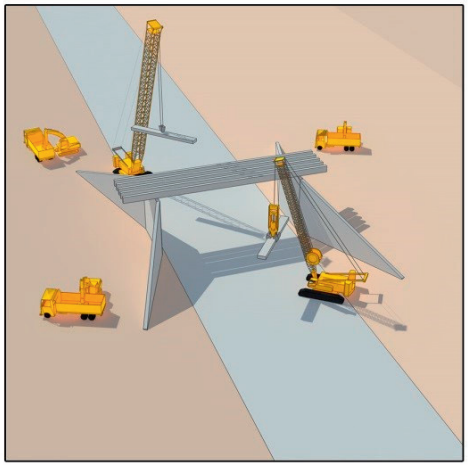

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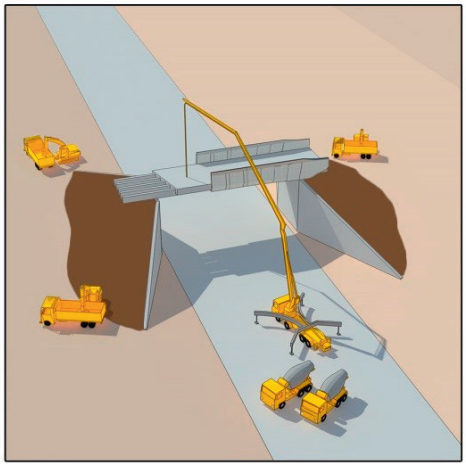

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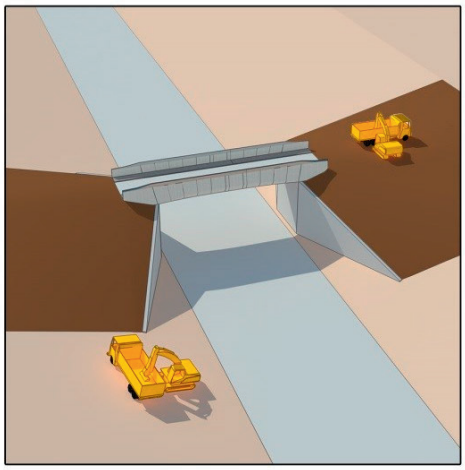

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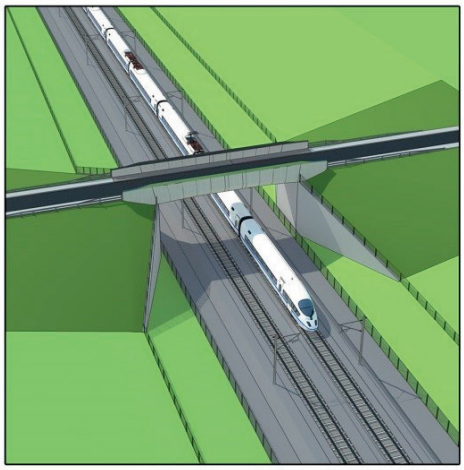

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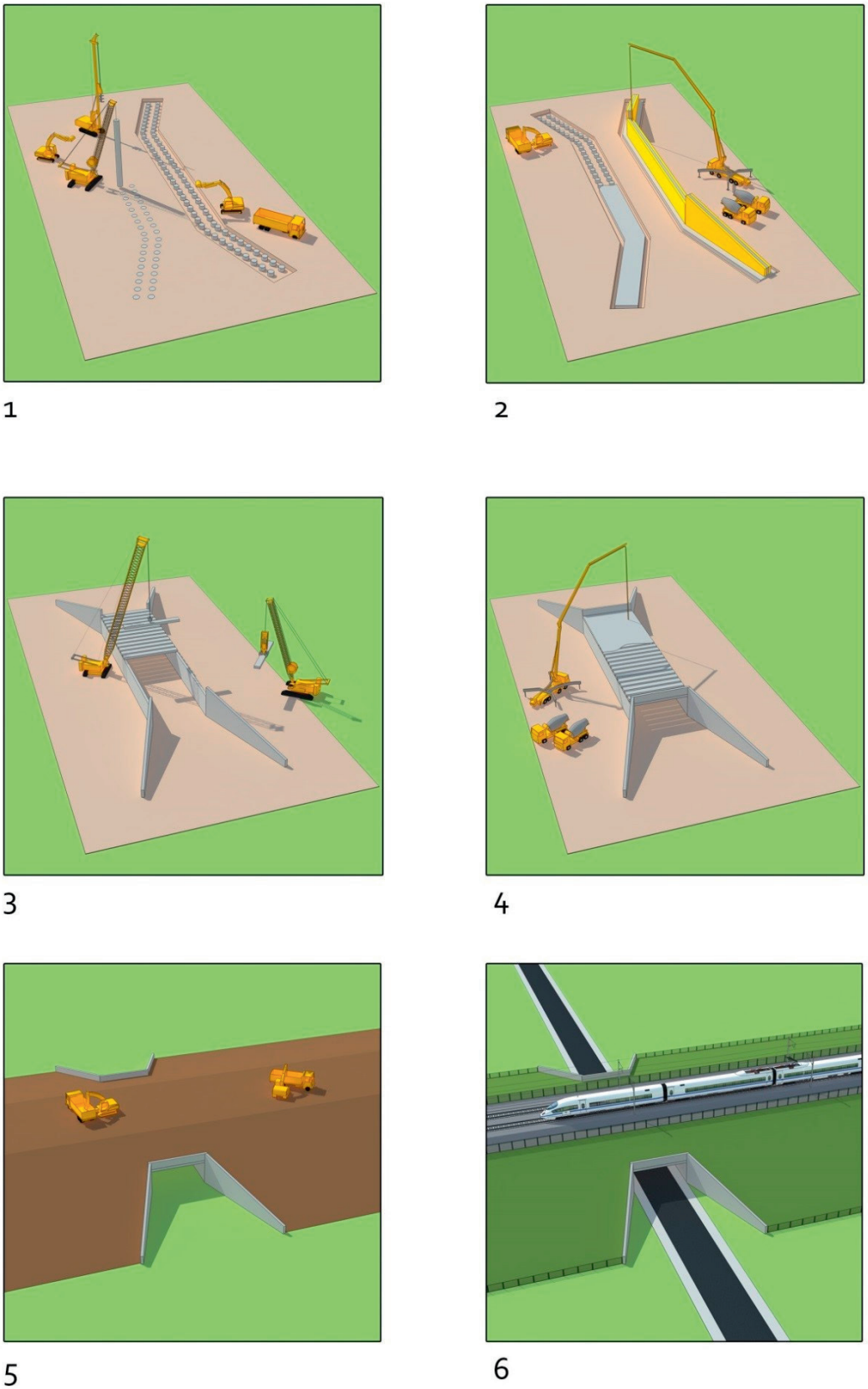
Figure 27: Generic sequence for constructing an underbridge



6.16 Infrastructure maintenance depot

6.16.1 Construction details for the IMD are described in Volume 2, Community Area Report 5, South Cheshire.

6.17 Railhead

6.17.1 A temporary railhead that will be served by the National Rail network is proposed at Stone to provide access for track-laying equipment. The railhead will be used as the delivery location for bulk rail borne materials such as ballast, track slab, rails and sleepers. Facilities at this railhead will include offices, storage, a rail marshalling yard and pre-assembly depot and rail reception maintenance loops. The railhead will operate 24 hours a day, seven days a week. Further information is provided in the Volume 2, Community Area Report 3, Stone and Swynnerton.

6.18 Noise barriers and bunds

6.18.1 Earth bunds used for noise mitigation will be constructed in the same way as embankments, as described in section 6.8. Bunds will be designed with a flat top for the construction of environmental barriers, where required. On completion of the bund, top soiling and landscaping will be undertaken.

6.18.2 Noise fence barriers will be installed in-situ or as pre-fabricated panels. On completion of the barrier, top soiling and landscaping will be undertaken.

6.19 Site restoration and landscape treatment

6.19.1 Landscape mitigation such as planting will be established at the earliest reasonably practicable opportunity during construction. Planting away from the route will be undertaken to reduce adverse landscape and visual effects, and to increase habitat and biodiversity value.

6.19.2 Site restoration will take place once the main construction works are complete, and in agreement with the landowner and the local planning authority. This will involve the removal of temporary structures, plant, materials and equipment. Any required infilling will be completed, followed by landscaping. The engineered embankments and/or cuttings will be reshaped, where appropriate, to integrate the alignment sympathetically into the character of the surrounding landscape.

6.19.3 The remainder of the permanent fencing will be erected as part of the landscaping works. Additional information regarding the approach to mitigation is contained within section 9.

6.20 Track

6.20.1 The railway tracks will either be laid on crushed stone (i.e. ballasted track) or on concrete (i.e. slab track).

6.20.2 Ballasted track will generally be constructed by:

- laying and compacting the sub ballast layer;
- laying and compacting the ballast layer;

- placing sleepers at regular intervals on the ballast;
- installing rails on the sleepers;
- pre-stressing the rails and welding the joints; and
- tamping and aligning the track to final position.

6.20.3 Slab track construction will use either pre-cast or cast-in-situ concrete elements to support the track, instead of ballast.

6.20.4 Slab track will usually be constructed by:

- constructing the hydraulic bound layer[114];
- placing the track slab on the hydraulic bound layer;
- installing the rails;
- pre-stressing the rails and welding the joints; and
- adjusting the track to final position.

6.20.5 It is expected that the completed sections of line can be used, for both types of track, for delivery of materials such as ballast, sleepers and rails to the point of installation.

6.21 Power supply

6.21.1 Access for construction of the traction power supply system will be via the local road network, although some elements may be delivered from the rail corridor.

6.21.2 Construction of the equipment compounds or feeder stations will begin with installation of the construction compound and security fencing, followed by the forming of concrete foundations and slabs, including under-slab ducts.

6.21.3 Road access will be suitably designed to take delivery of the plant and equipment required at each location. This may require widening part of the planned route from the nearest public highway and installation of a suitable foundation for craneage.

6.21.4 Secondary fit-out for traction power and associated prefabricated switch rooms will then take place.

6.21.5 Switch rooms and external transformers will be off-loaded by crane or slid from large vehicles, with the largest elements being delivered first.

6.21.6 The OLE will be installed by specialised rail-mounted machines, where construction phasing allows. The masts supporting the OLE will require foundations, such as concrete pads or monopiles[115], pre-cast piles[116] or steel screw piles[117] with reinforced

[114] Soil type materials (granular or cohesive) improved by the addition of various cementitious/asphaltic materials. It can be produced in-situ or elsewhere.
[115] A single large diameter pile with significant vertical and lateral load carrying capacity. It is used as an alternative to a pile group.
[116] A driven pile produced from pre-cast concrete.
[117] A displacement pile screwed into the ground in order to transfer vertical load into the ground.

concrete pile caps[118]. The masts will be lifted into place and bolted to the foundations from rail-mounted equipment, followed by installation of the OLE.

6.21.7 Installation of the power supply system will be co-ordinated and timed to achieve phased 'powering on' milestones for each section of the Proposed Scheme, so as to reduce the risk of prior deterioration of switchgear and exposed electrical components.

6.22 Train control and telecommunications

6.22.1 Train control and telecommunication equipment will generally be installed after the track is laid and the OLE system installed. This will involve the laying of cabling into the trough system throughout the route, and the installation of line-side cabinets and signage.

6.22.2 The line-side telecommunications equipment will be constructed from within the railway corridor and will require no additional land or access.

6.22.3 The radio mast antennae will be installed at the same time as the OLE masts from within the railway corridor. The equipment will be delivered to site from rail-mounted vehicles and lifted into place onto the foundations, with the workforce travelling on a rail-mounted vehicle.

6.22.4 The workforce will access the equipment from the permanent points of maintenance access for the rail corridor, where further fit-out is required.

6.22.5 Final installation of telecommunications systems will occur during the testing and commissioning phase.

6.23 Interfaces with the classic rail network during construction

6.23.1 The construction of the Proposed Scheme will involve physical and operational changes to the National Rail network.

6.23.2 The main points of interface with the National Rail network during the construction phase are identified in Table 4.

Table 4: Construction interfaces with the National Rail network

Location	Summary of work
Great Haywood: Colwich to Stone line	Construction of a bridge over the existing conventional railway.
West of Stone: Norton Bridge to Stone line	Construction of two bridges over the existing conventional railway. Work to the conventional railway would be required to install new 'reception roads' (sidings) to connect the conventional line to a HS2 construction depot.

[118] A concrete structure used to link a number of discrete pile elements into a single arrangement to support significant loads that the pile elements are not capable of supporting individually.

South of Madeley: WCML and out of use Silverdale line of the Stoke to Market Drayton line	Construction of a viaduct / bridge over the existing conventional railway lines.
South of Crewe: WCML	The Proposed Scheme would connect to the conventional railway to the south of Crewe. These connections would require one of the conventional lines to be re-built to the west of the existing railway. An additional two lines would be required to divert conventional freight trains off the WCML before the connection with the Proposed Scheme. HS2 lines would pass over these three conventional rail lines on a viaduct, which would be built before the new lines were opened. Some additional infrastructure would be needed between Madeley and Crewe to enable trains to cross between the lines.
Crewe: various rail lines	Some modifications to signalling and communications infrastructure may be required on the existing railway to facilitate the increased number of trains that would run through this area.

6.24 System testing and commissioning

6.24.1 The railway will be fully tested to ensure it can operate safely and reliably. Testing and commissioning of the Proposed Scheme will be aligned to the construction programme, moving through commissioning into trial operation in stages. The period of testing, commissioning and trial operation is expected to extend over approximately one year and nine months, commencing by 2026 and completing in 2027.

6.24.2 The programme of testing and commissioning will be divided into a number of phases, as defined below.

6.24.3 A certificate will be issued at the end of each phase of testing to confirm that the tests have been successfully completed and that the next phase can start. The phases include:

- phase 1: off-site testing – factory tests;
- phase 2: on-site testing – static tests;
- phase 3: on-site testing – commissioning;
- phase 4: on-site testing – integration tests;
- phase 5: on-site testing – migration tests;
- phase 6: rolling stock acceptance tests;
- phase 7: performance and operational tests; and
- phase 8: handover and acceptance.

6.24.4 Each of the systems to be tested will be broken down into commissioning lots. Each commissioning lot will be subjected to each test phase in sequence and is the smallest element that will be subjected to formal inspection. When breaking down the systems, due regard will be taken of the interfaces and dependencies between the

systems and between the commissioning lots within each system. This will allow for the test sequence logic and test programme to be developed.

6.24.5 Rolling stock acceptance tests will take place once a sufficient length of route has been commissioned, and will be followed by performance tests involving multiple trains to confirm operability. The classic compatible trains will be tested and commissioned on classic infrastructure at the same time. Final installation of telecommunications systems will also occur during the testing and commissioning phase.

6.24.6 Trial operations will allow operational procedures to be tested and refined at the same time as staff are trained.

7 Environmental impact assessment

7.1 Overview

Introduction

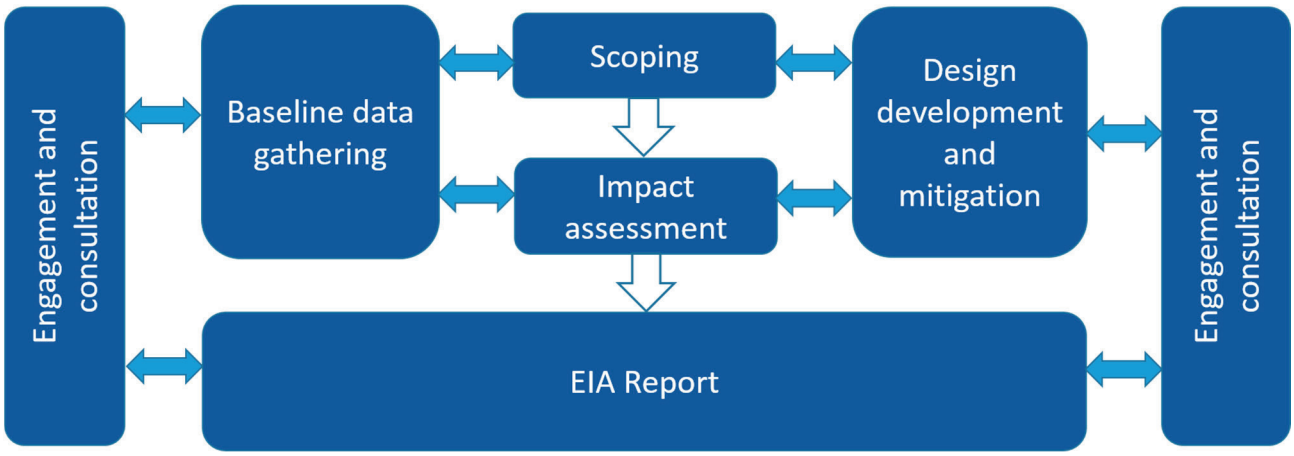
7.1.1 The purpose of EIA is to identify the likely significant effects of a proposed development on the environment. In simple terms, it does this by identifying the current (baseline) conditions, anticipating how these may change in the future, and predicting the potential impacts of the development across a range of topics. This section describes the general approach adopted for the EIA of the Proposed Scheme. Further information on the scope and methodology approach for each topic is summarised in section 8.

7.1.2 The working draft EIA Report is an interim report for consultation. The design and assessment of the Proposed Scheme are at an early stage of development and are presented here to enable the public and stakeholders to provide comments, which will be taken into account, as appropriate. The EIA and design of the Proposed Scheme will continue to be refined during and following this consultation. These refinements will be reflected in the formal EIA Report.

Preparation of the Environmental Impact Assessment Report

7.1.3 The main steps in the preparation of the formal EIA Report are shown in Figure 28 and set out below.

Figure 28: Environmental assessment process for Phase 2a



Scoping

7.1.4 The scoping phase established the overall scope and methodology for the assessment, including the range of environmental topics to be addressed, and included an initial round of stakeholder consultation. Initial scoping was carried out on an informal basis, as set out in the draft SMR[119], which was finalised through

[119] Arup/ERM (2016) HS2 Phase Two: West Midlands to Crewe EIA Scope and Methodology Report – draft for consultation, March 2016. Available on-line at

engagement and consultation with local authorities, a wide range of environmental organisations and the public.

Gathering of baseline data

7.1.5 Baseline studies are establishing the current baseline conditions, comprising the environmental conditions that exist in the vicinity of the Proposed Scheme and across the study areas for each topic. These studies comprise desk-top research to gather and evaluate previous environmental work and publicly available information, together with new environmental surveys and consultation with local groups. Relevant policies, guidelines and legislation, together with industry-accepted practice, are also being identified as part of this stage.

7.1.6 The current baseline is being extrapolated, where appropriate, into the future to take account of predicted or anticipated variations due to factors such as changing climatic conditions (based on trends within the UKCP09 projections[120]), policy, legislation, advances in technology and future developments. This is known as the future baseline. Future baseline conditions may also be altered by other developments. The identification of future developments includes those that may occur before or during the construction of the Proposed Scheme, with the potential to result in significant impacts and resultant effects.

7.1.7 As this is a working draft EIA Report, where information is not currently available professional judgement and reasonable assumptions have been used to provide an indication of likely impact to inform consultation and engagement on the Proposed Scheme.

7.1.8 Future developments will be identified in the formal EIA Report where they may introduce new environmental receptors[121] that could be significantly affected by the Proposed Scheme. Any mitigation proposed can be amended at a later date, in the event that the anticipated development does not take place, to reflect the change from the future baseline position.

Impact assessment

7.1.9 Assessment of the impacts and effects of the Proposed Scheme is being undertaken in accordance with the methodology outlined for each environmental topic in the draft SMR. This is also summarised within section 8 of this report. The assessment will identify the likely significant effects, the measures envisaged to mitigate adverse effects, and the likely significant residual effects (i.e. effects remaining following mitigation), during the construction and operation phase.

7.1.10 The working draft EIA Report presents preliminary environmental information in the form of:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506111/HS2_Phase_2a_EIA_Scope_and_Methodology_Report_Final_for_Comms_08-03-2016_WEB_1400.pdf.

[120] UKCP09 (2009), UKCP09 Climate Change Projections Report, http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf, Accessed: 11 April 2016.

[121] Receptors are defined as a component of the natural or built environment (such as human beings, water, air, a building, or a plant) that is affected by an impact of construction and/or operation of a proposed development. Residents of a new housing development close to the route are an example of a new receptor.

- baseline data gathered to-date,
- the impacts of the Proposed Scheme (and where possible, the significant environmental effects), both beneficial and adverse; and
- the means of avoiding or reducing the likely significant adverse effects.

7.1.11 The working draft EIA Report has taken account of relevant policies, guidelines, legislation and industry accepted practice in assessing impacts for each environmental topic, as well as the experience and professional judgement of specialists.

Mitigation

7.1.12 Mitigation measures are being identified throughout the development and assessment of the Proposed Scheme. More information on the approach to mitigation is set out in section 9.

Consultation and engagement

7.1.13 Stakeholder engagement has taken place throughout the design process and preparation of the working draft EIA Report, as described in section 3. Public consultation on the working draft EIA Report is taking place between September and November 2016.

Consideration of reasonable alternatives

7.1.14 Reasonable alternatives to the Proposed Scheme have been considered as part of the EIA. The strategic, route-wide and route corridor alternatives are described in Section 10. Local alternatives considered prior to November 2015 are addressed in section 11. Local alternatives considered since November 2015 are addressed in the Volume 2, community area reports. A more detailed account of the reasonable alternatives, how they were considered and the reasons for the choices made can be found in the Alternatives report as an appendix to the Volume 1.

Preparation of the formal EIA Report

7.1.15 The EIA and design of the Proposed Scheme will continue to be refined during and following the consultation on the working draft EIA Report. The formal EIA Report to be submitted to Parliament with the Bill will reflect the consultation responses, ongoing engineering design development and construction arrangements, further environmental baseline surveys and proposed further mitigation.

7.1.16 It is envisaged that the formal EIA Report will include the following additional volumes:

- Volume 4: Off-route effects – to describe an assessment of the off-route effects of the Proposed Scheme i.e. those aspects of the construction and operation of the Proposed Scheme that have the potential to generate significant environmental effects in locations remote from the route corridor; and
- Volume 5: Appendices and map books – containing supporting environmental information and associated map books.

7.1.17 The detailed technical appendices supporting the assessment will be published as part of, or alongside, the formal EIA Report.

7.2 Scope of the assessment

Introduction

7.2.1 The scope determines what is included within the assessment of the Proposed Scheme, in terms of:

- years and time periods – 'the temporal scope';
- areas – 'the geographic scope'; and
- topics – 'the technical scope'.

Temporal scope

7.2.2 The main construction works are expected to take place between 2020 and 2026 (including a period of testing and commissioning), although the duration, intensity and scale of construction along the route will vary over this period. The Proposed Scheme is expected to become operational in 2027. Topics have generally assessed the period of maximum intensity over the construction period and compared it to a defined baseline year.

7.2.3 The maximum level of operational activity (i.e. the number and frequency of trains and passengers) using the Proposed Scheme will be reached after the opening of the full Y-network, following construction of Phase 2b, which is expected in 2033. Therefore, consideration is being given to the implications of the operational rail traffic and passenger numbers associated with the full Y-network for relevant environmental topics. These topics include: traffic and transport; sound, noise and vibration; community; and air quality (in so far as transport-related emissions are concerned). The noise and vibration implications for receptors along the route, and any transport implications associated with passenger movements at stations and on other modes, are being assessed on the basis of the operational assumptions set out in section 4.5.

7.2.4 It has been assumed for the EIA that travel demand would not increase after 2036. This 'demand cap' has been used as a basis for evaluating the future use of HS2, road and air travel. Sensitivity assessment shows that this is a pessimistic scenario in that applying a later demand cap would result in more passenger journeys on HS2 and greater modal shift from other transport modes.

7.2.5 The EIA compares the future patterns of movement of transport and passengers resulting from the Proposed Scheme with the predicted transport and passenger movements without HS2, otherwise known as the 'do minimum case' (or 'future baseline' case).

7.2.6 The do minimum case refers to the future that would exist if the Proposed Scheme were not developed. This scenario takes account of other changes to transport infrastructure, including:

- electrification of the MML from St Pancras, thereby providing increased

capacity and faster journey times to the East Midlands;

- use of Intercity Express Rolling Stock on the ECML, resulting in increased capacity and faster journey times;
- improvements to WCML infrastructure and the WCML timetable to provide additional trains and faster running speeds;
- development of the Northern Hub to provide faster and more frequent services across the north of England; and
- development of the East West Rail scheme between Oxford and Milton Keynes to provide new local services and faster cross country services.

Geographic scope

7.2.7 The geographic (or spatial) scope is the area over which changes to the environment are likely to occur. This distance is influenced by the physical extent of the works, the nature of the baseline environment and the manner in which the effects are propagated. It takes account of both the land required permanently for rail infrastructure and the additional land required temporarily for construction.

7.2.8 Each of the environmental topics identifies the area within which impacts and effects have been assessed. This is summarised in section 8 and further explained within the SMR.

7.2.9 The reporting of local environmental impacts (and where practicable, likely significant effects) is presented in the Volume 2 community area reports. Volume 2 is split into five community area reports, each of which is based on a distinct geographical area, as shown in section 3.3.

7.2.10 The assessment of environmental impacts and effects that cover a wider geographical area is reported in Volume 3. These route-wide impacts and effects have been considered at a regional or national level, and include the effects of:

- HS2 services on the 'classic network' north of Crewe;
- changes to HS2 passenger levels on Phase One as a result of the Proposed Scheme and consequential effects; and
- consequential changes to rail traffic on other lines, especially on the WCML between Crewe and the north, and potential disruption at Crewe station during construction.

7.2.11 The assessment of effects that may occur at locations remote from the Proposed Scheme (i.e. off-route effects) will be presented in Volume 4 of the formal EIA Report.

7.2.12 The working draft EIA Report does not address environmental effects that may occur outside the UK (i.e. transboundary effects). The only such effects that are likely to be relevant relate to changes in international travel that may occur once the Proposed Scheme becomes operational. These changes include additional high speed services using HS1, together with possible impacts on other international modes of transport, such as air. Such changes are very difficult to anticipate, due to the many variables

involved (e.g. relative pricing between modes). However, the changes are unlikely to result in significant environmental effects.

Technical scope

7.2.13 The technical scope refers to the environmental topics that have been addressed in the assessment. The technical scope of the EIA of the Proposed Scheme will seek to meet the requirements of EIA Directive 2014/52/EU, in the absence of new regulations, as described in section 1.3 of this working draft. The working draft EIA Report describes the likely impacts, and where possible the potential significant effects, of the Proposed Scheme for the following topics:

- agriculture, forestry and soils;
- air quality;
- climate change;
- community;
- cultural heritage;
- ecology and biodiversity;
- electromagnetic interference;
- health;
- land quality;
- landscape and visual;
- major accidents and natural disasters;
- socio-economics;
- sound, noise and vibration;
- traffic and transport;
- waste and material resources; and
- water resources and flood risk.

7.2.14 These topics have been evaluated during the scoping process to determine the extent to which they require inclusion/consideration within the working draft EIA Report, having regard to whether they are likely to give rise to significant effects. It was determined as part of this process that all topics, with the exception of electromagnetic interference, could potentially give rise to significant effects.

Electromagnetic interference

7.2.15 Specific assessment of potential electromagnetic effects is not required as part of the EIA, since these effects can be 'designed out' of the Proposed Scheme.

7.2.16 High voltage electrical equipment creates electromagnetic fields (EMF), which can potentially have implications for human health and may cause electromagnetic

interference (EMI) to other electrical/electronic equipment (e.g. communications) or infrastructure (e.g. power lines). In addition, features such as tower cranes can cause temporary interference to TV reception.

7.2.17 The main potential source of EMI associated with the Proposed Scheme will be the traction power system, comprising the OLE along the route and supporting infrastructure such as feeder stations. The railway communications system will, in addition, generate radio signals.

7.2.18 The railway's own operating systems will need to be immune to EMI and radio interference, whilst levels of exposure for passengers and staff must be acceptable. This will be achieved by ensuring that all electrical equipment complies with the relevant standards for electromagnetic compatibility (EMC) and personal protection, for example BS EN 50121-5-2015[122] and BS EN 50122-1- 2011[123] and EU Directive 2013/35/EU[124] Electromagnetic Fields (EMF) limits, which is closely based on ICNIRP (International Commission on Non-Ionising Radiation Protection) guidance[125].

7.2.19 EMF extend over relatively short distances. Any residual risk to nearby receptors (e.g. residential properties, businesses or communications infrastructure) will not be significant, on the assumption that acceptable levels are achieved on the railway itself.

7.2.20 Equipment used during construction of the Proposed Scheme will also comply with applicable standards for EMF and EMC. Assuming that this equipment is installed, operated and maintained correctly, levels of electromagnetic emissions are unlikely to exceed the acceptable limits for workers or the public, or to cause EMI. Power supplies used for construction are generally insufficient to cause any significant EMI.

7.2.21 Tower cranes will be used in some locations during the construction phase. If complaints about interference are received (e.g. in relation to TV reception), appropriate remedial action will be taken to restore signal integrity at affected properties (e.g. by replacing aerials or boosting signal strength). However, the likelihood of such effects is decreasing as more people switch to digital or cable networks.

7.3 Impacts and effects

7.3.1 The working draft EIA Report identifies both beneficial and adverse impacts on environmental and community resources or receptors. The likelihood that an impact will give rise to a significant environmental effect depends on a number of factors, such as the magnitude of the impact and the sensitivity of the receiving environment. The formal EIA Report will identify the likely significant effects of the Proposed Scheme. It will also identify the level of impact that gives rise to the significant effects, and explain how adverse impacts will be mitigated.

7.3.2 The predicted impacts have generally been classified according to whether they are beneficial, adverse or negligible. They have been further categorised as low/minor,

[122] British Standards Institute (2015), *BS EN 50121-5-2015 Railway Applications, Electromagnetic Compatibility*.
[123] British Standards Institute (2011), *BS EN 50122-1-2011 Railway Applications, Fixed installations – Electrical safety, earthing and the return circuit. Part 1: Protective provisions against electric shock*.
[124] Official Journal of the European Union, *Directive 2013/35/EU on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)*.
[125] International Commission on non-ionizing radiation protection (2010), *ICNIRP Guidelines*.

medium/moderate or high/major. Whilst the definition of each category varies by topic, as shown in the SMR, these terms have generally been defined as follows, unless otherwise specified:

- beneficial: advantageous or positive change to an environmental resource or receptor;
- adverse: detrimental or negative change to an environmental resource or receptor;
- negligible: imperceptible impacts to an environmental resource or receptor;
- minor: slight, very short-term and/or highly localised impact;
- moderate: limited impact (by extent, duration and/or magnitude); and
- major: considerable impact (by extent, duration and/or magnitude) of more than local importance or in breach of recognised standards, policy or legislation.

7.3.3 The duration of impacts has been defined as either temporary or permanent. Impacts can occur either directly or indirectly. Direct impacts are those that will arise directly from construction or operation of the Proposed Scheme (e.g. due to the land required or to train movements). Indirect impacts are those that arise from consequential changes associated with the Proposed Scheme (e.g. the impacts on conventional rail services).

7.3.4 Impacts have been assessed qualitatively, based on professional judgement, in instances where quantification was not possible. Section 8 indicates where uncertainty exists, and the assumptions that have been made.

7.3.5 Effects deemed to be significant will be evaluated against recognised standards and accepted criteria for each environmental topic, where these are available. Professional judgement will be used in instances where no recognised standards or criteria exist, taking account of factors such as:

- spatial extent (e.g. local, district, regional, national or international);
- magnitude;
- duration (whether short, medium or long-term);
- frequency of occurrence;
- nature of the effect (whether direct or indirect, permanent or reversible);
- whether it occurs in isolation, is cumulative or interactive;
- sensitivity and number of receptors affected;
- value of a resource affected;
- performance against environmental quality standards; and
- compatibility with environmental policies.

7.4 Cumulative effects

Introduction

7.4.1 Cumulative effects are broadly defined as incremental effects that result from the accumulation of a number of individual effects. They may result either from a combination of effects arising from the Proposed Scheme (intra-project effects) or from an interaction between the effects of the Proposed Scheme with the effects of other reasonably foreseeable developments that are likely to be under construction or to have been completed (inter-project effects). Effects arising from developments that are expected to be completed before construction of the Proposed Scheme will be considered by extrapolating existing conditions as part of the future baseline. Any significant cumulative effects will be identified in the formal EIA Report.

7.4.2 Cumulative effects can be either temporary or permanent and can broadly arise from:

- the combined effects on a single receptor of a number of individual environmental impacts, for example noise, dust and traffic;
- the effects of existing and/or approved projects in the vicinity of the Proposed Scheme which are under construction or have been consented, including HS2 Phase One, which when combined with the effects of the Proposed Scheme may have an incremental significant effect; and
- the cumulation of individual effects on a receptor which when summed (including in a regional context or over the length of the Proposed Scheme), result in an effect of greater significance than the sum of the individual effects (i.e. synergistic effects).

7.4.3 Developments expected to be completed between 2020 and 2026 (i.e. before the Proposed Scheme is operational), may give rise to cumulative effects. However, smaller projects are unlikely to give rise to significant cumulative effects, as the scale of their construction impact, in combination with the Proposed Scheme, will not generate any noticeable increases in effects.

7.4.4 People living in developments to be completed before 2020 are included as receptors of construction of the Proposed Scheme and those in developments to be completed before 2027 are included as receptors of the operational effects of the Proposed Scheme.

7.4.5 Developments that may be completed after 2027 have generally not been taken into account. This is because development planning generally does not extend so far into the future and even where such developments can be identified, there is generally insufficient information available for an assessment of cumulative effects. In these cases it is assumed that the planning process for those developments will take the Proposed Scheme into account (and will therefore consider any cumulative effects at that time).

7.4.6 Committed developments are defined as developments that have planning permission or for which sites have been allocated in adopted development plans, which are on or close to the Proposed Scheme. Planning applications yet to be determined and sites where proposed allocations in development plans are yet to be

adopted, are termed proposed developments and have not been included in the assessment. The formal EIA Report will set out the committed developments that have been considered in determining the future baseline and/or in assessing the cumulative effects for each topic.

Phase One, Phase 2a and Phase 2b

7.4.7 The effects of the overlapping construction of Phase One and Phase 2a in the vicinity of receptors of impacts from the Proposed Scheme is being carefully considered, particularly at the interface around Fradley. The effects of subsequent Phase 2b development between Crewe and the north is also being considered as part of the EIA. These effects will be identified in the formal EIA Report.

7.4.8 The operational effects of the Proposed Scheme are being assessed on the assumption that Phase One and Phase 2b will also be open, so as to provide a reasonable worst-case basis on which to assess effects such as those relating to train noise. In this sense, these effects are cumulative, in that they reflect the combined operation of all phases of HS2.

7.5 Assumptions and limitations

7.5.1 The information and data upon which an EIA is based can be limited, which may affect the reliability of the conclusions of the assessment. A precautionary approach is being used in the EIA of the Proposed Scheme in identifying impacts and effects in instances where there is uncertainty or limited information. Any assumptions and limitations, and the consequences on the completeness or potential accuracy of conclusions, are described in the relevant environmental topic section within the working draft EIA Report.

7.5.2 The EIA and design of the Proposed Scheme will continue to be refined during and following the consultation on the working draft EIA Report, as explained in the Foreword. It is therefore a provisional document in several respects, and should be read as such.

8 Scope and methodology summary for environmental topics

8.1 Introduction

8.1.1 This section provides a summary, by environmental topic, of:

- assessment scope and methodology;
- the key assumptions and limitations underpinning the assessment methodology; and
- further work, including surveys and modelling, to be undertaken for each topic prior to completion of the formal EIA Report.

8.1.2 The full scope and methodology is contained within the draft SMR[126].

8.2 Agriculture, forestry and soils

Scope

8.2.1 The assessment covers agriculture, forestry and soils, which includes the environmental topic areas of soil, agricultural and forestry land, and farm and farm-based enterprises. In particular, it considers the potential impacts of the requirements for land in terms of agricultural land quality, soil resources, local farm businesses and on-farm enterprises, and agri-environment schemes. Such impacts may result directly from land required (both temporarily and permanently) for the construction and operation of the Proposed Scheme, and indirectly from impacts such as severance or pollution.

8.2.2 Effects will be identified for all agricultural and forestry land that will be required for the construction and operation of the Proposed Scheme, and for all holdings that include such land.

8.2.3 Most effects on agriculture, forestry and soils will arise during the construction phase and will be either temporary or permanent. Temporary effects include land that will be used during construction and restored to agricultural use using conserved soil resources on completion of construction (in agreement with the landowner), the severance of land during construction, and the initial effects of construction noise on adjacent agricultural activities. Permanent effects will be those that remain following the construction of the Proposed Scheme, including the land permanently required, and the permanent severance of land and effects on farm infrastructure. Operational impacts relate primarily to the effects of operational noise on agricultural and related enterprises and the ongoing management of operational railway land.

[126] Arup/ERM (2016) HS2 Phase Two: West Midlands to Crewe EIA Scope and Methodology Report – draft for consultation, March 2016. Available on-line at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506111/HS2_Phase_2a_EIA_Scope_and_Methodology_Report_Final_for_Comms_08-03-2016_WEB_1400.pdf.

Baseline

8.2.4 Information on current agricultural land quality is being derived from an interpretation of geological, topographical, soil, agro-climatic and existing detailed and predictive Agricultural Land Classification (ALC) information. This ALC information is being augmented by field surveys to validate its findings where required and where access is available. Desktop research is also being used to identify relevant agri-environmental schemes and woodlands. Details of land use and farming practices are being obtained primarily from interviews with landowners and businesses.

Methodology

8.2.5 Significant effects will be derived from the interaction between the magnitude of impact, the sensitivity of the affected resource/receptor and the relative scarcity or abundance of the resource/receptor in the locality. Impact magnitude is essentially a matter of its extent, duration or severity (e.g. the proportion of a holding subject to land required for construction and/or operation). Sensitivity reflects the resilience of a soil resource or business to accommodate change, whilst scarcity relates to the relative preponderance of a resource/receptor (e.g. best and most versatile (BMV) land in the locality or a niche business).

8.2.6 The areas of land required to construct and operate the Proposed Scheme will be calculated on the basis of the maximum extent of the permanent infrastructure and temporary works (including soil storage areas), as shown in the Bill plans.

Assumptions and limitations

8.2.7 It is assumed, as part of the assessment, that:

- agricultural land required for temporary purposes during construction, which is to be re-instated as agricultural land, will be restored to agricultural use by following good practice for soil handling, storage and placement, and will be returned to its original landowner;
- all agricultural soil resources generated by the Proposed Scheme will be used appropriately and on-site to fulfil one or more of the recognised functions of soil;
- all displaced ancient woodland soils will be translocated to form the basis of new woodland planting and that other woodland soils will be reused as appropriate, including as the basis for new woodland planting;
- land required for environmental mitigation measures will no longer be available for agricultural use, which is a worst-case assumption, although such land may be managed on a low input basis by agricultural interests;
- farm buildings and dwellings to be demolished as part of the Proposed Scheme will not be replaced[127]; and
- severed land will continue to be used by the holding where access is available

[127] Compensation will be available for landowners whose farm buildings and dwellings are demolished as part of the Proposed Scheme. However, the decision to replace such buildings will rest with the affected party.

to that land, and that, where required, new field accesses to severed parcels of land will be created from public highways.

8.2.8 Baseline information on farm holdings will be derived from publicly available sources and observations from public vantage points in instances where landowners and occupiers do not participate in farm impact surveys.

8.3 Air quality

Scope

8.3.1 The air quality assessment will include consideration of the potential effects of construction and operation. Construction effects would occur as a result of the construction activities, associated traffic movements and highway interventions. Operational effects on air quality would occur as a result of changes to road layouts and traffic flows.

8.3.2 The key pollutants being considered are: dust, nitrogen dioxide (NO_2), oxides of nitrogen (NOx) and particulate matter (PM10 and PM2.5). Traffic effects are being assessed for the peak years during the construction period and for the year of opening for operational effects.

8.3.3 The spatial scope of the assessment reflects the area over which effects are likely to be measurable, ranging from the immediate vicinity of the works (e.g. for dust emissions) to air quality management areas and the local authorities within which local air quality is monitored and managed. Criteria from the DMRB are being used to determine the relevant extent of the highway network to be assessed for traffic emissions.

Baseline

8.3.4 Information on current air quality has been obtained primarily from:

- local authority air quality review and assessment reports;
- monitoring data available from the national Automatic Urban and Rural Network (AURN);
- the Department for Environment, Food and Rural Affairs (Defra) Air Information Resource website; and
- the UK Air Pollution Information System.

8.3.5 Background air quality will also be monitored in instances where information is required to:

- verify modelling, and no suitable existing data are available; or
- determine existing concentrations – either in background locations or where pollutant concentrations may be high.

Methodology

8.3.6 The effects from dust during construction will be assessed using an approach developed from the guidance produced by the Institute of Air Quality Management (IAQM)[128]. This guidance assigns the scale of an effect according to the scale of the construction works and the number, proximity and sensitivity of the receptors. The effect is a combination of the likelihood of significant levels of dust occurring at receptors (i.e. dust impacts) and the extent of inconvenience or annoyance that may be caused, and as such is an assessment of risk (the probability of an event happening combined with the severity of it).

8.3.7 The assessment assumes that dust control measures would be applied to the construction activities, through the CoCP, so that dust levels at receptors are kept as low as reasonably practicable. For other types of receptors (such as nature conservation sites), the determination of the level of effect takes account of the potential level of impact, the sensitivity of the receptor to dust impacts, and the designation of the receptor.

8.3.8 The level of effects on individual receptors (e.g. residential properties close to roads) has been identified on the basis of air quality standards (EU/UK air quality limit values and objectives), in accordance with the descriptors used in the IAQM/Environmental Protection UK (EPUK) guidance on land-use planning and development control[129].

8.3.9 Traffic-related effects at receptors have been predicted using dispersion modelling. Dispersion modelling of point sources (e.g. combustion emissions from energy centres) has also been carried out where appropriate. The likelihood of nitrogen deposition on sensitive sites (e.g. protected habitats) has been assessed in accordance with the DMRB guidance.

Assumptions and limitations

8.3.10 Assumptions necessary to undertake the air quality assessment are set out in the SMR and in individual sections in the Volume 2, community area reports.

8.4 Climate change

Scope

Introduction

8.4.1 Climate change is being assessed in three ways as part of the EIA:

- a GHG assessment;
- an in-combination climate change assessment; and
- a climate change resilience assessment.

[128] Institute of Air Quality Management (2014) *Guidance on the assessment of dust from demolition and construction*. IAQM, London.
[129] Moorcroft and Barrowcliffe et al. (2015) *Land-use Planning & Development Control: Planning for Air Quality*. IAQM, London

Scope for GHG assessment

8.4.2 The GHG assessment will adopt a life cycle approach where all emissions irrespective of where they occur will be accounted for. The scope of the GHG assessment includes the following stages: pre-construction, construction, use (also referred to as operational emissions), end-of-life, and any additional emissions beyond the Proposed Scheme's boundary such as emission savings from tree planting and modal shift. For further detail on the scope of the GHG assessment refer to the SMR.

Scope for in-combination climate change impacts assessment

8.4.3 As set out in the SMR Section 8, the technical scope of the in-combination climate change impacts assessment has incorporated the following processes:

- an initial assessment of potential climate change impacts for all EIA topics during construction and operation; and
- a more detailed assessment of significant in-combination climate change impacts and effects for topics for which potential climate change impacts were more numerous or greater during construction and operation.

8.4.4 The physical scope of the in-combination climate change impacts assessment comprises the five community areas along the route of Phase 2a and the distances either side of the Proposed Scheme within which other topics are undertaking their own assessments of effects. The temporal scope of the in-combination climate change impacts assessment assesses effects for the 2020s (construction and start of operation) and the 2080s (operation).

Scope for climate change resilience assessment

8.4.5 The technical scope of the climate change resilience assessment will incorporate the following processes:

- an initial resilience assessment of all potential climate hazards for all infrastructure and assets associated with the Proposed Scheme to the end of their design life; and
- a further resilience assessment of significant climate hazards for relevant infrastructure and assets associated with the Proposed Scheme to the end of their design life.

8.4.6 The physical scope of the climate change resilience assessment comprises the five community areas along the route of Phase 2a. The temporal scope of the climate change resilience assessment will assess impacts for the 2020s (construction) and the 2080s (operation).

Baseline

Baseline for greenhouse gas emissions

8.4.7 The environmental baseline provides a reference point against which the impact of the Proposed Scheme can be compared. In the case of GHG emissions the baseline assessment will cover changes in travel patterns and modal shift, project UK grid

electricity generation emissions and any planned associated developments such as roads and depots.

Baseline for in-combination climate change impacts and climate change resilience

8.4.8 The trends within the UKCP09 climate change projections indicate changes to long-term, seasonal averages such as warmer and drier summers, milder and wetter winters, an increase in annual average temperature, and fewer days with frost.

8.4.9 Climate change is also expected to result in more extreme weather, including more very hot days, more intense rainfall, and an increase in dry spells. In addition, the probability of short periods of intense cold weather and of more frequent storms and high winds is also likely to increase but with a higher level of uncertainty. These changes in climatic averages and extreme weather events are likely to become more pronounced during the operation phase of the Proposed Scheme.

Methodology

Assessment of greenhouse gas emissions

8.4.10 The approach to the GHG assessment is primarily informed and guided by three key standards: the Publicly Available Specification (PAS) 2080, BS EN 1597 and BS EN 15804. The carbon footprint will be reported in terms of tonnes of carbon dioxide equivalents.

8.4.11 Assessments will be carried out for the following time periods, including 120 years to align with the assumed design life of the Proposed Scheme:

- 2020 – start of construction;
- 2027 – Proposed Scheme opening;
- 2041 – full technical capacity and operation of HS2 as a whole; and
- 2087 – 60 years of operation after opening.

Assessment of in-combination climate change impacts

8.4.12 The approach to the in-combination climate change impacts assessment has been informed by good practice and guidance including that from the European Commission[130], the Institute of Environmental Management and Assessment (IEMA)[131,132], and topic specific guidance published by the Food and Agriculture

[130] European Commission (2013) *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*. Available online at: http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf.
[131] IEMA (2010) *IEMA Principles Series: Climate Change Mitigation and EIA, IEMA; EIA and Climate Change*. Available online at: http://www.iema.net/eia-climate-change.
[132] IEMA (2015) *IEMA guide to climate change resilience and adaptation*. Available online at: Available online at: http://www.iema.net/eia-climate-change.

Organisation[133], Woodland Trust[134], the Forestry Commission[135], the Landscape Institute[136], the Health Protection Agency[137] and Defra[138].

8.4.13 Potential climate change impacts will be considered at the route-wide level for all topics and community areas. This initial in-combination climate change impact assessment will then identify EIA topics to be scoped in for a more detailed assessment. This more detailed assessment will determine whether there are any significant in-combination effects to report.

Assessment of climate change resilience

8.4.14 The approach to the climate change resilience assessment has been informed by good practice and guidance including that from the European Commission[139], the IEMA[140,141], RSSB[142], Network Rail[143] and the Cabinet Office[144].

8.4.15 The climate change resilience assessment will initially be considered at a route-wide level and include all relevant assets associated with the Proposed Scheme. It will be based on a high level climate change risk assessment which uses the projections of changes in climate averages and extreme weather events provided in UKCP09 to qualitatively assess the impacts of climate change on the Proposed Scheme using professional expertise and judgement.

Assumptions and limitations

Assumptions and limitations for greenhouse gas emissions assessment

8.4.16 There is a level of uncertainty behind the GHG assessment primarily due to the long time periods involved (i.e. 120-year design life). Projections on the carbon intensity of UK grid electricity generation vary significantly, whilst there are numerous sources of information on the carbon intensity of concrete and steel manufacturing. These limitations will be addressed by reporting a range of GHG emissions scenarios.

[133] Environment Agency (2016), Guidance - Flood risk assessments: climate change allowances. Available online at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances; Accessed February 2016.
[134] Woodland Trust; Climate change - the Woodland Trust's position. Available online at: https://www.woodlandtrust.org.uk/publications/2015/06/climate-change
[135] Forestry Commission; Forests and climate change, 2016. Available online at: http://www.forestry.gov.uk/climatechange .
[136] Landscape Institute; Landscape architecture and the challenge of climate change. Available online at: http://www.landscapeinstitute.org/PDF/Contribute/LIClimateChangePositionStatement.pdf
[137] Health Protection Agency; Health Effects of Climate Change in the UK, 2012. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/371103/Health_Effects_of_Climate_Change_in_the_UK_2012_V13_with_cover_accessible.pdf
[138] Defra; The England Biodiversity Strategy, 2011. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69446/pb13583-biodiversity-strategy-2020-111111.pdf.
[139] European Commission (2013) *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*. Available online at: http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf.
[140] IEMA (2010) *IEMA Principles Series: Climate Change Mitigation and EIA, IEMA; EIA and Climate Change*. Available online at: http://www.iema.net/eia-climate-change.
[141] IEMA (2015) *IEMA guide to climate change resilience and adaptation*. Available online at: Available online at: http://www.iema.net/eia-climate-change.
[142] RSSB; Tomorrow's Railway and Climate Change Adaptation: Final Report, 2016. Available online at: http://www.rssb.co.uk/Library/research-development-and-innovation/2016-05-T1009-final-report.pdf
[143] Network Rail; Climate change adaptation report, 2015. Available online at: http://www.networkrail.co.uk/Climate-Change-Adaptation-Report.pdf
[144] Cabinet Office; Keeping the country running: natural hazards and infrastructure, 2011. Available online at: https://www.gov.uk/government/publications/keeping-the-country-running-natural-hazards-and-infrastructure

Assumptions and limitations for in-combination climate change impacts assessment

8.4.17 Assumptions which have informed the in-combination climate change impacts assessment are as follows:

- mitigation measures for effects assessed by other topics will be implemented effectively; and
- the CoCP will provide appropriate mitigation measures for extreme weather related effects during construction.

8.4.18 Limitations of the in-combination climate change impacts assessment are as follows:

- the inherent uncertainty around climate change projections;
- the design life extending beyond the time horizons available from UKCP09 projections; and
- the lack of guidance for some topics in comparison to in-depth information for others which may lead to potential differences in the depth and breadth of assessments.

Assumptions and limitations for climate change resilience assessment

8.4.19 The climate change resilience assessment assumes that the Proposed Scheme will be designed to be resilient to impacts arising from current extreme weather events and climatic conditions, and in accordance with current planning, design and engineering practice and codes. The limitations of the climate change resilience assessment relate to the inherent uncertainty around climate change projections and the design life extending beyond the time horizons of climate change projections available from UKCP09.

8.5 Community

Scope

8.5.1 The community assessment addresses the likely effects on residential properties (and their occupants), community facilities (and their users), and communities as a whole. Effects may result from:

- a loss or gain to the community as a result of the land required for the Proposed Scheme or its construction;
- isolation as a consequence of barriers (physical, psychological and social) that communities would face resulting from construction or operation of the Proposed Scheme;
- in-combination effects relating to a change in the amenity value of community resources and residents, as a consequence of a combination of factors (noise and vibration, HGV traffic, air quality and visual impacts); and
- the temporary presence of construction workers and their demands on community facilities.

8.5.2 Effects relating to the severance of PRoW and highway and pedestrian diversions, are assessed as part of the traffic and transport topic. However, where PRoW are a 'promoted' destination in their own right as a recreational resource, they have been considered within the community assessment. Where impacts on open space and PRoW are considered, these have been informed by surveys of their use.

8.5.3 Open space that is privately owned and not available for use by the general public (e.g. woodlands on farmland) has been excluded from the assessment. However, land that is privately owned but open for public use (e.g. parks or gardens surrounding country houses) has been included in the assessment.

8.5.4 All significant community effects will be reported in the formal EIA Report. The formal EIA Report will also identify non-significant effects that are considered to be of importance in the study area.

Baseline

8.5.5 Information is being collected on the current location and use of community resources. Sources of information include:

- published sources such as Census data and Office for National Statistics – Neighbourhood Statistics;
- existing studies such as open space and housing needs surveys;
- data from other relevant assessment topics;
- specific supplementary surveys (e.g. of open space or PRoW use); and
- consultation with community organisations, user groups and local/national government.

8.5.6 Community resources are described in the environmental baseline only where they contribute to the local context or where they may be affected by the Proposed Scheme. Consequently, not all community resources within the study area are described.

Methodology

8.5.7 There are no industry-wide accepted methods for assessing community effects. The method that has been developed for predicting and assessing effects draws on existing guidance, analysis and methods established for other large infrastructure projects, including Phase One of HS2.

8.5.8 Effects have been derived from the interaction between the magnitude of impacts (which broadly reflect their severity, duration or extent) and the sensitivity of the resources and receptors (which broadly reflects their ability to accommodate impacts without fundamentally changing their functionality or amenity value).

8.5.9 The community assessment is largely based on qualitative information. However, relevant quantitative inputs have been used wherever possible (e.g. numbers of properties affected or percentage of open space displaced by land required for construction and/or operation). Opportunities to mitigate community effects are being identified during the course of the Proposed Scheme development and

consultation. Commitments that have already been made (e.g. to provide replacement open space) have been taken into account in the assessment described in this working draft EIA Report.

8.5.10 The assessment also draws on other topics for the assessment of in-combination effects. This takes into account the significant residual effects reported by other topics (e.g. sound, noise and vibration, landscape and visual and traffic and transport) and professional judgement about the sensitivity of the resource of receptors.

8.5.11 The spatial scope of the assessment varies, depending on the nature of the receptors and the impacts being considered. The effects of construction on the land used for construction and/or operation are confined to the immediate vicinity of the route. Effects resulting from a combination of impacts or relating to the overall functionality of a community will typically apply to wider areas such as neighbourhoods or parishes.

8.5.12 The impacts and effects of the Proposed Scheme are being assessed for the construction phase (2020-2026) and the first year of operation (2027), with one exception: the assessment of in-combination effects, since the operational noise assessment is based on the service frequency associated with Phase Two, which would not commence until some years later. For other topics, it is generally assumed that effects are unlikely to persist into the future. This is because new or replacement community facilities will have been provided where necessary and communities will adjust to the presence of the Proposed Scheme.

8.5.13 In-combination effects will be reported in the formal EIA Report. Significant in-combination effects arise from the combination of two or more residual significant effects reported by other disciplines on a group (street, hamlet or village) of residential properties or on community facilities. The assessment methodology excludes, for the purposes of reporting in-combination effects, residential properties where the total number of dwellings affected in a group is fewer than five. Impacts on individual properties or a group of less than five properties does not constitute a significant community effect. There are a number of individual properties or smaller groups of properties (of less than five) along the route where impacts may be experienced from other topics, such as sound, noise and vibration. These impacts will be reflected in other topic assessments where relevant.

Assumptions and limitations

8.5.14 Key assumptions underlying the assessment include the following:

- the baseline characteristics established during the EIA process will remain largely unchanged;
- the different assessments within the community section (e.g. isolation and in-combination effects) are not directly comparable in terms of determining significance of effect. Assessments are considered in aggregate as part of the community-wide analysis that will be presented under cumulative effects in the formal EIA Report; and
- professional judgement is being used by other disciplines (i.e. sound, noise and vibration, landscape and visual and air quality) to inform the assessment in-combination community effects. Any significant effects identified through

professional judgement will be reported in the same way as those identified through technical assessment.

8.6 Cultural heritage

Scope

8.6.1 Impacts on the following types of heritage asset are being assessed as part of the EIA:

- archaeological and palaeo-environmental remains including geological deposits that may contain evidence of the human past;
- historic landscapes; and
- historic buildings and the historic built environment.

8.6.2 Designated and non-designated heritage assets have been assessed. Effects arising from both construction and operation of the Proposed Scheme have been considered (e.g. effects arising from the requirement for land during construction or from visual intrusion into the setting of assets).

8.6.3 The study area for the assessment of heritage assets consists of the land required for construction (both temporary and permanent), plus 500m on each side.

8.6.4 The study area for the assessment of the settings of designated heritage assets has taken account of the zone of theoretical visibility (ZTV, described in section 8.10) and has been extended up to 2km from the land required, both temporarily and permanently, for the Proposed Scheme. A degree of professional judgement has been used to determine the extent of the study area within urban areas, to ensure that the assessment of the setting of designated heritage assets remains both proportionate and appropriate.

Baseline

8.6.5 Information about heritage assets is being obtained from a range of sources, including:

- registers of designated heritage assets held by Historic England;
- historic environment records;
- historic landscape character mapping;
- conservation area appraisals; and
- historic maps and aerial photography.

8.6.6 Information is also being gathered from specific surveys and research such as:

- light detection and ranging (LiDAR) surveys;
- site reconnaissance visits; and
- field-walking and geophysical surveys.

8.6.7 Survey work is being discussed with Historic England and local authority archaeologists on a case-by-case basis.

Methodology

8.6.8 There is no national guidance on the methodology for assessment of impacts on the historic environment and heritage assets. However, DMRB Volume 11 (Environmental Assessment) provides an approach to highway schemes and is of relevance to the Proposed Scheme. Also pertinent is the draft guidance on heritage impact assessments for Cultural World Heritage Sites (International Council on Monuments and Sites)[145], and a range of guidance from Historic England. These existing methodologies and guides have been considered during the development of the assessment methodology for the cultural heritage topic.

8.6.9 The NPPF requires that impacts on heritage assets are assessed in relation to the significance of the asset. This significance can be reflected in a range of ways; for example, evidential or historical, and can also be influenced by its setting.

8.6.10 Effects on the significance of heritage assets will be assessed on the basis of the type and magnitude of impact, and the severity of the effects, such as whether construction and/or operation of the Proposed Scheme will entail the removal of the heritage asset or intrusion into its setting. Appropriate mitigation measures will be identified and taken into account.

Assumptions and limitations

8.6.11 It has been assumed that all construction activity within the land required, temporarily or permanently, for the Proposed Scheme, will result in the removal of archaeological assets. The formal EIA Report will identify opportunities for the preservation of archaeological assets in-situ. Surveys to confirm or update the cultural heritage baseline from that presented in the working draft and formal EIA Reports will be required prior to construction. It is assumed that access will be available for these surveys and that the programme of investigation and recording will apply to these works.

8.6.12 The assessment of impacts is taking account of incorporated mitigation such as noise fence barriers, landscaping and planting. This mitigation includes measures set out in the draft CoCP, including methods for managing ground movements on heritage assets (draft CoCP, Section 10). As such, all assets within the predicted 10mm settlement contour[146] and/or where predicted ground movements cause a change in ground slope that exceeds 1:500, are being assessed in the baseline. Impacts relating to ground movements will be reported in the formal EIA Report.

8.6.13 Other assumptions and limitations of the cultural heritage impact assessment include:

- the LiDAR data do not encompass the entire Proposed Scheme; and
- planting as a means of visual screening for heritage assets such as built heritage will not be fully effective until maturity.

[145] International Council on Monuments and Sites (ICOMOS) (2011) *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties*.
[146] The area in which ground settlement is estimated to be 10mm in depth.

8.7 Ecology and biodiversity

Scope

8.7.1 The ecological impact assessment considers all ecological receptors which have the potential to be affected by the construction and/or operation of the Proposed Scheme. The assessment includes the consideration of effects arising from habitat loss, fragmentation of sites, severance of ecological corridors and networks, noise and visual disturbance, barrier effects to movement of fauna, lighting, changes in water quality and quantity, air pollution, and mortality as a result of collisions with trains.

8.7.2 The scope is limited to effects on the 'ecological value' of receptors. The social and economic value of ecological receptors such as nature reserves is considered separately in the community and socio-economic sections of the working draft EIA Report.

8.7.3 The spatial scope of the assessment depends on the ecological receptor under consideration and the magnitude and nature of the potential impacts. It has, as a minimum, included areas located within and adjacent to the land required for the construction of the Proposed Scheme. More information on the spatial scope of individual aspects is provided within the SMR.

Baseline

8.7.4 Existing biological data for the Proposed Scheme have been obtained from relevant Local Biological Records Centres and from national and local specialist data sources, such as barn owl groups. National and local biodiversity action plans and ancient woodland inventories have also been consulted. The geographic extents of search areas have varied, based on the likely value and mobility of the receptor involved.

8.7.5 A wide range of field surveys is being conducted to inform the EIA. The survey methodologies used have been based on standard approaches, and the extent and scope of surveys conducted has varied widely based on the species/habitat involved.

Methodology

8.7.6 The ecological impact assessment has taken account of the guidance published by the Chartered Institute of Ecology and Environmental Management (CIEEM)[147].

8.7.7 Each potential ecological receptor has been assigned a value according to one of the following geographical frames of reference: international; national; regional; county/metropolitan; district/borough; local/parish; and negligible. Individual effects considered to be significant at the local/parish level or below are as a general rule only reported in Volume 2, community area reports in relation to designated sites and European protected species. Potential cumulative and in-combination effects of multiple local/parish level effects and lists of local/parish level effects will be provided in the formal EIA Report.

[147] Chartered Institute of Ecology and Environmental Management (2016) *Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater and Coastal*. CIEEM.

8.7.8 In line with the CIEEM approach, the evaluation of species receptors has been based on the distribution and status of the species concerned, rather than only the legal protection.

Assumptions and limitations

8.7.9 The working draft EIA Report does not contain any field survey information, since surveys are ongoing. A precautionary approach to valuation has therefore been used for instances where baseline information is incomplete, to ensure that all likely impacts of the Proposed Scheme have been identified. Precautionary valuations have been based on all available information. These valuations are based on a consideration of available desk study data (including aerial photography and information from stakeholders), a comparison with similar habitat areas occurring in the wider local area, and a qualitative consideration against any factors that indicate suitability for the particular habitat or species in question. The degree of precaution built into the assessment for each receptor reflects the level of confidence in the existing data available. Field survey findings will be used for the formal EIA Report.

8.7.10 The ecological assessment of off-route effects will be based largely on information available from existing sources, recognising the constraints of such an approach. These effects will be reported in the formal EIA Report.

8.7.11 Other assumptions made for the purpose of the ecological impact assessment include the following:

- all habitats and features within the land required for the construction of the Proposed Scheme will be lost[148];
- all construction activity will occur concurrently across the entire length of the Proposed Scheme and will start at the beginning of the construction period – a worst-case scenario;
- by the time the Proposed Scheme is operational, otter will be present in all watercourses suitable for the species;
- the nominated undertaker will ensure that ongoing management of all mitigation and compensatory habitat is provided, either directly or through suitable legal and financial agreements with third parties; and
- the nominated undertaker will commit to monitoring habitats and species to ensure that predictions of effects are accurate and that mitigation/compensation is successful.

[148] The re-instatement and landscaping of these areas on completion of construction are considered as part of the proposed 'other mitigation measures, described in the Volume 2 community area reports. For the purposes of the ecological impact assessment 'other mitigation measures' is the term used to describe all mitigation, compensation and enhancement provided in addition to that which is inherent to the engineering design of the Proposed Scheme.

8.8 Health

Scope

8.8.1 Health is a new EIA topic introduced as a result of Directive 2014/52/EU. The definition of health used in the assessment follows that of the World Health Organization, which is to say that health is "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity".

8.8.2 The health status of a population is governed by a wide range of environmental, social and economic determinants. It is these determinants that the Proposed Scheme has the potential to affect. Some of the potential impacts on these determinants of health can only be assessed at a route-wide level, because of their diffuse geographical nature or because it is only meaningful to report the health effects for a large population. These potential health effects are reported in Volume 3: Route-wide effects. Other impacts on health determinants would be associated with more precisely defined locations and communities, and any potential health effects arising are reported in the Volume 2, community area reports. A fuller assessment of health effects, applying the assessment criteria set out in the final SMR, will be provided in the formal EIA Report.

8.8.3 Health assessment is a multi-disciplinary activity that cuts across the boundaries of health, public health, social sciences and environmental sciences. Many of the potential impacts on health determinants are described elsewhere in the working draft EIA Report and the assessment of health effects draws on this analysis in an integrated process.

8.8.4 The community level assessment of health and wellbeing effects is aligned with the study areas for related EIA topics, where relevant.

Baseline

8.8.5 Baseline data are being collected from a variety of sources. The data are being used to construct a community health profile, which will provide an overview of the prevailing socio-economic status of the existing population and an indication of levels of health and wellbeing. The analysis of data includes the identification of vulnerable sub-groups that may be particularly sensitive to particular health and wellbeing effects. Reference is also made to environmental baseline information collated by other topics, including environmental characteristics (e.g. noise, air quality and landscape character), and the presence of key features and resources used by the community.

8.8.6 The process of gathering baseline data is being undertaken in collaboration with related assessment topics including community and socio-economics.

Methodology

8.8.7 The assessment of health effects will be based on evidence linking impacts on determinants with health outcomes from published research and information gathered during the process of stakeholder engagement. Most of the health effects of development projects cannot be quantified since there are currently no robust or scientifically widely agreed upon methods for doing so, or because the types of data required cannot realistically be obtained. Therefore, it is anticipated that the

assessment will be largely qualitative in its description of health effects. Where there is sufficient information and reliable methods available to quantify health effects, this will be undertaken.

8.8.8 The assessment of health effects will be based on a set of criteria informed by available, up to date guidance, and developed using professional judgement and precedent from other large scale health assessments. The qualitative assessment process will use a set of criteria to define potential health effects, as set out in the SMR. These assessment criteria, and the methodology, will be reviewed during the process of engagement with stakeholders in the health sector.

8.8.9 Any quantitative assessment of health effects undertaken, for example for health and wellbeing effects associated with noise and air quality, will be based on established assessment methodologies for these health determinants.

Assumptions and limitations

8.8.10 Over the timescale of the Proposed Scheme's delivery, the profile and situation of affected communities will change, influenced by wider economic and policy change as well as demographic trends. The likely future community profile will be considered in instances where data and forecasts are available.

8.8.11 It will be necessary, for assessment purposes, to assume that the baseline characteristics established during the health assessment process will remain largely unchanged where such data and forecasts are unavailable.

8.8.12 The community profiles will be limited by the extent of publicly available data and data obtained through consultation and stakeholder engagement.

8.8.13 The assessment is being supported by a review of published research, using the most up to date and credible sources. The strength of evidence is in some cases well supported by research evidence and in other cases weak or non-existent. Consequently, professional judgement will be necessary to assess the likely way in which potential health impacts may occur.

8.9 Land quality

Scope

8.9.1 Potential effects include disturbance of contaminated land and ground contamination that could occur as a result of the Proposed Scheme. The main potential for impacts will occur during the construction phase, from disturbance of pre-existing contamination. Operational sources are also being considered (e.g. leaks or spillages within depots from line-side equipment or from trains). The assessment also includes consideration of any areas of geological significance, such as geological SSSI, local geological sites (LGS) and mineral resources or mining activity.

8.9.2 Potentially contaminated sites are being identified within the footprint of the Proposed Scheme and within 250m of the boundary of the construction works. Consideration has also been given to the possibility of disturbance to contamination, resulting in impacts at greater distances from the route (e.g. via pathways such as watercourses or aquifers), where appropriate.

8.9.3 Land contamination issues are closely linked with those involving water resources and waste. Issues regarding groundwater resources not related to land contamination are addressed in section 8.16 (water resources and flood risk) and Section 15 (water resources and flood risk) of the Volume 2, community area reports. Issues regarding the management of waste materials, including contaminated soils, are addressed in Volume 3: Route-wide effects, Section 15.

Baseline

8.9.4 Baseline information is being obtained from desktop sources, site visits and previous ground investigations. Desktop sources include published geological/ hydrogeological mapping, information from the Environment Agency (particularly for existing and historic landfill sites), historical mapping and local authority data. Site visits are being targeted at locations where a greater potential for current or historical contamination has been identified.

Methodology

8.9.5 A conceptual site model (CSM) and risk assessment approach has been used, in line with the Environment Agency guidance document CLR 11[149]. The CSM model provides an initial understanding of the types of contaminants that may be present, the receptors (i.e. people and the wider environment) that may be affected and the likely pathways by which contamination could spread.

8.9.6 This source/pathway/receptor model is being used to assess the potential for pre-existing contamination to cause a risk of impact on defined receptors at each location, for the period prior to, during and following construction (once any remediation has been carried out). The significance of effects will be derived from the change in level of risk, taking account of the sensitivity of the receptor.

8.9.7 The remediation of existing contamination, as part of the construction works, would be regarded as beneficial.

8.9.8 The methods for assessment of the significance of effects on geological sites and mining/mineral sites are set out in the draft SMR. These take into account the degree of impact that the construction activities may have on such sites, their sensitivity and importance.

Assumptions and limitations

8.9.9 No site-specific intrusive site investigations are being undertaken as part of the baseline data collection. Investigations will be undertaken during the detailed design process to provide contamination data for risk assessments, and where necessary, for detailed remediation design.

[149] Environment Agency (2004), *Model Procedures for the Management of Land Contamination CLR 11*.

8.10 Landscape and visual assessment

Scope

8.10.1 The assessment includes consideration of the effects on landscape and on visual receptors within the study area. The landscape and visual assessment is being undertaken for the following years:

- construction – an assessment of effects in winter during the peak period of the construction phase;
- operation year 1 – an assessment of effects in winter and summer during operation year 1;
- operation year 15 – an assessment of effects in summer during operation year 15, once any vegetation planted as part of the Proposed Scheme has matured or has achieved its design intention; and
- operation year 60 – to consider the benefits and/or negative effects in summer of maturity of tree planting. The results of the year 60 assessment will be reported in the formal EIA Report.

8.10.2 An interim ZTV has been prepared for the working draft EIA Report to aid understanding of the potential visibility of the Proposed Scheme during both construction and operation. This helps to determine the study area for the landscape and visual assessment and also supports the assessment of effects on the setting of cultural heritage assets. The ZTV shows the extent to which elements of the Proposed Scheme may be visible, but does not show the extent over which landscape and visual effects may be experienced, since the latter requires consideration of the extent to which visibility of the Proposed Scheme would beneficially or adversely affect a view from a particular receptor, using professional judgement.

8.10.3 The ZTV is based on visibility of the Proposed Scheme from the eye height of someone standing at ground level and takes account of the following factors:

- the existing topography;
- existing buildings, excluding any that will be demolished as part of the construction of the Proposed Scheme; and
- existing tree cover, excluding any trees that will be removed as part of the construction of the Proposed Scheme.

8.10.4 Thin bands of trees narrower than 10m are also excluded as, during winter, these will provide only minimal screening.

8.10.5 The ZTV for the construction phase takes account of the tops of activities or structures that will be present during construction, including:

- construction plant along the route, in compounds, at tunnel portals, cut-and-cover tunnels, depots, road diversions and any other known works;
- temporary fencing and hoarding;

- temporary stockpiling of materials;
- welfare facilities and storage;
- structures being demolished; and
- new permanent structures under construction.

8.10.6 Very tall construction plant (e.g. cranes) are excluded from the ZTV, since they rarely give rise to significant effects if they are the only elements visible.

8.10.7 The ZTV for the operation phase shows the visibility of the high speed trains and permanent structures, including:

- permanent depots;
- road/pedestrian diversions and bridges; and
- fencing and noise fence barriers.

8.10.8 The OLE is excluded from the model on the basis that this rarely gives rise to significant effects if it is the only element visible.

8.10.9 The ZTV for year 15 of operation (2042) will illustrate how planting proposed along the route will reduce visibility of the Proposed Scheme.

8.10.10 Landscape and visual receptors within 500m of the Proposed Scheme have generally been considered. However, this study area will be varied locally to take account of variations in visibility as indicated by the ZTV (e.g. with views likely to be more limited in urban areas and more extensive in open countryside or from elevated locations).

Baseline

8.10.11 Baseline information is being obtained from a combination of desktop research and fieldwork. Desktop sources include the Cannock Chase AONB Management Plan, published landscape character assessments (county level landscape character assessments), the National Character Areas and local development frameworks.

8.10.12 Fieldwork is being used to identify landscape character areas (LCA) and visual receptors. Fieldwork is being undertaken in both summer and winter to capture best and worst case, and will be accompanied by a comprehensive photographic record.

Methodology

8.10.13 The assessment has taken account of relevant guidance such as the Landscape Institute's Guidelines for Landscape and Visual Impact Assessment (3rd edition)[150] and DMRB Volume 11, Section 3, Part 5. The desktop and field studies have been used to identify a series of LCAs along the route. The value of each character area and its susceptibility to change resulting from the Proposed Scheme has been assessed, from which an evaluation of overall landscape sensitivity has been made. The significance of landscape effects will be derived from the interaction between the magnitude of

[150] Landscape Institute (2013) *Guidelines for Landscape and Visual Impact Assessment* (3rd Edition).

change (e.g. extent of land required for construction and/or operation or loss of features within a character area, plus introduction of new features) and its sensitivity.

8.10.14 The assessment viewpoints will be agreed with stakeholders (or competent authorities) during the course of consultation, so as to be representative of the range of views experienced by the relevant receptor groups in each location. The significance of visual effects will be derived from the interaction between the magnitude of change to these views and the sensitivity of receptors. Where views have a recorded value (e.g. protected views) this is also captured. Impacts on selected views will be illustrated by preparing verified photomontages from locations agreed with stakeholders. The photomontages will be included in the formal EIA Report.

Assumptions and limitations

8.10.15 Assumptions necessary to undertake the landscape and visual assessment are set out in the SMR and in individual sections of the Volume 2, community area reports.

8.11 Major accidents and natural disasters

Scope

8.11.1 The 2014 EIA Directive requires an EIA to include an assessment of 'the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or natural disasters which are relevant to the project concerned'.

8.11.2 For the purposes of this assessment, vulnerability is defined as the potential weakness of the Proposed Scheme to the risks to which it is exposed. A risk is defined as the hazard of an event (its consequences) factored by its probability (how likely it is to take place).

8.11.3 Major accidents or natural disasters are hazards that have the potential to affect the Proposed Scheme and include accidents during construction and operation caused by operational failure or natural hazards.

8.11.4 The assessment of 'Significant adverse effects' will include consideration of all factors identified in the 2014 EIA Directive (i.e. population and human health, biodiversity, land, soil, water, air and climate and material assets, cultural heritage and the landscape).

Baseline

8.11.5 There is no additional baseline information required as part of the major accident and natural disasters assessment beyond that gathered for the other environmental topics, since there are no additional environmental receptors. Therefore no additional surveys are planned.

Methodology

8.11.6 The assessment requires interaction with other assessment topics, in particular air quality, climate, community, ecology, health, socio-economics and water resources and flood risk.

8.11.7 The assessment is being undertaken with reference to the regulatory requirements, legislation and design standards in place for the construction and operation of the Proposed Scheme.

8.11.8 The baseline for the assessment will consider the regulatory requirements in place and will not reproduce for example the safety risk assessment that must be in place for the licence to use and operate the railway under the Common Safety Method for Risk Evaluation and Assessment (CSM-RA)[151].

8.11.9 The framework for the environmental risk assessment will follow a standard source-pathway-receptor approach, where sources (accidents and disasters) will be based on existing risk assessments, and receptors will include population and human health, biodiversity, land, soil, water, air and climate and material assets, cultural heritage and the landscape.

Assumptions and limitations

8.11.10 Key assumptions for the major accidents and natural disasters assessment are that:

- the new railway will not carry hazardous materials; and
- only those hazard events with a feasible source-pathway-receptor model are being considered.

8.12 Socio-economics

Scope

8.12.1 The potential socio-economic effects of the Proposed Scheme relate to three main areas: employment, businesses and the economy. Effects on employment levels are reported at a route-wide level within Volume 3, whilst effects on the local economy are reported by community area within Volume 2. Wider economic benefits are reported within Volume 3: Route-wide effects.

8.12.2 The effects can be beneficial (e.g. through direct job creation or via procurement of goods and services from local businesses) or adverse (e.g. due to land required for construction and/or operation requiring the relocation of businesses). The assessment has included consideration of effects arising during the construction and operation phases.

8.12.3 The route-wide assessment will identify effects resulting from land required for construction and/or operation, in-combination effects (e.g. as a consequence of the combination of significant residual effects from air quality, noise and vibration, visual impacts or construction traffic) and isolation effects on existing businesses and organisations, together with potential opportunities for construction and operational employment.

[151] EU Regulation 402/2013 (as amended) on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009.

Baseline

8.12.4 Baseline information is being obtained for a series of 'benchmark areas'. These relate to the areas across which economic functions and data can be readily understood. Data are being collected within these areas for a range of socio-economic indicators, including business demographics, employment, labour supply, skills, property market and where applicable, economic policy. Sources include official national data sets, local government, individual businesses and commercial property data sets.

Methodology

8.12.5 The assessment has drawn on guidance such as the Treasury Green Book[152], DfT WebTAG guidance[153] HCA Employment Density Guide[154] and the English Partnerships Additionality Guide[155].

8.12.6 The magnitude of effects is being assessed based on the interaction between the magnitude of impacts (e.g. their spatial extent and duration) and the sensitivity of the receptor (essentially the ability of a business, economy or market to absorb adverse change or to respond to beneficial change) taking into consideration the strength of the local economy and the availability of alternative premises.

Assumptions and limitations

8.12.7 Key assumptions underlying the assessment are described below.

8.12.8 Loss of trade within a business can be considered as a loss of turnover and represented as a change in employment at the affected business (assuming that there is a positive relationship between growth/contraction in a business's turnover and growth/contraction in employment at that business).

8.12.9 It is assumed that the employment within businesses affected by land required for the Proposed Scheme will either be lost or will be relocated. The employment implications are less clear for resources affected by isolation and/or changes in the combined effects of significant noise, air quality, visual and HGV congestion on trading conditions. Any employment implications are assessed at route-wide level, whilst impacts are assessed and reported at an individual resource level.

8.12.10 An indicative rate of successful business relocations for businesses on land required for the Proposed Scheme of 88% has been assumed, and it is assumed that no employment at these businesses will be lost. The rate of closure of directly affected businesses is therefore assumed to be 12% and it is assumed employment within these businesses would be lost[156].

8.12.11 It is assumed that a business experiencing an adverse effect on trade due to isolation or changes in the combined effects of significant noise, vibration, air quality, visual and HGV congestion can adopt a number of strategies before reducing employment.

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[152] HM Treasury (2003), *The Green Book: Appraisal and Evaluation in Central Government*, London, Her Majesty's Stationery Office.
[153] Department for Transport (2013), *WebTAG Home, Transport Analysis Guidance*; http://www.dft.gov.uk/webtag/, Accessed: 13 April 2016
[154] Homes and Communities Agency (HCA) (2015), *Employment Density Guide*.
[155] English Partnerships (2008), *Additionality Guide, A standard approach to Assessing Additional Effects of Projects* (3rd Edition).
[156] Research undertaken by London Development Agency (LDA) in relation to businesses required to relocate due to land requirements for the London 2012 Olympics, (30th June 2008), Request for Information/Freedom of Information Act by Mr Julian Cheyne, FOI291.

These strategies include cancelling/postponing investment in premises/ stock/ machinery; reducing staff working hours; cancelling/postponing plans to expand business; temporarily laying-off staff; renegotiating loans or mortgage; and increasing marketing or advertising activity. Any reduction in employment has been calculated by:

- estimating the total employment of the business(es) affected; and
- applying a percentage, based on the type of business activity/sector, to represent the likely proportion of employment that could be significantly affected by changes in the combined effects of significant noise, vibration, air quality, visual and HGV congestion or isolation on trading conditions.

8.12.12 It is assumed that the demand for and supply of construction labour in the rail sector will remain largely the same up to the commencement of the Proposed Scheme.

8.12.13 Operational employment on the classic network is assumed to remain the same as present as released capacity is utilised by new services.

8.13 Sound, noise and vibration

Scope

8.13.1 The assessment of sound, noise and vibration considers the likely significant noise and vibration effects arising from the construction and operation of the Proposed Scheme on:

- people, primarily where they live ('residential receptors') in terms of health and quality of life a) on an individual dwelling basis and b) on a community basis, including any shared community open areas[157]; and
- community facilities such as schools, hospitals, places of worship, and also commercial properties such as offices and hotels, collectively described as 'non-residential receptors' and 'quiet areas'[158].

8.13.2 Potential noise effects on animals, cultural heritage and tranquillity are reported in the ecology and biodiversity, cultural heritage and landscape and visual chapters, respectively.

8.13.3 In this assessment significant noise or vibration effects may be:

- adverse from an increase in sound levels or beneficial from a decrease in sound levels caused by the Proposed Scheme;
- temporary from construction or permanent from the operation of the Proposed Scheme;
- direct, resulting from the construction or operation of the Proposed Scheme,

[157] Shared community open areas are those that the National Planning Practice Guidance identifies may partially offset a noise effect experienced by residents at their dwellings and are either a) relatively quiet nearby external amenity spaces for sole use by a limited group of residents as part of the amenity of their dwellings or b) a relatively quiet external publicly accessible amenity space (e.g. park to local green space) that is nearby.
[158] Quiet areas are defined in the draft Scope and Methodology Report as either Quiet Areas as identified under the Environmental Noise Regulations or are resources which are prized for providing tranquillity.

and/or indirect, resulting from changes in traffic patterns on existing roads or railways that result from the construction or operation of the Proposed Scheme; and

- off-route, caused by the Proposed Scheme outside of the study area around the new railway and associated infrastructure.

8.13.4 HS2 Ltd has engaged with the environmental health practitioners acting for the local and county authorities along the line of route. There have been two forms of engagement. The first is Phase 2a: sound, noise and vibration environmental meetings on route-wide matters and has included the review of the assessment methodology, baseline methodology and route-wide noise control measures. The second form of engagement is directly with each relevant local authority on local matters such as assessment locations, baseline monitoring locations, local conditions, location of quiet areas (as described in the draft SMR) and baseline monitoring results.

8.13.5 The term 'sound' describes the acoustic conditions which people experience as a part of their everyday lives. The assessment considers how those conditions may change through time and how sound levels and the acoustic character of community areas is likely to be modified through the introduction of the Proposed Scheme. Noise is defined as unwanted sound and hence adverse effects are termed noise effects rather than sound effects, and mitigation is, for example, termed 'noise' barriers.

Baseline

8.13.6 Information on the existing airborne sound environment is being obtained from desktop research and extensive field surveys. Sound level monitoring is also being undertaken at locations suggested by local communities, where the monitoring will provide further information relevant to the assessment. The aim is to obtain objective data that describe the existing sound environment that is supported by a subjective assessment of the soundscape at each location. The assessment presented in the working draft EIA Report is based upon the desktop research only.

8.13.7 Future changes in the airborne sound baseline will be considered where significant effects of HS2 might occur and where the future baseline is predictable with reasonable certainty, for example, due to growth in traffic flows or the introduction of committed developments.

8.13.8 It is likely that the majority of receptors adjacent to the route are not currently subject to ground-borne noise or vibration. Major existing railways are the only likely sources. Baseline vibration surveys have not been undertaken. The assumption that there is no baseline vibration provides a reasonable worst-case basis for the assessment of likely significant effects.

Methodology

8.13.9 The assessment reported in the formal EIA Report will identify likely significant noise and vibration effects (both beneficial and adverse) and describes the measures envisaged to avoid or reduce these significant effects.

8.13.10 The method for identifying significant noise or vibration effects from the construction and operation of the Proposed Scheme draws on best practice from other major

infrastructure projects, and is consistent with current Government noise policy[159], and guidance[160]. The assessment takes health outcomes into account within the context of Government policy on sustainable development, which seeks to:

- avoid significant adverse impacts on health and quality of life;
- mitigate and minimise adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

8.13.11 Government guidance is based on the premise that once sound becomes perceptible, the effect on people and other receptors used by people (for example schools, hospitals) increases as the total level of sound increases. The Government policy guidance defines four levels of effect at increasing severity: effect; adverse or beneficial effect; significant adverse or beneficial effect and unacceptable adverse effect. It also notes that noise level triggers should be set to define the onset of 'adverse' effects and 'significant adverse' effects and that these triggers should reflect the nature of the noise source, the sensitivity of the receptor and the local context.

8.13.12 Therefore for the Proposed Scheme, trigger values for the onset of both 'adverse' and 'significant adverse' effects on health and quality of life have been defined for noise and vibration, as described in the SMR. These are based on best practice and previous projects.

8.13.13 'Significant adverse' effects of health and quality of life are reported in the assessment as 'likely significant effects'. 'Adverse' effects on health and quality of life on a larger community group may also be evaluated, cumulatively, as a 'likely significant effect' in the assessment. The criteria for identifying 'likely significant effects' are set out in the SMR.

Assumptions and limitations

Construction assumptions

8.13.14 The assessment for the formal EIA Report will include consideration of noise and vibration on a month-by-month basis, assuming that the mitigation measures defined in the draft CoCP have been implemented. Noise levels will vary day-to-day. The highest daily levels may sometimes be around 5dB higher than the monthly average levels but could also be substantially lower on other days. The working draft EIA Report is based on a qualitative assessment of the activities based upon the working methods assumed for the EIA of HS2 Phase One.

8.13.15 It is anticipated that there may be some night-time working during works to cross or tie into existing roads and railways. In these situations, it is expected that the noise effects would be limited in duration and hence are unlikely to be significant. Any noise effects arising from these short-term construction activities will be controlled and reduced by the management processes set out in the draft CoCP.

[159] Defra (2010), *Noise Policy Statement for England* (NPSE) and Department for Communities and Local Government (2012), *National Planning Policy Framework*.
[160] National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk; Accessed: 13 April 2016.

Operational assumptions

8.13.16 The effects of noise and vibration from the operation of the Proposed Scheme have been assessed based on the likely train flows.

8.13.17 The assessment is based on the expected passenger service frequency for Phase 2a with Phase One and Phase 2b services, as identified in section 4.5.

8.13.18 There will be regular line inspections and planned maintenance work at night at some locations along the route. At any one location on the route, maintenance is likely to be very occasional. Given the irregularity of the activity and short duration at any one location, maintenance work is considered unlikely to give rise to significant noise or vibration effects.

8.13.19 A small number of diesel-powered specialist engineering trains will travel on most nights from the IMD to either inspect the line or to a location of planned maintenance. Planned train movements will leave the IMD as soon as possible after passenger services finish at 24:00 and are likely to return to the IMD shortly before passenger services start again at 05:00. It is assumed that the engineering trains will be specified and operated so that any adverse noise effects are no greater than those for the night-time passenger services.

8.13.20 It is assumed that HS2 trains will be quieter than the relevant current European Union specifications, as reported in the Phase One main ES[161]. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia. The track will be specified to reduce noise, as will the maintenance regime. Overall these measures would reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on the new track.

8.13.21 Passenger services have been assumed to operate at up to 360kph (225mph) unless constrained by the design of the route as described in the relevant Volume 2, community area report. Services will be timetabled based on a speed of 330kph (200mph) where the maximum operational speed of 360kph applies. It is assumed that around 10% of services will operate at the full speed of 360kph.

8.13.22 In the years before the full Phase Two services commence (i.e. with Phase 2b in operation), the operating speeds are assumed to be the same as those described above although there would be fewer trains per day over the Phase 2a route as described in section 4.5. At the start of Phase 2a operation the airborne noise and vibration levels at receptors along the route would be around 2-3dB lower than those predicted with full, long-term Phase Two (i.e. with Phase 2b) operation.

[161] HS2 Ltd (2013), London- West Midlands Environmental Statement – Volume 1, Introduction to the Environmental Statement and the Proposed Scheme, November 2013. Available online at: https://www.gov.uk/government/publications/hs2-phase-one-environmental-statement-volume-1-introduction-to-the-environmental-statement

8.14 Traffic and transport

Scope

8.14.1 The traffic and transport assessment covers all relevant modes of transport, including cars, HGV, public transport (road and rail), equestrians, walking and cycling, waterways and air. The assessment has included consideration of effects resulting from physical changes to transport networks (including road or bus route and PRoW diversions) and from the additional trips generated by the Proposed Scheme both during construction (including HGV movements and worker trips) and after opening (e.g. trips made by new/reassigned passenger capacity and by employees), causing congestion or other effects on existing road users.

8.14.2 The spatial scope includes direct changes to the highway (road and PRoW) network, together with the extent of the relevant networks likely to be significantly affected. This extent has varied according to the magnitude and nature of the impacts, and the characteristics of the network, in each case.

Baseline

8.14.3 The assessment will take 2015/16 baseline conditions and adjust these for future assessment scenarios in 2023 (for construction) and 2027 and 2041 (for operation). This adjustment will take account of background growth and changes in transport flows from known improvements to networks and planned and committed developments.

8.14.4 Current transport conditions will be derived from a combination of surveys, modelling and site visits. Future baseline conditions will be derived by taking into account both changes in the demand for travel (by applying growth factors to the baseline traffic and incorporating, where relevant, committed and planned developments) and change to the transport supply network (by considering committed and planned transport improvement schemes). Where appropriate, transport modelling will be used to inform the future baseline conditions.

Methodology

8.14.5 The assessment has taken account of best practice guidance published by the DfT. Consideration is being given to the effects of traffic congestion and delay, road safety, parking and loading, public transport, vulnerable road users (including cyclists, pedestrians and equestrians) and navigable waterways. The evaluation of significance will take account of guidance such as DMRB Volume 11, WebTAG and IEMA guidelines. Key assessment criteria have included:

- delays in public transport;
- congestion at stations/interchanges;
- delays, diversions or volumetric changes in traffic flows;
- changes to parking provision or demand;
- changes in journey time, amenity or ambience for vulnerable road and PRoW users (pedestrians, cyclists, equestrians);

- accident and safety risks;
- severance impacts on non-motorised modes; and
- obstruction of navigable waterways.

8.14.6 Effects will be addressed by comparing the future baseline[162] with the additional traffic generated by the Proposed Scheme. These will be reported in the formal EIA Report.

Assumptions and limitations

8.14.7 The modelling for the transport assessment and future year assessments will require a number of assumptions to be made relating to:

- committed developments and transport schemes;
- socio-economic forecasts (e.g. population, employment, economic conditions);
- demand forecasts; and
- travel characteristics, including: modal share of trips; traffic flows; public transport passenger flows; traffic speeds and congestion; and journey times.

8.14.8 Surveys or modelled flows have been used or flows have been estimated on the basis of surrounding flows in instances where existing traffic flow information has not been available. Where there are no data for pedestrians and cyclists, flow levels which trigger the most sensitive criteria have been assumed so that a robust assessment has been made.

8.14.9 In general, the assessment of construction traffic has been based on the assumption that there will be one inward and one outward route to and from each compound (and that these routes are often the same route).

8.14.10 Utilities works (including diversions) will be assessed in detail for the formal EIA Report where they involve major works and where there would be potentially significant traffic and transport impacts and effects from the works separately, or in combination with other works. In this context 'major works' have been assumed to include:

- large pipes and sewers;
- high pressure gas pipeline diversions;
- extra high voltage underground cable diversions; and
- overhead pylon diversions.

8.14.11 More minor utilities works are expected to result in only localised traffic and pedestrian diversions that will be of short duration.

[162] The future baseline includes the traffic from general baseline growth and from committed and planned developments in the area.

8.15 Waste and material resources

Scope

8.15.1 The assessment identifies the likely significant environmental effects from the off-site disposal to landfill of solid waste that will be generated by the construction and operation of the Proposed Scheme. The quantity of waste requiring off-site disposal to landfill will be calculated and compared to the amount of landfill capacity projected to be available during construction and operation.

8.15.2 The scope includes wastes generated during construction (i.e. from earthworks, construction and demolition activities and from worker accommodation sites) and operation (i.e. from passengers, rolling stock maintenance facilities, and track and ancillary infrastructure maintenance). It does not include material inputs to construction (e.g. aggregates).

8.15.3 Liquid waste is addressed in the water resources and flood risk assessment (Volume 2, community area reports, Section 15).

8.15.4 The direct and indirect effects of waste-related transport are addressed within Volume 2, community area reports, Section 14 (traffic and transport), Section 5 (air quality) and Section 13 (sound, noise and vibration).

8.15.5 Issues relating to mineral resources and contaminated land are addressed within Volume 2, community area reports, Section 10 (land quality).

8.15.6 The scope includes any contaminated material identified within the land quality assessment that cannot be remediated and is suitable only for off-site disposal to landfill.

8.15.7 The spatial scope (and study area) for the assessment has been defined as the counties (local area) and former regional planning jurisdictions (regional area) through which the route of the Proposed Scheme will pass. This represents the administrative areas for which waste arisings and waste infrastructure data are available and within which the various waste streams are likely to be managed.

Baseline

8.15.8 The baseline describes environmental conditions with respect to the types, quantities and management of waste generated and the availability (types and capacity) of waste infrastructure within the study area.

8.15.9 Baseline conditions have been obtained from the latest available published data from the Environment Agency, Defra and waste planning authorities. Future baseline data are based on the extrapolation of this data for the construction and operation phase, and other published forecasts.

Methodology

8.15.10 Forecasts of the quantities of waste that will require off-site disposal to landfill have been based on an integrated earthworks design approach for the Proposed Scheme (for surplus excavated material) and evidence-based landfill diversion rates (i.e. for

reuse, recycling and recovery) applicable to waste from construction, demolition, worker accommodation sites and operational activities.

8.15.11 The quantities of surplus excavated material and other wastes requiring off-site disposal to landfill have been compared to the projected landfill capacity that will be available during construction and operation.

8.15.12 Assessment and mitigation have been considered with respect to relevant legislation, policy and guidance applicable to the generation and management of waste in England.

Assumptions and limitations

8.15.13 Consideration of material resources in the assessment is limited to the beneficial reuse of material arising from construction of the Proposed Scheme. Excavated material is only considered to be waste if it is not required or is unsuitable for construction of the Proposed Scheme.

8.16 Water resources and flood risk

Scope

8.16.1 The assessment includes consideration of all surface water and groundwater bodies, including their associated water resources, chemical and biological quality, hydromorphology, hydrology and flood risk. The spatial scope of the assessment is based upon the identification of surface water and groundwater features within 1km of the centre line of the route, except where there is clearly no hydraulic connectivity. For surface water features in urban areas, the extent was reduced to 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at depots, professional judgement has been used in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this spatial scope is defined as the study area.

8.16.2 In addition to surface water, the assessment addresses potential hydrological and qualitative effects on groundwater within source protection zones, due to, for example, dewatering for tunnelling and major sub-surface construction works. Groundwater within 1km of the centre line of the Proposed Scheme is considered where it falls within 10m of the lowest possible depth of construction or dewatering.

8.16.3 Impacts to groundwater quality from existing land contamination are presented in section 8.9 and in the Volume 2, community area reports, Section 10 (Land quality). Impacts on biological receptors and ecology are presented in section 8.7 of this report and in the Volume 2, community area reports, Section 8 (Ecology and biodiversity).

Baseline

8.16.4 Baseline information has included the following:

- surface water and groundwater hydrology, quality, designations, licensed abstractions and private water supplies;
- floodplain extents for the following annual probability events: 1 in 100 (1%) and

1 in 1,000 (0.1%); and

- areas at risk of surface water flooding.

8.16.5 Current projections indicate that climate change may affect the future baseline against which the impacts of the Proposed Scheme are being assessed. The projected impacts of climate change on peak river flows and peak rainfall intensities are being considered in the assessment using the recommended allowances contained in the Environment Agency guidance issued in February 2016[163]. Whilst other changes may occur in the water baseline due to climate change, these are unlikely to change the significance of the effects of the Proposed Scheme reported in the Volume 2, community area reports.

8.16.6 Information is being obtained primarily from secondary/published sources such as the Environment Agency, Lead Local Flood Authorities, British Geological Survey and water companies, supplemented where necessary by targeted survey and sampling of surface waters, as well as hydraulic modelling. Hydrogeological information is being obtained from geological maps and borehole logs where available. In some areas springs and spring fed streams also give an indication of groundwater levels. Consultation has taken place with relevant organisations, both to obtain information and to identify potential concerns.

8.16.7 WFD classification data in Volume 2 is taken from the Environment Agency River Basin Management Plan annexes. These classifications are the formal baseline against which the Environment Agency will assess compliance with the no deterioration objective in 2021. This information will be supplemented by specialist surveys where these are required to confirm the significance of the likely effects and to develop appropriate mitigation.

Methodology

8.16.8 The assessment has taken account of relevant policy and guidance, as set out in the draft SMR. Effects will be derived from the interaction between the magnitude of impact and the value of the receiving water body or flood receptor. Impact magnitude has been based on quantitative criteria wherever possible. Receptor value reflects its degree of vulnerability or importance, for example vulnerability to flooding, or relative importance of a water body for water supply, biodiversity or recreation.

8.16.9 A separate assessment is being undertaken considering effects of water bodies and the mitigation required to ensure compliance with WFD legislation. This assessment, which is being undertaken in accordance with current guidance and best practice, is informing the EIA and the development of mitigation measures.

Assumptions and limitations

8.16.10 The following assumptions have been made for the working draft EIA Report:

- the Environment Agency's Flood Maps adequately define areas currently at risk of flooding (although this information is being supplemented by modelling

[163] Environment Agency (2016) Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities.

work currently in progress);

- all licensed ground and surface water abstractions are assumed to be active and sensitive to disruption;
- all watercourses, other than minor drainage ditches, have been assumed to be of high or very high value, unless surveys have been completed that confirm otherwise;
- springs, issues or seepages shown on Ordnance Survey maps are conservatively assumed to be surface expressions of groundwater bodies (aquifers), although some of these may be land drainage issuing at the surface;
- in the absence of site specific data, it is assumed that the permeable alluvium and/or river terrace deposits which underlie the River Trent and its tributaries are likely to be in hydraulic connection with these surface watercourses and provide an element of baseflow, particularly during drier periods;
- railway track drainage will, where reasonably practicable, be kept separate from existing land drainage that crosses the route;
- existing surface water or groundwater contamination is assumed to be potentially present where a desk study research suggests that there is a potential source of contamination in the area; and
- where there are limited borehole records available from which to understand the local geological and hydrogeological conditions, it is assumed that topography has some control over groundwater flow directions with groundwater level contours roughly parallel to topographic contours.

8.16.11 The estimated zone of influence, and therefore the assessment of the potential impact of dewatering on receptors, is based on a reasonable worst-case assessment using available literature, values of hydraulic parameters and geological cross sections. Hydraulic conductivity values, obtained from available literature, are being used in conjunction with professional judgment to estimate the maximum extent of the zone of influence that is likely to be produced when dewatering of a cutting occurs. The hydraulic conductivity values used are generally in the high range of literature values to provide a realistic factor of safety to the estimated zone of influence.

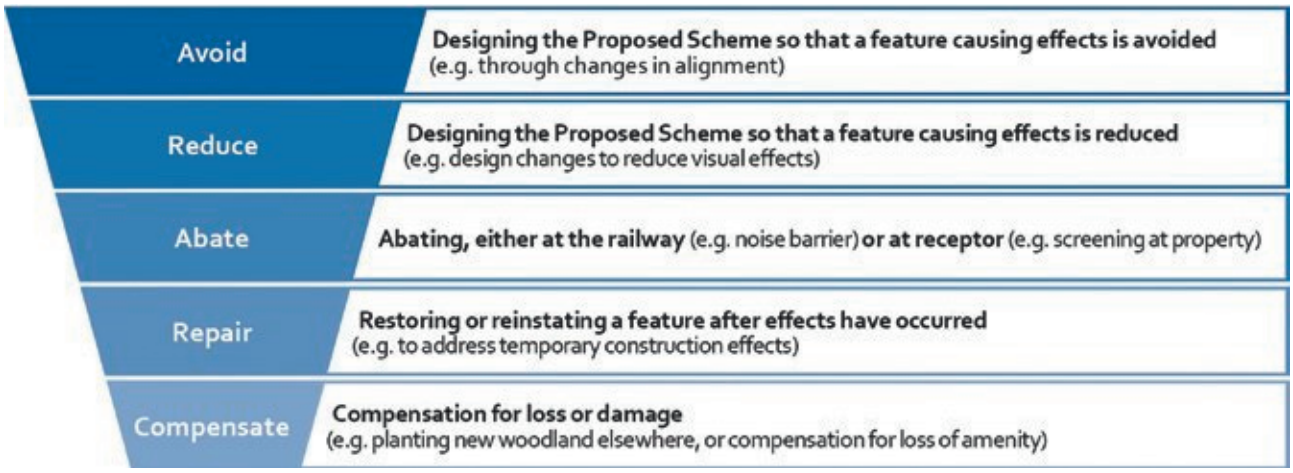
8.16.12 Surveys of water features and hydraulic modelling of rivers and watercourses within the community area are in progress. The assessment may, therefore, be updated for the formal EIA Report.

9 Approach to mitigation

9.1 Overview

9.1.1 The 2014 EIA Directive requires an EIA Report to include "a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment". Such measures are described generically in this working draft EIA Report as mitigation measures. A hierarchical approach to mitigation has been used: priority has been given to avoiding or preventing effects; and then (if this was not possible), to reducing or abating them; and then, if necessary, to offsetting them through restoration or compensation. In some cases, such measures may actually lead in the longer term to an overall improvement in the environment. The hierarchy is illustrated in Figure 29.

Figure 29: Mitigation hierarchy



9.1.2 Mitigation opportunities will continue to be identified during development of the Proposed Scheme prior to the submission of the Bill. The EIA process is iterative, which is likely to enable further refinement of the Proposed Scheme, with the objective of avoiding or reducing significant adverse environmental effects. Mitigation measures will be identified by regularly reviewing the likely significant adverse environmental effects identified during the ongoing assessment process and considering these at design workshops within the HS2 project teams. Design modifications will be considered to avoid or reduce significant adverse effects.

9.1.3 HS2 Ltd is developing the mitigation incorporated into the Proposed Scheme through:

- the HS2 Sustainability Policy – to set environmental standards that the Proposed Scheme should aim to achieve, thereby structuring and guiding the design;
- collaborative working between environmental assessment and engineering design teams – to achieve improved design outcomes;
- community engagement and consultation – to allow local people, environmental organisations and responsible authorities to raise issues and propose design and mitigation changes to be considered within the Proposed Scheme;

- recording of proposed mitigation along the route to gauge the consistency of approach applied along the route; and
- CoCP – an HS2 Ltd document which describes the approach to be taken during construction to reduce adverse effects on communities and the environment, including through the use of LEMPs.

9.1.4 The working draft EIA Report describes the likely effectiveness of the adopted mitigation. The formal EIA Report will identify the significant residual effects (i.e. those remaining after mitigation). Not all such effects would be adverse, and beneficial effects are reported where it is reasonable to do so.

9.1.5 Some mitigation is currently under development, since the design development and environmental assessment are ongoing. Measures may be added or amended as a result of consultation on the working draft EIA Report. Furthermore, some mitigation will be defined in principle in the working draft EIA Report, but the actual measures or mechanisms to be used, or the land to be involved, will not be defined until the formal EIA Report.

9.1.6 Mitigation measures will therefore continue to emerge during the course of the assessment. This section provides a preliminary description of the range of measures and policies that have either already been adopted or will be considered as the assessment proceeds. These measures are principally of three types:

- mitigation that is provided through the planning and design of the Proposed Scheme, which is not shown explicitly as such on the scheme drawings;
- mitigation that requires additional physical features, which is shown on the scheme drawings; and
- mitigation to be delivered through further measures in accordance with HS2 Ltd policies, which includes:
  - committed mitigation – measures for which agreement(s) are in place with the affected party and/or local authority; or
  - other mitigation – measures for which there is a commitment to reach an agreement with the affected parties and/or local authority.

9.1.7 Examples of the first two types of measure are described in section 9.2. The approach to mitigation, including the "further measures and policies" for each topic, is described from sections 9.3 onwards.

9.1.8 Construction impacts will be mitigated through the application of the CoCP in addition to mitigation through design and policy.

9.1.9 Opportunities for mitigation beyond that described in the working draft and formal EIA Reports will be considered as part of the detailed design process in accordance with the EMRs.

9.2 Incorporated mitigation

9.2.1 Mitigation that is being incorporated into the route alignment and design of the Proposed Scheme includes:

- selection of the Proposed Scheme from a range of alternatives taking account of environmental issues;
- alignment of the Proposed Scheme where reasonably practicable to avoid impacts at source, especially on residential properties, community facilities, public open space, business premises, farm buildings, sites of environmental and ecological importance and important heritage features;
- design of the vertical alignment of the Proposed Scheme (i.e. height below/above existing ground level) to achieve, where reasonably practicable:
  - an excavated material management strategy based on detailed consideration of materials arising from excavations and material required to build embankments or for land profiling in order to reduce the need to import material or to dispose of surplus excavated material;
  - noise mitigation at sensitive locations by placing the route within cutting; and
  - visual screening using natural landforms.
- provision of bridges or underpasses to avoid the severance of roads, PRoW and private accesses, where reasonably practicable;
- creation of new habitats and other features of ecological value to compensate for losses;
- avoidance or reduction of impacts on floodplains and the provision of replacement flood storage areas;
- provision of retained cuttings (i.e. with vertical or near-vertical retaining walls), in order to reduce the amount of land required;
- provision of noise fence barriers and earth bunds for noise mitigation;
- provision of planting to screen views to assimilate the Proposed Scheme into the local landscape; and
- provision of balancing ponds, in order to control the volume of surface water runoff from the Proposed Scheme in rural areas.

9.3 Restitution of open space and community facilities

9.3.1 Significant effects on a community resulting from the loss of public open space or of a community facility are likely to be mitigated in one of the following ways:

- improvements or alterations to the remaining portion of the public open space (in instances where the public open space is partially occupied) or community facilities, for example reconfiguring pitch layouts or relocating play areas;

- improvements to other public open spaces or community facilities in the area;
- improving accessibility to other existing public open space or community facilities; and/or
- identifying land owned by the relevant local authority that could be brought into use as public open space or used to accommodate community facilities with the local authority's agreement.

9.3.2 There will also be a requirement for land used as open space or as a community facility that is temporarily occupied by the Proposed Scheme to be restored in agreement with the relevant local authority. Consideration will be given to providing compensatory open space or community facilities as part of the design of the permanent works within the Bill limits where there is a permanent and significant community effect resulting from the permanent loss of public open space or a community facility.

9.3.3 The draft CoCP includes provisions to mitigate community effects during construction, including:

- appointment of community relations personnel;
- a community helpline to handle enquiries from the public;
- sensitive layout of construction sites to reduce nuisance; and
- maintenance of public roads, cycleways and PRoW around construction sites, where reasonably practicable, to avoid their deterioration due to construction traffic.

9.3.4 The specific measures within the CoCP for the mitigation of individual noise, air quality, visual and construction traffic effects will also serve to reduce in-combination effects [164] and isolation effects on community facilities, residential properties and open space.

9.4 Agriculture, forestry and soils

9.4.1 Impacts on agricultural holdings will vary according to the size of the holding and the nature of its use and business. Work with farmers and landowners is being undertaken to assist in mitigating the effects of the Proposed Scheme on their businesses where reasonably practicable.

9.4.2 Topsoil and subsoil will be stripped prior to construction and stored appropriately to enable agricultural land to be restored and reused after the completion of construction.

9.4.3 Land restoration will be followed by an aftercare period during which the land will be managed to achieve the appropriate level of agricultural productivity.

[164] Significant in-combination effects are the result of cumulative residual effects associated with noise and vibration, air quality, landscape and visual and HGV construction traffic impacts on residential and community resources. The in-combination effect of two or more residual significant effects arising from these other topic assessments results in a significant in-combination effect.

9.4.4 Land drainage schemes and water supplies used for livestock and irrigation may be severed or otherwise affected by the Proposed Scheme. Where necessary, the land drainage schemes and water supplies will be re-instated or made good as early as reasonably practicable to enable their continued functioning during the construction period.

9.4.5 The Proposed Scheme will inevitably sever some accesses within agricultural holdings and create new field layouts that will require new accesses. The scheme drawings included in the working draft EIA Report show the new accesses under or over the railway that are currently proposed to mitigate this impact. Where necessary, these accesses will be built as early as reasonably practicable, so that they can be used during construction. In addition, the contractor will be required to consult with the affected farmers to agree the phasing of the works so as to reduce severance. Where appropriate access arrangements cannot be provided during construction, the severed land will be acquired, subject to agreement between the appropriate parties.

9.4.6 Further details of the approach to compensation for land compulsorily acquired is discussed within Section 1.6.

9.5 Air quality

9.5.1 There are no proposed air quality mitigation measures beyond those contained in the draft CoCP (e.g. in relation to dust emission) or described in the transport assessment in relation to road traffic.

9.6 Climate change

Greenhouse gas emissions

9.6.1 The HS2 Sustainability Policy describes the Proposed Scheme's approach to climate change as being to 'minimise the carbon footprint [of the Proposed Scheme] as far as practicable and deliver low carbon long distance journeys that are supported by low carbon energy'. Carbon minimisation is further described in the HS2 Ltd Carbon Minimisation Policy[165]. HS2 Ltd has also endorsed[166] the Government's Infrastructure Carbon Review[167], reinforcing its commitment to pursing lower carbon solutions that cost less and also release the value of lower carbon through leadership, innovation and procurement.

In-combination climate change impacts

9.6.2 The HS2 Sustainability Policy defines the other aspect of the Proposed Scheme's approach to climate change as being to 'build a network which is resilient for the long-term and seek to minimise the combined effect of the project and climate change on the environment'. Resilience is further described in the HS2 Ltd Resilience Strategy.

[165] See HS2 Ltd (2016), High Speed 2 Information Paper – E10: Carbon, Version 1.5, 21 March 2016. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509168/E10_-_Carbon_v1.5.pdf
[166] The Green Construction Board, Statement of Endorsement, http://www.greenconstructionboard.org/index.php/resources/infrastructure/statement-of-endorsement, Accessed: July 2016.
[167] HM Treasury (2013), Infrastructure Carbon Review, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260710/infrastructure_carbon_review_251113.pdf, Accessed: July 2016.

9.6.3 To address part of this policy objective, the in-combination climate change impacts assessment will consider how climate change, in combination with the impacts of the Proposed Scheme, may affect the receiving environment.

9.6.4 The approach to the mitigation of in-combination climate change impacts and effects is further described in the draft SMR and in Volume 3: Route-wide effects.

Climate change resilience

9.6.5 To address the other part of the policy objective, the climate change resilience assessment will consider how climate change impacts may affect the resilience of infrastructure and assets associated with the Proposed Scheme.

9.6.6 The approach to ensuring the resilience of the Proposed Scheme is further described in the draft SMR and Volume 3: Route-wide effects.

9.7 Cultural heritage

9.7.1 The design of the Proposed Scheme has sought to avoid direct impacts on all heritage assets. Where this has not been possible, a range of measures will be implemented to mitigate the impact on such assets.

9.7.2 A Heritage Memorandum will be prepared setting out the commitments of the Secretary of State to the historic environment and heritage assets. The memorandum provides a framework for the nominated undertaker, Historic England, local authorities and other stakeholders to work together to ensure that the Proposed Scheme is designed and constructed with proper regard to the historic environment. The memorandum will form part of the EMRs (as described in Section 1.4) that represent the overarching commitment by the Secretary of State to afford appropriate management and protection of people, and the natural, cultural and built environment.

9.7.3 Route-wide approaches will be developed by the nominated undertaker in consultation with Historic England and local authorities. A route-wide generic written scheme of investigation: historic environment research and delivery strategy (GWSI:HERDS) will be prepared setting out the research framework and general principles for design, evaluation, investigation, recording, analysis, reporting and archive deposition to be adopted for the design development and construction of the Proposed Scheme. The GWSI:HERDS will be supported by strategies, technical standards and procedures that will provide the detailed mechanisms for the delivery of the works. These will be set out as requirements in construction procurement documentation. The process will be carried out and overseen by suitably qualified archaeological and heritage specialists.

9.7.4 The nominated undertaker will record, analyse, report and publish the results of all historic environment investigations, and will archive the resulting records, artefacts and materials in suitable repositories.

9.7.5 The Bill will dis-apply various legislative provisions currently in place for affected nationally designated heritage assets: scheduled monuments and listed buildings. The Bill will identify the affected assets and will provide an alternative planning mechanism. The nominated undertaker will enter into heritage agreements with local

authorities for listed buildings and with Historic England for scheduled monuments. As part of each agreement, a method statement for specified works in relation to these named heritage assets will be submitted to the local authorities and Historic England for agreement within specified timescales.

9.7.6 The Bill will dis-apply the various legislative provisions in instances where construction of the Proposed Scheme will directly affect burial grounds, human remains and monuments. A project-specific regime will be put in place to ensure that all human remains and burial grounds are afforded all due dignity, care and respect. A Burial Grounds, Human Remains and Monuments Procedure will be used to implement these requirements.

9.7.7 Mitigation measures have been developed in consultation with other disciplines, notably landscape, to ensure that heritage assets have been incorporated into mitigation works such as sympathetic design to the local historic landscape or townscape. Further discussion with other disciplines will be undertaken during detailed design to identify any further measures that can be incorporated to avoid or reduce impacts on cultural heritage assets.

9.7.8 Where there may be an effect on the viability of an asset, potentially leading to dereliction or changes in management affecting heritage assets, mitigation will be addressed on a case by case basis with relevant stakeholders. Mitigation measures will take account of the range of effects that will have been identified in the formal EIA Report.

9.8 Ecology and biodiversity

9.8.1 The Proposed Scheme is being designed to avoid or reduce impacts on habitats, species and other features of ecological value where reasonably practicable.

9.8.2 Efforts have been made to reduce the duration, scale and extent of the anticipated effects in instances where avoidance has not been possible or practicable. Appropriate compensation or enhancements will be identified to offset effects that are still anticipated following mitigation.

9.8.3 There areas will include provision of areas to act as receptor sites for habitats and species that will be translocated prior to construction and thus require land that will not be subject to any construction works, and of areas where habitats of ecological value will be created following the completion of construction.

9.8.4 Mitigation and/or compensation requirements for non-statutory sites and other notable habitats are being developed and will be described in the formal EIA Report.

9.8.5 The Proposed Scheme is being designed to seek to achieve a no net loss in biodiversity at a route-wide level as far as reasonably practicable. Habitat losses and gains will be measured using a modified version of the Defra biodiversity offsetting metric, which has been developed in consultation with Defra and Natural England. The metric will be revised to take account of Natural England's independent review prior to its application.

9.8.6 The proposed methodology to be used for the offsetting calculation will be published in a technical note.

9.8.7 An Environmental Memorandum will include a commitment to provide long-term management of habitat creation to ensure that the target value of these habitats is achieved. This may be achieved through a variety of potential mechanisms, including the following:

- retention and management of the land by the nominated undertaker;
- returning the land to the original landowner, with an agreement to manage it within the required parameters;
- transferring the land for management by a third party, such as a Wildlife Trust; or
- developing a bespoke management arrangement on a case-by-case basis.

9.8.8 Mitigation and compensation to address effects on legally protected species will, where appropriate, include translocation or relocation of species, the provision of replacement habitat and provision of special measures such as underpasses and green bridges to facilitate the movement of species across the route.

9.8.9 Formal applications for derogation licences for protected species will be made after Royal Assent and are likely to be accompanied by updated baseline surveys to be conducted when powers of access become available under the Bill.

9.9 Health

9.9.1 Recommendations to address the negative effects and maximise the positive effects of the Proposed Scheme on health are being fed back to other EIA topics and the design team during the assessment process.

9.9.2 It is anticipated that the majority of potential design-based interventions for health improvement will be incorporated through the scheme design and wider EIA process – for example, route design to avoid (where reasonably practicable) residential properties and other sensitive receptors, vertical alignment, incorporation of bunds and other measures to reduce noise and visual effects. This incorporated mitigation is part of the Proposed Scheme assessed in the EIA. Other, non-design related mitigation measures may be made with regard to the construction process and ongoing management and delivery of the Proposed Scheme. These will be incorporated into the CoCP and other HS2 strategies and policies as appropriate.

9.10 Land quality

9.10.1 Mitigation of the effects of pre-existing contaminated soils or groundwater would mainly take place at off-site treatment centres and take the form of various established methodologies for soil and groundwater remediation, such as:

- soil washing;
- soil stabilisation;
- bio-remediation; and
- in-situ or ex-situ groundwater treatment.

9.10.2 Soils that are not responsive to in-situ or ex-situ treatment will be deposited within a suitably licensed landfill, in the small number of cases where this occurs.

9.10.3 Appropriate remediation methods will be used to prevent contamination migration, such as vertical and horizontal barriers (for ground gases and leachates within old landfills), and soil cover systems. Where piling through contaminated soils is required, preventative measures will be adopted to mitigate the potential for contaminant migration down pile bores.

9.10.4 Methods to mitigate temporary effects during the process of remediation, within the construction period, are described in the draft CoCP.

9.10.5 Mitigation measures for mining/mineral resources may include prior extraction of the resources for use within the Proposed Scheme or elsewhere. A plan will be discussed and agreed in advance with relevant mineral/landowners, mineral planning authorities and other stakeholders to help manage affected minerals, where this is reasonably practicable.

9.11 Landscape and visual assessment

9.11.1 Measures to mitigate landscape and visual impacts are part of an integrated design approach that includes consideration of engineering requirements, environmental considerations and best practice design. The landscape proposals will incorporate mitigation measures for landscape, noise, ecology, agriculture, cultural heritage and open space.

9.11.2 Mitigation measures are being developed to:

- avoid or reduce effects on the character and setting of the landscape, including valued, designated and historic landscape features;
- seek to enhance such resources where appropriate; and
- avoid or reduce effects on the visual amenity of residential communities, receptors and users of the landscape due to potential intrusion into, obstruction of, or loss of existing views.

9.11.3 Landscape mitigation measures have also been designed to provide visual screening for built heritage. Landscape earthworks can help to attenuate noise. Woodland and grassland habitats can create areas of ecological benefit.

9.11.4 The mitigation is being considered firstly at a strategic scale with consideration given to the route alignment and the horizontal and vertical levels required to reduce landscape and visual effects. In addition, careful consideration is being given to the design (and/or to the design approach) of the many individual elements of the Proposed Scheme, to ensure that they are sympathetic to the local landscape or townscape. Specific measures include:

- design of earthworks to achieve visual screening and integration of the route into the local landscape, and to facilitate the restoration of agricultural land;
- provision of new planting and protection of important areas of existing vegetation;

- design and setting of new structures such as bridges, viaducts and buildings;
- design and setting of new operational infrastructure;
- landscape design associated with new, diverted or realigned roads and PRoW;
- design of noise mitigation, including earthworks and noise fence barriers to ensure good fit with the local landscape and townscape;
- design and appearance of fencing, including boundary and security fencing; and
- design of diverted watercourses and balancing ponds to ensure integration with the local landscape.

9.11.5 The design or external appearance of new structures will be subject to the approval of the relevant local authority.

9.11.6 Mitigation will also seek to reduce the effects of construction through, for example, advance planting, temporary screening or earthworks. Temporary or permanent mitigation will be installed at the earliest opportunity, where appropriate. Planting away from the route will also be established to reduce adverse landscape and visual effects.

9.11.7 The nominated undertaker will maintain landscaped areas within the rail corridor to an appropriate horticultural standard, and will ensure that the maintenance of other landscaped areas is secured through agreement. The aim is to ensure that the planting scheme successfully establishes and develops, so that it achieves its mitigation objective and remains effective thereafter in perpetuity.

9.11.8 Areas of mitigation provided outside the rail corridor will, where reasonably practicable, be transferred to third parties, subject to agreements to ensure that the necessary management objectives are met.

9.11.9 Landscape maintenance will incorporate a risk assessment for vegetation in landscape areas. Visual inspections of mitigation planting (and/or existing planting in the vicinity of the Proposed Scheme) will be carried out on a regular basis to determine whether it poses a risk to the safe operation of the railway. Maintenance operations will ensure that trees within all operational land (and adjoining land if applicable) cannot fall onto the track, overhead lines or other line-side equipment.

9.12 Major accidents and natural disasters

9.12.1 The Proposed Scheme will be designed to reduce as far as possible the risk of major accidents occurring. For example:

- for construction, the HS2 Corporate Health and Safety Strategy and 'Safe at Heart' programme are applied to identify and mitigate accident risks; and
- for operation of the high speed railway, the safety of the railway is being considered under CSM-RA, whereby hazards with the potential to cause a major accident during railway operation are identified, assessed and mitigated.

9.13 Socio-economics

9.13.1 Businesses displaced by the Proposed Scheme will be compensated within the provisions of the National Compensation Code. This recognises that businesses displaced from their existing premises by compulsory purchase will usually seek to relocate to another site. The code normally provides for the cost of such relocation to be taken into account under the heading of disturbance compensation.

9.13.2 The National Compensation Code is considered a fair basis for compensation in respect of such costs. HS2 Ltd recognises the importance of displaced businesses being able to relocate to new premises and will therefore provide additional support over and above statutory requirements to facilitate this process.

9.13.3 All reasonably practicable steps will be undertaken to limit the impact of the Proposed Scheme on existing businesses, thereby keeping to a minimum the need to incur liability for disturbance compensation to such businesses.

9.13.4 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the line of the route in terms of supplying goods and services and obtaining employment. There is a commitment to work with suppliers to build a skilled workforce that fuels further economic growth across the UK.

9.13.5 No further mitigation of significant temporary in-combination effects is proposed at this stage. However, the measures set out in the draft CoCP will, where reasonably practicable, provide further mitigation for individual significant effects (noise, vibration, air quality, visual, construction HGV traffic) on a case-by-case basis.

9.14 Sound, noise and vibration

Introduction

9.14.1 The development of a new high speed railway requires that provision be made for mitigation measures to protect the environment from intrusive noise and vibration.

9.14.2 The Proposed Scheme is being designed to manage and control the impact of railway noise and vibration, in so far as is reasonably practicable:

- by avoiding or reducing significant noise effects; and
- where there are opportunities to do so, by reducing existing exposure to noise or vibration through the provision of mitigation.

9.14.3 Mitigation of likely significant adverse noise or vibration effects is, where practicable, being incorporated into the Proposed Scheme in the following order:

- through alignment design: that is, keeping the railway as far from as many sensitive receptors as possible (whilst taking into account other environmental impacts and engineering considerations);
- at source: the project has the opportunity to design and specify a complete railway system including quieter trains, track and their maintenance to reduce noise emission;
- by noise barriers: delivered, for example, as fence barriers or constructed

cuttings using landscape earthworks or as a combination of both; and

- by reducing noise entering property.

9.14.4 Priority has been given to mitigation at source, for example through train or alignment design. Consideration is then given to the provision of noise barriers. These types of measures are prioritised since they will reduce effects on the environment as a whole, and on amenity, as well as inside properties.

9.14.5 Preference has been given to the most sustainable means of providing the necessary noise mitigation. For example, providing a noise barrier in a rural location by a landscape earthwork is, where practicable, preferred to a fence noise barrier. This is because the landscape earthwork can be shaped to follow the grain of the landscape, it can be used to return as much land as possible to agricultural or community use, and it reduces the need to move surplus excavated material from the Proposed Scheme off-site and along local roads.

Construction

9.14.6 Construction noise and vibration will be controlled and managed in accordance with the draft CoCP as described in section 6.3.

Operation

9.14.7 The development of the Proposed Scheme has sought to keep the route alignment as low as reasonably practicable and away from main communities. These avoidance measures have protected many communities from likely significant noise or vibration effects.

Airborne noise

9.14.8 HS2 trains will be quieter than the relevant current European Union specifications. This will include reduction of aerodynamic noise from the pantograph[168] that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia. The track will be specified to reduce noise, as will the maintenance regime. Overall these measures would reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on the new track.

9.14.9 Noise effects will be reduced in other locations along the line by landscape earthworks provided to avoid or reduce significant visual effects and engineering structures such as cuttings.

9.14.10 The Proposed Scheme will include noise barriers in the form of landscape earthworks, noise fence barriers and/or parapet barriers on viaducts to avoid or reduce significant airborne noise effects. Such mitigation will be identified taking account of:

- environmental and health benefit;
- cost;

[168] A device that is attached to the roof of an electric train to collect power through contact with the overhead catenary wire.

- engineering practicability;
- other environmental effects caused by the further noise mitigation; and
- response from consultation and stakeholder engagement (such as a stated preference for a noise barrier in the form of landscape earthworks rather than a fence).

9.14.11 Tunnel portals will be designed to avoid significant airborne noise effects caused by the trains entering the tunnel.

9.14.12 Significant noise effects from the operational static sources such as line-side equipment will be avoided through their design and the specification of noise emission requirements.

9.14.13 Noise insulation measures will be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996[169] (the Regulations). The assessment reported in the formal EIA Report will provide an estimate of the buildings that are likely to qualify under the Regulations. Qualification for noise insulation under the Regulations will be identified and noise insulation offered at the time that the Proposed Scheme becomes operational.

9.14.14 Where required, as well as improvements to the noise insulation of windows facing the railway, ventilation will be provided so that windows can be kept closed to protect internal sound levels.

9.14.15 Following Government's emerging National Planning Practice guidance, where the noise from the use of new or additional railways authorised by the Bill measured outside a dwelling exceeds the Interim Target defined by the World Health Organisation (WHO) Night Noise Guidelines for Europe[170], residents are considered to be significantly affected by the resulting noise inside their dwelling. The effect on people at night due to the maximum sound level as each train passes has also been assessed[171]. The WHO Interim Target is set at a lower level of noise exposure than the Regulations trigger threshold for night noise. In these particular circumstances, following the methodology set out in the Regulations (i.e. pertaining to new or additional railways) where night-time noise levels are predicted to exceed 55dB[172], or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion, noise insulation will be offered for these additional buildings.

Ground-borne noise and vibration

9.14.16 Significant ground-borne noise or vibration effects will be avoided or reduced through the design and maintenance of the track and track-bed.

[169] Her Majesty's Stationery Office (1996), *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations*, London.
[170] World Health Organization (2010), Night Noise Guidelines for Europe.
[171] During the night (2300-0700) a significant effect is also identified where the Proposed Scheme results in a maximum sound level at the façade of a building at or above: 85 dB L_{pAFmax} (where the number of train pass-bys exceeding this value is less than or equal to 20); or 80 dB LpAFmax (where the number of train pass-bys exceeding this value is greater than 20).
[172] Equivalent continuous level, $L_{pAeq,23:00-07:00}$ measured without reflection from the front of buildings.

9.15 Traffic and transport

Construction

9.15.1 The draft CoCP sets out various mitigation measures to reduce the impact of construction traffic. These include:

- traffic management measures and plans, which will be prepared in consultation with the highway and traffic authorities and emergency services;
- an approach to reduce the impacts of temporary road and PRoW closures or disruption to railways or navigable waterways;
- use of internal haul routes for construction vehicles within the construction sites to reduce the need to use public roads;
- workplace travel plans to reduce employee movements to/from construction sites and compounds; and
- various management procedures intended to reduce the impact of construction traffic; agreed routes for construction (HGV) vehicles, keeping to the main road network (e.g. motorways and strategic trunk roads and other 'A' roads).

9.15.2 Traffic management mitigation to be used during construction and utility works may include temporary lane closures, junction signal retiming, temporary traffic signals, tidal flow workings, reduced lane widths and overnight/weekend (instead of daytime/weekday) road closures. Traffic diversions will be provided where temporary road closures are required.

9.15.3 New highway crossings of the Proposed Scheme will be built offline, where reasonably practicable, so that they can be completed prior to closure of the existing road. This will avoid or substantially reduce disruption to road users. A diversionary route and temporary bus stops (where necessary) will be identified for bus routes affected by temporary road closures.

9.15.4 During the construction phase, PRoW routes will be maintained operational where reasonably practicable. Where routes cross the Proposed Scheme and are required to be diverted, generally the alternative PRoW crossing of the Proposed Scheme will be constructed prior to any closure of existing routes. Where routes cross the Proposed Scheme in proximity to the existing route, a temporary alternative alignment may be required before the new crossing on the existing alignment is available. In some instances, routes may need to pass through construction compounds and interface with the haul road. Where this is necessary, the movement through the compounds and across haul roads will be managed to minimise any conflict with construction vehicles and to provide safe routes for users.

9.15.5 Some construction workers could live on-site during the week, arriving on Sunday evening/Monday morning and departing on Friday evening/Saturday morning. This will reduce the level of construction employee traffic travelling to and from compounds during the week and will encourage off-peak travel.

9.15.6 The need for mitigation will be considered for adverse impacts that could occur at some distance from the Proposed Scheme. Where appropriate, these will be reported in the formal EIA Report.

Framework travel plan

9.15.7 An over-arching framework travel plan will be produced. This will be based on the framework travel plan for HS2 Phase One and amended where relevant for Phase 2a. It will require travel plans to be used along with a range of potential measures to mitigate the impact of transport and movement associated with construction, maintenance and operation of the Proposed Scheme. The scope of this will include:

- a construction workforce travel plan – the framework will:
  - inform site-specific plans that the lead contractors will be required to produce;
  - aim to reduce workforce commuting by private car, especially sole occupancy; and
  - encourage the use of sustainable modes of transport, where practicable.
- consideration of the travel movements arising from operation of the IMD – the framework will provide guidance on the expected contents of a depot-specific travel plan, which will be the responsibility of the depot operators; and
- consideration of how operational, delivery and servicing and car parking management plans will be included in travel plans.

9.16 Waste and material resources

9.16.1 Sustainable materials will be sourced and made efficient use of for construction of the Proposed Scheme. The aim is to minimise waste and maximise the proportion of material diverted from landfill.

9.16.2 The principles of the waste hierarchy will be followed, with priority given to the prevention of waste generation, followed (where this is not possible) by reuse, recycling and recovery of waste respectively, with disposal to landfill adopted only as a last resort.

9.16.3 The majority of excavated material that will be generated across the Proposed Scheme will be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either with or without treatment.

9.16.4 The nominated undertaker will seek to provide any surplus excavated material that arises and which cannot be beneficially reused for the earthworks of the Proposed Scheme for:

- use in other local construction projects, where opportunities arise at the time of construction; and/or
- use for restoration of mineral sites, where the transportation of that material does not result in significant environmental effects (in which case sustainable placement will be used).

9.16.5 Further opportunities will be investigated during detailed design for the prevention, management and treatment of waste during the operational phase of the Proposed Scheme.

9.17 Water resources and flood risk

9.17.1 The design of the Proposed Scheme will include sustainable drainage systems, where reasonably practicable, to control the rate, volume and quality of runoff from the rail corridor and other infrastructure, taking projected climate change impacts into account. These systems will encourage storm water to soak into the ground or, where that is not reasonably practicable, discharge it into watercourses or surface water/combined sewers at a rate matching existing runoff rates, or at an otherwise agreed rate at each location, taking account of any low flow problems with watercourses. These drainage systems will, where reasonably practicable, also help to maintain the quality of receiving waters.

9.17.2 Where the Proposed Scheme has the potential to increase flood risk, its design will reflect the approach required by the NPPF and the supporting Technical Guidance (e.g. incorporation of flood resilience and resistance). The aim is for there to be no increased risk of flooding for vulnerable receptors during the lifetime of the Proposed Scheme, taking projected climate change impacts into account. If required, the design will mitigate any loss of floodplain by creating replacement flood storage areas for the one in 100 (1%) annual probability flood, with an allowance for climate change.

9.17.3 Impacts on groundwater flows and quality will be analysed, and where the assessment predicts that a likely significant adverse effect may occur, a strategy to manage the risk will be agreed with the Environment Agency.

9.17.4 The design of the Proposed Scheme will seek to ensure that controlled waters are protected from pollution and that appropriate water quality standards are met. A compliance assessment of the WFD and a draft operation and maintenance plan for water resources and flood risk will be undertaken for the formal EIA Report.

9.17.5 Engagement has been, and will continue to be, undertaken with the Environment Agency, Lead Local Flood Authorities, water companies and the Canal & River Trust, to ensure that likely residual significant adverse effects are managed and mitigated appropriately.

10 Strategic, route-wide and route corridor alternatives

10.1 Introduction

Background

10.1.1 This section sets out the background to the consideration of alternatives by HS2 Ltd and DfT during development of the Proposed Scheme, and describes the strategic, route-wide and route corridor alternatives. A more detailed account of these alternatives, how they were considered and the reasons for the choices made can be found in the Alternatives report as an appendix to the Volume 1.

10.1.2 Local alternatives considered prior to November 2015 are addressed in section 11. Local alternatives considered since November 2015 are addressed in the Volume 2, community area reports. Further details on local alternatives considered both prior to and since November 2015 can also be found in the Alternatives report.

Regulatory requirements

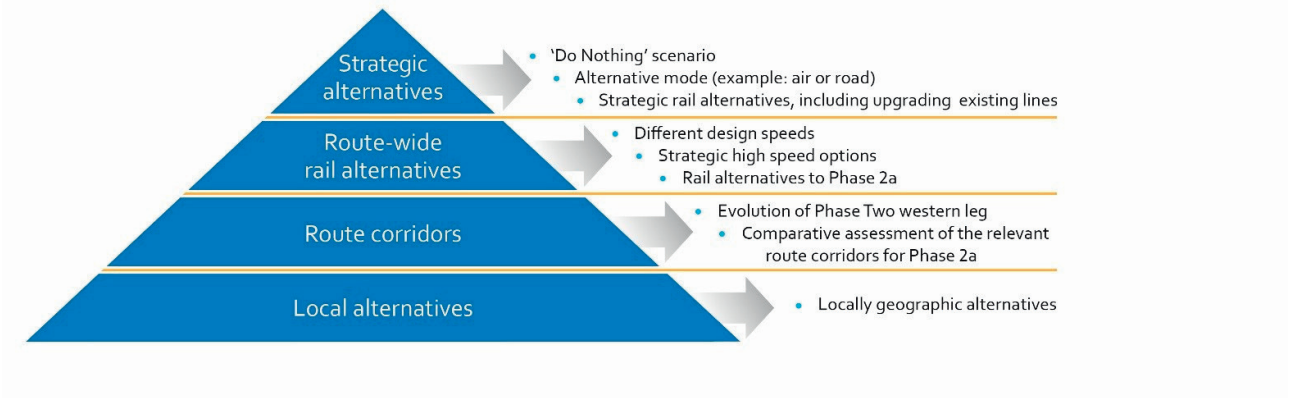
10.1.3 EIA Directive 2014/52/EU[173] requires an EIA Report to include:

> "A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."

Definition of alternatives

10.1.4 The alternatives reported here are grouped into four categories, as shown in Figure 30.

Figure 30: Hierarchy of alternatives considered



[173] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014, amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.

Option generation, sifting and selection

10.1.5 Hs2 Ltd has been preparing and refining proposals for a new high speed line from London to the West Midlands and the north since the beginning of 2009, at the same time as the Government has been considering and comparing the emerging HS2 scheme with the strategic alternatives. In both strands of work a wide range of options were considered, and these were assessed against selection criteria derived from three sources:

- the Government's transport and economic objectives to provide for long-term demand;
- The Treasury Green Book requirements to ensure that public funds are spent on activities that provide the greatest benefits to society, and that they are spent in the most efficient way [174]; and
- national sustainability objectives and environmental policies and requirements.

10.1.6 For the more specific selection of options for the Proposed Scheme, the appraisal criteria were grouped under eleven headings:

- strategic fit;
- construction feasibility;
- operational feasibility – trains (HS2 and Network Rail);
- operational feasibility – operations (stations, depots etc.);
- operational feasibility – passengers;
- demand;
- costs;
- environment (using EIA topic areas);
- safety;
- commitments; and
- development opportunities.

10.2 Strategic alternatives

Do nothing

10.2.1 The 'do nothing' scenario implies carrying out no further investment in transport infrastructure to meet the demand met by the Proposed Scheme, beyond the projects that are already committed. This would effectively allow crowding conditions to worsen to such an extent that individuals would be deterred from travelling, thereby

[174] HM Treasury (2003), *The Green Book. Appraisal and Evaluation in Central Government,* Her Majesty's Stationery Office, London.

restricting demand to the available capacity. However, successive governments have concluded that such an approach is not an acceptable way of meeting the future travel needs of the country or of ensuring that the economic benefits of improved accessibility are realised.

10.2.2 In 2008 the then Government reiterated its commitment to provide sufficient capacity to serve forecast demand in the long-term: "The Government remains committed to investment and to tackling the problems of congestion and crowding"[175].

10.2.3 In 2012 the previous Government, having considered the responses to the HS2 consultation concluded:

> "The Government's view is that continuing investment in steps to meet rising demand for intercity travel is necessary, given the importance of these journeys to the success of the UK economy. Measures to address intensifying and more extensive crowding, growing rail congestion and the consequent increasing challenge of running a reliable railway for passengers are vital if the transport system is to continue to support economic growth[176]."

10.2.4 The option of failing to provide for growing demand would not be consistent with the Government's objectives for economic growth nor with the 2011 National Infrastructure Plan aim "to improve connectivity and capacity between main urban areas and between them and international gateways, to deal with longer term capacity constraints[177]".

10.2.5 The Government does not believe it is tenable to do nothing. In addition to the negative economic effects, there would be severe individual impacts either crowding people off the networks, or allowing the experience to become so unpleasant that people choose not to travel.

Other modes

Domestic aviation

10.2.6 The main reasons why domestic air services are not a realistic or acceptable alternative to high speed rail for serving future growth in intercity travel are as follows:

- for shorter journeys (e.g. less than 400 miles) aviation cannot offer door-to-door journey times comparable to road or rail, due to the time taken for travel to the airport, check in, security and so on;
- the capacity of London's airports is limited and providing for future growth in international travel will be a significant challenge without also serving additional demand from domestic air services; and
- the carbon emissions per passenger kilometre from air travel are significantly greater than those from high speed rail. Whilst reductions in the carbon

[175] Department for Transport (2008), Delivering a Sustainable Transport System: Main Report, November 2008.
[176] Department for Transport (2012), *High Speed Rail: Investing in Britain's Future – Decisions and Next Steps*. Her Majesty's Stationery Office, London.P18, para 13.
[177] National Infrastructure Plan (HMT) (2011), https://www.gov.uk/government/publications/national-infrastructure-plan-november-2011, Accessed: October 2013.

intensity of air travel per flight up to 2050 are expected, these are likely to be offset in part by the expected growth in passenger miles and hence the number of flights.

Roads

10.2.7 New motorways could provide extra capacity between cities and could address other transport issues, since cars are an extremely flexible means of providing door to door transport. However, new roads are rarely a realistic option for increasing commuter capacity into city centres without entailing unacceptable property destruction and community severance. Nor can cars offer anything like the centre-to-centre journey times or the reliability of high speed rail, especially at times when traffic is most congested. For all these reasons the Government decided not to give further consideration to new motorways as an alternative to HS2. However, it did not discount the possibility that decarbonisation of road transport might alter the case for road infrastructure in the very long-term, though not for city-centre markets[178].

10.2.8 In 2009 the then Government nevertheless commissioned studies to explore the potential for a package of road capacity enhancements to accommodate increasing travel between London and the West Midlands[179]. Four packages of enhancements to the M1/M6, M40, M25 and M42 were examined, with each representing an incremental improvement on the previous package.

10.2.9 Together the four packages represent an approximation to the realistic maximum potential for increasing capacity on the motorways between London and the West Midlands. They would provide only a fraction of the additional intercity capacity of a new rail line, and little or none of its capacity into city centres. Whilst they could increase the capacity of all the relevant motorways by approximately 20%, this should be compared with the Government's central forecast of growth in strategic road traffic of 46% by 2040[180]. Where schemes can be justified, the Government intends to implement capacity enhancements on the strategic road network. In June 2013 it announced the biggest programme of road investment since the 1970s, including hundreds of miles of extra lanes on the busiest motorways through the use of managed motorways (now smart motorways) technology[181].

Strategic high speed route options

10.2.10 Though the Proposed Scheme is a discrete project that can be justified on its own merits, it has been conceived as part of a long-term strategy for a network of high speed lines connecting the major conurbations. In 2009, Hs2 Ltd was asked to consider the potential for extension of the core London-West Midlands route specifically to connect Britain's four largest conurbations – London, Birmingham, Manchester and Leeds.

10.2.11 The strategic choices are determined by the locations of the major cities, which suggest a network based on a western route to Liverpool/Manchester, and an eastern

[178] Department for Transport (2012), High Speed Rail: Investing in Britain's Future – Decisions and Next Steps. Her Majesty's Stationery Office, London, P45
[179] Atkins (2010), High Speed Two Alternative Study Strategic Outline Case.
[180] Department for Transport and Highways Agency (2013), Action for Roads, P17.para 1.22
[181] HM Treasury (2013), Investing in Britain's Future P13 and P17 para. 2.11-13

route via some or most of the cities in the East Midlands, and South and West Yorkshire. North of Leeds, Teesside and Tyneside lie on the eastern route, but there are no conurbations in the North-West to the north of Manchester. In Scotland, there are a number of permutations for serving Edinburgh and Glasgow, but in order to create a like-for-like comparison of the routes through England, all options considered by HS2 Ltd assumed the same configuration in Scotland.

10.2.12 With this geographic context in mind, three families of option were prepared in outline, analysed and compared:

Inverse 'A' — Bifurcate the line north of Birmingham with an eastern branch to the East Midlands, Sheffield, Leeds and Newcastle; and a western branch to Manchester and Scotland, with a link between Manchester and Leeds and a spur to Liverpool.

Reverse 'S' — A single line to Newcastle and Scotland via Manchester and Leeds, with a spur to Liverpool.

Reverse 'E' — A single line to Newcastle and Scotland via East Midlands, Sheffield and Leeds, with trans-Pennine branches from Sheffield and Leeds to Manchester and Liverpool.

10.2.13 In 2009/10 a high level sustainability appraisal was undertaken. At that stage there was no line of route for any of the options north of Birmingham, so the aim was to ensure that the options were appraised on a consistent basis to identify whether there were any distinguishing environmental considerations that should be taken into account before any decision on the strategic route. Although there are numerous environmental features and issues that could influence detailed route choice, no environmental or sustainability issues were identified that would affect the strategic decision on whether HS2 should be extended on both sides of the Pennines or only on the east or west side.

10.2.14 In February 2010 HS2 Ltd submitted a report to Government[182] on the demand and business case analysis of the proposals. The analysis concluded that the Inverse 'A' had a benefit-cost-ratio (BCR) of 2.3:1, compared to 1.9:1 and 1.8:1 for the Reverse 'E' and Reverse 'S' respectively reflecting the following characteristics of the options:

- the Inverse 'A' option would be the most expensive because the total length of route is so much greater. However, it would provide much better value for money because it connects London and Birmingham directly to both sides of northern England. It would be more comprehensive, would offer better overall journey times, particularly to Scotland, and the benefits would be consequently much greater. The link between Leeds and Manchester would need to be justified on trans-Pennine passenger flows because north-south passengers would use the new lines either side of the Pennines;
- the Reverse 'E' option could not offer better journey times from London or Birmingham to Manchester/Liverpool than HS2 trains continuing to the north-

[182] HS2 Ltd (2010), High Speed Rail, London to the West Midlands and Beyond.

west from Lichfield via the WCML; and

- the Reverse 'S', would be the least expensive of the three families of option, but offered the lowest value for money because it could not serve the East Midlands or Sheffield and the time savings to Leeds, the North-East and Scotland would be much less than the other two options.

10.2.15 After considering the consultation responses, in January 2012 the Government confirmed its intention to promote hybrid Bills for the Y network[176] (i.e. the Inverse 'A' but no further north than Manchester and Leeds and without the trans-Pennine link between these cities), incorporating links to the West Coast and East Coast main lines

10.3 Route-wide rail alternatives

Higher or lower design speeds

Higher design speed

10.3.1 The Proposed Scheme has been designed for a maximum speed of 360kph, but with a capability to allow the operating speeds to increase to 400kph as high speed technology develops. Maximum speeds are lower where this is impractical, such as in tunnels and at junctions. As a desk exercise, HS2 Ltd explored the options of a higher design speed. It concluded that a higher speed would save little time because of the distance taken to accelerate between stations and the effect of features that permanently restrict speed. It concluded that 400kph represents a reasonable maximum design speed, given likely technology development over the coming decades[183].

Conventional speed

10.3.2 Scheme development in 2009-10 included a high-level consideration of building a conventional speed version of the proposed London-West Midlands route. There was no scheme design for a classic speed railway to compare with the high speed proposal. However, it was assumed to comply with the same specification as HS2 in all respects except speed, and that it would follow the same route and provide the same connections, stations and level of service.

10.3.3 In January 2012 the Government concluded that any environmental advantage of a conventional speed line would be relatively marginal and that "the additional benefits generated by designing a new line to accommodate high speed services, compared to the only real long-term alternative of a new conventional speed line, would outweigh the additional costs by a factor of more than four to one"[184].

Reducing design speed locally to mitigate adverse environmental effects

10.3.4 After the public consultation on Phase One in 2011, HS2 Ltd considered whether environmental impacts could be reduced by reducing speed. Trains could reach the maximum design speed on only around half of the 400kph route – the section

[183] Department for Transport and HS2 Ltd (2012), Review of HS2 London to West Midlands route selection and speed, Section 4.2.
[184] Department for Transport (2012), High Speed Rail: Investing in Britain's Future – Decisions and Next Steps. Her Majesty's Stationery Office, London, P72, para 3.96.

between Amersham and Birmingham Interchange station. Six areas on this section of the route were identified where environmental concerns had been expressed and where there was potential to alter the route alignment. In other areas a reduced design speed would not affect the alignment.

10.3.5 For three of the six areas, it was considered that any environmental benefits could more advantageously be achieved by realigning and mitigating the high speed route without the need to reduce design speed, and for the remaining three areas it was considered that this effect could be achieved through mitigation only. HS2 Ltd therefore concluded:

> "The only environmental improvements delivered by a lower maximum design speed would be a marginal reduction in noise impacts, which would be outweighed by a substantial reduction in economic benefits. We consider that mitigation of the consultation route, the approach we have taken, is a more appropriate way of reducing environmental impacts, particularly noise. This would also be the case for a line designed at a conventional speed."[185]

10.3.6 Having reviewed all this work the Government concluded that the new line should be high speed[186], not classic speed, that 400kph is the appropriate maximum design speed for the line[187], and that the route should not be realigned to a lower design speed[188].

Options for upgrading existing main lines

10.3.7 In March 2010 DfT commissioned a review of the potential for upgrades to the WCML and the CML, focusing on the London-West Midlands corridor. A number of upgrade packages were developed to serve anticipated demand after 2021, assuming that there would be no reductions to existing services and that additional trains would not be permitted to compromise their reliability.

[185] Department for Transport and HS2 Ltd (2012), Review of HS2 London to West Midlands route selection and speed. Executive Summary, Para 8.
[186] Department for Transport (2012), High Speed Rail: Investing in Britain's Future – Decisions and Next Steps. Her Majesty's Stationery Office, London, P23, para 38.
[187] Department for Transport (2012), High Speed Rail: Investing in Britain's Future – Decisions and Next Steps. Her Majesty's Stationery Office, London, P86, para 5.14.
[188] Department for Transport (2012), High Speed Rail: Investing in Britain's Future – Decisions and Next Steps. Her Majesty's Stationery Office, London, P86, para 5.19.

10.3.8 The packages were as follows:

Rail Package 1 (RP1)	Longer long distance trains on the WCML (14-car and 17-car options);
Rail Package 2 (RP2)	Increasing the long distance services into Euston to 16tph (compared with the current 13-14tph peak services) by effectively providing four tracks throughout and grade separation as far north as Crewe[189];
Rail Package 3 (RP3)	Package 2 plus additional capacity on the Chiltern route to allow four fast WCML London - Birmingham trains to be diverted to the CML, releasing capacity on the WCML for other services;
Rail Package 4 (RP4)	Package 3 plus further upgrades to the CML to reduce London to Birmingham journey times; and
Rail Package 5 (RP5)	Package 4 plus additional capacity between Birmingham and Stafford to enable two WCML trains per hour between London and the North West to be diverted to the Chiltern route, releasing capacity on the WCML for other services.

10.3.9 It was concluded that:

- RP1 was unlikely to be significantly less expensive or disruptive than providing the infrastructure for more train services. This option was not considered to be economically viable, and was therefore not appraised any further;
- RP2 would provide a moderate increase in rail capacity on the WCML. Overall, the appraisal concluded that Package 2 would reduce journey times (by 12 minutes to Birmingham and 6.5 minutes to Manchester). It would have only moderate environmental impacts, but implementation would be disruptive to existing services; and
- RP 3-5 would offer relatively small crowding relief on the WCML in relation to the very substantial cost.

10.3.10 Reviewing the analysis of these options, the Government in 2010 decided to continue to prepare proposals for a new high speed line. This was because the upgrade packages would together cost more than a new line, but would offer only marginal reductions in journey times and at best only half the capacity benefit, as well as being very disruptive to implement (the cost of which was not included in the appraisal)[190].

10.3.11 Whilst the five rail packages focused on the London-West Midlands corridor, the Y network to Manchester and Leeds provides capacity and time saving directly to the North West, the East Midlands and Yorkshire. It was therefore considered necessary to evaluate and consult on more comprehensive packages before the decision was

[189] Atkins (2010), HS2 Strategic Alternatives Study Rail Interventions Report, P15.
[190] Department for Transport (2010), High Speed Rail – Command Paper. Her Majesty's Stationery Office, London.,P46 para. 2.22 and P50, para 2.40-6.

taken to promote a hybrid Bill for the Proposed Scheme. Three new scenarios were therefore developed that also included enhancement to the MML and ECML:

- scenario A, which explored the effects of lengthening trains on all three main lines;
- scenario B, which examined the provision of more long distance trains, based on RP2 for the WCML and additional trains on the MML and ECML; and
- scenario C, which was based on RP3 and further increases in East Coast long distance trains.

10.3.12 Meanwhile, the 51m group of local authorities put forward an 'optimised' variant of Rail Package 2 the 'Optimised Alternative' (OA) designed to maximise the capacity potential of the existing lines. The OA is based on the RP2 option, but with additional capacity and reduced infrastructure. The 51m proposal did not include additional platforms at Euston or four-tracking between Beechwood and Stechford, but did include works to increase line speed at Northampton. Compared with RP2, there would be more capacity enhancement on outer suburban services and less on long distance services.

10.3.13 The proposed service changes comprised a 15tph service on the fast lines:

- lengthening long distance trains to 12 cars (except Liverpool Lime Street trains);
- reconfiguring one first class carriage to standard class;
- running additional peak long distance services; and
- running four fast line services to outer suburban destinations.

10.3.14 The capacity benefits from the OA are additionally constrained by the fact that it only generates a limited number of additional train paths – just three per hour in the peak, two of which are allocated to semi-fast services to Northampton. Therefore, the distribution of any additional capacity would necessarily be uneven between destinations[191].

[191] Department for Transport (2012), Review of the Government's Strategy for a National High Speed Rail Network, P44-45, para 5.3.13-18.

10.3.15 When it reviewed the evidence on the upgrade options in January 2012, the Government noted that the appraisals showed strong BCR and significantly lower capital costs, whilst taking account of Network Rail's reservations on capacity and crowding, operational issues, unquantified additional costs and disruption to services over a long period during construction. It also accepted that upgrades would tend to have lower environmental and sustainability effects on landscape, townscape and noise than a new-build line. On carbon emissions it weighed the advantage of lower emissions against the opportunities for a new high speed line to attract passengers from domestic aviation. However, the key consideration was that an extensive package of upgrades would not address demand, capacity and crowding in the long-term. It concluded:

> "The Government's view is that any sustainability and cost advantages are outweighed by the substantial disbenefits of enhancing existing lines. Furthermore, even if some options may offer good value for money, they fail to offer an effective long-term solution to crowding issues and therefore cannot be considered a viable alternative to new lines. There is a significant risk that an approach of this kind would simply create years of delay and disruption for passengers and freight services, and even after that only give rise to a railway that it is still overcrowded, delaying but not avoiding the need for new lines. For these reasons, the Government does not favour this strategic approach to addressing the long-term rail capacity constraints."[192]

Rail alternatives to Phase 2a

Background

10.3.16 The DfT commissioned studies to assess the alternatives to accelerating the delivery of a new high speed line between West Midlands and Crewe (i.e. Phase 2a) in May 2015[193].

10.3.17 A number of potential alternatives to Phase 2a were developed. These options were then sifted down to three options which were taken forward for detailed analysis. The criteria used for this sift was that the options needed to:

- enable delivery of the Phase 2a train service;
- deliver a similar level of capacity as Phase 2a; and
- and deliver an environmental impact that is no worse than Phase 2a.

10.3.18 Options taken forward were then assessed against the Phase 2a objectives. Two of these options (the low and medium cost options) focused on enhancing the classic rail network to improve connectivity and capacity by bypassing some of the current capacity constraints on the WCML, and so delivering some improvements to journey time and performance. The third (high cost) option looked at a different way of

[192] Department for Transport (2012), High Speed Rail: Investing in Britain's Future – Decisions and Next Steps. Her Majesty's Stationery Office, London, P72. para 3.92
[193] Atkins, November 2015, *Rail Alternatives to HS2 Phase 2a*. A report for the Department for Transport. Available on-line at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480645/rail-alternatives-to-hs2-phase-2a.pdf

delivering Phase 2a so that it connects with the WCML further south of Crewe at Baldwin's Gate. These options are described below.

Low cost option

10.3.19 This would involve 6.8km of new 225kph alignment which would join onto the Stone Line via a grade-separated junction. This section of the Stone Line would be upgraded to allow 225kph running. This would connect onto 10.8km of new 225kph alignment which would finally connect into the WCML north of Norton Bridge. This option would have three flat junctions and one grade-separated junction with the WCML.

Medium cost option

10.3.20 This would involve using 15.2km of the Phase 2a alignment from Streethay Junction to Great Haywood, a 4.8km high speed spur to the Stone Line, upgrade of 6.5km of Stone Line to 225kph, and 10.8km of new 225kph alignment to the WCML near Norton Bridge. It would involve building one flat junction with the WCML and two flat junctions on to the Stoke-on-Trent branch.

High cost option

10.3.21 This would involve using 42.5km of the Phase 2a alignment from Streethay Junction joining the WCML 18.3km south of Crewe at a flat junction onto the WCML where high speed trains would run along these fast lines for 18.3km to Crewe.

Conclusions

10.3.22 As with Phase 2a, the levels of benefits, revenues and costs for the alternatives were assessed, as part of the full "Y" network and as an incremental over Phase One. They were also assessed against a number of strategic objectives around journey time, capacity, reliability, construction and environment.

10.3.23 The analysis of value for money and strategic objectives shows that the alternative options to Phase 2a:

- do not provide the same level of connectivity benefits for the major cities of the Midlands and the North due to lower journey time improvements;
- do not provide as much additional capacity to meet the long-term needs for the north-south railway as Phase 2a;
- do not provide as much additional released capacity for commuters and freight on the WCML as Phase 2a, limiting the potential of the WCML to cope with increases in demand;
- offer a less robust solution to the problem of resilience and performance, particularly on the WCML, which suffers from relatively high levels of unreliability;
- could have a greater impact on services on existing lines as construction work is carried out (the low and medium cost options only); and
- might be worth considering if the objective was only to improve journey times to Crewe, but do not provide as good a step towards the full HS2 network.

10.3.24 Further information is provided in the Alternatives Report (in the appendix to the Volume 1). This includes the high level environmental assessment that was undertaken for each of the alternative options.

10.4 Route corridor alternatives

10.4.1 An HS2 route corridor via Crewe was established as the proposed western leg of Phase Two in 2013, and was subject to consultation between July 2013 and January 2014. Alternatives to this, including other routes via Crewe, as well as routes via Stoke-on-Trent and to the east of Stoke-on-Trent, were considered during earlier scheme development and were consulted upon as part of the 2013/14 consultation.

10.4.2 The corridors via Stoke-on-Trent and to the east of this were discounted due to various sustainability, engineering and cost considerations, which are described in the Alternatives Report (in the appendix to the Volume 1). Some of the key sustainability constraints included the Peak District National Park, South Pennine Moors SAC, Churnet Valley Site SSSI and other community and heritage impacts around Stoke-on-Trent and Mobberley.

10.4.3 Of the preferred corridor via Crewe, a variant that passed to the south of Pasturefields SAC was adopted as the preferred route. This route was assessed as having a negligible risk of impact on the European designated habitat, as well as having other engineering and environmental advantages (including reduced community impacts).

10.4.4 Following consultation on the proposed route via Crewe in 2013/14, another alternative corridor via Stoke-on-Trent was considered in response to representations by Stoke-on-Trent City Council. This alternative was considered against the post-consultation refined route (which later became the preferred route) via Crewe. This concluded that the route via Crewe generally performed better in a number of aspects because it would:

- require fewer property demolitions;
- affect fewer people in terms of potential annoyance from noise;
- have less impact on cultural heritage assets (e.g. listed features and buildings);
- affect fewer areas designated for biodiversity and wildlife protection;
- affect fewer watercourses (but more groundwater resources);
- impact on fewer active and disused landfills;
- journey time savings; and
- improve regional connectivity.

10.4.5 Further information on route corridor alternatives is provided in the Alternatives Report in the appendix to the Volume 1.

11 Local alternatives

11.1 Introduction

11.1.1 This section describes the main local alternatives that were considered during development of the Proposed Scheme prior to November 2015.

11.1.2 The main local alternatives were addressed in 2014, in response to feedback following publication of the preferred route for consultation purposes in July 2013 (the consultation route). They comprised alternatives raised during the course of consultation, and as a result of revised engineering standards and general improvements in cost and ease of construction. Local alternatives considered since November 2015 are reported in the Volume 2, community area reports. Further details on local alternatives considered both prior to and since November 2015 can be found in the appendix to Volume 1.

11.2 Alternatives to the consultation route

11.2.1 Most of the alternatives considered took the form of different alignments, and were intended to address the environmental impacts at specific locations. The alternatives were assessed against factors such as their cost, engineering feasibility, impact on journey time and compliance with the AoS criteria.

11.2.2 In some locations it was concluded that the alternatives proposed did not offer any net benefit and the alignment used for the consultation scheme was retained. In others the route was amended. The revised scheme formed the basis of the route that was the subject of the Government's announcement in November 2015.

11.2.3 The local route alternatives considered during this process are set out in Table 5 for relevant locations. In each case, the issue raised by the consultation scheme is given and the design response (i.e. to amend the scheme or not) is explained. The technical reports supporting this process were published by HS2 Ltd in November 2015[194] as part of the Government's announcement. Alternatives that have been the subject of detailed design work since that time are reported in Volume 2, community area reports and the Alternatives report as an appendix to the Volume 1.

Table 5: Main local alternatives considered following consultation prior to November 2015 preferred route announcement

Location	Concern or proposal raised during consultation	Project response (November 2015)
Pipe Ridware	The location and height of the railway past the village of Stockwell Heath; landscape impacts around Pipe Ridware; and the location of the maintenance loops.	An option was adopted that includes provision for maintenance loops and requires slightly shallower cuttings to the south of Stockwell Heath, although with similar horizontal alignment to the consultation route.
Great Haywood to Yarlet	The location of the railway past Staffordshire County Showground and through Hopton; the location and	This was not adopted in November 2015. None of the options considered would deliver

[194] Department for Transport (2015), *Phase 2a publications*. https://www.gov.uk/government/collections/hs2-phase-two-from-the-west-midlands-to-leeds-and-manchester#department-for-transport-phase-2a-publications

	height of the railway past Marston and Yarlet; and the impacts to Great Haywood Marina, Ingestre Conservation Area and other scattered settlements.	sufficient sustainability benefits to outweigh the additional anticipated costs.
Hopton	The clearance of the existing alignment over the Kingston Brook south of Hopton; and the landscaping and mitigation associated with the green tunnel at Hopton.	A route slightly higher than the consultation route was adopted. This replaces the green tunnel with a 5m-high landscaped retaining wall. This option provides the most viable solution to the Kingston Brook watercourse crossing, with the 5m high retaining wall providing a similar comparable level of noise and visual mitigation associated with the green tunnel.
M6 crossing and Swynnerton	The height of the route over the M6 and past the village of Swynnerton (Conservation Area) and potential impact on Swynnerton boreholes adjacent to the M6.	The consultation route was retained as the preferred option. Other alternatives considered would have increased impacts on the local environment and would have incurred additional cost without resolving the concerns highlighted following consultation.
Whitmore Heath	The tunnel portal locations and the impacts of the route on Whitmore Wood ancient woodland.	A reduced length of cut-and-cover tunnel was included in the design. The length was reduced by 150m south of Whitmore Heath approaching the bored tunnel. This was on the basis of the reduced environmental impact through Whitmore Wood (narrower footprint, including a partially retained cut on the northern side of the route) and slightly reduced noise and visual impacts as a result of an additional section of cut-and-cover tunnel to the south of Whitmore Heath.
Madeley tunnel	Location of the southern tunnel portal and the proposed realignment of the A525 at Madeley; and impacts on properties, Barhill Wood Ancient Woodland and highways at Bar Hill.	Options to extend the tunnel to the south of the A525 were not adopted in November 2015. The land required for the consultation route at Bar Hill was amended to avoid direct impact on the ancient woodland.
Crewe junction	The height of the viaducts at Chorlton; and the layout of the junction to the south of Crewe and interaction with the proposed IMD.	An option was adopted that would follow a similar alignment to the consultation route but which would stagger the connections with the WCML, thereby reducing the maximum height of the railway.

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