



HS2 London to the West Midlands Appraisal of Sustainability

Main Report Volume 1

A Report for HS2 Ltd

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55 Victoria Street
London SW1H 0EU
T 0207 944 4908

TTUHS2enquiries@hs2.gsi.gov.uk

Principal author	Nick Giesler	
Key contributors	Andrew Bryant, Andrew Mayes, Amanda Pownall, Sheenagh Mann, Sam Turner, Tony Selwyn, Yaser Ali	
Technical contributors	Carbon and climate	Matt Ireland, Tony Selwyn, Andrew Bryant, Water Environment
	Landscape & townscape	Gillespies, Nick Giesler
	Cultural heritage	Cotswold Archaeology
	Biodiversity	Ecology Consultancy Ltd, Nick Giesler
	Water and flood risk	Water Environment, Andrew Bryant
	Air quality	John Rowland, Enan Keogh
	Noise and vibration	John Fisk, Sasha Villa, Mark Southwood, Rob Adnitt
	Community integrity and accessibility	Vicky Ward, Sheenagh Mann
	Equality	Vicky Ward, Future Inclusion
	Health and well-being	Institute for Occupational Medicine, Sheenagh Mann
	Socio-economics	Derval Cummings, Stuart McCully, Colin Buchanan (consultants)
	Resources and consumption	Andrew Mayes, Tony Selwyn, Sam Turner, Andrew Bryant
Reviewers	Mark Southwood, Stuart McCully, Roger Cooper	

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Structure of the AoS report and appendices

Non-Technical Summary
Main Report Volume 1
Main Report Volume 2 – Plans and Appraisal Framework
Appendix 1 – The Appraisal Process
Appendix 2 – Greenhouse Gas Emissions
Appendix 3 – Socio-economic Assessment
Appendix 4 – Associated Assessment Reports
Appendix 5 – AoS Technical Reports
Appendix 6 – March 2010 Preferred Scheme and Main Alternatives: AoS information

List of Acronyms

AA	Appropriate Assessment	NEC	National Exhibition Centre
AONB	Areas of Outstanding Natural Beauty	NNR	National Nature Reserves
AoS	Appraisal of Sustainability	NPS	National Policy Statements
AQMA	Air Quality Management Area	ODPM	Office of the Deputy Prime Minister
ATOC	Association of Train Operating Companies	OHLE	Overhead line equipment
BAP	Biodiversity Action Plan	OS	Ordnance Survey
CCC	Committee on Climate Change	PPS	Planning Policy Statement
CLG	Communities and Local Government	Ramsar	Site designated under Ramsar Convention
CO ₂	Carbon dioxide	RES	Regional Economic Strategy
CRoW	Countryside and Rights of Way	RIGS	Regionally Important Geological and Geomorphological Sites
DaSTS	Delivering a Sustainable Transport System	RPG	Regional Planning Guidance
DDA	Disability Discrimination Act	RS	Regional Strategy
DECC	Department of Energy and Climate Change	RSSB	Rail Safety Standards Board
DfT	Department for Transport	RTS	Regional Transport Strategy
DMRB	Design Manual for Roads and Bridges	SA	Sustainability Appraisal
EIA	Environmental Impact Assessment	SAC	Special Area of Conservation
EqIA	Equality Impact Assessment	SCP	Sustainable Consumption and Production
EU	European Union	SEA	Strategic Environmental Assessment
GOWM	Government Office for the West Midlands	SINC	Site of Importance for Nature Conservation
GWML	Great Western main line	SIP	Sustainable Industrial Policy
HIA	Health Impact Assessment	SPA	Special Protection Area
HRA	Habitat Regulations Assessment	SPZ	Source Protection Zone
HS1	High Speed One (formerly Channel Tunnel Rail Link – CTRL)	SSSI	Sites of Special Scientific Interest
HS2	High Speed Two	SUDs	Sustainable drainage systems
IMD	Indices of Multiple Deprivation	TaSTS	Towards a Sustainable Transport System
IPC	Infrastructure Planning Commission	TBM	Tunnel boring machine
LDD	Local Development Documents	TSI	Technical Specifications for Interoperability
LTP	Local Transport Plan	WCML	West Coast main line
MCA	Multi Criteria Analysis	WebTAG	Web Transport Appraisal Guide
Mt	Million tonnes	WHO	The World Health Organisation
NATA	The New Approach to Appraisal		

1 Introduction

1.1 Purpose of the AoS report

- 1.1.1 This report, prepared by Temple Group Ltd and Booz and Co. (UK) Ltd, describes the extent to which the new high speed railway, High Speed Two (HS2) proposed by the Government between London and the West Midlands (the ‘proposed scheme’) supports objectives for sustainable development. It contains the findings of an Appraisal of Sustainability (AoS) that has helped to inform development of the proposed scheme.
- 1.1.2 Sustainability embraces considerations of economic development and job opportunities, and effects on communities, as well as environmental considerations such as landscape, natural environment and climate change.
- 1.1.3 The AoS report and its non-technical summary are two of the documents issued in support of the *High Speed Rail: Investing in Britain’s Future*, prepared by the DfT. Other key documents comprise the *Economic Case for High Speed Rail – The Y Network and London-West Midlands* and *High Speed 2: Route Engineering Report*.
- 1.1.4 The remainder of this report describes:
- the proposed scheme;
 - the appraisal process (supported by *Appendix 1*);
 - the alternatives (these are addressed in the main consultation document);
 - the policy context which drives both HS2 and its AoS;
 - the baseline conditions against which the impacts of the scheme have been assessed;
 - the sustainability performance of the proposed scheme; and
 - information on mitigation and monitoring of impacts.
- 1.1.5 Volume 2 of the main report presents more detailed plans of the proposed scheme in the context of the key sustainability features. It also includes the supporting AoS framework, which captures the key sustainability information for the proposed scheme.

1.2 Objectives for HS2

- 1.2.1 The construction of a new high speed rail line has several objectives, namely to:
- enhance passenger capacity;
 - create faster journeys;
 - encourage modal shift;
 - improve connectivity; and
 - support regeneration and growth.

1.3 Summary of the HS2 proposals

- 1.3.1 The main focus of this AoS report is to appraise a proposed high speed rail connection between London and the West Midlands. Along with the 225km of new railway, the proposed scheme includes:
- a redeveloped station at Euston serving both high speed and conventional speed (classic) services;
 - a rail connection linking HS2 with the existing High Speed 1 Channel Tunnel Rail Link (HS1) line;

- an interchange with Crossrail and other services at Old Oak Common allowing access to Heathrow, as well as connections to the West End, the City and Docklands areas of London;
- provision to allow future connection to Heathrow directly off the high speed line;
- a new interchange station near Birmingham Airport;
- depots at Washwood Heath (in Birmingham) for rolling stock and at Calvert (north-east of Bicester) for infrastructure maintenance;
- a spur into Birmingham alongside the existing Tamworth & Nuneaton line west of Water Orton, with a terminus at Curzon Street; and
- a route which joins the West Coast Main Line (WCML) at a new junction north of Lichfield.

1.3.2 The proposed scheme addressed by this report reflects certain modifications requested by Government and follows further work to consider options that included connections with Heathrow and options to further mitigate the potential effects of HS2 Ltd's recommended scheme published in March 2010.

1.3.3 The Government has now endorsed the development of proposals that would extend HS2 northwards from the West Midlands. This would comprise two legs, one running from the West Midlands to Manchester and then connecting with the WCML, the other branching eastwards from the West Midlands to run through the East Midlands and South Yorkshire and on to Leeds, with a connection to the East Coast Main Line (ECML). These are currently the subject of ongoing design and appraisal and are not addressed in this report.

1.4 Determining the scope of the AoS

1.4.1 The AoS of the scheme was undertaken in line with planning requirements. It was devised to determine the extent to which HS2 reflects and promotes sustainable development through the integration of environmental, social and economic considerations. It has helped to ensure that decisions are made that contribute to sustainable development and to demonstrate that proposals are reasonable given the main alternatives. The scope of the AoS reflected the level of detail available at this stage of the project (see Section 4).

1.4.2 A range of appraisal and assessment techniques were available to help define the scope of the AoS. In particular the European Strategic Environmental Assessment (SEA) Directive¹ was key to determining the overall appraisal framework, although the scheme would not qualify as either a plan or a programme under the terms of the Directive.

1.4.3 In addition, as a major transport scheme, the principles of NATA/WebTAG², the DfT's multimodal guidance on appraising transport projects and proposals, have been addressed within the AoS.

1.4.4 The way that these and other appraisal techniques have been integrated with the AoS is described in *Appendix 1*.

1.5 Defining sustainability

1.5.1 The standard definition of sustainability is "economic and social development that meets the needs of the current generation without undermining the ability of future generations to

¹ European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment", as transposed in the UK by The Environmental Assessment of Plans and Programmes Regulations 2004 Statutory Instrument 2004 No.1633

² NATA is the Department for Transport's New Approach to Appraisal, which is supported by WebTAG – a web-based Transport Analysis Guidance tool (www.dft.gov.uk/webtag)

meet their own needs”³. Four sustainable development priorities taken from the UK Sustainable Development Strategy: *Securing the Future*,⁴ underpin this definition and form the basis for this AoS. These are:

- reducing greenhouse gas emissions and combating climate change;
- natural resource protection and environmental enhancement;
- creating sustainable communities; and
- sustainable consumption and production.

1.5.2 These four priorities provide the basis against which the AoS appraised HS2 proposals, although the second was adapted to include cultural resources to reflect this key consideration for HS2.

1.5.3 The DfT’s *Delivering a Sustainable Transport System (DaSTS, 2008)*⁵ (see Section 6.2) explains how the DfT is seeking to achieve sustainability in transport. The DaSTS strategy sets out its own five goals for sustainable transport which are broadly in line with these four priorities.

³ 1987 World Commission on Environment and Development (WCED), otherwise known as the Brundtland Commission

⁴ HM Government (2005) UK Sustainable Development Strategy: *Securing the Future*, TSO. This document was published by the previous document, but remains valid at the time of writing

⁵ DfT (2008) *Delivering a Sustainable Transport System* TSO

2 Overview of the proposed scheme's potential impacts

- 2.1.1 HS2 would have a number of sustainability impacts - some beneficial, some adverse.
- 2.1.2 The proposed HS2 route and stations and the new transport opportunities that the proposed scheme would create would enhance economic competitiveness, support wider economic growth and bring about enhanced employment opportunities. In supporting economic competitiveness, the benefits to businesses which would arise directly from the faster journeys potentially enabled by HS2 are valued at some £11.0 billion over 60 years.
- 2.1.3 Further economic benefits would accrue by HS2 effectively bringing cities closer together and by encouraging businesses (as well as workforces) to cluster around HS2 and, particularly, West Coast Main Line (WCML) stations. These businesses would operate more efficiently and competitively by being closer to one another. Such benefits could be worth a further £3.0 billion over 60 years. By opening up areas to the effects of wider competition and wider markets, the proposed scheme would be expected to deliver a further £1.0 billion of benefits. There could also be economic benefits due to transport improvements encouraging more people to work, although these would be relatively minor.
- 2.1.4 HS2 would also be expected to benefit people making commuting, leisure and other personal journeys. Over 60 years this is estimated to be worth some £6.4 billion of additional benefits. In total, when all of these factors are added together and benefits from fewer road accidents and better air quality are taken into account, economic benefits for the wider UK community from the London to West Midlands phase of the project are estimated to be £21.8 billion over 60 years.
- 2.1.5 The new railway stations would be the catalyst for new commercial enterprise and, over time, would stimulate opportunities for businesses to relocate and prosper at Euston as part of the over-site station development; at Old Oak Common where an interchange station would influence the development of the Park Royal Opportunity Area; in the West Midlands where the interchange station would support the development and connections with the National Exhibition Centre (NEC) and airport, and at Curzon Street in central Birmingham where HS2 passengers would have immediate access to the city centre's new proposed commercial quarter as well as its existing facilities.
- 2.1.6 Overall, it has been forecast that HS2 could attract some 30,000 jobs from the planned growth in employment for London and the West Midlands to the areas around the proposed HS2 stations. The scheme is also expected to provide 1,500 permanent operational employment opportunities, many of which would be new jobs. An estimated 9,000 jobs would also be created during construction. HS2 would displace a number of businesses and associated jobs; for example at Washwood Heath and Old Oak Common. However, it is likely that many of these displaced jobs would be re-established elsewhere. Close working between HS2 Ltd, local councils and local businesses would be undertaken to help to reduce the potential for adverse impacts on those affected.
- 2.1.7 As HS2 replaced some of the existing fast services on the WCML, space would be created on the WCML to allow new services for towns and cities between London and the West Midlands and additional commuter, local and regional services as well as opportunities for freight services. This would offer further stimulation to business.
- 2.1.8 Both HS2 and new services on the WCML would offer opportunities for a low carbon form of transport. The extent to which CO₂ emissions would be reduced, however, would crucially depend on how carbon-efficient electricity generation becomes in the future. It would also depend on any reduction in the number of flights (due to people switching to high speed train services) being maintained, as well as on the resulting available take-off and landing slots remaining vacant.
- 2.1.9 The redevelopment of Euston station has been recognised by the Mayor of London and Camden Council as a potential catalyst for the regeneration of the Euston area as a whole.

But, in order to achieve this, substantial property demolition would be required, including some 190 dwellings on the Regent's Park Estate and some 25 further dwellings. The immediate effect of this upon the local community at Euston would be significant. HS2 Ltd would be committed to working closely and at an early stage with the London Borough of Camden and the GLA and with community groups, residents' associations and affected residents generally to ensure that effective arrangements are in place to meet the housing needs of those affected by demolition of these dwellings, and to help to address wider impacts on the local community. At Washwood Heath in Birmingham, the construction of a new rolling stock depot would require the demolition of around 30 dwellings and the loss of a number of commercial premises. A similar approach to Euston, involving close working between HS2 Ltd and Birmingham City Council and with local residents and businesses would be undertaken to help to minimise disruption to this community.

- 2.1.10 Elsewhere property demolitions, although significant to those people directly affected, would be reasonably low in number given the scale of the scheme.
- 2.1.11 There would be some localised disruption along the route during construction. The main centres of population are in the greater London and greater Birmingham areas. The route would also pass in the vicinity of a number of more dispersed villages, hamlets and isolated farmsteads in the countryside. For the purposes of construction HS2 Ltd would develop and implement a code of practice that would contractually bind the companies building the route to reduce impacts to a practicable minimum.
- 2.1.12 Similarly, during operation railway noise would affect some people living along the proposed route. Further appraisal work has made assumptions about what could realistically be achieved through additional mitigation, such as noise barriers. On this basis, 'high' noise levels would affect fewer than 10 dwellings. Approximately 150 properties would be likely to experience levels of noise which would qualify for noise insulation payments under existing statutory compensation arrangements. There would be up to 4,700 dwellings identified on the proposed route corridor that would be likely to experience a noise change of 3 decibels or more (3dB being a just perceptible change in total noise over an assessment period) that results in a daytime noise level of 50 decibels or more (referred to in this document as a 'noticeable' noise change).
- 2.1.13 Experience from HS1 and other high speed railways shows that potentially significant effects from vibration and ground-borne noise (audible vibration) in properties over tunnels can be avoided. HS2 Ltd is committed to ensuring that no significant effects occur over tunnels through London and the Chilterns.
- 2.1.14 The proposed route between London and the West Midlands would include some 225km of new railway, passing through a variety of metropolitan, suburban and rural areas. Surface sections have been located alongside existing railways and roads over some 55km. Tunnels, totalling some 29km, would be provided to pass through hilly ground and to avoid the densest population in London. The proposed route has been lowered in places and 90km would be in deep or very deep cutting. Some 2km of cutting near to certain villages in rural areas would be covered for environmental benefits to form 'green bridges'. Elsewhere, approximately 85km of the proposed route would be at ground level or on embankment and 21km would be on viaduct.
- 2.1.15 The Chiltern Hills, much of which is designated as an area of outstanding natural beauty (AONB), would be crossed predominantly in tunnel and deep cutting with short elevated sections variously on embankment and viaduct to the south of Wendover where the route would be in close proximity to the A413 and Chiltern Railway. Some visual impact would be inevitable but of the 20.5km of railway through the AONB, all but 2km would be either in tunnel, in cutting and/or alongside the A413 main road. Extensive tree planting, as well as the creation of planted earth mounds or 'bunds', carefully blended into the landform, would help to further screen views and integrate the railway into the landscape.

Figure 1 – Cuttings, like those used on HS1, would help to screen views [Arup]



- 2.1.16 Refinements to the proposed route have ensured that no Grade I and II* listed buildings would be demolished, although the setting of three Grade II* buildings would be likely to be affected. Fifteen Grade II listed buildings would need to be demolished. Some listed structures in the Euston area would need to be relocated and the design of Euston Station and its associated over-site development would need to take into account the setting of Euston Gardens and the northern part of the Bloomsbury Conservation Area.
- 2.1.17 Three Registered Parks and Gardens would be physically impacted. However in each case further route refinement has been undertaken to limit the landtake and effects upon the settings of these features.
- 2.1.18 Two protected sites of archaeological importance would be physically impacted. These scheduled monuments, Grim's Ditch in the Chilterns and a Roman villa site in the vicinity of Edgcote would be subject to prior archaeological investigation and academic study, in line with Government guidance.
- 2.1.19 The proposed new railway would present a significant opportunity to reinforce and enhance biodiversity. It would provide a green corridor to be colonised by plants and animals, and could link with and form connections between existing habitats. There would, however, be adverse effects at a number of sites.
- 2.1.20 No internationally protected sites of ecological interest would be adversely affected and impacts to nationally protected sites would be restricted to a small number of locations. Partial landtake would be required from two sites of special scientific interest (SSSI). A number of locally designated sites and important habitats, such as ancient woodlands, would be physically impacted. Where sites of ecological interest and local importance are considered likely to be affected, further work would be undertaken during more detailed design, and management plans would be drawn up and implemented to help minimise the adverse effects on biodiversity.
- 2.1.21 Where the proposed route would cross rivers it has been designed to take account of future flood risks by the inclusion of structures to bridge these areas. In some places, the proposed route would pass in tunnel through important ground water resources.

Construction techniques would be implemented to reduce such risks to a practicable minimum.

- 2.1.22 The proposed new railway would make good use of land that has had a previous industrial or railway use. However, some productive agricultural land would be lost. Although the most important Grade 1 land would not be affected, the proposed route would pass across Grade 2 agricultural land for some 20km. Further work would be undertaken during later design stages to seek to reduce agricultural landtake and severance.
- 2.1.23 Construction of the proposed scheme would generate and consume large quantities of materials. HS2 Ltd would seek to re-use as much of this as possible within the scheme design, for embankments and landscape proposals. Opportunities would be sought to use any surplus spoil within other schemes and proposals; disposal to landfill would be used as a last resort.

3 Scheme description

3.1 Technical and operational specification

3.1.1 At this stage, HS2 Ltd has defined the technical and operational requirements to enable achievement of the HS2 project objectives (see **Section 1.2**). They derive in large part from the EU Technical Specifications for Interoperability (TSI) which defines requirements for all new high speed lines and their connections to the existing classic rail network. In summary HS2 is required to achieve the objectives outlined below.

- **Safety:** the railway system must operate safely and reliably, seeking, through design, construction, operation and maintenance, to prevent incidents occurring in the first place and, where risks remain, to mitigate them as far as is reasonably practicable.
- **Interoperability:** high speed trains across Europe must be able to travel on different countries' railways.
- **Services:** the new route between London and the West Midlands would accommodate readily available, interoperable, European gauge, high speed trains between London and Birmingham; and modified high speed rolling stock between London and destinations north of the West Midlands.
- **Operating hours:** services would operate 5am to midnight Monday to Saturday and 8am to midnight on Sunday, with maintenance and engineering activities undertaken at other times.
- **Passenger capacity:** for demand modelling purposes, the assumed train seating capacity would be a maximum of 550 per 200m long high speed captive unit (i.e. 1100 seats for each two unit train).
- **HS2 Services:** HS2 would accommodate, at day one, a maximum of 14 trains per hour (tph) in each direction (assuming 14 tph during the high peak hour and typically 10 tph at other times during the day). An ultimate capacity of 18tph is based on longer term high speed network assumptions and anticipated improvements in train control and braking technology. The HS1 link would accommodate three trains per day in each direction.
- **Train speed:** HS2 infrastructure would be designed to a maximum speed of 400kph, but trains would travel at a maximum of 360kph at day one of operation. Trains on the HS1 link would travel at a maximum of 160kph.
- **Journey times:** At day one of operation, the following approximate journey times are assumed ⁶:

From London to:	Journey time ⁷
Birmingham	49 minutes
Manchester	104 minutes
Liverpool	110 minutes
Preston	108 minutes
Glasgow (via Preston)	240 minutes

- **Rail corridor:** the rail corridor would accommodate two tracks with a fence to fence width of 22m for an at-grade railway (reduced to 15m where space is restricted) to allow for the inclusion of access tracks, etc. Consideration has been given at this stage for using up to 25m clearance on each side of the route for landscaping,

⁶ Assumes high speed line London to West Midlands only at Day 1, with onward journey via WCML.

⁷ Journey times currently include an allowance for one stop at Old Oak Common as well as other stops in the Midlands and north.

vegetation plantings, etc. In practice space requirements would be determined for each location, depending on mitigation requirements and whether the line was in cutting or on embankment. A more detailed corridor proposal would be developed following an assessment of vegetation along the perimeter of the proposed line of route in conjunction with third parties to assess the impact of 'leaf fall' on the operation of the railway and on any desired planting arrangements.

- **Electrification:** assumes provision of 25-0-25kV AC autotransformer fed overhead line equipment capable of supporting 20 tph in each direction. The AC energy supply would be designed to permit the use of regenerative braking as a service brake able to exchange power seamlessly with other trains or with the primary network supplier.

3.2 Rolling stock

3.2.1 It is assumed that all services operated on HS2 would use high-speed trains only. In order to serve both the London to Birmingham route and destinations further north, it was assumed that two types of train would be required. These would comprise:

- "HS2 Captive" GB or GC gauge⁸ off-the-shelf standard high speed train, captive to the HS2 route, i.e. running from London to Birmingham only.
- "Classic-compatible" high-speed train, built to UK1 gauge but with the same traction characteristics as the captive HS2 train, would operate to destinations on the WCML north of Lichfield.

3.2.2 Both types of trains would be maximum 200m long, and capable of being connected to form 400m trains.

3.2.3 The proposed rolling stock depot for use by both classes of train would be located in the West Midlands, in the Washwood Heath area.

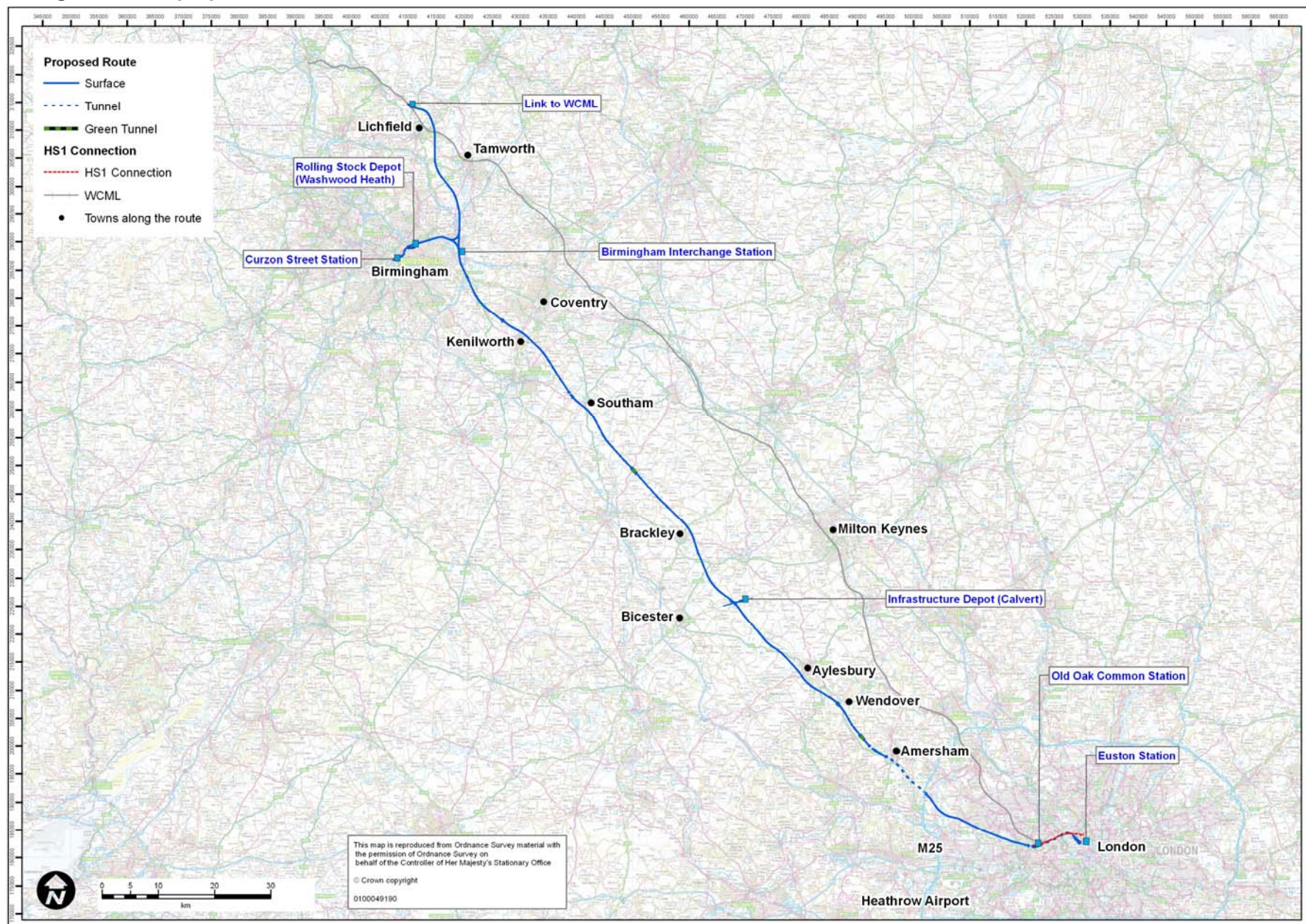
3.3 Route description overview

3.3.1 The proposed scheme (see **Figure 2**) would run from an expanded London Euston station to a connection with the WCML north of Lichfield with a spur into a new terminus station at Curzon Street in central Birmingham. There would also be new stations at Old Oak Common in west London and on the eastern outskirts of Birmingham. The station at Old Oak Common would provide an interchange with services to Central London, the City and Docklands and Heathrow via Crossrail and with other services to South Wales and the west of England via the Great Western Main Line (GWML). The interchange station on the outskirts of Birmingham between Marston Green and Coleshill would provide a connection to the National Exhibition Centre (NEC) and to Birmingham Airport.

3.3.2 Between Euston and Old Oak Common the proposed scheme would be in tunnel and would require three emergency intervention and ventilation shafts, one approximately every 2km. These would service the HS2 tunnels, as well as the HS1 link which would run broadly parallel with them. The line through Old Oak Common station would be in an open box structure before entering a short tunnel to join the Northolt corridor where the route would be on the surface alongside the existing Central Underground lines to Ruislip. The proposed route would follow the Northolt corridor, along which it would converge with the Chiltern Line corridor, to just beyond West Ruislip. Beyond West Ruislip station and Ruislip golf course, the proposed route would diverge north westwards across the Colne Valley towards the Chilterns.

⁸ Gauge refers to the overall height and width of the train.

Figure 2 – The proposed scheme



- 3.3.3 Grade-separated junctions would be included in the designs where the route passes to the north of Heathrow, at Northolt, West Ruislip and a location between the Colne Valley and the M25. These would allow extension of the railway to the airport at a later date.
- 3.3.4 The proposed route would be in tunnel under the south eastern part of the Chilterns entering just to the east of the M25 and emerging north-west of Amersham Old Town to follow the A413 corridor mostly in cutting before passing to the south-west of Wendover and Aylesbury. The surface route would continue across Buckinghamshire and the north-east corner of Oxfordshire into Northamptonshire, and would pass to the east of Brackley. It would pass to the east of Banbury and to the south west of Southam and between Coventry and Kenilworth before passing to the north east of Balsall Common to join the M42 corridor near junction 6 (A45).
- 3.3.5 An interchange station on the outskirts of Birmingham would provide a connection to the NEC and to Birmingham Airport. At Water Orton (north of Coleshill), a delta junction would provide the spur into central Birmingham. The spur line would follow the existing rail corridor into central Birmingham where a new terminus station would be provided at Curzon Street⁹.
- 3.3.6 The HS2 main line would continue north from Water Orton passing to the west of Tamworth and to the east of Lichfield before linking into the WCML.
- 3.3.7 The remainder of this section of the report provides a more detailed description of the proposed scheme. **Figure 3**, **Figure 4** and **Figure 5** illustrate the route description. More detailed plans are contained in Volume 2 to the main report.

3.4 The London terminus

- 3.4.1 Euston Station would be the London terminus where the current station would be remodelled as a single level station with ten platforms of 415m length for HS2 services, four platforms of 415m for use by both HS2 and 'classic' trains (trains on the existing railway network), and 10 platforms with lengths of 320m and 280m for classic only services. The concourse for the new station would be situated above the platforms or close to street level.
- 3.4.2 The remodelled station would be extended approximately 70m to the south and about 40m to the west. The southern extent of the station would be just to the north of the existing Euston Square Gardens, requiring the demolition of the existing office blocks situated at the front of Euston station. The western extension would be to the eastern side of Coburg Street and would continue northwards across Cardington Street to Hampstead Road.
- 3.4.3 The western extension would require the demolition of several buildings on Melton Street and Cardington Street as well as those at the eastern ends of Euston Street and Drummond Street. This extension would also require the majority of St James Gardens. The widening to accommodate the new station would require the replacement of the existing Hampstead Road bridge and the removal of housing blocks from the northern part of the Regent's Park Estate.
- 3.4.4 The classic lines would leave the new Euston station on the east side and follow the existing corridor to the north-west, passing under the new Hampstead Road bridge. The new HS2 lines on the west side of the new station would also pass under the new Hampstead Road bridge before diving down into a pair of single bore tunnels.

⁹ Referred to previously as Fazeley Street station.

Figure 3 – The proposed scheme: section between London and Aylesbury

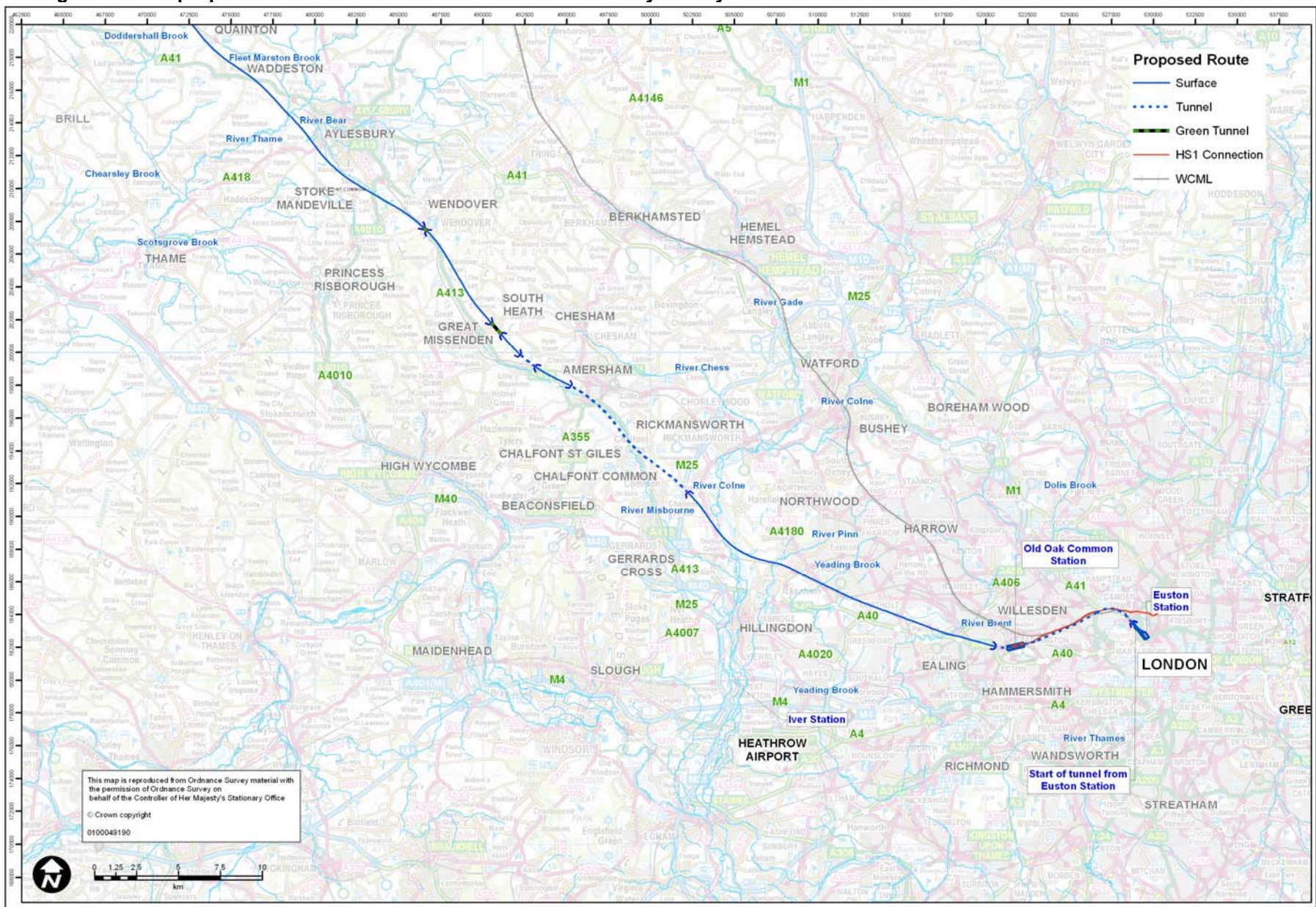


Figure 4 – The proposed scheme: section between Aylesbury and Southam

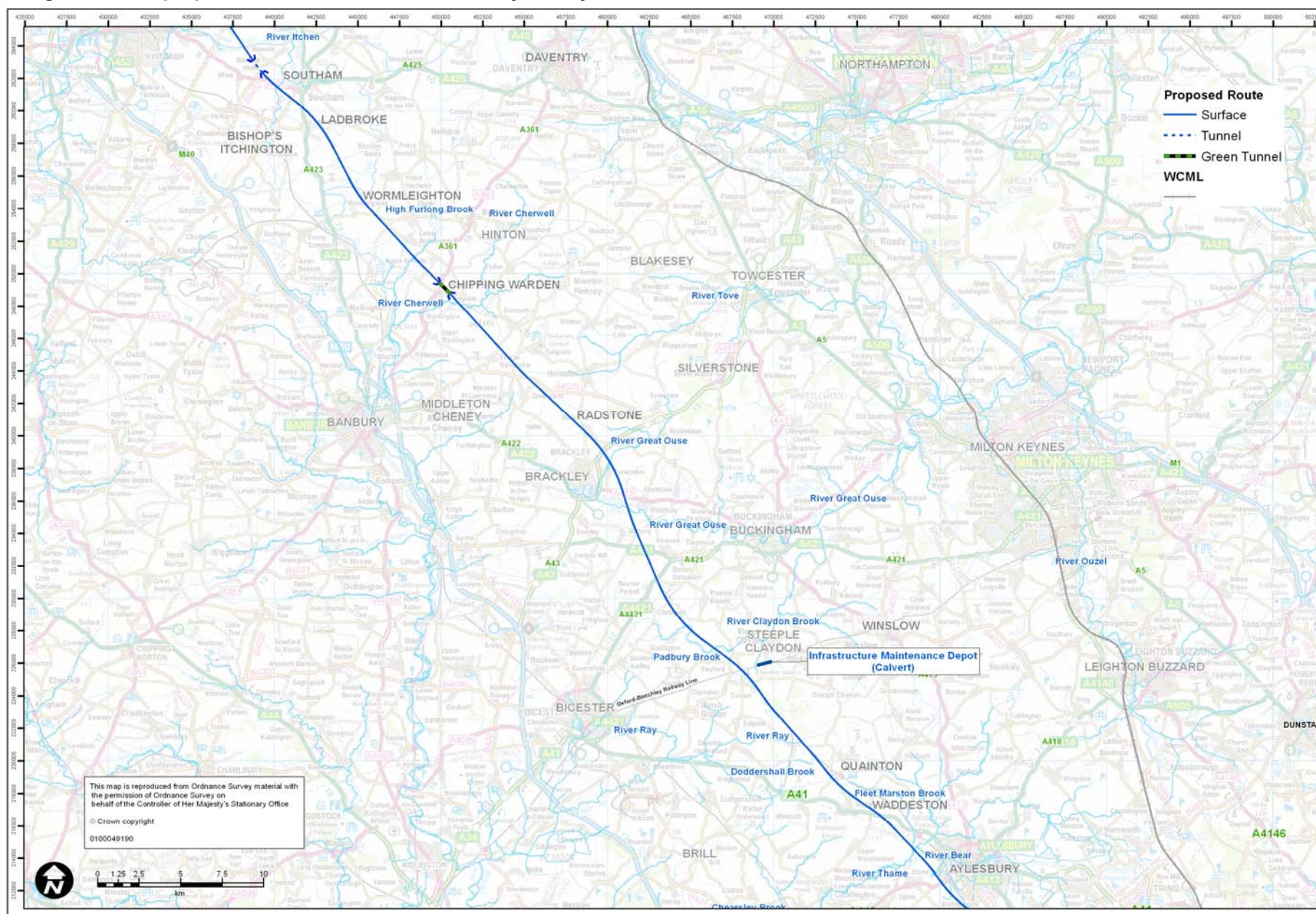
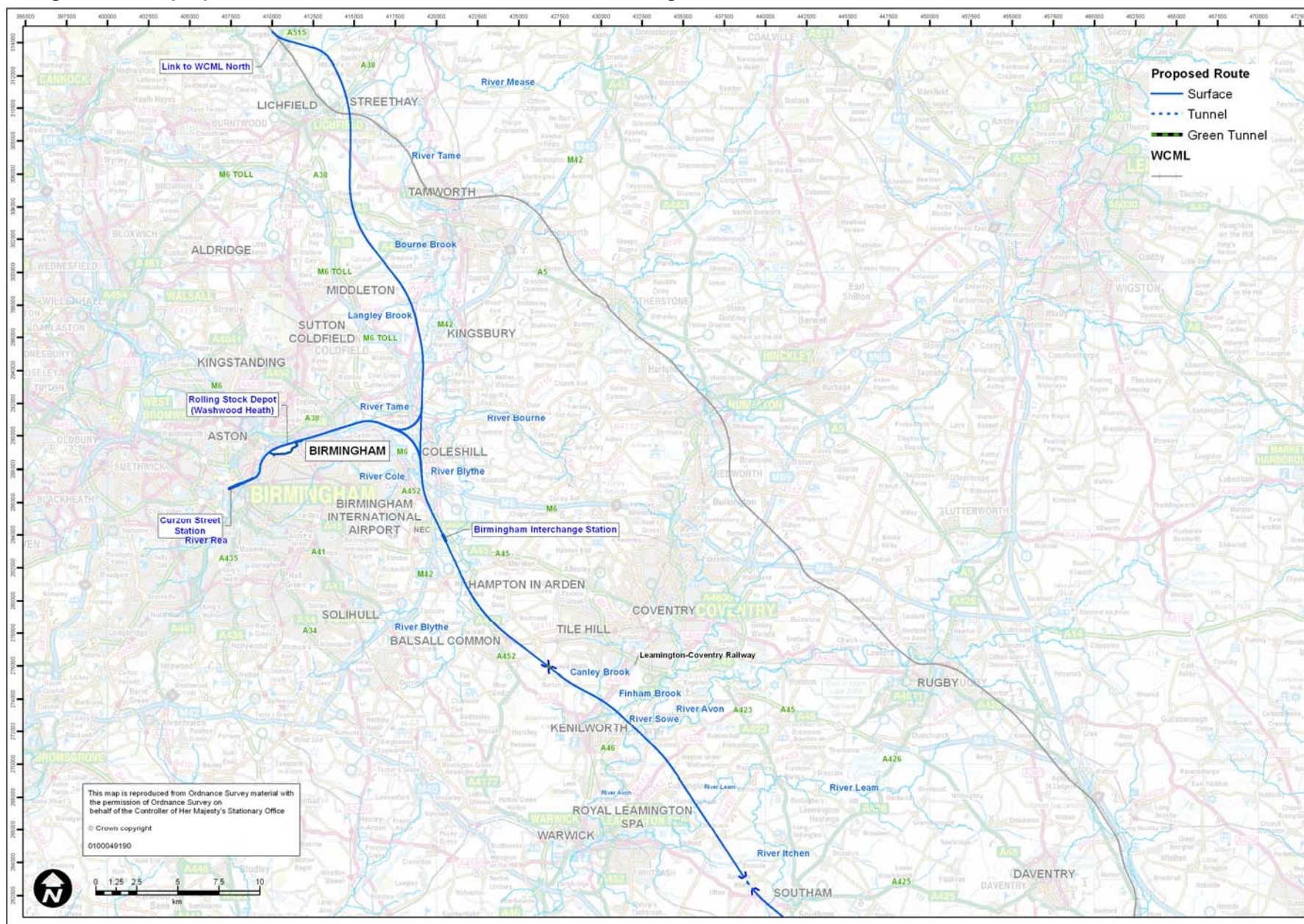


Figure 5 – The proposed scheme: section between Southam, Birmingham and Lichfield



3.5 Euston to Old Oak Common

- 3.5.1 From the Euston portal, the proposed scheme would be in tunnel to Old Oak Common. The route would consist of twin 7.25m internal diameter tunnels, connected by cross passages at 250m intervals.
- 3.5.2 Through this section the tunnels would follow an alignment below and broadly parallel with the existing rail corridor. The detailed vertical alignment would be refined at a more advanced stage of design to optimise the tunnel boring machine (TBM) design requirements.
- 3.5.3 The proposed scheme would then move to a more westerly direction, beneath Kensal Green cemetery, passing beneath the Grand Union Canal and into an open box where lines would enter the new Old Oak Common station.
- 3.5.4 It is assumed at this stage that there would be three ventilation/intervention shafts connecting the surface to the tunnel, between Euston and Old Oak Common. Locations for these are proposed at Adelaide Road, Alexandra Place West and Salusbury Road.

Scheme revisions at Euston to Old Oak Common

In comparison to the March 2010 published scheme, the proposed tunnel out of Euston would extend some 100m further north, beneath Belsize Park, and would be about 10m deeper, before returning to its former alignment west of Finchley Road. This revision was made in order to allow the alignment to pass below the proposed tunnel intervention points.

- 3.5.5 The station at Old Oak Common would occupy the site of the existing GWML depot, which would need to be relocated. Proposals for relocation of the depot are yet to be established, but would have their own sustainability implications, and would be the subject of EIA were the scheme to proceed. There would be six platform faces and it is assumed that all trains on the high speed line would stop at Old Oak Common. During construction the area may be used temporarily for storage of tunnel spoil prior to re-use elsewhere on the scheme or disposal offsite.
- 3.5.6 The station would provide an interchange with the GWML and Crossrail. Platform faces to serve GWML services and Crossrail services (together with two platform faces to provide turn back facilities for Crossrail) would be provided. Crossrail Ltd proposes to site their new maintenance facility and stabling (for up to 35 trains) immediately north of the proposed new HS2 station.
- 3.5.7 The new HS2 station would be configured to act as a junction for connection by tunnel to HS1.

Connection with HS1

Between the proposed Old Oak Common Station and the St. Pancras area, it is proposed to construct a single-track rail connection between the existing HS1 line and the proposed HS2 line. The HS1 link would comprise a single-track, GC-gauge link from Old Oak Common to the North London Line (NLL) at Camden Junction carrying trains at a maximum speed of 160kph. The route would use a tunnel approximately 15m below ground level between, and of the same internal diameter as, the two HS2 tunnels.

The three tunnels would be sufficiently close to allow them to share the three intervention shafts. Between the shafts at Alexandra Place and Adelaide Road the HS1 link would begin to rise to cross over the Euston-bound HS2 tunnel and then run to its north as the HS1 link begins to rise to the surface. The portal of the HS1 link tunnel would be near the disused Primrose Hill station.

From Camden junction the link would use the southern line across the existing Camden viaduct through Camden Market. It would require modification of the existing Camden Station platform which would be shared by NLL and HS1- HS2 services.

The existing connection between HS1 and the NLL corridor at the St Pancras Tunnel Portal (developed for Eurostar access to the temporary maintenance facilities at North Pole) would be re-used. Much of the NLL would require upgrading to GC gauge, thus requiring track lowering and a number of bridge reconstructions.

3.6 Old Oak Common to the M25

- 3.6.1 At the western end of the box, the proposed scheme would enter a short tunnel to pass under housing at Wells House Road and part of North Acton to emerge to the west of Park Royal Road. This area is currently in use as an aggregate storage yard and would allow sufficient space to accommodate and facilitate the construction of the portal structure.
- 3.6.2 The route would then follow the Northolt corridor, a 12km stretch between Park Royal (just beyond Old Oak Common) and West Ruislip Station. This is the existing four track rail corridor occupied by two LUL Central Line tracks on the south side and Network Rail tracks to the north side.
- 3.6.3 The first 8km towards Northolt Junction would be constructed on the trackbed of the existing railway (the former GWR London to Birmingham line), as there is limited space available within the existing railway land boundary. Throughout this section, existing overbridges would need to be demolished and replaced to allow for the GC gauge required by HS2. Several such replacements would be required in the Park Royal area before the proposed scheme reaches the Hanger Lane gyratory system, where the A40 Western Avenue and the railway corridor pass under the A406 North Circular Road. In order to accommodate the required GC gauge, it would be necessary to increase the headroom and widen the eastern road overbridge. There would be a risk of significant disruption to traffic over several months in relation to this work; considerable attention would therefore be given to ensuring that these impacts were minimised through use of extensive temporary traffic management.
- 3.6.4 West of the Hanger Lane gyratory, the scheme would pass over the River Brent on a new viaduct with new embankments at each end. It would be about 40m north of the existing rail corridor. Through Perivale the scheme would be to the north of the lines in the existing rail corridor which is predominantly straight and raised on an embankment. Over a 3km length, several existing rail over-bridges would need to be widened.
- 3.6.5 Through Greenford, the rail corridor is bounded on the northern side by a series of aggregate yards, low level industrial premises and scrap yards. The proposed scheme would pass through some of these (to the north of the existing rail corridor) before passing over the Grand Union Canal on a 40m long new bridge. The railway corridor would need to be widened at the southern end of this route section, which would necessitate the replacement of the A312 Mandeville Road bridge at Northolt station and the Eastcote Lane road bridge over the rail corridor.

- 3.6.6 Just beyond Northolt station the proposed scheme would include a grade-separated junction to enable a future connection to Heathrow airport. This would necessitate a corridor width sufficient to accommodate the twin Central Line tracks and the four HS2 tracks and the junction, but the link itself would not form part of the proposed scheme.

Provision for rail links to Heathrow

Considerable additional work has been undertaken between March and November 2010 to establish whether there is a case for providing a rail link between HS2 and Heathrow, and to investigate possible ways of achieving this; this is described in the *Consultation Document*. The Government's proposed strategy for a national high speed network includes a direct spur to Heathrow to be constructed as part of a second phase. HS2 Ltd has therefore made provision to allow for the addition of a connection to the airport at that point. A direct route via Heathrow is not recommended.

To enable a loop or spur link from HS2 to Heathrow to be added at a later date without major disruption to the operation of a new railway it would be necessary to construct junctions, including an overbridge to allow the primary route to pass over any Heathrow link, to ensure continued operation of the newly opened HS2 route. Provision is therefore made at Northolt, West Ruislip and a location between the Colne Valley and the M25, which would allow either a spur or a loop link to the airport to be constructed at a later date. They would be compatible with any of the station locations considered to date for a Heathrow interchange.

- 3.6.7 At Northolt Junction the twin track Chiltern Line from Marylebone station joins the corridor and runs adjacent to the Central Line to West Ruislip. This junction would be improved as part of the Chiltern Line upgrade (Evergreen 3). The two HS2 tracks would dive under the future Chiltern Line before rising to run alongside the existing railway, but the rail corridor would need to be widened requiring some permanent land acquisition. The scheme would run on the north-east side of the corridor.
- 3.6.8 At South Ruislip, the existing Chiltern Line from Marylebone station joins the rail corridor on a grade separated junction. The proposed scheme would stay to the north of the existing lines requiring some reconfiguration of the junction to avoid permanent impacts on an existing waste transfer facility. This would result in a six track rail corridor comprising twin Central Line tracks, twin Chiltern Line tracks and twin HS2 tracks.
- 3.6.9 Passing west of South Ruislip station and over Bridgewater Road on a new bridge, the proposed scheme would run to the north of the existing Ruislip Gardens station on an embankment. As the proposed scheme approached West Ruislip station it would pass over the Piccadilly and Metropolitan LUL lines on a new bridge. It would pass immediately north of the station at West Ruislip.
- 3.6.10 From West Ruislip station the proposed scheme would continue on the north side of the Chiltern Line along the edge of the Ruislip golf course and then diverge to the north-west crossing over the River Pinn on a new bridge. After a short stretch of cutting, the proposed scheme would cross the Colne valley on a 3.6km long viaduct. This would cross three flooded gravel pits, the River Colne, the Grand Union Canal and two roads (including the A412 North Orbital Road) and part of the Mid Colne Valley SSSI.
- 3.6.11 The viaduct would end immediately to the north of Northmoor Hill Wood. The scheme would continue on a series of embankments and cuttings across farmland, passing under the M25 in a twin bore tunnel which would continue on into the Chilterns.

Scheme revisions in the Northolt corridor

Minor revisions within the Northolt corridor would result in the scheme leaving Old Oak Common on a steeper incline, meaning a shorter open cut box. This would reduce the land take from adjacent properties, although not reducing the number of properties affected overall. It was previously thought necessary to reconstruct both the road overbridges at Hanger Lane, but further route refinement has confirmed that only the easternmost of the two bridges would require reconstruction.

The March 2010 published route runs at surface level through the Northolt Junction area but would conflict with the recently authorised Evergreen 3 Chiltern Line route improvement plan which changes the current railway line arrangements at Northolt Junction. Route refinement work has therefore developed a new surface proposal, which would lower the HS2 tracks to pass under a southerly re-alignment of the Chiltern Line junction, which would pass over HS2 on a low viaduct.

Provision would be made for future construction of a connection to Heathrow. This would require the construction of nearly 2km of retained embankment on the north side of the alignment to allow an increase in railway corridor width of 12-15m. This would run from the Grand Union Canal to just east of Northolt Junction. An additional underbridge would also be required, which would be constructed within the railway boundary.

3.7 M25 to Aylesbury

- 3.7.1 Routing a high speed railway from London to the West Midlands would necessitate crossing the Chiltern Hills, the majority of which are designated an AONB. The proposed scheme would be in tunnel from the M25 until a point to the north-west of Amersham Old Town. The 9.5km tunnel would consist of twin bores and would be predominantly at depths of 25m to 45m. The tunnels would pass to the north of Chalfont St Peter and under Chalfont St Giles, beneath some residential properties. They would then follow the Misbourne arterial valley before passing beneath a number of residential properties on the south side of Amersham. The bored tunnels would emerge on the north side of Amersham Old Town. The route would be in a deep, partially retained cutting at this point. A 'green bridge' over the cutting would be provided approximately mid-way between Old Amersham and Little Missenden, allowing continued access over the railway for two public footpaths.
- 3.7.2 It is envisaged that four shafts would be required along the 9.5km tunnel between the M25 and the west of Amersham to provide sufficient ventilation, pressure relief and emergency egress. Potential sites would need to be of sufficient size to accommodate the shaft and have access to a highway. They would be designed to avoid significant environmental effects, particularly visual intrusion, through positioning and landscaping treatment. Four potential sites have been identified: north-east of Chalfont Common; west of Chalfont St Giles; north of Chalfont St Giles; and south of Amersham. There would be some flexibility in the exact location (around 50m either side of the route and around 100m longitudinally) so it may be possible to consider other locations.
- 3.7.3 The route would pass into a single bore tunnel for a little over 1km beneath the existing Chiltern Line to the north-east of Little Missenden.

Scheme revisions Amersham to Little Missenden

In the March 2010 published proposals, a substantial open cutting was proposed between Old Amersham and Little Missenden. The 'green bridge' structure that would now enclose part of this section has been introduced both to enable continued access across the railway and to minimise visual impacts from the railway. The cutting itself would now be partially retained to reduce its width. This would have particular benefits for the Grade II* Registered Park and Garden of Shardeloes, which was significantly affected under the previous proposals, and whose landscape and wider setting would now be largely preserved.

The short section of bored tunnel north of Little Missenden would be slightly longer than proposed in March 2010.

Figure 6 – Green bridges help to provide local mitigation for settlements [Arup]



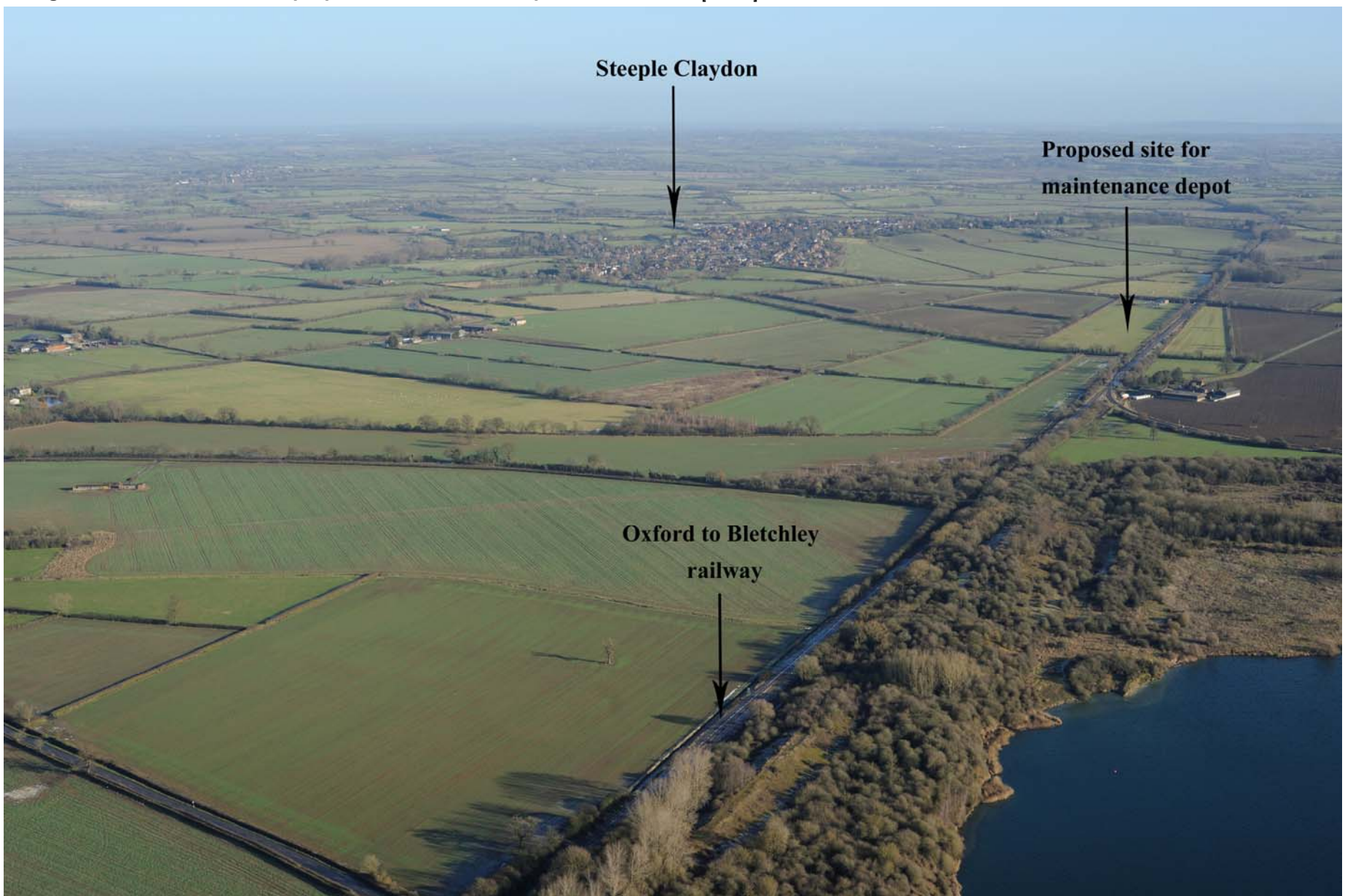
- 3.7.4 The proposed scheme would emerge from tunnel higher up the Misbourne valley north-east of Great Missenden, where it would pass through a series of cuttings covered by a continuous 900m long green bridge. Local road crossings over the green bridge would be possible at or close to existing ground level.
- 3.7.5 The proposed scheme would then pass in cutting to the west of South Heath and north-east of Great Missenden, through part of the scheduled monument of Grim's Ditch. It would cross the Wendover Dean valley on a 450m long viaduct and then the A413, a minor road and the existing railway on a 600m long viaduct.
- 3.7.6 West of Wendover, the proposed scheme would pass through a 300m covered tunnel. Ellesborough Road and Bacombe Lane would be diverted via the A413 roundabout south of Wendover.

Scheme revisions South Heath to Wendover

In comparison to the March 2010 published proposals, the vertical alignment would be lowered by around 5m and would include a long 'green bridge' linking the bridges carrying Chesham Road, Frith Hill Road and Bowood Lane across the route. It would cover the line entirely as it passed South Heath, so screening the most densely populated part of South Heath from railway noise, maintaining land continuity entirely to the south of the village, and mitigating noise and visual impacts on a number of dispersed farm properties and dwellings throughout. It would also allow Chesham Road and Frith Hill Road to cross the line at ground level, avoiding elevated road noise and the need for new elevated road structures at this location.

- 3.7.7 The scheme would then pass onto embankment before crossing over the A4010 Risborough Road on a bridge. It would continue mostly on viaduct north-westwards to pass towards the south-west side of both Stoke Mandeville and Aylesbury. The Princes Risborough to Aylesbury branch of the Chiltern Line would be diverted over the proposed line, south of Aylesbury.

Figure 7 – Aerial view of the proposed maintenance depot site at Calvert [HS2 Ltd]



3.8 Aylesbury to the Kenilworth-Coventry gap

- 3.8.1 The alignment would pass through part of Hartwell House Grade II* Registered Park and Garden and the Aylesbury Park Golf Club before crossing under the A418 Oxford Road. It would pass in a north-westerly direction generally at grade but on low viaduct structures to carry it over flood plains.
- 3.8.2 The scheme would then pass over the A41 to the east of Waddesdon. The topography becomes relatively flat towards Quainton so it would continue at grade or on low viaduct or embankment. It would pass adjacent to the Sheephouse Wood SSSI, before crossing under the Oxford to Bletchley railway line between the villages of Calvert and Twyford. An infrastructure maintenance depot would be located about 2km north-east of Calvert. This would be served mostly by rail but would also require access to the trunk road network.

Scheme revisions past Aylesbury

The proposals past Aylesbury have been altered from the March 2010 published scheme. This would take the route eastwards by 75 to 85 metres past Hartwell House to take the line further away from the house and associated grounds but through the edge of Aylesbury Park golf course. Although still passing through the registered park, the scheme would do so on ground that has already been remodelled and planted in recent years as part of the golf course development. This would maintain the integrity of the landscaped grounds associated with the house.

The increased distance from the house would make earthworks and additional screen planting simpler and more effective, and would avoid the need to remove the established planting on the boundary as well as taking less planting from within Rifle Spinney. A move eastwards would also place the line at the northern end of the avenue at a point where the existing ground level is generally higher and the avenue has been replanted in recent years. That would put the line in a deeper cutting and, with the removal of some newer avenue trees plus ground re-modelling, effective screening could be provided.

The realignment would bring the line slightly closer to the outskirts of Aylesbury, but not to such an extent that it would result in significant additional noise impacts.

- 3.8.3 As the proposed route passes Mixbury, the topography becomes more undulating and a series of cuttings would be required towards Brackley. It would then pass to the east of Turweston, crossing over the River Great Ouse on viaducts at two locations. The proposed scheme would cross Helmdon Disused Railway SSSI in cutting just south of Radstone.

Scheme revisions past Brackley

A revision to the March 2010 published proposals sees the proposed route move eastwards away from Mixbury to pass in deep cutting east of Turweston, passing further east of Brackley and Greatworth, a little closer past Radstone but in deeper cutting, before re-joining the original alignment. This revision would help to reduce noise and visual impacts at Mixbury, Turweston, Brackley and Greatworth. It would also avoid conflict with the South Northamptonshire development aspirations for north and east Brackley. It would, however, affect a SSSI that was previously avoided.

- 3.8.4 The proposed scheme would continue north-west near Greatworth and Thorpe Mandeville in a series of cuttings and embankments. The eastern grounds of Edgcote House would be crossed on a low viaduct. The scheme would then pass east of Chipping Warden in deep cutting covered by a green bridge, before continuing through a disused RAF base. It would continue north-westwards generally on low embankment and at grade and would cross over the Oxford Canal near Wormleighton before passing north-east of Ladbroke and south of Southam.

Scheme revisions Chipping Warden to Southam

Revisions to the March 2010 published proposals see the proposed route move some 100m north-east, thus avoiding the ornamental lake in the grounds of the Grade I listed Edgcote House and views from the house, but impinging the site of a scheduled Roman villa. A new 'green bridge' at Chipping Warden is also proposed on this revised length of route between Greatworth and Wormleighton.

The proposed scheme has been revised to take a more easterly alignment north of Boddington, taking the route away from the village of Ladbroke to a position halfway between there and Southam to the north-east. The route would be at ground level, avoiding the flood plain and the need for a lengthy viaduct across the open valley in this location. Although now closer to Southam, the surface alignment would offer opportunities for mitigation using earth bunds and screening that would provide a better fit through this rural location.

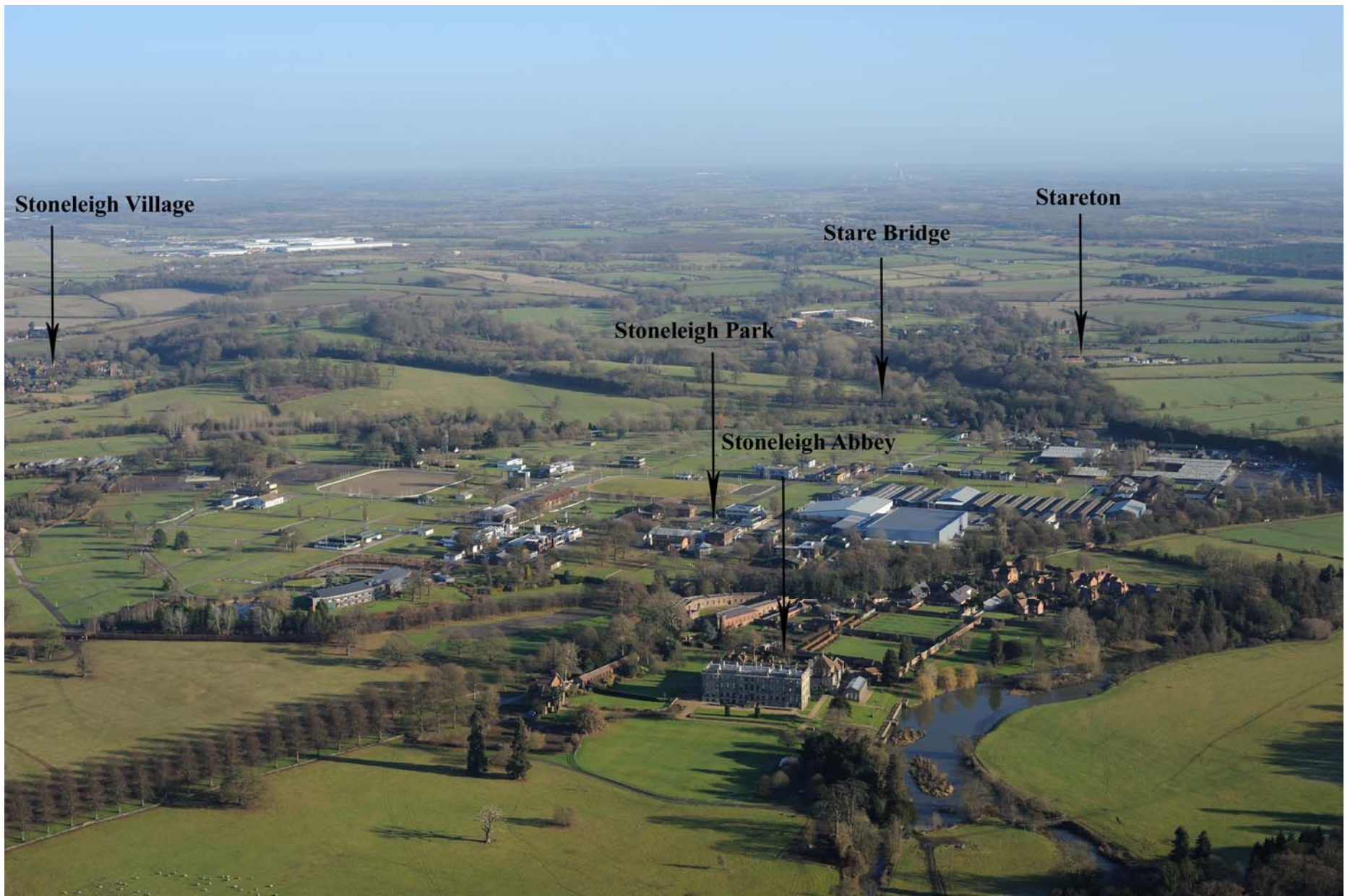
- 3.8.5 Approaching Long Itchington and Ufton Wood, the scheme would enter deep cutting before passing in twin bore tunnels for some 1.4km beneath the wood, a SSSI. The scheme would pass over the Grand Union Canal and enter deep cutting east of Offchurch. The scheme would continue north-west at grade, passing over the River Leam, and in cutting through the southern part of South Cubbington Wood and in the approach to Stoneleigh Park.
- 3.8.6 The proposed scheme would largely avoid the Grade II* Registered Park, but pass through the eastern side of the adjacent National Agricultural Centre (Stoneleigh Park Exhibition and Conference Centre). It would continue over the River Avon and then beneath the A46 and the A429, passing north-east of Kenilworth in cutting.

Scheme revisions around Stoneleigh

The March 2010 preferred route has been moved south-west between the Rugby Road and the Kenilworth Road. The proposed alignment has been lowered by some 5 to 10 metres across the Avon valley. As a result the degree of severance of the historic parkland at Stoneleigh would be significantly reduced and the outlook of the Grade II* listed and scheduled monument of Stare Bridge would be better maintained. The route would move further from Stoneleigh Village but closer to properties on the eastern edge of Kenilworth and Cubbington, although at a lower level than previously. While this would reduce potential visual and noise impacts, it would require further noise and landscape mitigation around these settlements.

The revised alignment would now avoid the historic hamlet of Stareton and would reduce land take from Long Itchington and Ufton Woods SSSI. It would, however, involve the likely demolition of a Grade II listed building and would put another at risk of landtake subject to more detailed design. It would also involve significantly greater land take from the Stoneleigh Park Exhibition and Conference Centre.

Figure 8 – Aerial view of Stoneleigh Park_[HS2 Ltd]



3.9 Kenilworth-Coventry gap to Birmingham Interchange and NEC

- 3.9.1 The proposed route would join a disused rail corridor just south of Burton Green, through which it would pass in an old railway cutting, where a green bridge would be constructed over the cutting to allow continued access through the village. It would then continue along the disused railway corridor towards Berkswell passing to the north east of Balsall Common. East of the existing Berkswell station the proposed alignment would diverge from the disused railway corridor, crossing over the Birmingham to Coventry railway and past Berkswell House on a viaduct.
- 3.9.2 The proposed scheme would run alongside the A452 on an embankment running north of Balsall and Bradnock's Marsh. East of Hampton-in-Arden the A452 would be raised to lift the road over the proposed alignment. Similarly, the A45 would be raised over the scheme, allowing an at-grade approach into the proposed Birmingham Interchange station.

Scheme revisions at Burton Green

At Burton Green, although realignment was considered, this would have brought the route closer to other properties on the southern edge of the village and to residents at Balsall Common. However, modifications to the proposals from March 2010 have seen a lowering of the alignment and the covering of the proposed route through Burton Green to avoid greater severance of the village and to provide noise and visual mitigation.

3.10 Birmingham Interchange and NEC to the WCML connection (Lichfield)

- 3.10.1 A new HS2 station would be constructed adjacent to the NEC and just to the east of the M42. A people mover would provide a direct link between the interchange station and both the NEC and Birmingham Airport, which is on the Birmingham to Coventry railway line. It would require new local road access necessitating possible works to the A452, the A45, bridges at junction 6 on the M42 and at junction 4 on the M6. The risk of traffic disruption over several months from this work would necessitate extensive temporary traffic management. It is likely that some 7,000 car parking spaces also would be required and that this would be provided in multi-storey accommodation.
- 3.10.2 South of the proposed new station the alignment would widen to four tracks with the outer two tracks splitting again to create four platform lines and two through lines. North of the proposed new station and to the west of Coleshill HS2 would comprise a four track railway with the outer pair of lines splitting to create a grade separated delta junction taking two tracks into central Birmingham and four tracks continuing on the mainline. The overall form of the junction would enable high north-south through-speeds between London and the route northwards with slower speeds for services into and out of Birmingham.
- 3.10.3 The route northwards would pass through Coleshill Hall Farm onto a viaduct to cross the River Cole and M42. East of Gilson Hall the route would be in cutting before rising over the A446 and the Birmingham to Nuneaton railway on new bridges. The route would then cross the River Tame, sewage works, canalised river and the Birmingham to Derby railway using a viaduct. The northwards link from Birmingham would tie into the mainline at this point via a grade separated junction. The route would then return to ground level and pass in cutting east of Dunton Hall.
- 3.10.4 The main HS2 route would return to a two track railway before rising on a 320m viaduct, which would take the proposed scheme over the M42 and the Birmingham and Fazeley Canal. The proposed alignment would then pass east of both the Belfry Golf Course and the village of Middleton. Two viaducts would carry the tracks over flood plains adjacent to the golf course, requiring a diversion of the A4091.

- 3.10.5 North of Middleton, the A5 would be raised over the proposed scheme which would pass through Whittington Heath Golf Course and continue towards Streethay, crossing a watercourse with a 200m viaduct.
- 3.10.6 The proposed scheme would pass about 400m north-east of Streethay on a 150m viaduct which would carry it over the A38. It would run parallel to the WCML for 3km, about 1.5km from it, before converging with the WCML north of Lichfield. This would require a grade-separated junction about 1km south of Handsacre.

Scheme revisions Hints to the WCML connection

The proposed scheme has been revised from the March 2010 published scheme over some 15km between Hints, south of the A5, and the WCML connection in order to take it further away from Lichfield. The revision introduces a marginally tighter curve which would reduce the line speed by around 10kph, but in so doing it would allow the alignment to move eastwards increasing the distance from Lichfield from about 400m to between 900m and 2000m, and taking it from the west side to the east side of Streethay. This shift would bring the line closer to Whittington and Huddlesford, although it would still be some 800m and 450m respectively from the western edges of these settlements.

The proposed WCML connection has been moved some 1.5km northwards, to connect at a point north-west rather than south-east of the A515.

3.11 The link into Birmingham Curzon Street

- 3.11.1 North of the proposed Birmingham Interchange station the proposed alignment would cross to the west side of the M42 and to the north side of the M6. It would require the demolition of a roundabout over the M42 which would be rebuilt further to the north. While the main HS2 route north would cross back over the M42, the spur lines into central Birmingham would be carried over the slip roads on bridges before swinging west to join the existing railway corridor near Water Orton.
- 3.11.2 The proposed scheme would run on the south side of the existing railway as it approaches the A452 Chester Road bridge, which would be rebuilt and raised to allow HS2 trains to pass underneath. The scheme would then cross the M6 corridor into central Birmingham.
- 3.11.3 When the M6 was constructed it had to cross from the south side of the existing railway corridor to the north side near Washwood Heath. To achieve this, the existing railway and the River Tame, which is also in this corridor, were crossed by a series of portal structures supported by lines of piers which carry the deck structures on which the M6 is aligned. The existing railway and the river Tame therefore lie under what is effectively a tunnelled structure, at minimum clearance over the existing railway.
- 3.11.4 In order to accommodate the HS2 tracks through this area, the river would be realigned south of the M6 structure, allowing HS2 to use the existing river channel. To achieve the necessary vertical clearances HS2 would need to be lowered and bunding would be required along the realigned river to reduce the risk of flooding.
- 3.11.5 Having passed under the M6 to the south side of the motorway, the proposed scheme would cross the A4040 Bromford Lane and the Heartlands Spine Road. This would require a realignment of both Bromford Lane and the Spine Road. Between Bromford Lane and Aston Church Road, the proposed alignment would lie on the south side of the existing railway line which itself is on the south side of the Heartlands Spine Road. A depot is proposed at Washwood Heath, to service and maintain HS2 trains and carriages.
- 3.11.6 The proposed scheme would then pass under Aston Church Road which would need to be realigned to create adequate headroom. The alignment, still on the south side of the existing lines, would then cross over the Grand Union Canal before crossing under the Saltley viaduct. The viaduct would require reconstruction to create the necessary headroom.

- 3.11.7 Between Saltley viaduct and the proposed Birmingham Curzon Street station the proposed scheme would be on an elevated structure which would start immediately after crossing under the viaduct. The elevated structure would cross to the north side of the existing railway lines through a box structure before continuing as a normal viaduct towards the proposed Birmingham Curzon Street station.
- 3.11.8 The proposed new station would comprise three island platforms providing six platform edges serving 400m long trains. The concourse would be located at high level above Park Road and would lead into Moor Street Queensway.
- 3.11.9 The new station would be located in an area known as Birmingham Eastside, a regeneration initiative in this part of the city. It would require the demolition of buildings constructed as part of the initiative and would affect the implementation of others that have been granted planning permission.

3.12 Power supply

- 3.12.1 New power infrastructure would be required for the high speed route. The details of this are yet to be developed and the appraisal of this infrastructure is, accordingly, at a lower level of detail than that for the rail infrastructure.
- 3.12.2 HS2 trains would draw power from overhead line equipment, requiring connections to the National Grid 400kV network approximately every 55km. These feeder stations would need approximately a 100m x 100m square of land at a point near to where the National Grid cable crosses the line of route. They would require good road access, be securely fenced, and would need at least one large electrical pylon, although most structures and buildings within the compound would be low level and could be effectively screened, for example, by landscaping.
- 3.12.3 Possible locations for feeder stations would be subject to detailed discussions with National Grid plc regarding the suitability of potential connection points to their network.
- 3.12.4 In addition to feeder stations, smaller autotransformer stations¹⁰ would need to be provided at approximately 11km intervals. Each would require approximately 50m x 20m of land adjacent to the HS2 line and would be incorporated within the overall railway footprint to minimise additional land take from outside the proposed boundary lines.

3.13 Released capacity

- 3.13.1 The introduction of services on a new high speed line would have an impact on existing services. Some existing fast services on the WCML between the West Midlands (south of Lichfield) and London could be replaced by HS2, releasing capacity for other services on this section of the line. This could enable a service more appropriate to the changing requirements of the route's users, both passengers and freight. For example, the planned growth in population in the Milton Keynes, Northampton and Rugby areas would be better catered for by an increase in the number or capacity of services calling at those locations. Train services on the Coventry to Birmingham New Street route could be altered to provide a more regular stopping pattern better suited to the needs of both local passengers and those travelling between towns in the Midlands.
- 3.13.2 No significant changes are envisaged for service levels and stopping patterns on other routes such as the Chilterns Line and Midland Main Line.
- 3.13.3 The potential impacts of this released capacity and of the new services introduced to fill it have been taken into account in the demand modelling and, as a result, by those aspects of the AoS dependent on it, including climate change, air quality and socio-economic

¹⁰ Power supply dissipates with distance from feeder stations; in order to redress this, autotransformer stations are required to ensure that sufficiently high power would be available in these areas of the railway.

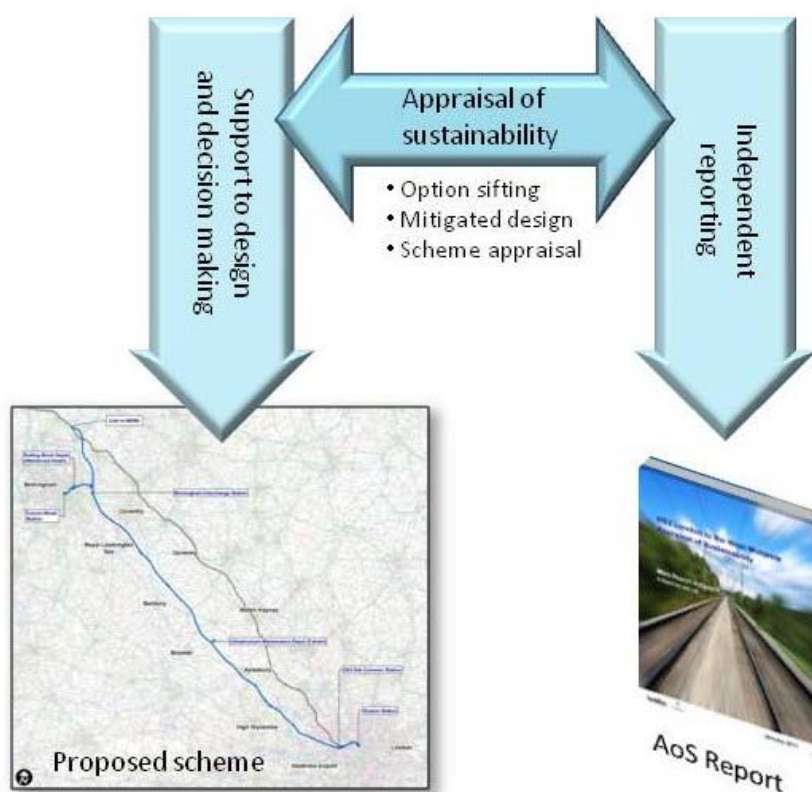
elements. Consideration of these impacts for other elements of the AoS has been undertaken at a commentary level.

- 3.13.4 As well as catering for population growth by the provision of additional passenger services, some of this released capacity could also be used for additional freight services. No specific investigation of released capacity for freight traffic has been undertaken. However, the WCML is particularly suitable for linking the Channel Tunnel, the Haven Ports, Tilbury, Southampton and London with the distribution centres in the East and West Midlands. Additional freight services could run on the southern section of the WCML (i.e. south of Lichfield), serving existing or new distribution centres. North of Lichfield (where HS2 would re-join the WCML) the capacity of the existing network is constrained, so no additional freight is envisaged at this stage.

4 The AoS process

4.1 Role of the AoS

- 4.1.1 The AoS was devised as a way of assessing objectively how HS2 would support or conflict with objectives for sustainable development. Objectivity in reporting the findings is key to the AoS, and the independence of the appraisal process is important in securing this. The AoS has also been integral to defining the proposed route and stations through the information it has provided to the design team and the recommendations made to HS2 Ltd. This dual role would continue: supported by a team of sustainability experts, further appraisal and assessment (as part of EIA) would be integral to design development through close working with both HS2 Ltd and the wider engineering team; and conclusions that emerge from the AoS would feed the independent reporting of scheme performance and would assist the future consideration of mitigation to help overcome particular issues of concern. A fuller description of the AoS process is provided in *Appendix 1*.



4.2 Supporting scheme design

- 4.2.1 Sustainability issues have been accommodated within the scheme design through:
- sustainable design aims (see *Appendix 1*): these were developed as basic principles of good practice for the design teams to accommodate as part of scheme definition;
 - features maps: key sustainability features were mapped so allowing the design teams to accommodate *various* constraints and opportunities within route alignments;
 - comparative frameworks: sustainability impacts for different options were recorded on 'appraisal frameworks', which allowed options to be compared equitably;
 - direct liaison with the engineering teams: the AoS team worked directly with the design team when required in order to provide specific guidance on alignment issues and to develop mitigation;

- discussion with key government departments, as well as statutory agencies including Natural England, English Heritage and the Environment Agency; and
- direct input to decision forums: the sustainability impacts of options under consideration were presented by the AoS team at review fora to allow HS2 Ltd to make decisions about options to be progressed.

4.3 Defining sustainability objectives

4.3.1 At the commencement of the AoS, sustainable development objectives were defined to provide benchmarks against which the scheme could be appraised. These were developed with reference to:

- the overall objectives for HS2;
- the former Government's stated objectives and priorities for sustainable development and sustainable transport;
- the sustainability issues of most direct relevance to a high speed railway; and
- other core key processes, including NATA/WebTAG.

4.3.2 Draft AoS objectives were discussed with key stakeholders (see Section 4.6 on Consultation) and revised on the basis of comments received from these groups before being finalised. A total of 18 key issues emerged from the consultation process and provided a framework within which 33 sustainability objectives were developed and agreed.

Table 1 – Key sustainability issues for HS2 and sustainability objectives for the AoS

Key sustainability issue	Sustainability objective
Reducing greenhouse gas emissions and combating climate change	
Climatic factors and adaptability	<ul style="list-style-type: none"> • Improve resilience of rail network against extreme weather events
Greenhouse gases	<ul style="list-style-type: none"> • Contribute to the reduction of greenhouse gas emissions by facilitating modal shift from road and air to rail • Reduce relative contribution made by rail to greenhouse gas emissions by promoting energy efficient technologies
Natural and cultural resource protection and environmental enhancement	
Landscape and townscape	<ul style="list-style-type: none"> • Maintain and enhance existing landscape character • Maintain and enhance existing townscape character
Cultural heritage	<ul style="list-style-type: none"> • Preserve and protect archaeological assets • Preserve and protect historic buildings • Preserve and protect historic landscapes
Biodiversity	<ul style="list-style-type: none"> • Maintain and enhance biodiversity
Water resources	<ul style="list-style-type: none"> • Protect surface water resources • Protect groundwater resources
Flood risk	<ul style="list-style-type: none"> • Conserve and enhance the capacity of flood plains
Creating sustainable communities	
Air quality	<ul style="list-style-type: none"> • Maintain and enhance local air quality
Noise and vibration	<ul style="list-style-type: none"> • Maintain and enhance the local noise environment • Maintain the local vibration environment
Community integrity	<ul style="list-style-type: none"> • Maintain and enhance community integrity

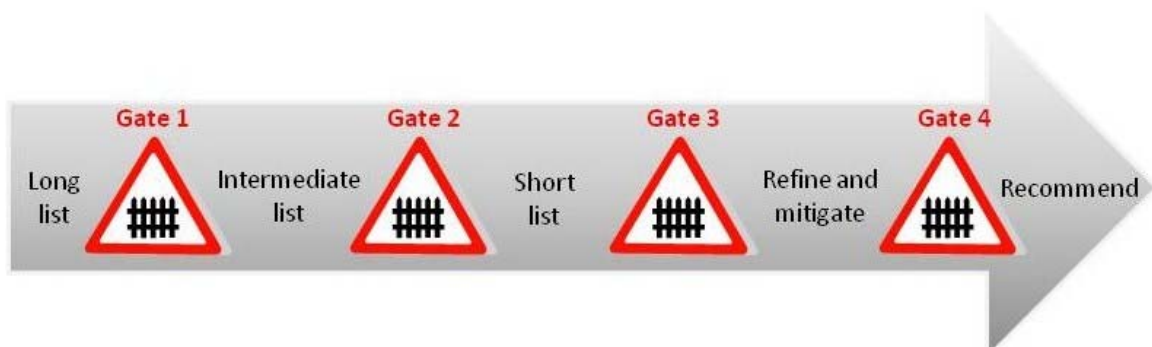
Key sustainability issue	Sustainability objective
Accessibility	<ul style="list-style-type: none"> • Maintain and enhance pedestrian access • Maintain and enhance access to public transport • Maintain and enhance public transport interchange
Health and well-being	<ul style="list-style-type: none"> • Maintain and improve mental well-being • Maintain and improve physical health • Reduce health inequalities
Security and safety	<ul style="list-style-type: none"> • Contribute to the reduction of road traffic accidents • Protect against crime and fear of crime
Economic prosperity	<ul style="list-style-type: none"> • Support economic competitiveness and make efficient use of public funds • Support wider economic growth and maintain and enhance employment opportunities
Economic welfare	<ul style="list-style-type: none"> • Support wider economic welfare growth • Support planned developments • Maintain and enhance regeneration
Sustainable Consumption and Production	
Soil and land resources	<ul style="list-style-type: none"> • Maintain and enhance land resources • Encourage the use of brownfield sites
Waste generation	<ul style="list-style-type: none"> • Prevent and minimise waste production
Resource use	<ul style="list-style-type: none"> • Conserve and protect primary material resources

4.3.3 These objectives formed the basis of the AoS and the comparative appraisal of different options.

4.4 The AoS and option development

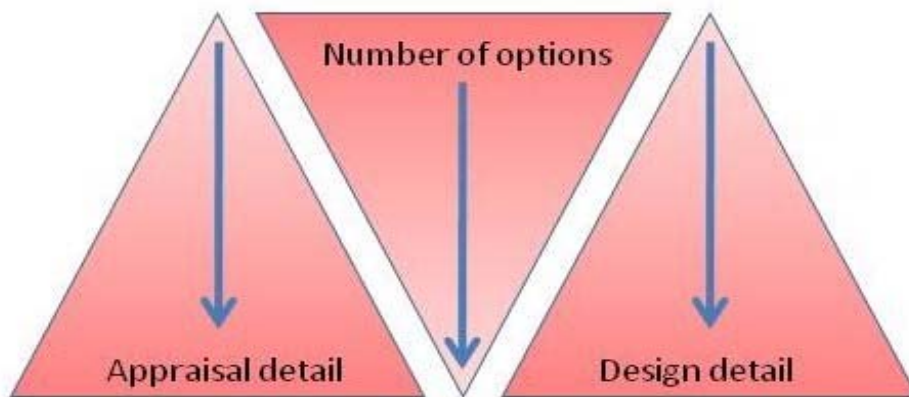
4.4.1 HS2 Ltd’s overall approach to defining options and identifying preferences followed a staged process that saw a long list of over 90 options gradually reduce through an intermediate list and a short list to a preferred scheme with a small number of main alternatives that were included in the HS2 Ltd Report issued to Government in March 2010.

Figure 9 – The staged sifting of options



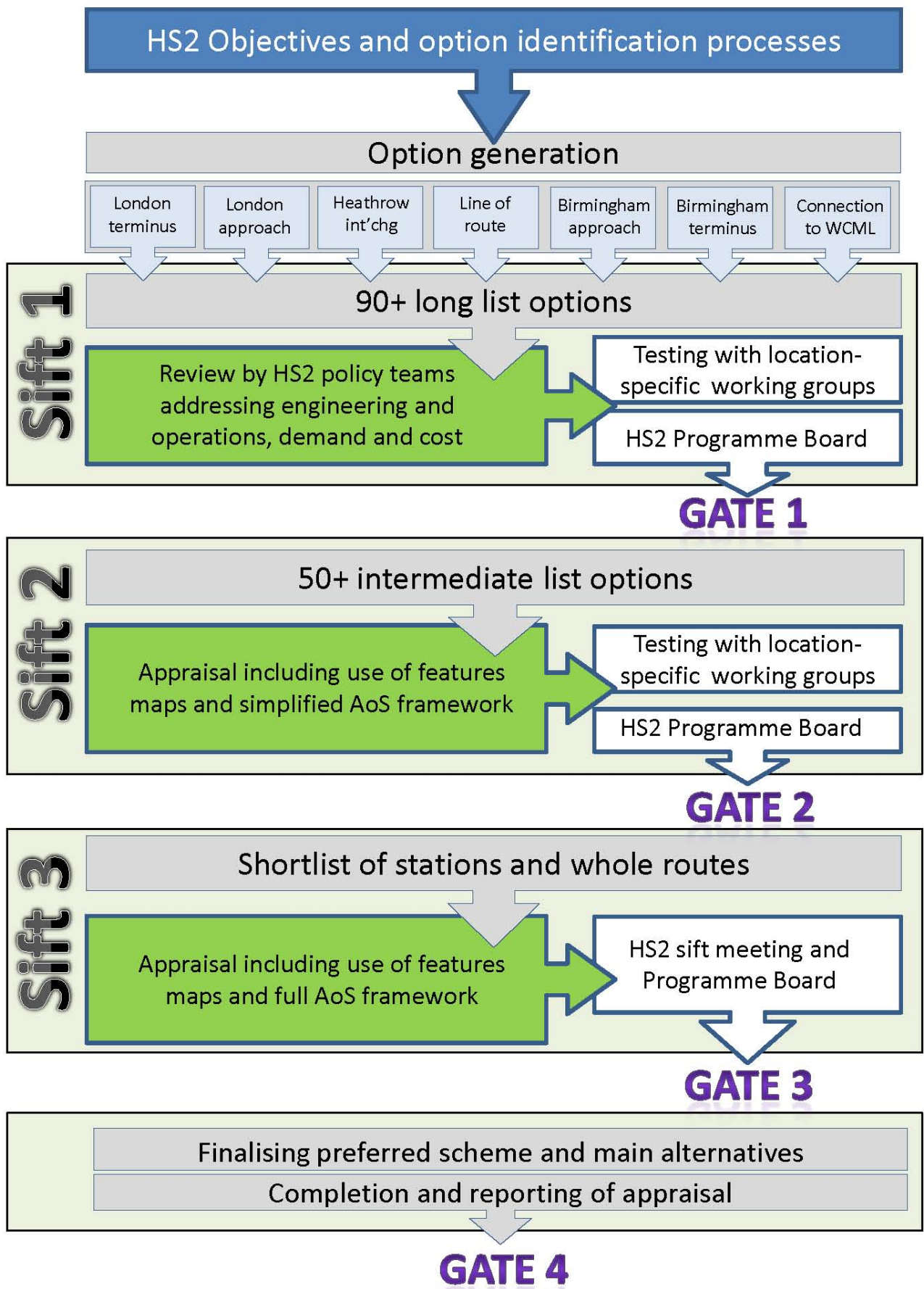
4.4.2 The AoS was a key element in this sifting process. It became sequentially more comprehensive in its coverage and detail as less-favoured options fell away and the level of design detail increased for those that remained (see **Figure 10**).

Figure 10 – Design and appraisal detail increases as option numbers reduce



- 4.4.3 Sustainability information was captured initially within a series of simplified AoS frameworks that included the most critical information; for example the highest status conservation designations. This information was used during the second sift and helped in selecting the options that emerged from Gate 2 (see **Figure 9**). Full AoS frameworks were used to capture a wider range of more detailed sustainability information during the Sift 3 appraisal. This process, and the contribution of sustainability information to it, is illustrated in **Figure 11**.
- 4.4.4 Since its publication in March 2010, a number of revisions have been made to HS2 Ltd's preferred scheme. These have involved examination of a number of other options including local route realignments to mitigate potential impacts, new options for connection with Heathrow, and some worked up elements of the scheme, such as an HS1 connection and tunnel shaft locations. The AoS has continued to provide an input to the development of options.

Figure 11 – The three stage sifting process



4.5 Evaluating and reporting scheme performance

4.5.1 Within the completed AoS frameworks, the assessors determined for each objective the degree to which the scheme is supportive or unsupportive. This used a five level scale, with additional categories where the information was either not currently known or the criterion was not applicable to the route section under review.

- - Highly unsupportive of objective
- Unsupportive of objective
- 0 Neutral
- + Supportive of objective
- + + Highly supportive of objective

4.5.2 This appraisal drew on the DfT's WebTAG guidance, which provides advice on determining an overall evaluation for several combined impacts and ensuring equitability between different topics (e.g. ensuring that a negative ecological conclusion is comparable with a negative noise conclusion).

4.5.3 A series of specialist workshops held during the appraisal process were vital in helping to determine whether appraisal summaries were equitable or not since they exposed each assessor's conclusions to those of their peers, prompting debate and adjustment where necessary.

4.5.4 The same AoS process is being undertaken currently for the development of options for HS2 linking the West Midlands with Manchester and Leeds respectively, which will yield an AoS report for these options during the course of 2011.

4.6 Consultation

4.6.1 The AoS method drew on the requirements of related appraisal processes, as well as on techniques developed on other rail projects, including HS1 (the Channel Tunnel Rail Link). This was set out in a draft Scoping Report, which was the subject of consultation with a number of key stakeholders, identified on the basis of statutory advice in relation to Part 2 of the Planning Act 2008¹¹ and the Environmental Assessment of Plans and Programmes Regulations 2004.

4.6.2 Consultation was managed through the establishment of an AoS Reference Group. A series of meetings of the group were held to discuss the methodology of the appraisal, the sustainable design aims and accompanying guidance and, at a later stage, the emerging findings. These were discussed in the context of the geographical area involved; the scale, nature and location of the proposals; and, during the later stages, the key findings of the AoS.

4.6.3 Membership of the AoS Reference Group comprised representatives from:

- Environment Agency;
- Natural England;
- English Heritage;
- Government Office Network Lead: Planning and Housing;
- Department for Environment, Food and Rural Affairs;
- Department for Culture, Media and Sport;
- Department of Health;

¹¹ Planning Act 2008: Consultation on list of statutory consultees for National Policy Statements

- Department for Energy and Climate Change;
- Department for Transport; and
- Scottish Government (through the SEA Gateway as a link with Scottish SEA Consultation Authorities).

4.6.4 In addition to consultation with the Reference Group, HS2 Ltd met with all relevant local authorities potentially directly affected by the proposed route and stations.

4.6.5 The proposed route will be subject to public consultation, starting in February 2011, for which this document has been produced. The consultation will also cover the Government's broader strategy for high speed rail.

4.7 Continuing the AoS

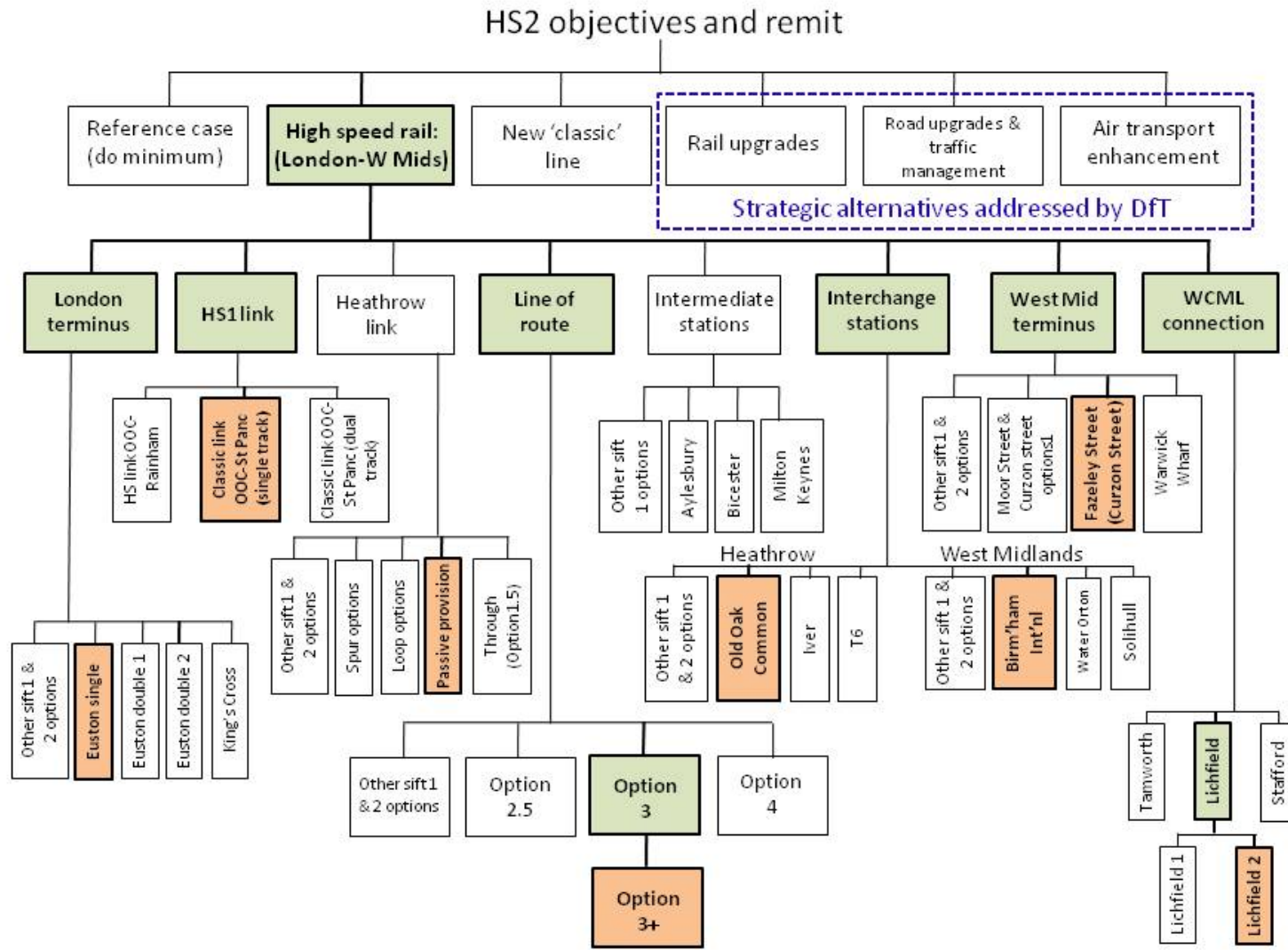
4.7.1 The AoS is a high level appraisal devised in large part to support the development of scheme options. Any impacts identified by it and reported here should be viewed as provisional at this stage. Further more detailed design work would be carried out in due course on the proposed scheme and on any changes to it that are secured through consultation during 2011.

4.7.2 Ongoing design would continue to be supported by sustainability appraisal through the statutory assessment processes. Environmental Impact Assessment (EIA) would be chief amongst these and would introduce mitigation proposals that address, where feasible, any significant environmental effects. The continuation of processes already commenced under the AoS, namely equality impact assessment (EqIA) and appropriate assessment of European designated ecological sites, as well as non-statutory processes, such as health impact assessment (HIA), would be undertaken alongside the EIA, where appropriate.

5 Alternatives

- 5.1.1 The document *High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed Y Network* describes why the Government considers that increasing demand will create a need over the next twenty to thirty years for additional capacity to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. It explains why the Government does not believe that transferring rail demand to road travel or domestic aviation would be an appropriate solution. It also describes the potential options that the Government has identified for enhancing rail capacity, including enhancements to existing infrastructure and both high speed and conventional new lines, and sets out the Government's assessment of their costs and benefits.
- 5.1.2 In considering strategic transport solutions, the Government has considered numerous factors, including:
- capacity and crowding benefits;
 - journey time benefits;
 - reliability impacts;
 - agglomeration and wider economic benefits;
 - employment and regeneration benefits;
 - carbon benefits;
 - financial costs and revenues;
 - local and environmental impacts; and
 - disruption to existing passengers.
- 5.1.3 On the basis of an assessment against these factors, the Government believes that a new high speed rail network would offer benefits significantly greater than those offered by any other option.
- 5.1.4 The main consultation document: *High Speed Rail: Investing in Britain's Future*, describes the approach taken to appraise route and design alternatives from which, in Spring 2010, HS2 Ltd identified a preferred scheme. This scheme, described by HS2 in its March 2010 report, was considered by HS2 Ltd to best meet the overall objectives of the project. The rationale for this preference is described in the context of the main scheme alternatives.
- 5.1.5 In describing the option selection process, the main consultation document summarises the role and conclusions of the AoS at that time. A fuller presentation of the findings of the AoS with respect both to the March 2010 preferred scheme and the main alternatives is provided in *Appendix 6*.
- 5.1.6 At the request of the Secretary of State several months have since been spent refining the March 2010 preferred scheme to mitigate particular impacts as much as possible, and investigating other alternatives, such as a direct route through Heathrow. This is also described in the main consultation document. The revised scheme proposals, published on 20 December 2010 and described in Section 3, have adopted these various changes.
- 5.1.7 **Figure 12** summarises the path followed in investigating the strategic and scheme alternatives that has led to the proposed scheme that forms the principal subject of the AoS Report. Green items indicate those that were progressed during the option development phase. Orange items indicate those that now form the proposed scheme.

Figure 12 – The path to the proposed scheme



6 Policy drivers

6.1 Policy drivers for the scheme

- 6.1.1 Improvements in rail transport are seen by government, in all its forms, as a cornerstone to sustainable development, which is now fundamental to land use planning, transport, social and economic policy in the UK. The latest *National Infrastructure Plan*¹² was published in October 2010. In it, Lord Sassoon states that “*the immediate challenge is to rebuild the economy, creating conditions for enterprise to flourish based on an expansion of the private sector*”. The Plan aims to channel investment to help rebalance the economy across all regions. *Chapter 4: Plan for Investment*, provides a programme for transport infrastructure investment and a commitment to contribute to sustainable growth and tackling climate change.
- 6.1.2 The *European Spatial Development Perspective* (1999)¹³ recognises that efficient transport is a basic prerequisite for strengthening the competitive situation and social and economic cohesion of the European Union (EU). A key objective of the EU Sustainable Development Strategy (2006) is to ensure that European transport systems meet society’s economic, social and environmental needs whilst minimising their undesirable effects on the economy, society and the environment. EU transport policy is contained in *European Transport Policy for 2010: A Time to Decide* (2001)¹⁴ which proposes some 60 measures aimed at developing a European transport system capable of shifting the balance between modes of transport, revitalising the railways, promoting transport by sea and inland waterways and controlling the growth in air transport. The Commission presented a review of the White Paper on 22 June 2006, which states that the 2001 objectives are still relevant but that, over the last five years, the economic context defining Europe’s transport policy has changed. The Commission has produced a draft white paper on transport¹⁵, which, in laying down plans for the next decade, envisages a radically different transport system by 2020, with a single European transport area, open markets, greener infrastructure and low-carbon technologies.
- 6.1.3 HS2 could make a significant contribution to improved transport in the UK with the potential for wide ranging environmental, economic and social benefits that support these national and EU principles for transport development. It would directly support the *National Infrastructure Plan 2010* which identifies investment in a high-speed rail network as one of the main ways the rebalancing of the economy can be achieved. The Plan states “*a new high speed rail network could transform journey times on key inter-urban routes and radically reshape the UK’s economic geography: connecting this country’s great cities and international gateways and helping bridge the North-South divide ...*”.
- 6.1.4 This chapter of the AoS evaluates this potential contribution, as well as possible conflict, within the context of current and emerging policy. It looks at the national priorities for sustainability (Section 6.2) and the current sustainability policy framework (Section 6.4). It focuses on how HS2 could support or may conflict with recent policy changes promoted by central government and the drive to create a ‘big society’, as announced by the Prime Minister on 19 July 2010. It also examines the impact of the scheme on local development policy and the scheme’s potential support for this. This reporting of local benefits feeds directly into an overview of the national benefits of the scheme.
- 6.1.5 Since the commencement of the AoS, a change of Government has taken place, resulting in a clear sense of transition with regard to strategic policy. Things continue to change rapidly as the Government’s priorities become manifest in emerging documents. It is

¹² National Infrastructure Plan 2010: HM Treasury

¹³ European Commission (1999) *European Spatial Development Perspective*. Office for Official Publications of European Communities

¹⁴ European Commission (2001) *European Transport Policy for 2010: A Time to Decide* EC

¹⁵ Commission of the European Communities (August 2010). *Draft White paper on Transport: A Single Transport Area, Smart Mobility for People and Businesses*.

therefore inevitable that the situation as reflected and described here, based on Government policy of mid December 2010, will rapidly become overtaken by events. Nevertheless overarching priorities are already clear, even if the mechanisms of achieving them are still emerging. This new strategic direction and emphasis is described below, alongside the extant frameworks for delivery.

6.2 Sustainable transport

6.2.1 *Towards a Sustainable Transport System: Supporting Economic Growth in a Low Carbon World (2007)*¹⁶ (TaSTS) sets out the previous Government's response to recommendations for transport and the economy made by Sir Rod Eddington (2006). It sets out measures to improve the contribution of transport to economic growth and productivity, and ensure that it will help deliver a reduction in carbon emissions as set out by the Stern Review of the Economics of Climate Change. *Delivering a Sustainable Transport System (2008)*¹⁷ (DaSTS) explains how the DfT is currently implementing TaSTS in a way that addresses both immediate problems and longer term challenges that are critical to economic development and quality of life.

6.2.2 On 10 September 2010 the Secretary of State for Transport confirmed Government commitment to sustainable transport initiatives but introduced the need for a balance against cost¹⁸. He stated:

"the Coalition Government is committed to the sustainability agenda in everything it does, including transport....But, ... we are all too conscious of the fact that sustainability means so much more than simply 'carbon reducing'. Sustainable solutions have, of course, first and foremost to be environmentally sustainable. But they must also be fiscally and economically sustainable... And they must be socially sustainable as well - promoting social mobility and recognising the aspirations of the least-advantaged in our society..."

6.2.3 The emphasis is on the relationship between transport and economic growth and how improved transport can deliver financial benefits across the nation. The Secretary of State is committed to prioritising those transport investment schemes which support economic growth.

6.2.4 The Transport Select Committee has now launched an inquiry into transport and the economy¹⁹. The Committee recognises that a good transport system is the pre-condition of the long-term economic growth required to drive the UK's economic recovery. The priorities for investment identified by Sir Rod Eddington in 2006 were reducing congestion in urban areas, on key interchange urban corridors and at key international gateways. The inquiry will look at whether conditions have materially changed since the report and what the priorities should be now, in order to deliver growth, both nationally and regionally.

6.2.5 The DfT November 2010 Business Plan (2011-2015) sets out a firm commitment to HS2 and high speed rail. On 10 July 2010²⁰ the Secretary of State said the Government would continue to press ahead with HS2 and stated:

"I want to reiterate this Government's commitment to high speed rail...This Government's vision for high speed rail is of a network that is truly UK wide, with seamless links to Heathrow, and connections to Europe. Such a network will have the potential to increase capacity, improve connections and encourage a modal shift from long road journeys and short haul flights – stimulating economic growth and contributing to our climate change targets.....It will transform the prospects of our

¹⁶ DfT (2007) *Towards a Sustainable Transport System: Supporting Economic Growth in a Low Carbon World*

¹⁷ DfT (2008) *Delivering a Sustainable Transport System TSO*

¹⁸ IBM START Conference: Business Summit 10 September 2010

¹⁹ House of Commons oral evidence taken before the Transport Committee. *Transport and the Economy*. July-December 2010

²⁰ BT Convention Centre, Liverpool: 8 July 2010

regional cities and the powerhouse of the London economy.it will help to close regional pay and wealth differentials as we literally shrink our country into a single travel to work area”.

- 6.2.6 Any proposed scheme must therefore be considered within the context of national objectives for sustainability and the need to promote and redistribute economic growth.

6.3 Drivers for sustainable development

National priorities

- 6.3.1 *The UK Sustainable Development Strategy: Securing the Future (2005)*²¹ set out the previous Government’s approach to tackling the problems of climate change, poverty and environmental degradation, enabling people to satisfy their basic needs and enjoy a better quality of life for future generations. The Government has not yet signalled any departure from this overarching approach and indeed ministers continue to emphasise the significance of issues such as climate change, flood protection, biodiversity, and waste reduction, albeit within the context of greater austerity and a focus on localism. The key priority areas for action from *Securing the Future* therefore continue to be viewed as pertinent, namely:
- reducing greenhouse gas emissions and combating climate change;
 - natural resource protection and environmental enhancement;
 - creating sustainable communities; and
 - sustainable consumption and production.
- 6.3.2 On 30 July 2010 the Government produced *Measuring Progress: Sustainable Development Indicators 2010*, which brings together an extensive range of indicators to measure the country’s progress on sustainable development and meeting the key priority areas outlined above. The AoS is central to assessing whether HS2 meets these priorities for climate change, resource protection (both natural resource and cultural resource), sustainable communities and sustainable consumption and production.
- 6.3.3 The following section looks at the main policy drivers for sustainability as they relate to HS2. The objectives defined by relevant policies and regulations are reflected in the AoS objectives. The extent that HS2 would support or conflict with them is the subject of this document and the results are reported in Section 8. National planning guidance has for many years been set out within planning policy statements (PPSs). It is the intention of the Government now to replace all the PPSs with the National Planning Policy Framework, which seeks to condense existing planning policy guidance. Until the framework is in place, PPSs remain current and are referred to here.

Climate change

- 6.3.4 The Kyoto Protocol to the UN Framework Convention on Climate Change²² (ratified by the UK in 2002) commits the UK to reducing greenhouse gas emissions by 12.5% below 1990 levels by 2012. The Department of Energy and Climate Change was established in October 2008 and the Climate Change Act 2008 came into force soon after. This commits the UK to reduce emissions from greenhouse gases by at least 80% (compared to 1990 levels) by 2050. The Act also puts in place the framework for establishing carbon budgets. These are outlined in more detail in Section 7.3. Agreements reached at the recent Cancun COP16/CMP16²³ summit, including an objective of peaking greenhouse gas

²¹ HM Government (2005) UK Sustainable Development Strategy: Securing the Future, TSO

²² UN (1998) Kyoto Protocol to the UN Framework Convention on Climate Change UN

²³ COP16/CMP6 is the 16th edition of Conference of the Parties of the United Nations Framework Convention on Climate Change (COP) and the 6th Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) held in Cancun, Mexico between November 29 and December 10 2010.

emissions and an overall 2°C target to limit temperature rise, will only add further emphasis on meeting existing and setting new emission targets. Following the agreement the Prime Minister said *“I am clear that Britain will meet its international obligations.... I will continue to make the case for a global, comprehensive and legally-binding climate agreement”*.

- 6.3.5 Electric rail is a relatively carbon-efficient form of transport²⁴ (see Section 7.3). Therefore, rail’s biggest contribution to tackling climate change in the short-term comes from increasing its capacity, so that it can accommodate demand-growth as people and firms factor carbon-costs (as well as comfort and convenience) into their travel and transport decisions. The Government recognises the “need to make the transport sector greener and more sustainable, with tougher emission standards and support for new transport technologies”²⁵. In particular, it sees a high speed rail network as being a contributing factor to a low carbon economy.
- 6.3.6 The extent to which rail is successful in this respect depends substantially on the future carbon footprint of energy generation. The UK Low Carbon Transition Plan sets a path towards 40% of UK electricity coming from low carbon sources, and the recent consultation document on electricity market reforms would make low carbon energy production dominant in the UK’s energy mix²⁶. Nevertheless, it is important to recognise that high speed rail has high energy demands and has a larger carbon footprint or carbon intensity than certain other modes, particularly conventional rail and bus. However, the Committee on Climate Change’s (CCC) proposed Fourth Carbon Budget views HS2 as an integral part of the climate agenda in the UK through its role in providing an alternative to domestic and short-haul aviation. In its review of UK aviation, the CCC states *“we assessed a maximum potential emissions reduction of 2 MtCO₂ annually through switching from aviation to high-speed rail, with two caveats that this would require a low-carbon electricity system, and would also need complementary levers such as withholding any slots released at capacity constrained airports”*²⁷.
- 6.3.7 Despite rail’s relatively good performance the previous Government also recognised that the rail industry must also reduce its own carbon footprint by setting itself targets for reducing CO₂ emissions per passenger-kilometre and per tonne-kilometre. The Government will encourage progress by funding research and writing environmental objectives into passenger franchises. Equally, rail’s relative performance in reducing carbon emissions will depend on the success of other modes (car and plane) in reducing theirs.

Natural and cultural resources

- 6.3.8 The Government proposes to issue a Natural Environment White Paper in spring 2011, having just finished consulting on the discussion paper²⁸. The White Paper will outline the Government’s priorities for the natural environment, setting out a framework for practical action by Government, communities, businesses and other organisations to deliver on that ambition.
- 6.3.9 The Government has signalled its intent to introduce measures to protect wildlife and promote green spaces and wildlife corridors in order to halt the loss of habitats and restore biodiversity. *Making Space for Nature*²⁹ identifies the continued threat to wildlife sites which are deemed vulnerable owing to their small size and isolation. In response, the Secretary of State recognized the need to *“work together to find innovative ways to protect*

²⁴ HM Government (2009) The UK Low Carbon Transition Plan *ibid*

²⁵ Election 2010 Coalition Government: Transport

²⁶ DECC (2010) Electricity Market Reform: Consultation Document

²⁷ Committee on Climate Change (Dec 2010) The Fourth Carbon Budget. Reducing emissions through the 2020s

²⁸ An invitation to shape the Nature of England. Defra July 2010

²⁹ Making Space for Nature: A review of England’s Wildlife Sites and Ecological Network, Defra, September 2010

and enhance our wildlife habitats” and the role of everyone in “helping to create, manage and improve these areas”.

- 6.3.10 The conservation of flora and fauna in the UK is delivered by a range of legislation. At the highest level The Habitats Directive³⁰ establishes a European ecological network known as "Natura 2000". The Habitat Regulations³¹, which implement the Directive in the UK, require competent authorities to restrict development that adversely affects the integrity of such European sites. They also require that plans that may adversely affect the integrity of such sites be subject to specific assessment under the Directive. The need for such assessment has been explored in tandem with the AoS (see HRA Screening Report, *Appendix 4.1*). The Regulations also make it an offence to harm listed species of animals and plants.
- 6.3.11 UK environmental plans, policies and programmes include the UK Biodiversity Action Plan (1994)³² which currently has 391 species action plans, 45 habitat action plans and 162 local biodiversity action plans with targeted actions, and the Delivery Plan 2008-2012 England's Trees, Woods and Forests (2008)³³. Amongst other things, the UK BAP aims to conserve and enhance biological diversity within the UK.
- 6.3.12 This aim is reflected at policy level. Planning Policy Statement 9 (PPS9) *Biodiversity and Geological Conservation* (2005)³⁴ outlines Government planning policies for protection and enhancement of biodiversity and geodiversity through the planning system.
- 6.3.13 PPS7 Sustainable Development in Rural Areas (2004) sets out Government's planning policies for rural areas. In particular, for schemes affecting nationally designated areas such as Areas of Outstanding Natural Beauty, any assessment of impacts should address the need for the development in terms of national considerations and public interest.
- 6.3.14 A draft PPS, *Planning for a Natural and Healthy Environment* was published for consultation, which was completed in March 2010. This was to combine, amongst others, PPS9 and PPS7, but the introduction of the National Planning Policy Framework will obviate this document.
- 6.3.15 Government policy on the historic environment is set out in PPS5 *Planning for the Historic Environment*³⁵. PPS5 aims to conserve our heritage, and in particular heritage assets (those of historic, archaeological, architectural or artistic interest). The Government *Vision Statement on the Historic Environment 2010*³⁶ was published to complement and underpin PPS5 and its supporting Practice Guide.
- 6.3.16 The water environment is subject to a number of emerging regulatory mechanisms and management tools. The draft Floods and Water Management Bill³⁷ and its consultation paper set out Government proposals to improve flood risk management and ensure water supplies are more secure. Environment Agency Catchment Flood Management Plans recommend the best ways of managing the risk of flooding within named catchments over the next 50 to 100 years.
- 6.3.17 The European Water Framework Directive, which has been part of UK law since 2003, aims to bring about the planning and delivery of a better water environment. It includes objectives to achieve good ecological status and good surface water chemical status by 2015, and to achieve good groundwater quantitative and chemical status by 2015. Under the Framework, draft River Basin Management Plans have been put together to protect and

³⁰ Habitats Directive and Regulations (Conservation (Natural Habitats & c) Regulations (as amended)

³¹ The Conservation of Habitats and Species Regulations 2010

³² HM Government (1994) UK Biodiversity Action Plan London: HMSO

³³ DEFRA b(2008) Delivery Plan 2008-2012 England's Trees, Woods and Forests

³⁴ DCLG (2005) PPS9 Biodiversity and Geological Conservation

³⁵ CLG (March 2010) Planning Policy Statement 5: Planning for the Historic Environment

³⁶ The Government's Statement on the Historic Environment for England 2010. HM Government

³⁷ Defra and Welsh Assembly (2009) Draft Flood and Water Management Bill

improve the water environment of the 11 river basin districts in England and Wales. These set environmental objectives for each body of water. Further information on the basins affected by HS2 is given in Section 7.4.

Sustainable communities

- 6.3.18 The concept of sustainable communities is used within the AoS to encompass all aspects of HS2 that affect the health, wellbeing and prosperity of people. This covers a range of policy and legislation addressing issues such as health, equality, economic development, and environmental protection. HS2 is likely to both support and conflict with various elements of policy under this wide-ranging heading.
- 6.3.19 The concept of sustainable communities still features significantly in Government thinking. Indeed the central role of communities in influencing their own agendas is fundamental to the concept of the 'Big Society'. The Localism Bill, which was presented to Parliament on 13th December 2010 and is expected to receive Royal assent in late 2011, sets out the case for a radical shift of power from the centralised state to local communities, and describes six actions to deliver decentralisation down through every level of government to every citizen. The Bill will provide a legislative framework for change.
- 6.3.20 The Sustainable Communities Act 2007 aims to promote the sustainability of local communities. On 15 December 2010 the Secretary of State invited local authorities under the Act to consult their communities and ask them how they would like to improve their local area, or become involved in Big Society projects. If local authorities subsequently want to take forward an idea but find they cannot, they can submit a formal proposal to the Government, requesting the removal of the barrier that is stopping them. This emphasis on the role of the community is expanded under '*the new approach*' in Section 6.4, which sets out the proposals of the Government to promote a 'Big Society'.
- 6.3.21 A range of legislation and policy exists to protect communities and individuals from environmental impacts such as noise. The Noise Policy Statement for England (15 March 2010) sets out the long term vision of Government on noise policy and defines, within the context of this policy, specific aims, namely 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. The National Air Quality Strategy³⁸ provides a similar if more detailed framework for work and planning on air quality issues, and defines air quality standards and objectives to be achieved.
- 6.3.22 The Equality Act 2010 provides a legislative framework to protect the rights of individuals that updates, simplifies and strengthens previous legislation. The potential for HS2 to affect equality groups disproportionately because of characteristics of race, age, disability, sexual orientation and faith has been considered in outline insofar as it is possible to do so at this stage (see EqIA Screening Report, *Appendix 4.2*). It would be assessed in more detail as proposals are developed further. An important exclusion from the Act was the duty on Government to consider inequality impacts from decisions that affect "socio-economic disadvantage" (of which HS2 would be a prime example). Such issues are now to be addressed directly by welfare and economic policy. On a larger scale, the DfT Business Plan³⁹ states that high speed rail would "*help bridge the North-South divide that has for too long limited growth outside London and the South East*".
- 6.3.23 The UK Department of Health's *Tackling Inequalities – A Programme for Action 2003 and the 2007 Status Report* sets out plans to tackle health inequalities in the UK and outlines how transport related policies and measures could address health inequalities⁴⁰. For example, people's accessibility to work, key services and the encouragement of exercise

³⁸ The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007) Defra, Scottish Executive and Welsh Assembly

³⁹ Business Plan 2011-2015, DfT 8 November 2010

⁴⁰ Department of Health (2003) *Tackling Inequalities – A Programme for Action 2003*

could be improved by the development of consistent transport and land use planning policies.

- 6.3.24 Transport has an important role in ensuring the health and well-being of people and communities. The key objective of the World Health Organisation's *Collaboration between Health and Transport Sectors in Promoting Physical Activity* (2006)⁴¹ is to increase the provision of sustainable travel to improve the health and well-being of citizens. Although this refers principally to walking and cycling, rail provides an opportunity to support these modes through the integration of stations with cycle and pedestrian networks and provision of facilities such as cycle parks.

Sustainable consumption and production

- 6.3.25 In 2008 the EU endorsed the *Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan*⁴², which includes a series of proposals on sustainable consumption and production that will contribute to improving the environmental performance of products and increase the demand for more sustainable goods and production technologies. It also seeks to encourage EU industry to take advantage of opportunities to innovate.
- 6.3.26 Sustainable consumption and production not only relates to industrial processes but also to the sustainable use of natural resources such as minerals and biomass, environmental media such as air, water and soil, and flow resources such as wind, geothermal, tidal and solar energy and space (land area). The EU has adopted a *Thematic Strategy on the Sustainable Use of Natural Resources* (2006)⁴³, which aims to ensure that the consumption of resources and their associated effects do not exceed the carrying capacity of the environment, and to break the linkages between economic growth and resource use.
- 6.3.27 Changing Patterns: UK Government Framework for Sustainable Consumption and Production (2003) sets out actions and measures to promote:
- better products and services, which reduce the environmental impacts from the use of energy, resources, or hazardous substances;
 - cleaner, more efficient production processes, which strengthen competitiveness; and
 - shifts in consumption towards goods and services with lower impacts.
- 6.3.28 HS2 would inevitably require significant land and materials. This is described, insofar as it is possible to do so at this early stage of design, in sections 8.17 to 8.19. HS2 Ltd would, however, plan for the efficient use of resources and materials in the construction of the scheme.

6.4 Development planning in the UK

Context

- 6.4.1 Two key themes are emerging from central government: the need for new transport schemes to be considered within the context of the economic benefits that they could generate (as explained in Section 6.2 above) and the drive for such economic benefits to be achieved locally.
- 6.4.2 This section outlines the framework for land use planning in the UK, both current and emerging. It then looks at the local land use policy and sustainability development context around HS2 stations at Euston, Old Oak Common and in Birmingham.

⁴¹ WHO (2006) *Collaboration between Health and Transport Sectors in Promoting Physical Activity*

⁴² European Commission (2008) *Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan* EC

⁴³ European Commission (2006) *Thematic Strategy on the Sustainable Use of Natural Resources*

Current land use planning system

- 6.4.3 The current development plan system in England is prescribed in the Planning and Compulsory Purchase Act 2004 and the Local Democracy, Economic Development and Construction Act 2009. A development plan currently comprises the Regional Strategy (London Plan in London) and the associated development plan documents. At a local level, development planning also comprises the range of documents which make up the Local Development Framework. The Localism Bill, currently before Parliament, proposes the abolition of regional strategies but, until the Bill becomes law, they remain a component of development plans.
- 6.4.4 *PPS1: Delivering Sustainable Development (2005)* sets out the framework for the delivery of sustainable development through the planning system. It states that policies and planning decisions should be based on:
- up-to-date information on the environmental characteristics of the area;
 - the potential impacts, positive as well as negative, on the environment of development proposals (whether direct, indirect, cumulative, long-term or short-term)⁴⁴; and
 - recognition of the limits of the environment to accept further development without irreversible damage.
- 6.4.5 *PPS4: Planning for Sustainable Economies (2009)* provides the policy framework for planning for sustainable economic development in urban and rural areas, including town centres and is a material consideration in the formulation of land use plans and decisions on development. The emphasis is on the contribution that planning can make in helping to deliver jobs, investment and improved productivity, and on the importance of towns and cities. It emphasises the delivery of sustainable transport infrastructure in order to support planned economic development.
- 6.4.6 *PPG13: Transport (2001)*⁴⁵ has three objectives for integrating planning and transport: to promote more sustainable transport choices for carrying people and moving freight; promote accessibility to jobs, shopping, leisure facilities and services by public transport, walking and cycling; and reduce the need to travel, especially by car. These would each potentially be supported by HS2.
- 6.4.7 The 2008 Planning Act provides a framework for obtaining development consent for a range of national significant infrastructure projects. If a decision is taken to proceed with high speed rail, the Government is proposing to seek the necessary planning consents through the hybrid Bill process (as it did for Crossrail and HS1) rather than through generic national planning regimes and consenting processes.

The new approach

- 6.4.8 On 19 July 2010 the Prime Minister launched the concept of the 'Big Society' to the UK. Its focus is the redistribution of power from central government to local communities, (effectively decentralisation) and the redistribution of wealth across the UK. The announcement was supported by the Cabinet Office Draft Structural Reform Plan (June 2010) which sets out the agenda for implementation of these policies. The emphasis is on a 'bottom up' approach to land use planning looking at local aspirations for development. Measures will include a radical reform of the planning system and the transfer of power from central to local government.

⁴⁴ For certain projects there is also a requirement to comply with the provision of Directive 85/337/EC on the assessment of the effects of certain public and private projects on the environment.

⁴⁵ CLG (2001) Planning Policy Guidance 13: Transport. Updated January 2011.

- 6.4.9 The move to a locally led approach to planning would be implemented through provisions contained in the Localism Bill. This Bill also includes provisions which would abolish Regional Strategies, support the development of neighbourhood plans, allow communities to run local authority services, and hold local referendums where people request them.
- 6.4.10 As a project of national significance, HS2 itself cannot rely on investment or decision-making at a local scale. The National Infrastructure Plan 2010⁴⁶ states “...*the Government recognises that it will need to intervene in certain markets to incentivise necessary investment where ... there are high social or environmental costs preventing the investment; there are high risks associated with the investment; and the infrastructure is in the wider national interest and of strategic importance to the national economy*”. However, HS2 has considerable potential to support a locally driven approach to planning and growth, particularly through its implications for the redistribution of wealth. The Government believes the national economy has become unbalanced, with too much growth in the London area whilst other parts are left behind. The aim is to foster local enterprise, support local business and promote local prosperity. Local growth will be achieved through local enterprise partnerships, which will be strategic bodies bringing together private and public sector partners to identify the barriers to economic growth in their areas. Twenty four local enterprise partnerships were announced within the Local Growth White Paper on 28 October 2010, including partnerships for Birmingham and Solihull; and Southeast Midlands. HS2 could have a key role to play in supporting such local growth initiatives.

6.5 Development planning regionally and locally

Overview

- 6.5.1 The following sections examine the principle of stations in London and the West Midlands. They consider whether HS2 would support development and transport policy at both the regional and local levels, and how the local community may potentially benefit. The last section looks at capacity relief and the potential impact on regional policy and growth aspirations.
- 6.5.2 Local authorities along the HS2 route have developed a wide range of planning policies which cover every aspect of sustainable development from landscape and nature conservation, through to cultural heritage, flood protection, environmental protection and economic development. This has not been reviewed in detail at this stage given the essentially strategic nature of the AoS and the early stage of project development. The conclusion from the appraisal to date is that HS2 would support some of these and conflict with others.

London stations

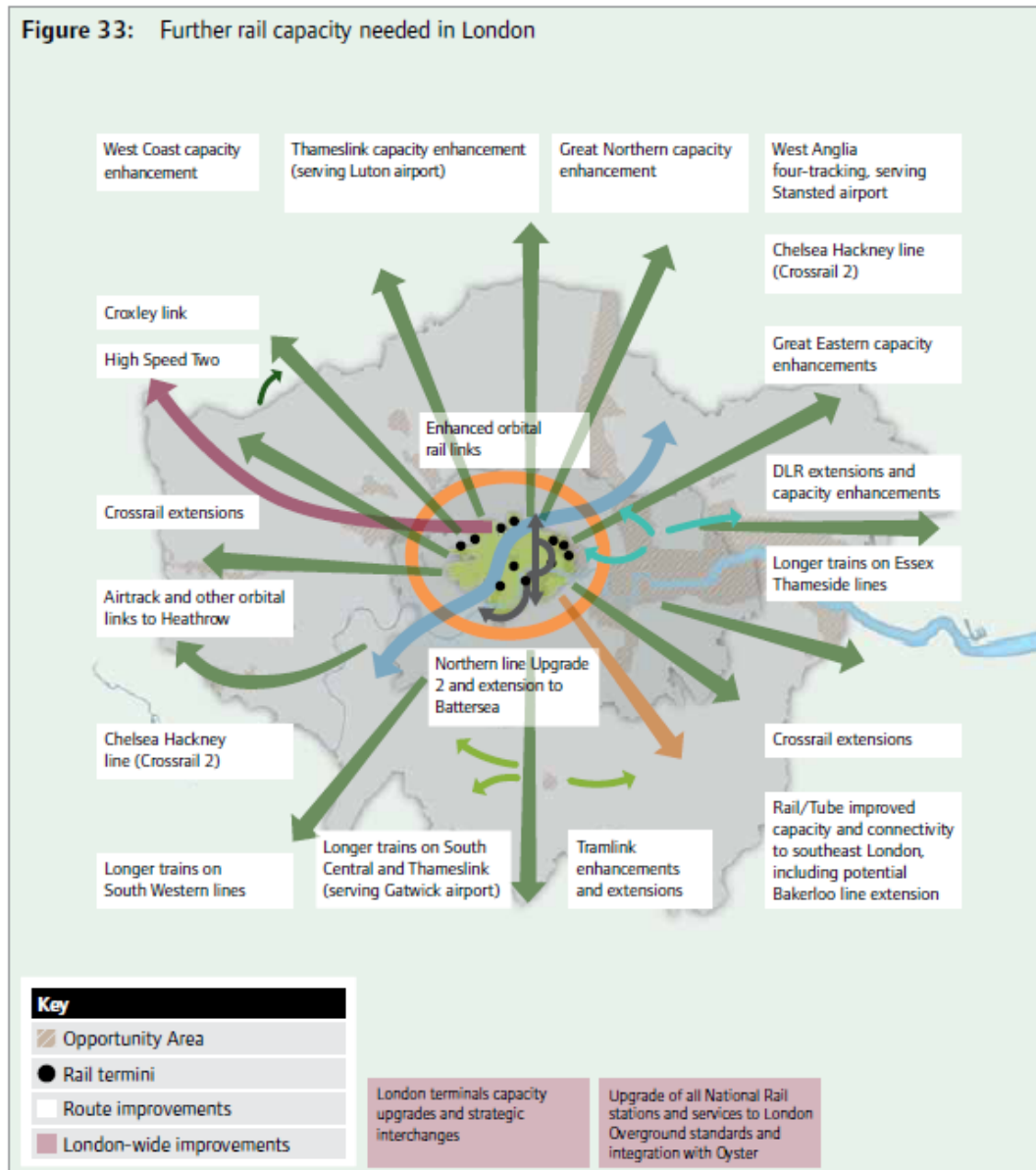
- 6.5.3 The Mayor published the updated draft London Plan in October 2009 (known as the Spatial Development Strategy for Greater London), titled the Consultation Draft Replacement Plan. It is supported by the Mayor’s Economic Development Strategy (Public Consultation Draft October 2009) and the Mayor’s Transport Strategy (adopted May 2010). Together these documents provide a strategic plan for London setting out an integrated economic, environmental, transport and social framework for the development of London.
- 6.5.4 The draft London Plan is based on six core objectives which it states ‘embody the concept of sustainable development’. These are:
- a city that meets the challenges of economic growth and population growth;
 - an internationally competitive and successful city;
 - a city of diverse, strong, secure and accessible neighbourhoods;

⁴⁶ HM Treasury and Infrastructure UK (October 2010) National Infrastructure Plan 2010

- a city that delights the senses;
- a city that becomes a world leader in improving the environment; and
- a city where it is easy, safe and convenient for everyone to access jobs, opportunities and facilities.

- 6.5.5 The draft London Plan identifies Opportunity Areas across London as the Capital's major reservoirs of brownfield land with significant capacity to create new housing, commerce and other development linked to potential improvements to public transport accessibility. Policy 2.13 sets out objectives to help local authorities achieve this growth potential. The proposed terminal of HS2 at Euston would be located within the London Central Activities Zone (CAZ) and the Euston Opportunity Area. The draft Plan identifies it as a major national and commuter rail terminal with large areas of underutilised space. It states Euston has the potential to accommodate 5,000 new jobs and 1,000 new homes.
- 6.5.6 The proposed station at Old Oak Common falls within the Park Royal/Willesden Junction Opportunity Area. The draft London Plan promotes the development of 'gateway' sites with the potential for industrial uses in combination with the scope for improvements in strategic rail accessibility at this location. The area is identified for 14,000 jobs and 1,500 new homes. The HS2 station at Old Oak Common would also fall within a designated Area for Regeneration under Policy 2.14 where the Mayor is committed to addressing social exclusion and tackling spatial areas of deprivation.
- 6.5.7 HS2 would improve transport interchanges within London, as well as accessibility to other key cities, and would promote economic development, regeneration and rejuvenation. It would provide a major stimulus in helping local authorities achieve the full growth potential of these opportunity areas in support of policy 2.13.
- 6.5.8 The draft London Plan emphasises that improved transport is central to the achievement of policy objectives. It acknowledges the need for close co-ordination between land use and transport planning to promote sustainable spatial development, in particular the policies set out in the Planning Policy Guidance on Transport, PPG13. Policy 6.1 focuses on integrating transport and development. It states *'the Mayor will work with all relevant partners to encourage closer integration of transport and development'* and outlines a series of measures to achieve this which include: seeking to improve the capacity and accessibility of public transport; improving interchange between different forms of transport; and supporting development that generates high levels of trips only at locations with high levels of public transport. HS2 would support this through providing improved transport interchanges at Euston and Old Oak Common. It is also expected to provide a major catalyst for the redevelopment of Euston which would generate high levels of trips at a key CAZ location.
- 6.5.9 The Mayor's Transport Strategy (MTS) supports the policies set out in the draft London Plan. The executive summary states that *'in order to reduce crowding and maintain the efficiency and effectiveness of the transport system, further investment in transport infrastructure will be required. To support a thriving economy the Mayor recognises that efficient connectivity is required at all levels - international, national, inter-regional, London wide, sub-regional and local'* para E13. In order to support economic development and population growth the strategy supports *'the development of high-speed rail in the UK and better rail services to Europe as an alternative to short and medium haul air travel'* para E13. Proposal 8 states the Mayor will seek further rail capacity across London's rail network. HS2 is specifically identified as one of the potential schemes that would enhance the 'capacity provision on radial rail routes to Central London and address levels of crowding and congestion' (see **Figure 13**). It also states that it may be appropriate to 'improve access to rail services by providing additional stations'.

Figure 13 – The Mayor’s options to enhance capacity provision and address crowding and congestion include HS2⁴⁷



Euston

- 6.5.10 The London Borough of Camden’s Core Strategy was adopted on 8 November 2010. It replaces the majority of the policies within the 2006 UDP (only the land use proposal sites remain). The 117,000m² site of Euston Station is identified as a land use proposal site. The preferred use is ‘*improved transport interchange and mixed use including residential*’. The draft London Plan indicates that Euston Station lies within an Opportunity Area, where subject to improved public transport accessibility and capacity, higher density development could produce significant numbers of new homes. It expects a minimum of 1,000 new homes and 5,000 new jobs up to 2026. The Site Allocations Preferred Approach envisages ‘*the redevelopment of Euston could have the potential to include around 1,500 homes and in the region of 70,000 square metres of business space*’ [page 36]. The council’s aspirations are to create a new station of the highest quality with increased passenger capacity, as a fundamental element of a phased, integrated public transport interchange that improves connection between travel modes, and provides easy and convenient

⁴⁷ Taken from Chapter 5 of the Mayor’s Transport Strategy (May 2010) GLA

movement for users of rail, underground, buses and taxis. The Core Strategy is supported by a Supplementary Planning Document (SPD), *Euston: A framework for Change – Planning Guidance for the Euston Area and Key Sites* which sets out the detailed planning for the area. This includes specific measures to ensure a sustainable development in line with the key policies set out by the draft London Plan.

- 6.5.11 HS2 would be likely to have a significant positive effect on the regeneration of the area in the immediate vicinity of Euston station. The potential impact of HS2 on the area's regeneration is discussed further in Section 8.16.

Old Oak Common

- 6.5.12 The London Borough of Hammersmith and Fulham have consulted on the Local Development Framework (LDF) Proposed Submission Core Strategy which sets out the strategic objectives for the borough (consultation ended 12 November 2010). The LDF states that the Council will promote Old Oak sidings and the former North Pole Eurostar depot as a location for a major rail interchange between the proposed HS2 line, Crossrail, the Great Western Main Line and West and North London lines. The long term vision for this is to transform the area with substantial mixed use regeneration '*made possible principally by the projected HS2 rail line and Crossrail*'. It is allocated for 1,600 homes and 5,000 new jobs which could '*secure the future growth for London in a very sustainable way*' [proposed submission core strategy para. 8.148]. The area supports mainly industrial and railway uses. It is the largest remaining concentration of industrial premises in the borough and is included in the Park Royal Opportunity Area in the draft London Plan. The draft Plan aims to protect and maintain Park Royal as the largest industrial employment location in London. Hammersmith and Fulham '*support the location of a new high speed rail hub station with links to a new Crossrail Station and the West London Line at Old Oak Common Sidings. If this proposal is confirmed it would provide the opportunity for interchange with Crossrail and other services passing through the area and would be a major catalyst for regeneration*' para 8.152. The proposed HS2 station at Old Oak Common would directly support these Core Strategy and draft London Plan policies by acting as a major catalyst for the redevelopment and regeneration of the area.
- 6.5.13 The potential impact of HS2 on the area's regeneration is discussed further in Section 8.16

Birmingham

- 6.5.14 The overall spatial strategy for the West Midlands region is one of sustainable development through development and renewal of major urban areas. It identifies the improvement of the quality of transport networks as key. HS2 could contribute to achieving the vision through strengthening the region's strategic national and international transport links.
- 6.5.15 The Birmingham Core Strategy Final Draft [the Core Strategy] went out to consultation on 28 October 2010. It sets out the spatial framework for the development of Birmingham up to 2026 and will replace the UDP (adopted in 2005). On 29 September 2010 The City Council also started consultation on the Big City Plan. This will be a non-statutory city centre prospectus identifying and promoting immediate development opportunities within the context of existing planning frameworks.

Figure 14 – Aerial view of Old Oak Common^[HS2 Ltd]



- 6.5.16 Birmingham is a major employment centre drawing in workers from across the West Midlands region to the City Centre. The Core Strategy provides a 'vision' which sees the city centre continuing to flourish as a centre for international finance and business services and as a destination for shopping, business, tourism and major cultural events with world class conference facilities and venues. The Core Strategy aims to create an economy that will be robust and diverse enough to perform alongside European and international competitors. It identifies a move to a knowledge based high value economy, expansion of economic and cultural diversity and improved connectivity as critical to achieving this vision. A total of 50,600 housing units will be required between 2010 and 2026 to support the anticipated growth and development of the City, 20,000 of which will be needed in the city centre.

Birmingham Curzon Street

- 6.5.17 The Core Strategy identifies five areas for transformation within the City Centre. These form logical extensions to the core area and will drive growth and regeneration. Eastside is identified as one of these growth areas. It is located to the east of the city centre, in the area between the Bullring and Lawley Middleway, and from Dartmouth Circus in the north to the Birmingham-London railway line in the south. It includes Millennium Point, Aston University, a number of Birmingham City University campuses, Matthew Boulton College, and South Birmingham College. It was identified by the City Planning and Regeneration Service as the largest physical regeneration project in Birmingham (comprising 170ha). It was targeted for multi-billion pound investment by a wide range of organisations and businesses to provide many different new land uses and up to 12,000 new jobs. However, the project was directly linked to finance from land sales, which were dramatically hit by the economic downturn.
- 6.5.18 The Core Strategy now commits to some key projects within the area, including the Eastside City Park. The HS2 Birmingham Curzon Street station would be located within the Eastside. The Core Strategy identifies a new HS2 rail terminus as a significant catalyst for regeneration of the area and, despite the impacts on some of the new buildings already built or committed, states it will support 'the integration of HS2 in the city centre and the development of the new terminus building' [Policy CC4]. It also states that '*the redevelopment of New Street Station will have strengthened Birmingham's role as the hub of the transport network, with high-speed rail links connecting Birmingham to the Capital.*' The development of Eastside and provision of new housing and jobs would support Policy CC1 which sets out a Spatial Strategy for the City Centre and Policy SP24 for the Distribution of New Housing Provision.
- 6.5.19 The potential impact of HS2 on the area's regeneration is outlined in Section 8.16. However the City Council has commissioned a new Masterplan to reconfigure proposals around HS2 and to consider interim development in the period up to 2026 when the station would be operational.

Birmingham interchange

- 6.5.20 Birmingham lies at the heart of the West Midlands Region. It states that 'the main international gateway to Birmingham is provided by Birmingham Airport' and that 'the quality of the transport links between this area and the city centre is a key issue'. Objective 1 identifies improving connectivity as a key factor in the promotion of Birmingham's national and international role as a global city. Birmingham is well placed at the crossroads of the national transport network to reinforce its role as the regional centre for the West Midlands and to develop its national and international role. The Core Strategy identifies key issues as the expansion of Birmingham Airport and the development of a high speed rail link. It sees a key role for HS2 in the creation of an 'An Innovative and Connected City'. An HS2 station at Birmingham Airport would support the Core Strategy Objective 1 '*to promote Birmingham's national and international role as a global city*' by

potentially providing a high speed link to the Capital and rail connections to other cities in the UK and Heathrow Airport.

- 6.5.21 The proposed station site is approximately 13km east of Birmingham city centre, and 7km north-east of Solihull, occupying green belt in this otherwise highly built-up area. The potential impact of HS2 on the area's regeneration is discussed further in Section 8.16.

Capacity Release

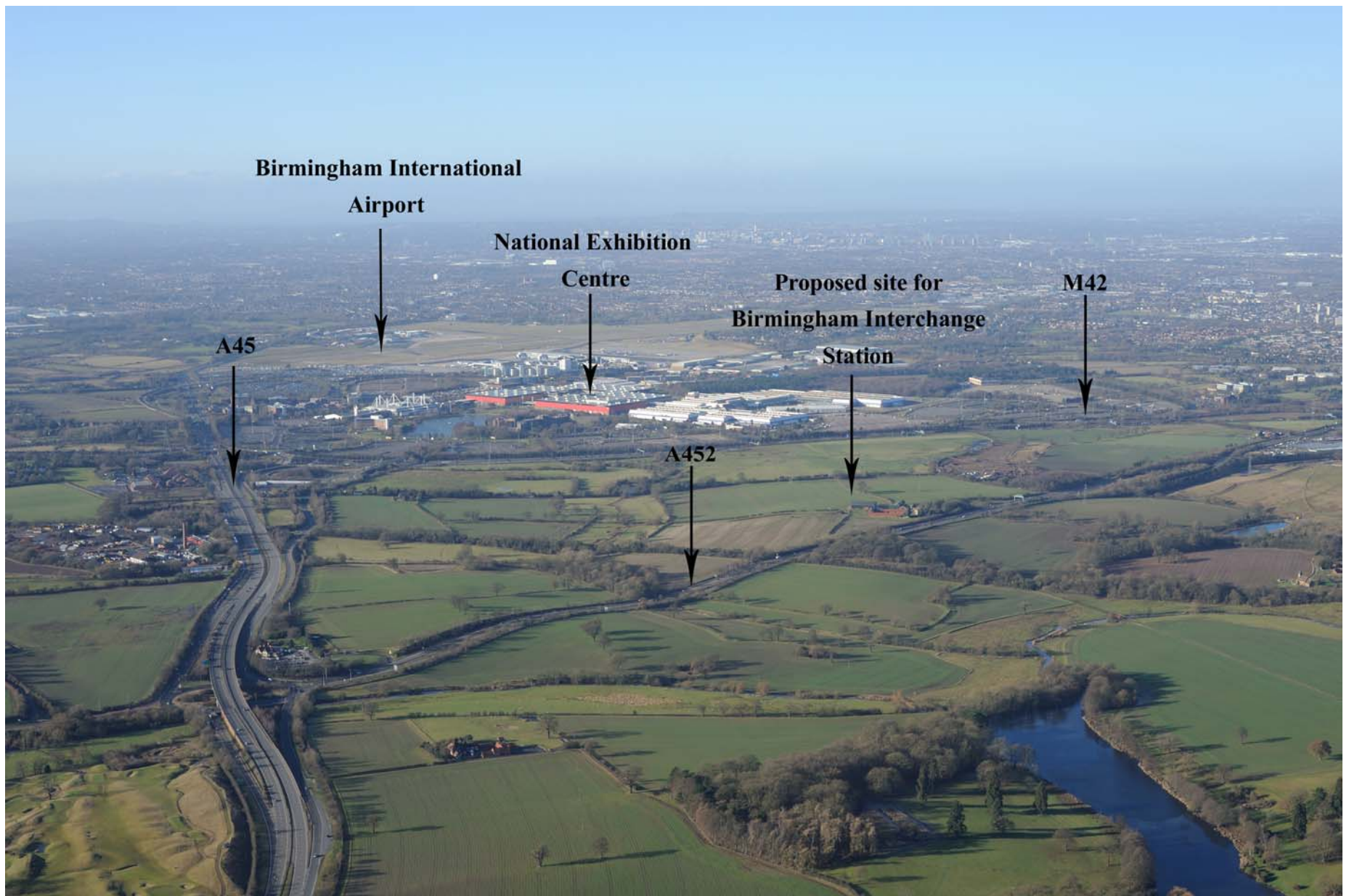
- 6.5.22 Milton Keynes is one of four potential growth centres in the South East region to 2021 and is forecast to become a city of regional importance with a population of over 300,000⁴⁸. The strategy produced by the Milton Keynes Partnership includes growth policies for Milton Keynes and the wider South East growth area, and the South West growth area in Aylesbury Vale.
- 6.5.23 The West Midlands RS panel report recommended 33,500 new dwellings in Coventry between 2006 and 2026 and Coventry is designated a 'growth point' with the housing supply being increased by 2016⁴⁹. It also recommends an additional 11,000 new dwellings in Rugby between 2006 and 2026.
- 6.5.24 The West Northamptonshire Emergent Joint Core Strategy projects a minimum of 43,000 new dwellings by 2026 in the Northampton Implementation Area⁵⁰. The Joint Planning Unit published a local approach to housing provision in November 2010 that showed 26,200 houses in Northampton by 2026 (9,000 of which have already been built).
- 6.5.25 Released capacity on the WCML would enable an increase in the frequency of services, so increasing commuting into Birmingham from the Coventry corridor. The number of fast trains per hour on the WCML to London during the peak hour would also increase, as would the number of fast trains into Birmingham International and Birmingham New Street. There would also be an increase in the number of services between Milton Keynes Central and London Euston. These service improvements would encourage people to relocate to the larger towns on the WCML, thereby supporting their plans for growth.

⁴⁸ The new plan for Milton Keynes – a growth strategy to 2031 (Milton Keynes Partnership, June 2006)

⁴⁹ Coventry, Solihull and Warwickshire Sub-regional Housing Growth Strategy (May 2010)

⁵⁰ West Northamptonshire Emergent Joint Core Strategy (July 2009)

Figure 15 – Aerial view of the proposed Birmingham interchange station site [HS2 Ltd]



7 Sustainability baseline

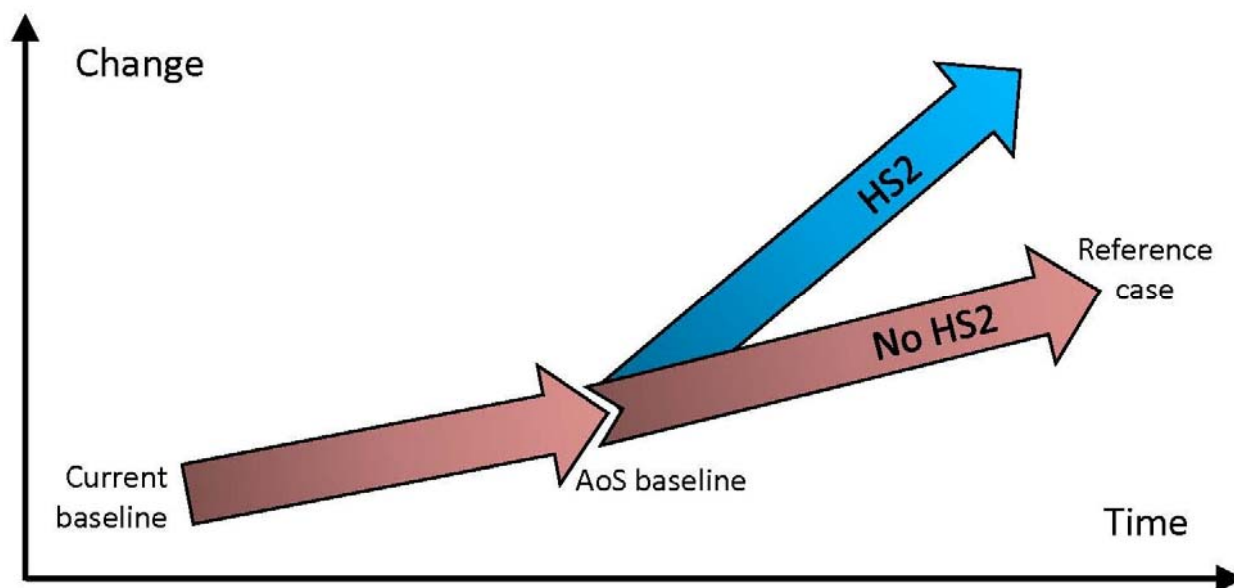
7.1 Overview

- 7.1.1 This section describes the baseline, against which any changes resulting from the proposed implementation and operation of HS2 have been appraised. The baseline describes the conditions expected to prevail at various assessment dates: when construction would commence (presumed to be 2017), when high speed services would start (presumed to be 2026) and 15 years into operation (presumed to be 2040). However, such projections are uncertain: the baseline described here therefore represents the baseline at December 2009 when the AoS work commenced, but updated where necessary to accommodate any recent changes that have been identified. There is also consideration given to a future baseline that accommodates changes to an existing baseline due to natural and human influences.
- 7.1.2 As well as appraising sustainability impacts against the baseline, the AoS also describes the reference case – a projection of how the baseline might be expected to change beyond the assessment dates in the absence of HS2.
- 7.1.3 Physical characteristics and designated areas have been identified from published information available at November 2010. Some other sustainability issues have been defined through projections up to 2017 (when HS2 construction would commence), 2026 (when HS2 operations would commence) and 2040 (following 15 years of an operational scheme). The sustainability features that were considered by the AoS are illustrated within the detailed plans, contained in Volume 2 to the main report.

7.2 The Reference Case and the future baseline

- 7.2.1 Assumptions have been made on how the 'current' baseline will change between now and the stated assessment dates. Beyond these dates, further anticipated changes to the baseline in the absence of HS2 define the Reference Case. This is illustrated below.

Figure 16 – The Reference Case is a continuation of the baseline



- 7.2.2 The 'natural' or background change to the baseline (in the absence of HS2) between now and the future may be considerable or it may be negligible. Natural or historic features might be expected to change very little over the timeframe of the appraisal; for example, a scheduled monument may have been in existence for a thousand years and there is no

reason to believe it will change significantly within the AoS timeframe and beyond. In this example (all other things being equal), the current baseline, AoS baseline and Reference Case would be the same. In other examples, particularly those influenced strongly by human activity, change is constant and the AoS needs to take account of how this change is likely to occur between now and the assessment dates; for example, road traffic flows in the current baseline, AoS baseline and Reference Case are likely to be quite different from each other.

- 7.2.3 Understanding the likely extent and nature of the background change for each sustainability issue between now and the assessment dates is important in undertaking the AoS. In this section these likely changes are described under the 'future baseline'. The next four sections describe, for each of the four UK sustainability priority areas, current and future baseline conditions. The main consultation document (*High Speed Rail: Investing in Britain's Future*) sets out why the Government considers that increasing demand will create a need over the next twenty to thirty years for additional capacity to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. In practice therefore, if HS2 were not progressed then it is likely that other transport improvements would be required, such as enhancements to the strategic road network, provision of additional runway capacity to serve increased flight demands, or provision of rail upgrades or a new conventional speed railway.

7.3 Reducing greenhouse gases and combating climate change

Projections for climate change

- 7.3.1 The climate will change due to the accumulation of carbon dioxide (CO₂) and other greenhouse gases in the atmosphere resulting from human activities. The UK Climate Change Projections Report⁵¹ contains projections to the 2080s of mean changes in summer, winter and annual temperatures, precipitation, humidity and cloud cover. Predictions are for warmer summers (especially in southern England) and winters. Changes in rainfall are also envisaged: although with no simple pattern, they generally predict wetter winters and dryer summers.

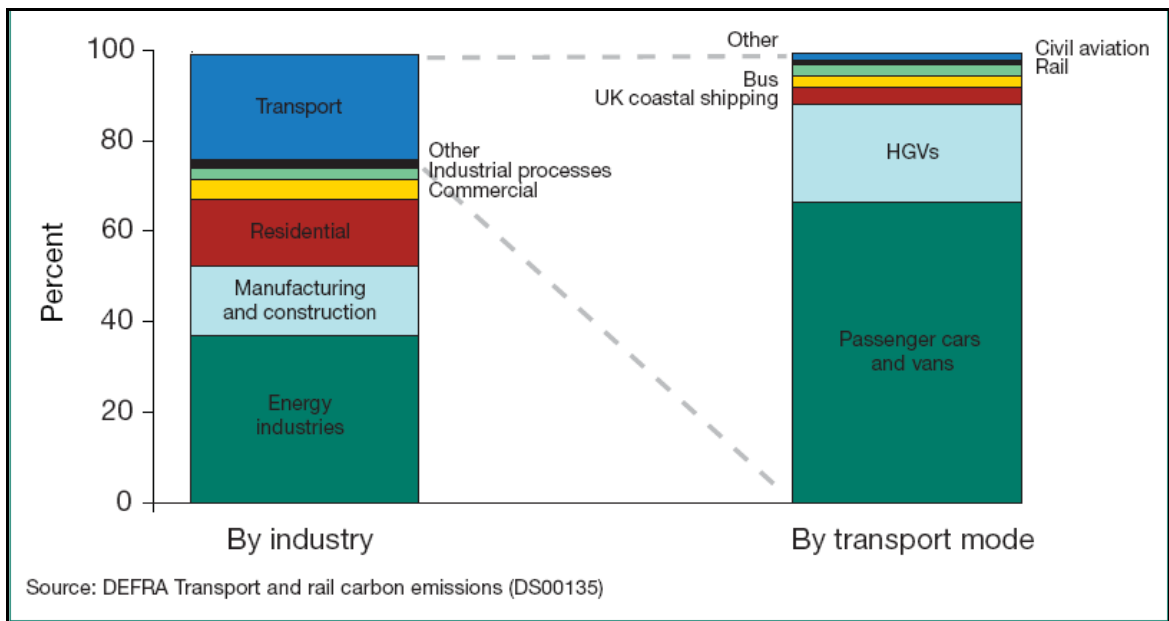
Causes of climate change: CO₂ emissions in the UK

- 7.3.2 In the widest context, any impact of HS2 on climate change on a global scale would be negligible. However, in the UK context, HS2 may have a contribution to make. This is examined in more detail in *Appendix 2* and is summarised in Section 8.3. There are a number of uncertainties in determining the potential impact of HS2. Some would depend on the performance of HS2 (such as the energy efficiency of the trains and its success in attracting passengers away from other modes, such as air travel), whereas others would depend on background change: for example the carbon footprints of the energy used to power trains, as well as that of competing transport modes, which would have a bearing on their relative performance against HS2. This section reviews the main CO₂ emissions in the UK and projects how those that would have a bearing on HS2's performance (principally power generation and transport) are likely to change independently of HS2.
- 7.3.3 The UK contributes about 2% to global man-made emissions with CO₂ accounting for about 84% of these emissions. Surface transport currently accounts for around 19% of total UK greenhouse gas emissions, and 22% of CO₂ emissions⁵². Of this, rail travel accounts for about 2%. This is shown in **Figure 17**.

⁵¹ Murphy, J.M., et al (2009), UK Climate Projections Science Report: Climate change projections. Met Office Hadley Centre, Exeter

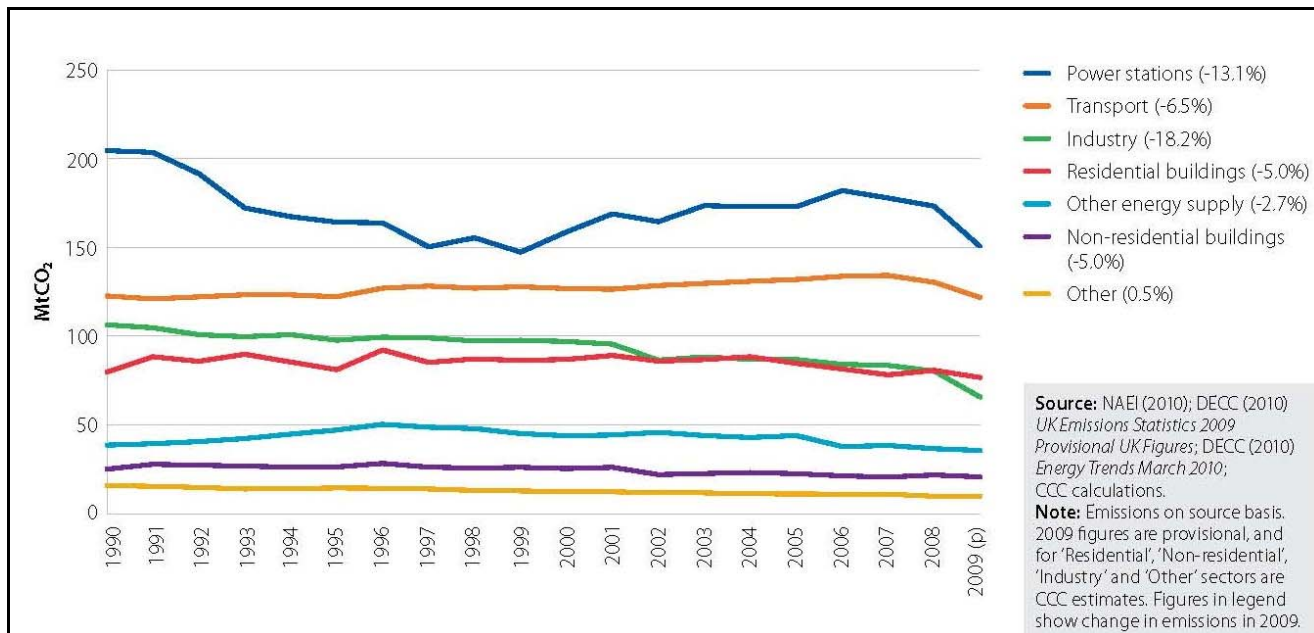
⁵² Committee on Climate Change. The Fourth Carbon Budget. Reducing emissions through the 2020s (December 2010)

Figure 17 – Sources of UK CO₂ emissions



7.3.4 Projections for future UK CO₂ emissions show a fall from around 491 million tonnes (Mt) in 2010 to between 421Mt and 405Mt in 2020⁵³. Of this, transport emissions are expected to reduce gradually from current levels of 127Mt to between 113Mt and 105Mt in 2020, depending on different pricing and growth scenarios, but accounting for a marginally increased proportion of emissions over this time, to about 26%⁵⁴. **Figure 18** illustrates for each sector how CO₂ emissions in the UK have changed since 1990.

Figure 18 – CO₂ emissions by source: 1990-2009⁵⁵



⁵³ These assume implementation of the Low Carbon Transition Plan: DECC (Amended 20th July 2009) UK Low Carbon Transition Plan: National Strategy for climate and energy

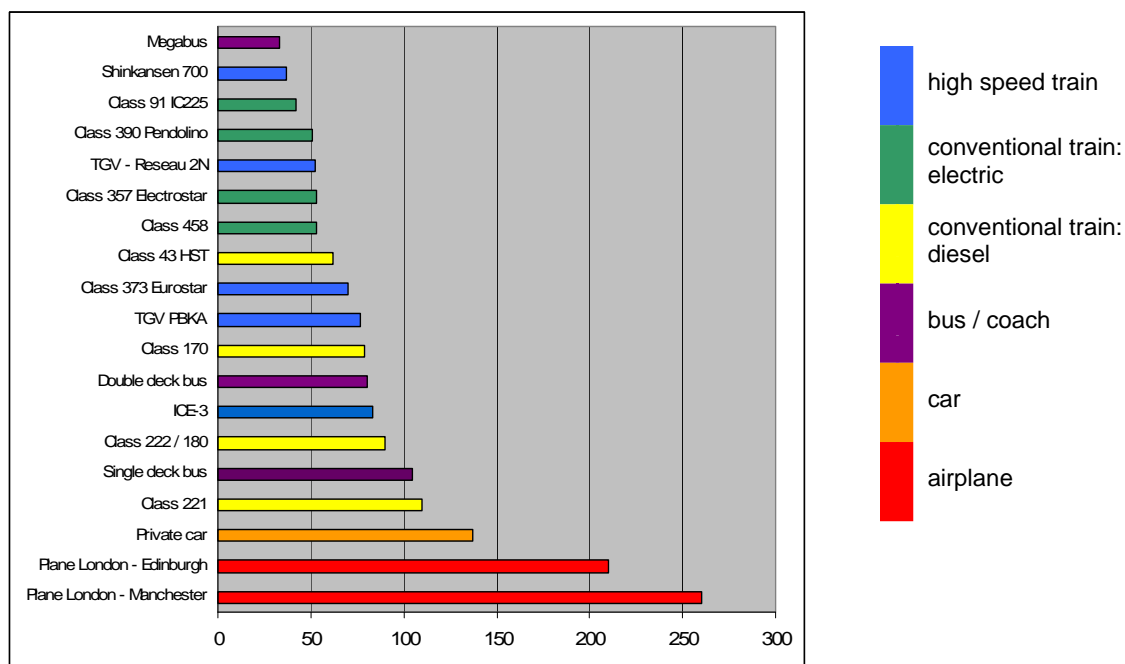
⁵⁴ See Appendix B to DECC (2010) Updated Emissions Projections. These figures do not accommodate trading of carbon units under the EU Emissions Trading Scheme

⁵⁵ Committee on Climate Change (June 2010). Meeting Carbon Budgets – ensuring a low-carbon recovery 2nd Progress Report to Parliament

Emissions from transport modes

7.3.5 The contribution of different forms of transport has been examined to understand the relative performance of high speed rail. **Figure 19** presents information on a comparative study of CO₂ emissions of different segments of the domestic UK rail industry compared with other transport modes⁵⁶. It uses current figures for converting generated electrical energy to CO₂, consistent with Defra's policy for transport emissions⁵⁷. It does not provide an authoritative league table of transport modes but presents broadly comparative data of CO₂ emissions, which can be a surrogate for energy consumption.

Figure 19 – Grams of CO₂ per passenger-kilometre⁵⁸



7.3.6 **Figure 19** shows that, in terms of CO₂ emissions per passenger kilometre, the least polluting means of transport currently are electric trains (both high speed and conventional), and Megabus type intercity buses. The worst performers were found to be planes, private cars and diesel-powered trains in decreasing order.

7.3.7 More recent studies have provided greater clarity on the relative performance of CO₂ emissions from high speed and conventional trains. Network Rail, in its comparison of emissions between high speed and conventional rail⁵⁹, demonstrates the significant net benefit of high-speed rail services over equivalent conventional services in terms of energy consumption and greenhouse gas emissions per passenger-km in the context of proposed new line development.

7.3.8 A 2009 study for Eurostar⁶⁰ using measured electricity consumption data from the Eurostar energy logging train found actual consumption to be much lower (by 30%) than the previous estimated values.

⁵⁶ Rail Safety and Standards Board (2007) T618 – Traction Energy Metrics.

⁵⁷ Defra (June 2007) Passenger Transport Emissions Factors - methodology paper

⁵⁸ Adapted from Department for Transport (2007) Relative carbon performance of rail compared to other modes; and Rail Safety and Standards Board (2007) T618 – Traction Energy Metrics. Data assumes the following load factors: urban bus 20%, intercity coach 60%, intercity rail 40%, all other trains 30%, domestic airlines 70%, and cars 30%. Road, air and diesel powered rail vehicles emissions have been increased to take account of refinery losses and electric powered vehicles take into account losses in the grid. Figures for planes include a factor for radiative forcing

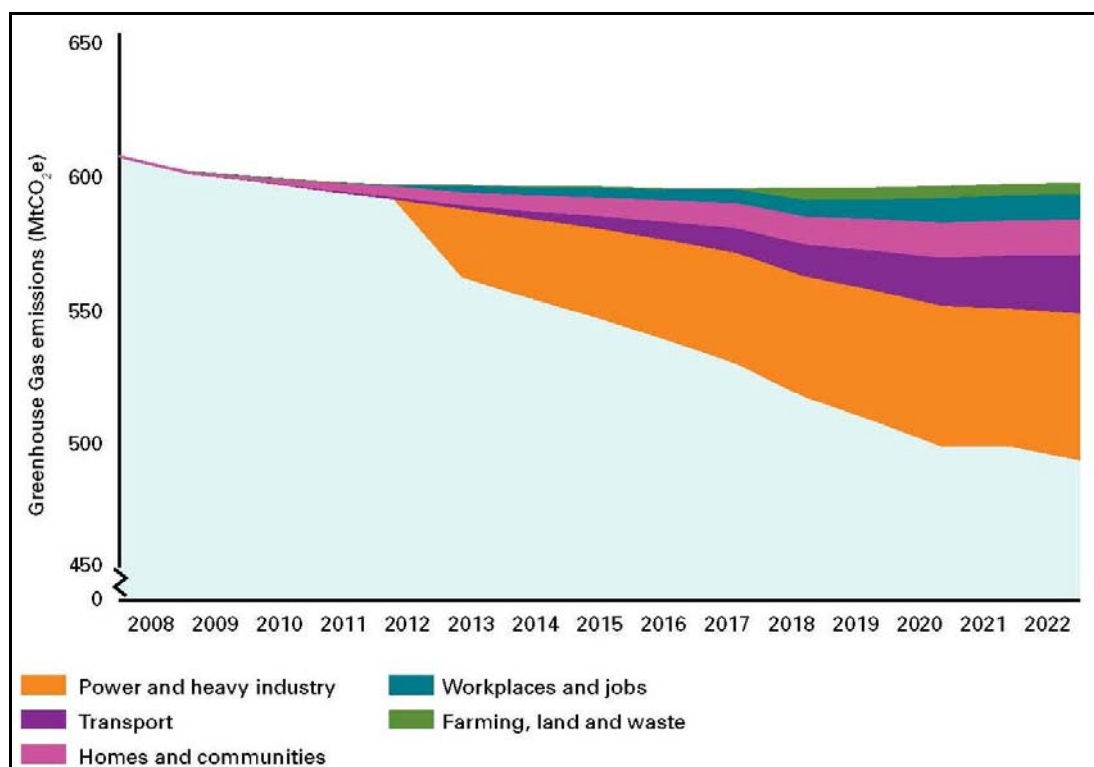
⁵⁹ Network Rail (2009) Comparing environmental impact of conventional and high speed rail

⁶⁰ Eurostar (Jan 2009) Update of Eurostar CO₂ emissions using energy logging train data.

Future baseline – general context

7.3.9 The Climate Change Act 2008 sets legally binding targets to reduce greenhouse gas emissions in the UK by at least 80% by 2050, and to reduce CO₂ emissions by at least 26% by 2020, against a 1990 baseline. A key action to help to deliver the Act's requirements is a carbon budgeting system. The first three carbon budgets (for 2008-12, 2013-17, and 2018-22) were set by the Government at levels leading to a 34% reduction (on 1990 levels) in greenhouse gas emissions by 2020; the fourth carbon budget, covering the period 2023-2027, will be set by the end of June 2011, based on published advice from the Committee on Climate Change (CCC)⁶¹. All sectors of the economy will need to play a part in meeting these budgets and the way that they do this is set out in the UK Low Carbon Transition Plan⁶². The projected impact of this plan on carbon emissions is set out in **Figure 20**. This shows the potential contribution each sector can make to reducing greenhouse gas emissions.

Figure 20 – Central projections for the net UK carbon account with and without the UK Transition Plan package of policy measures⁶³



7.3.10 The full details of assumptions used in the climate change assessment are included in *Appendix 2*.

Future baseline – power generation

7.3.11 Power generation using fossil fuels is the highest direct source of carbon emissions in the UK, with three quarters of our electricity currently generated using coal and gas. Although measures taken at the point of use through increased efficiencies form an important strand to emissions reduction, the Government is also promoting low carbon sources of electricity, prompted by, *inter alia*, European Commission proposals for the UK to increase the share of renewables in its energy mix from around 1.5% in 2006 to 15% by 2020⁶⁴. The Annual

⁶¹ Committee on Climate Change (December 2010) The Fourth Carbon Budget. Reducing Emissions through the 2020s.

⁶² DECC's Low Carbon Transition Plan (*ibid*)

⁶³ From DECC's UK Low Carbon Transition Plan (*ibid*)

⁶⁴ BERR (June 2008) UK Renewable Energy Strategy: Consultation Document

Energy Statement⁶⁵ sets out a host of measures to lower the carbon footprint of energy generation.

- 7.3.12 The UK Low Carbon Transition Plan sets a path towards 40% of UK electricity coming from low carbon sources (renewables, nuclear and fossil fuel plants fitted with carbon capture and storage technology) by 2020, relying on various legislation and mechanisms such as the EU Emissions Trading System. The 2010 Annual Energy Statement assumes that by 2020 around 30% of UK electricity will come from renewables consistent with the target in the Renewable Energy Strategy. However, in response to a question from the Secretary of State for the Environment, the CCC has proposed that the UK adheres to the European 2020 renewables target of 15%⁶⁶.
- 7.3.13 Whatever is achieved, the delivery of these changes in the power sector will rely on provisions within the Planning Act 2008 and in particular the strategic approach as set out in the Energy National Policy Statement⁶⁷.

Future baseline – transport emissions

- 7.3.14 Different reports about emissions from the rail sector make different assumptions about future energy mixes, ranging from a relatively conservative 10% reduction in CO₂ emissions per kWh between 2007 and 2020⁶⁸, to a very ambitious 50% reduction by 2020 and 80% reduction by 2050⁶⁹. The latter report suggests that carbon emissions from high speed rail travel in the future could be very low indeed. Certainly a reasonable assumption is that, over time, the greenhouse gas emissions per passenger-km produced by conventional electric trains and high speed trains would reduce, and would reduce faster than emissions from other sectors.
- 7.3.15 The CCC's Fourth Carbon Budget Report⁷⁰ sets out transport's contribution to reducing CO₂. Surface transport abatement scenarios are built up from the scenarios for more efficient conventional vehicles, electric vehicles, biofuels and hydrogen vehicles. Different abatement scenarios envisage reductions in CO₂ of between 8% and 36%.
- 7.3.16 Automotive technology is also likely to see an increasing proportion of ultra-low carbon vehicles on the road, powered by hydrogen fuel cells, batteries or a combination of battery and conventional internal combustion (hybrid vehicles). Increasing use of biofuels may also contribute to a reduction in net carbon emissions, although this is an area of controversy: the Gallagher Review warned that unsustainably produced biofuels have the potential to increase net greenhouse gas emissions and incur other undesirable outcomes, for example on local agriculture and biodiversity.
- 7.3.17 In terms of emissions from aircraft, the International Civil Aviation Organization has agreed global fuel-efficiency goals, and a global aspirational goal of carbon neutral growth from 2020, and is discussing the need for emissions reductions in the long-term. An EU government and industry body, the Advisory Council for Aeronautics Research in Europe, has set targets for aircraft manufacturers to reduce carbon dioxide emissions from new aircraft by 50% per passenger kilometre and reduce emissions of nitrogen oxides (another greenhouse gas) by 80%, relative to a 2000 base. But greenhouse gas emission abatement opportunities in the aviation sector, now and in the future, are generally perceived as being limited, and the Climate Change Act 2008 does not yet include emissions from international aviation⁷¹.

⁶⁵ DECC Departmental Memorandum (July 2010) Annual Energy Statement

⁶⁶ Letter from Lord Turner to Rt Hon Chris Huhne (10 Sept 2010). Committee on Climate Change website – latest news

⁶⁷ DECC (2009) Draft Overarching National Policy Statement for Energy (EN-1). Planning for new energy infrastructure

⁶⁸ Booz Allen Hamilton (2007) Estimated carbon impact of a new north-south line

⁶⁹ Greengauge (2007) Energy consumption and CO₂ impacts of High Speed Rail: ATOC analysis for Greengauge 21

⁷⁰ Committee on Climate Change (Dec 2010) *ibid*

⁷¹ Defra (2008) Climate Change Bill: Final Impact Assessment

- 7.3.18 The CCC was asked to advise on the previous Government's target to reduce UK aviation CO₂ emissions to below 2005 levels by 2050. Its report, published in December 2009⁷², addresses the basis for the target, given forecast growth in passenger demand, and sets out the range of factors that might contribute to meeting it. However, reductions are expected to be achieved from a combination of measures, including more efficient aircraft, operations and air traffic management.

7.4 Natural and cultural resource protection and environmental enhancement

Overview

- 7.4.1 Natural and cultural resource protection and environmental enhancement, at this level of appraisal, considers statutorily protected environmental features (of international and national importance), and other relevant non-statutory features where information is readily available. No site surveys have been undertaken at this stage. The resources considered by the AoS are listed below and illustrated within the detailed plans, contained in Volume 2 to the main report.

<p>Landscape and townscape</p> <ul style="list-style-type: none"> • National parks • Areas of outstanding natural beauty (AONB) • London protected views • Local landscape designations
<p>Cultural heritage</p> <ul style="list-style-type: none"> • World heritage sites • Scheduled monuments • Listed buildings (Grades I, II* and II) • Registered parks and gardens (Grades I, II* and II) • Historic battlefields • Areas of archaeological interest • Conservation areas
<p>Ecology and biodiversity (inc geodiversity)</p> <ul style="list-style-type: none"> • Actual (and candidate) special areas of conservation (SAC/cSAC) • Actual (and proposed) special protection areas (SPA/pSPA) • Ramsar sites • National nature reserves (NNRs) • Sites of special scientific interest (SSSI) • Local nature reserves (LNRs) • Sites of importance for nature conservation (SINCs) • Ancient woodlands • Biodiversity action plans (BAP habitats and species)
<p>Water and flooding</p> <ul style="list-style-type: none"> • Rivers and river catchments • Source protection zones (Zones 1, 2 and 3) Water quality • Flood risk areas (Zones 3b, 3a and 2)

⁷² Committee on Climate Change (2009) Meeting the UK aviation target – options for reducing emissions to 2050

- 7.4.2 The following sections provide an overview of the main resources between London and the West Midlands. Maps identifying these features are presented in *Volume 2*.

Landscape and townscape

- 7.4.3 Natural England has defined national character areas⁷³ of broadly homogenous landscape. Defining what makes the character of these areas distinct helps to identify the features that give a locality its 'sense of place', and pinpoint what makes it different from neighbouring areas. In this way it is possible to understand what elements of each landscape are relatively more sensitive to change and equally what kinds of change might be deemed more acceptable. Twelve character areas are crossed by the proposed route (see **Figure 21**⁷⁴). The characteristics of the six that would be crossed most extensively are summarised below.

Landscape character areas

Northern Thames Basin. Diverse landscape with a series of broad valleys and extensive areas of broadleaf woodlands. Landform varied with a wide plateau divided by the valleys. Towns, motorways, railways and electricity pylons are a major influence on character. Many river valleys have been extensively modified by reservoirs and gravel pits. Smaller, tree-lined valleys support villages that contrast with more heavily developed floodplains. Broader plateaux are mainly farmed, with field patterns exhibiting the regular shape characteristic of 18th century enclosures.

Chilterns. The Chilterns are composed of chalk hills and plateaux with prominent escarpments in many places, and numerous dry valleys. They contain extensive areas of beech woodland, scattered villages and farmsteads, and a network of ancient green lanes which link numerous archaeological sites and settlements. The enclosed and intimate landscapes of the valleys contrast with the more open plateau top and extensive views from the scarp.

Upper Thames Clay Vales. A broad belt of open, gently undulating lowland farmland contains contrasting landscapes, including enclosed pastures of the wet valley bottoms and more settled open arable land. This is a predominantly pastoral landscape including regular fields within a well-defined network of trimmed hedgerows and brick-built buildings.

Northamptonshire Uplands. This is a relatively remote and undeveloped landscape of rounded, undulating hills with many long, low ridgelines and frequent deserted and shrunken settlements. Open arable land contrasts with pasture enclosed by good hedges with frequent hedgerow trees. Straight, wide roads often follow the ridges. Older buildings are of ironstone and limestone with some brick

Dunsmore and Feldon. Large geometric fields are divided by straight hedges with many hedgerow trees. They provide a plateau landscape of open, flat, rather empty character with long views. Some areas have a strong urban influence.

Arden. The well-wooded, rolling farmland landscape has an ancient pattern of small fields, winding lanes and dispersed, isolated hamlets. Contrasting patterns of well-hedged, irregular fields and small woodlands are interspersed with larger semi-regular fields on former deer parks and estates, and a geometric pattern on former commons.

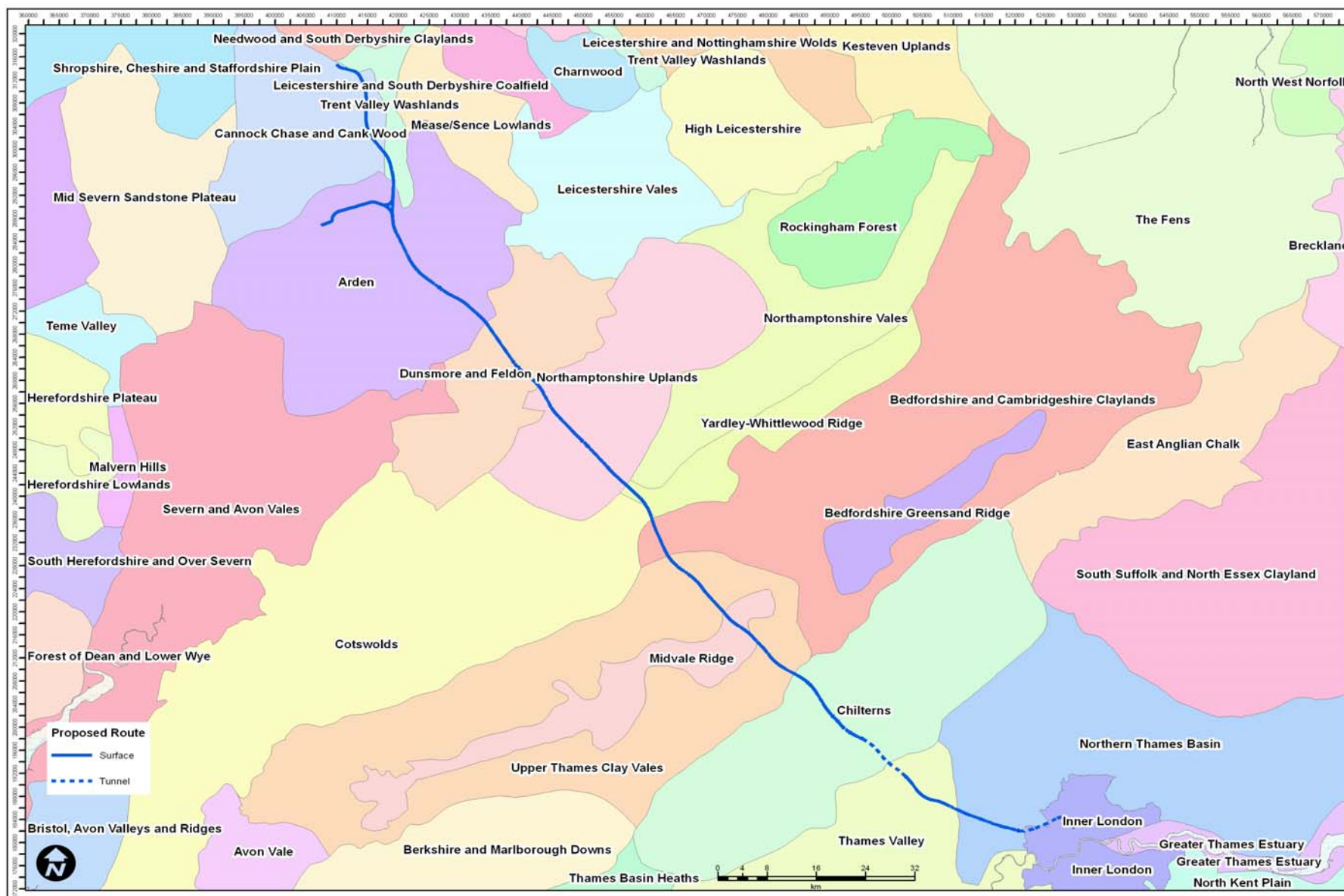
- 7.4.4 There are also a number of notable urban townscapes within towns and cities between London and the West Midlands, but particularly around the terminus in London where historical and architectural attributes are key to the local character.
- 7.4.5 The Chilterns AONB is crossed by the scheme. A management plan for the Chilterns AONB has been prepared by the Chilterns Conservation Board⁷⁵. This *“sets out the special qualities of the area, identifies the management issues it faces, presents a vision of the AONB as a special place and provides policies and actions to guide the work of all of those who care for the area over the next five years”*.

⁷³ Natural England (2009) Natural Character Areas,

⁷⁴ Photos are from Natural England (2009) Natural Character Areas

⁷⁵ Chilterns Conservation Board (2008) Chilterns Area of Outstanding Natural Beauty Management Plan 2008 - 2013

Figure 21 – The proposed scheme: section between Aylesbury and Southam



- 7.4.6 Country parks, such as Denham and Bayhurst Wood in the Colne Valley and Sheldon and Kingfisher in Birmingham provide a recreational as well as a landscape resource. Other important landscape settings are associated with stately homes of which there are a very large number between London and the West Midlands, particularly in the Chilterns and around the outskirts of Birmingham. These have historical as well as landscape significance.
- 7.4.7 **Future baseline:** Most of the national character areas are likely to change to small degrees. Near urban areas, particular pressures stem from expansion of settlements, new power lines, golf courses, upgrading of roads, continuing pressure for landfill and minerals extraction. In more rural areas, changes are expected from agricultural intensification, loss or deterioration of hedges, and a gradual 'suburbanisation' of the rural character⁷⁶. The growth points at Coventry and Birmingham and Solihull are likely to be particularly affected, although provisions for green infrastructure set out in local development documents could mitigate some of these impacts.

Cultural resources

- 7.4.8 The area between London and the West Midlands contains many listed buildings and conservation areas, with particular clusters in London and Birmingham city centre. Scheduled monuments are quite scarce, although remnants of the Iron Age earthworks of Grim's Ditch occur at several locations including the Chilterns, Harrow in north-west London, Berkshire and North Oxfordshire.
- 7.4.9 Registered parks do not occur in great numbers but they tend to be of substantial size. Shardeloes near Amersham is set in grounds and gardens that overlook the Misbourne valley; Hartwell House is located in countryside about 3km west of Aylesbury; and Stoneleigh Park east of Kenilworth is situated within a gap between Coventry and Leamington Spa that provides an obvious corridor for the alignment.
- 7.4.10 Listed buildings are found in greatest numbers within central London and Birmingham, particularly around the station termini, where they are within or close to conservation areas. Otherwise they are found in various locations across the area, with Grade II buildings occurring in particular abundance.
- 7.4.11 **Future baseline:** Most of the historical sites and archaeological monuments in the HS2 area are unlikely to be affected in the future due to their protected status. However, a few may be adversely affected by development pressure. An extension of the runway at Birmingham Airport would affect the Bickenhill Village Conservation Area and several archaeological features. The planned intensification of development in London, the South East and West Midlands, particularly around the more urban areas, is likely to slowly erode the quality of the historical landscape.

Biodiversity

- 7.4.12 A Habitats Regulations Assessment screening was undertaken in tandem with the options sifting process (see HRA Screening Report, *Appendix 4.1*), which identified several internationally designated sites within 10km of the various route options; chief amongst these are Chilterns Beechwoods Special Area of Conservation (SAC); Aston Rowant SAC; Burnham Beeches SAC and South West London Waterbodies Special Protection Area (SPA) and Ramsar site.
- 7.4.13 There are numerous other nature conservation sites scattered across the area, including SSSIs which occur throughout but in relatively higher densities along the western edge of the Chilterns and associated with the riverine systems around Oxford. Ancient woodlands

⁷⁶ Natural England (2009) Natural Character Areas,

are also scattered across the area but are found in greatest abundance across the Chilterns.

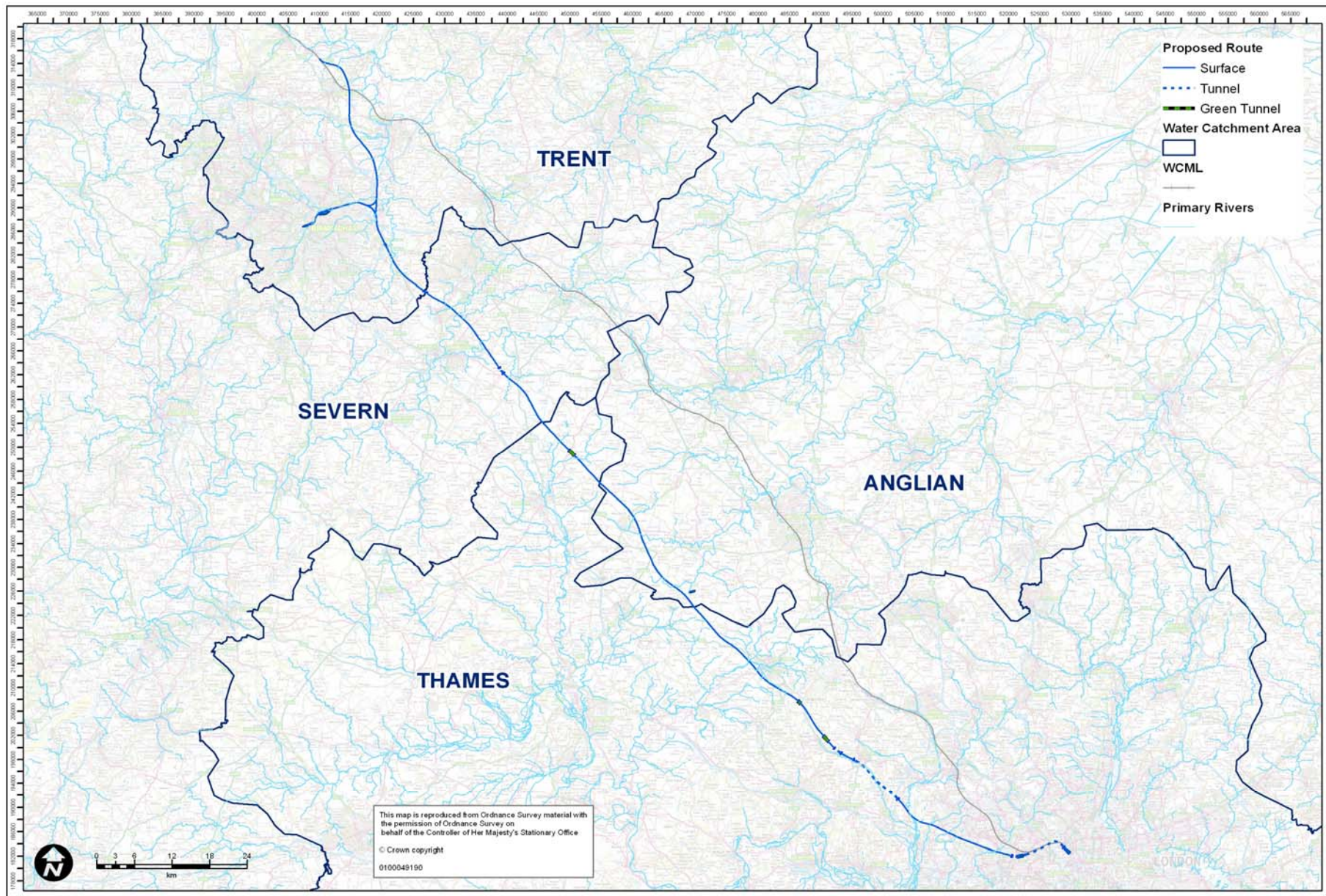
- 7.4.14 **Future baseline:** The condition of most of the nationally and internationally designated nature conservation sites near the proposed HS2 route is likely to remain the same or improve over the next twenty years. The integrity of international sites should be protected through the requirements of the European Habitats and Birds Directives. Almost all of the SSSIs near the proposed HS2 route are defined by Natural England as being in 'favourable' or 'unfavourable [but] recovering' condition. The only SSSIs on or near the proposed scheme whose conditions are problematic are:
- part of the Mid Colne Valley SSSI near Harefield, which is in unfavourable condition due to under-grazing;
 - Helmdon disused railway SSSI, which is in unfavourable condition, largely due to scrub encroachment into calcareous grassland; and
 - the whole River Blythe SSSI near Leamington Spa / Kenilworth, which is in unfavourable but unchanging condition due to invasive species and water pollution from agriculture/run-off and discharge.
- 7.4.15 An extension of the runway at Birmingham Airport would affect Bickenhill Meadows SSSI and Shadowbrook Lane Meadows SSSI as well as areas of more local biodiversity interest.
- 7.4.16 More generally, the biodiversity status of the area between London and the West Midlands is expected to decline slightly in the future. The sustainability appraisals of the London Plan (2004) and Regional Strategies for the South East (2006), East of England (2007 and 2009⁷⁷) and West Midlands (2007) suggest that biodiversity would be adversely affected by proposed development on greenfield land.

Water and flooding

- 7.4.17 Water quality in the river catchments which would be traversed by HS2 (shown in **Figure 22**) is variable, with some catchments particularly affected by poor water quality.
- In and near London, 23% of the rivers and lakes in the Colne catchment monitored by the Environment Agency are of good ecological status or potential. The main pressures are from groundwater abstraction, and physical modification due to urbanisation and flood protection.
 - Near Aylesbury, the Thames and South Chilterns catchment is currently significantly affected by pollution from sewage works and agricultural run-off, and physical modification from land drainage and urbanisation. Only 8% of monitored rivers and lakes achieve good ecological status or potential.
 - Near Banbury, the Cherwell catchment is affected by sewage works, agricultural run-off and drainage: 32% of monitored rivers and lakes currently achieve good ecological status or potential.
 - Around Coventry and Leamington Spa, only 11% of monitored rivers and lakes in the Warwickshire Avon catchment currently achieve good ecological status or potential due to problems with sewage discharge and diffuse (urban and agricultural) run-off.
 - Around Birmingham, the Tame, Anker and Mease catchment is heavily affected by sewage treatment works. Only 3% of monitored rivers and lakes currently achieve good ecological status or potential.

⁷⁷ An interim integrated SA has been submitted following a ruling in May 2009 by the High Court which issued a judgment that the Sustainability Appraisal of the East of England RSS had failed to test reasonable alternatives to two of its proposals, and has remitted those proposals to the Government to reconsider them.

Figure 22 – Map of part of the Thames river basin district



- 7.4.18 Areas of particular flood risk include the River Colne west of London, the River Ray around Bicester, the River Thames west of Aylesbury, the River Cherwell and Oxford Canal north and east of Banbury, the River Avon south of Warwick and Leamington Spa, and the River Tame east and north of Birmingham.
- 7.4.19 **Future baseline:** Although water quality in these catchments is generally expected to improve in the future as a result of measures taken to implement the European Water Framework Directive, improvements are likely to be slow. By 2015, no significant change is expected for the catchments with the lowest quality, namely: the Tame, Anker and Mease (3% achievement), Thames and South Chilterns (8%) and Warwickshire Avon (11%). Neither is any change in quality expected for the Cherwell catchment. The Colne catchment's compliance is expected to improve from 23% to 27% by 2015, and the Upper Bedford Ouse catchment from 26% to 29%.
- 7.4.20 The main types of improvements expected as a result of the first six-year Water Framework Directive are a reduction in the physical impacts of urban development, clean-up of contaminated land, a framework for management of invasive non-native species and improved agricultural management⁷⁸. Further improvements are expected through subsequent rounds of River Basin Management Plans.
- 7.4.21 The area prone to flooding is expected to increase in the future as a result of climate change. This has been taken into account in the flood risk assessments carried out at regional and local level, and future development is not expected to increase flood risk.

7.5 Creating sustainable communities

Overview

- 7.5.1 Impacts on communities, both positive and negative, are those that potentially affect the health, well-being and amenity of people⁷⁹. The term 'community' refers to a group of people whose identity is defined by recognised attributes of activity, location and/or sensitivity, although the precise physical extent of a community is often difficult to map.
- 7.5.2 Mapped features that relate directly to community identity or that help with the appraisal of community impacts are listed below and illustrated within the detailed plans, contained in Volume 2 to the main report.
- growth points;
 - growth areas;
 - eco-towns;
 - super output areas and indices of multiple deprivation;
 - registered common land;
 - greens;
 - open country;
 - country parks; and
 - air quality management areas.

⁷⁸ Environment Agency (2009) Water for life and livelihoods: first cycle River Basin Management Plans submitted to Ministers in September 2009.

⁷⁹ Impacts on natural and cultural resources can affect people indirectly, but are addressed separately. They should, however, be considered when considering overall health impacts

Population and communities

- 7.5.3 HS2 would pass through four regions: London, East of England, South East, West Midlands; some of which have the highest populations in England⁸⁰.
- 7.5.4 Residential areas have been identified as sensitive to potential impacts owing to residents' generally heightened sensitivity to noise, air quality and severance, as well as direct impacts of landtake and demolition. There are high concentrations of residential development within London and Birmingham, and also in larger settlements in between.
- 7.5.5 **Future baseline:** The Office of National Statistics reports that the English population is projected to grow from 51.5 million in 2008 to over 55 million by 2018, equivalent to an average annual rate of growth of around 0.7 per cent. Assuming that migration patterns over the next 10 years mirror those of the last 10 years (which is far from certain), the population in England is projected to continue to grow, reaching almost 61 million by 2033. Current and projected populations in the regions are set out in **Table 2**.

Table 2 – Change in population, 2008 - 2018

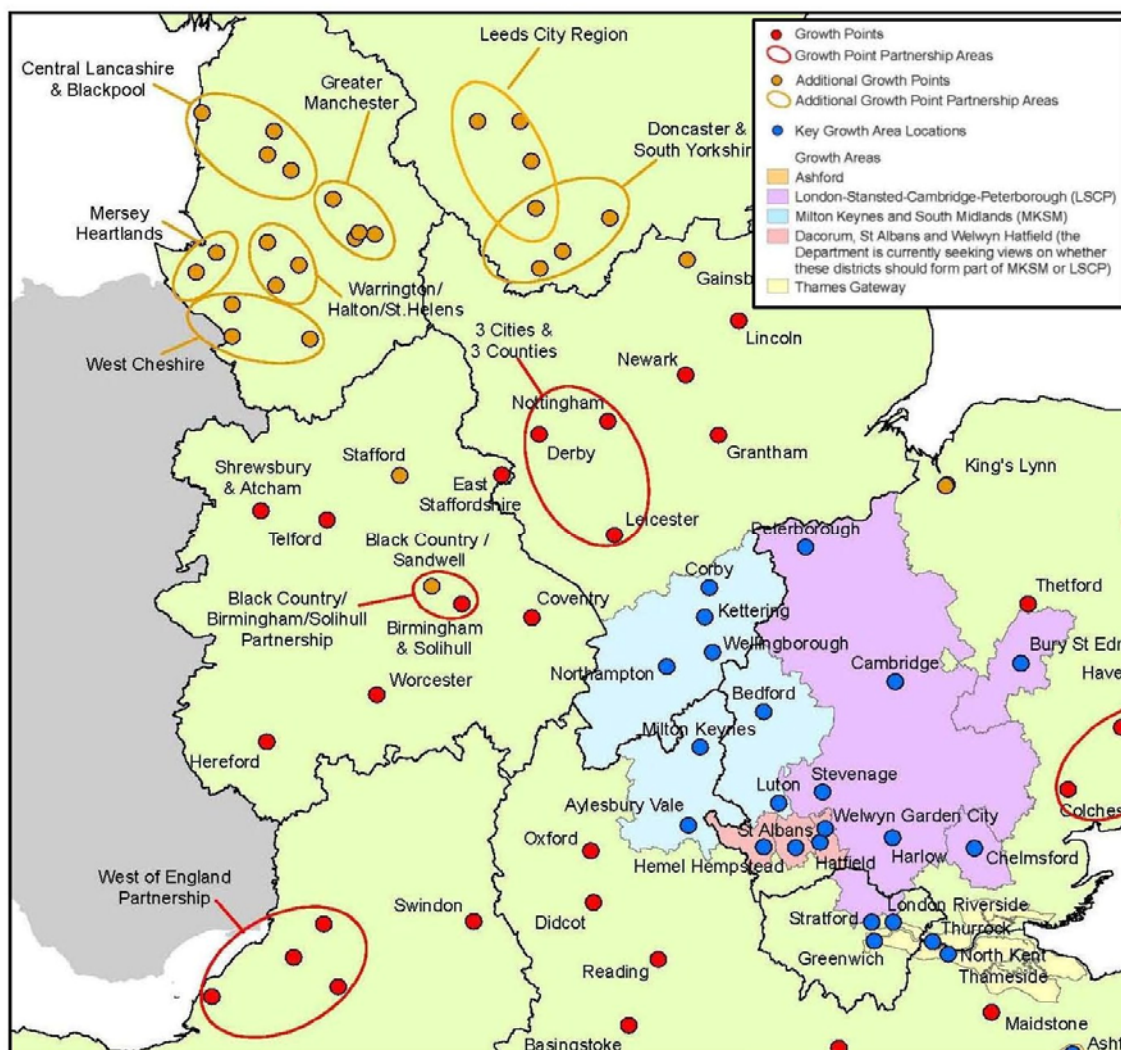
Region	2008 population (millions)	Projected 2018 population (millions)	Projected population increase 2008 – 2018 (%)
London	7.7	8.3	8.7
East Midlands	4.4	4.8	8.3
West Midlands	5.4	5.7	5.2
East of England	5.7	6.3	10.0
North East	2.6	2.7	4.1
North West	6.9	7.1	3.5
South East	8.4	9.0	8.0
South West	5.2	5.6	8.4
Yorkshire and Humber	5.2	5.6	8.5

- 7.5.6 RSs' evidence base supports increased rates of house building to accommodate not only this increased population, but also the additional households formed through divorce, people living longer, and a general trend towards smaller household size. Although the planning framework for this growth is to change following the withdrawal of RSs, the underlying aspirations and key drivers behind them will remain.
- 7.5.7 Regional authorities have designated Growth Areas and Growth Points; these are shown in **Figure 23**. Also 15 local authorities and partnerships are leading eco-development/eco-town projects⁸¹, subject to local planning decisions. Areas designated for growth are summarised as:
- Growth Points (designated by the local authority for strategic growth proposals) at Oxford, Coventry and Birmingham and Solihull.
 - Growth Area (designated specifically to tackle housing supply in the wider South East) at Milton Keynes; and
 - eco-town (comprising a new community with 5,000 -15,000 homes adhering to strict standards of building and performance, including environmental building standards and low carbon energy sources) at Bicester.

⁸⁰ Office of National Statistics (May 2010) 2008-based sub national projections of the future population of English Government Office Regions

⁸¹ PPS locations: North West Bicester, St Austell, Whitehill-Bordon and Rackheath.

Figure 23 – Growth Areas and Growth Points⁸²



7.5.8 Further population growth has been projected for 2031, and the National Housing and Planning Advice Unit has proposed that the regions should consider developing considerably more housing than was planned for in the RSs⁸³.

Air quality

7.5.9 Air quality in the UK as a whole has improved over the last 20 years, and most of the area between London and the West Midlands is currently achieving national air quality standards. However, air quality is a problem in London, with 2010 European limit values for NO₂ and particulates not being achieved in many parts⁸⁴. In Hillingdon the council designated an air quality management area (AQMA) for NO₂ from its southern borough boundary up to the Chiltern-Marylebone railway line. In addition Camden Council has declared its entire borough an AQMA for NO₂ and PM₁₀. Euston Station is located within an area of this borough that is of particularly poor air quality.

7.5.10 There are localised areas of poor air quality between London and the West Midlands. They are generally along roads, for example in Aylesbury and Kenilworth/Warwick.

⁸² CLG: <http://www.communities.gov.uk/documents/housing/pdf/898634.pdf>

⁸³ National Housing and Planning Advice Unit (2009) More homes for more people: advice to Ministers on housing levels to be considered in regional plans

⁸⁴ Mayor of London (2002) Cleaning London's Air: The Mayor's Air Quality Strategy

- 7.5.11 Existing air quality is also poor in the Birmingham area. Birmingham city is classed as an AQMA due to NO_x standards being exceeded (primarily due to car traffic), as well as parts of Coleshill to the east of the city, and Walsall to the north⁸⁵.
- 7.5.12 **Future baseline:** Over the next 10-15 years, UK-wide, air quality is expected to continue to improve, primarily as a result of tightening Euro emission standards for cars and lorries and cleaner energy generation⁸⁶.
- 7.5.13 However, the model used to make the predictions did not include the higher housing figures that are still likely despite abolition of regional planning bodies. Nor did it accommodate proposals in the draft energy National Policy Statements for new power stations, which envisage much higher levels of fossil fuel use than were assumed by the model. Even if the new power stations use 'clean coal' technology as proposed, they will still have some impact on air quality.
- 7.5.14 A Defra study⁸⁷ also suggests that assumptions about vehicle emissions should add 15% to European emission standards to take account of real-world effects such as poor maintenance, low tyre pressure, poor driving, and increasing use of air conditioning. Defra's Air Quality Expert Group (2007) "*recommends that local authorities, and any other users of the future-year adjustment factors, currently provided by Defra to adjust monitoring data, should exercise caution, as actual decreases in NO₂ concentrations at some sites may be considerably smaller than those calculated using these adjustment factors*"⁸⁸. Nevertheless, one can assume that, in most parts of the HS2 corridor, future air quality to 2020 / 2026 will be better than today's.
- 7.5.15 As a result, the UK National Air Quality Archive⁸⁹ predicts that the annual mean air objectives for NO₂ and PM₁₀ will be met in the Birmingham area by 2026, when HS2 is expected to be in operation. However it is unlikely that the annual mean objective for NO₂ or PM₁₀ will be met at Euston Station by this time.
- 7.5.16 After this time, air quality may deteriorate to some extent as increases in road traffic offset other gains, but this is by no means certain.

Noise and vibration

- 7.5.17 The Government's noise mapping website⁹⁰ provides separate data for noise from roads and railways (although not from air travel), but without providing an overall total noise level. It is therefore not possible to get a comprehensive feeling for existing areas subject to elevated cumulative noise levels from these different transport modes. As part of its draft noise action plans, Defra provides maps that identify "first priority locations", which are subject to particularly high levels of noise from roads and railways. Drawing on these and through general knowledge about the noise environment of the area between London and the West Midlands, the locations with noise environments dominated by transport are likely to be as follows:

⁸⁵ West Midlands Regional Assembly (2007) Final Sustainability Appraisal Report of Draft RSS Phase Two Revisions for the West Midlands

⁸⁶ Grice, S. et al (2006). Baseline projections of air quality in the UK for the 2006 review of the Air Quality Strategy, report to Defra et al; and Grice, S. et al. (2007). Updated projections of air quality in the UK for base case and additional measures for the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007, report to Defra et al.

⁸⁷ Defra (2007). Passenger transport emissions factors: Methodology paper.

⁸⁸ Air Quality Expert Group (2007). Trends in primary nitrogen dioxide in the UK

⁸⁹ Grice, S. et al (2006). Baseline projections of air quality in the UK for the 2006 review of the Air Quality Strategy, report to Defra et al; and Grice, S. et al. (2007). Updated projections of air quality in the UK for base case and additional measures for the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007, report to Defra.

⁹⁰ Defra (2009) Noise mapping

London

- North and east of Heathrow Airport.
- Along the M25.
- Along main arterial roads and rail lines in London.
- Clusters of rail noise around Wormwood Scrubs, Willesden in west London, Kings Cross, Euston and Camden area generally in central and north London

London to West Midlands

- Along motorways (M40 and M6) and major A roads (A40, A413, A452, A45 and A38).

The West Midlands

- Along the M6 on the north and north-east side of Birmingham.
- Along the M42, especially its junction with the M6.
- Birmingham city centre
- At Birmingham Airport – particularly to the north-west and south-east along flight paths

7.5.18 **Future baseline:** The Government formally adopted Noise Action Plans for 23 agglomerations, major roads, and major railways in March 2010. The plans aim to manage noise, particularly from railways and roads. Amongst the agglomerations to be covered by these plans are London and Coventry. The area of Old Oak Common and the A40 to the west of Old Oak Common has been identified as a priority area for noise management.

7.5.19 The masterplan for the development of Birmingham Airport to 2030 proposes an extension to the existing runway at its south-east end, expansion of the terminal facilities, further car parking and new road transport access. Under the masterplan, the number of people affected by daytime noise levels of 57dB_{L_{Aeq}} would rise from 26,800 in 2006 to 55,150 in 2030; and those affected by 66dB_{L_{Aeq}} would rise from 500 in 2006 to 3,200 in 2030⁹¹. Airport authorities are expected to develop noise action plans to address these issues.

Severance and access

7.5.20 As outlined in DfT appraisal guidance, access to the public transport system is of particular relevance for people without their own motor vehicle. As such, information has been collected on car availability levels in areas that would benefit from direct connections to HS2 services, as well as other parts of the WCML affected by the reconfiguration of services to accommodate HS2.

7.5.21 Average levels of car availability vary considerably within London. The number of households in inner London without access to a car is considerably higher than the current national average of 26% due in large part to the availability of good public transport alternatives. Car availability in outer areas of London is comparable with the national average. Households in areas to the north of London along the WCML to Northampton also have higher than average access to motor vehicles.

7.5.22 For the West Midlands, the proportion of households without access to a car is higher than the national average, although Wolverhampton is closer to the national average.

7.5.23 The situation for other key locations along the WCML is mixed. On average, households in Liverpool, Manchester and Glasgow have very low levels of car availability compared to the national average, as do those in Stoke-on-Trent and Preston, whereas Rugby, Crewe and Carlisle have higher levels of car availability. In the case of the wider Merseyside and Greater Manchester area, levels of car availability are closer to the national average, although in the West and South West of Scotland, car availability is low, as it is in Glasgow.

⁹¹ Birmingham Airport Ltd. (2007) Towards: 2030, Planning a sustainable future for air transport in the Midlands, Airport Master Plan to 2030.

- 7.5.24 **Future baseline:** No clear data was identified to indicate how car ownership will change in the future, although, based on past trends, it is likely to increase. In the decade to 2006, car ownership went up by 30% to 29.6m, while the UK population rose by 4%⁹².

Tranquility

- 7.5.25 Tranquility is a complex concept that can perhaps best be summarised as ‘getting away from it all’. Examples of factors affecting tranquility include closeness to roads and buildings, how noisy and crowded a place is, and whether it offers views of open countryside. The Campaign to Protect Rural England (CPRE) has produced regional tranquility maps based on 44 such factors. They show that the London and Birmingham metropolitan areas are amongst the least tranquil areas in England, with the transport corridors between them (notably the M40 and M1/M6) also having noticeably reduced tranquility⁹³. This is shown in **Figure 24**.
- 7.5.26 **Future baseline:** Over the past 40 years or so, tranquil areas have decreased substantially as a result of new roads, airports and urban development. This trend is likely to continue with the increasing population planned within the vicinity of some parts of HS2, and major infrastructure projects, such as expansion of Birmingham Airport.

Deprivation and regeneration

- 7.5.27 The English Indices of Deprivation 2007 are the Government’s official measure of deprivation. They are applied to small areas known as Lower Super Output Areas (LSOAs), which typically contain between 1000 and 3000 people. The Indices of Multiple Deprivation (IMD) amalgamate 37 different indicators covering aspects of deprivation including income, employment, health and disability, education, skills and training, barriers to housing and services, living environment and crime. The IMD for each LSOA identifies its relative level of deprivation in comparison to all other LSOAs in England. The LSOAs falling in the lowest 20% for IMDs are used by this appraisal to identify the most deprived areas.
- 7.5.28 In the area between London and the West Midlands, the following areas are comparatively more deprived:
- South East region: Milton Keynes, Slough, parts of Oxford city⁹⁴;
 - London: south Brent / north Ealing / White City area south of Wormwood Scrubs to the west⁹⁵; and
 - West Midlands: Birmingham centre, Wolverhampton, Walsall, also north-east of Coventry⁹⁶.
- 7.5.29 Information on multiple deprivation has been used to help to identify communities that would be more vulnerable to adverse impacts and, equally, that have the greatest potential to benefit. The information has been used to inform a qualitative analysis of the potential socio-economic benefits, particularly in relation to areas of current and proposed regeneration⁹⁷.

⁹² RAC Foundation (April 2009) The Car in British Society

⁹³ Campaign to Protect Rural England (date unknown) Tranquility

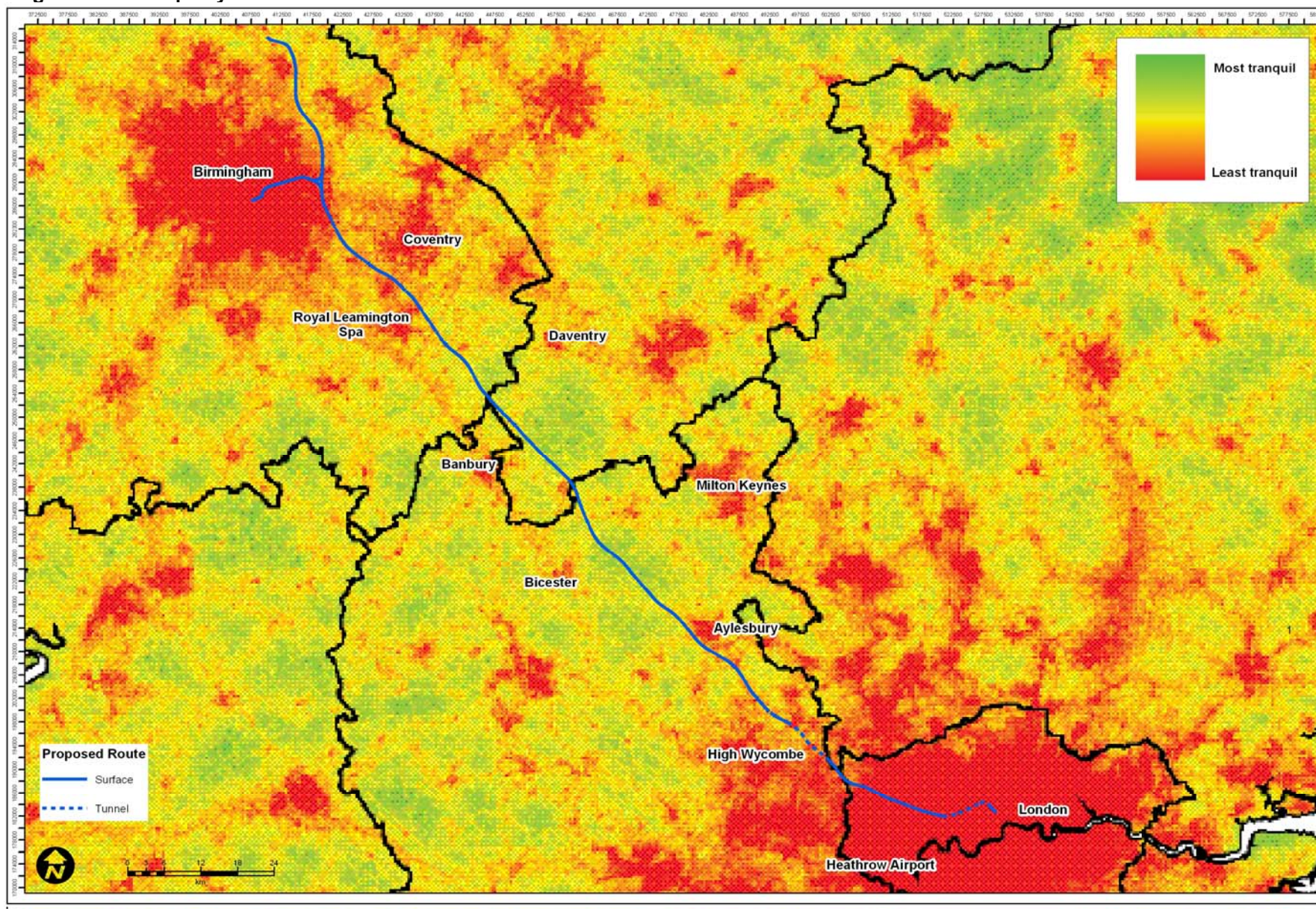
⁹⁴ Government Office for the South East (2009) Regional Spatial Strategy for the South East: Sustainability Appraisal and Habitats Regulations Assessment / Appropriate Assessment of the Secretary of State’s Final Revisions

⁹⁵ London Councils (2007) Index of Multiple Deprivation (IMD) 2007

⁹⁶ West Midlands Regional Observatory (2009) Indices of Deprivation 2007

⁹⁷ Including East of England RSS; East of England RES; London Plan; London economic development. strategy; South East RSS; South East RES; West Midlands RSS and West Midlands RES.

Figure 24 – Tranquility in the area between London and the West Midlands



- 7.5.30 **Future baseline:** Local development documents were reviewed to determine any key development proposals along the line of the proposed route. Plans in *Volume 2* show where regeneration and growth is focused.
- 7.5.31 Areas proposed as a focus for development in local development documents, Regional Strategies and national government reports (including the 'Western Wedge' of London; the Milton-Keynes and Aylesbury Vale sub-region; and growth points in Coventry, Birmingham and Solihull) were considered (see also Section 7.5.7).

7.6 Sustainable consumption and production

Overview

- 7.6.1 Sustainable consumption and production addresses the efficiency in use of material resources, including land. HS2's direct impacts in terms of consumption and production would depend on factors such as route length, route topography, and the line of the HS2 route compared with other linear infrastructure. The following summarises some of the aspects that have been considered.
- 7.6.2 Features that are mapped and that relate directly to land consumption, or that help with the appraisal of sustainable consumption and production, are listed below and illustrated within the detailed plans, contained in Volume 2 to the main report:
- green belt (and Metropolitan Open Land in London);
 - agricultural land (Grade 1 and 2);
 - minerals planning areas;
 - waste planning areas;
 - EA registered "Special Sites" for Contamination and Registered Landfills; and
 - contaminated land registers (local authority sites).
- 7.6.3 The following sections provide an overview of the main resources within the area between London and the West Midlands. Maps identifying these features are presented at *Volume 2*.

Land resource

- 7.6.4 Aside from the value of the land as a resource of ecological, cultural or aesthetic value, which is addressed above under natural and cultural resources, its material value in planning terms is also a key consideration. This is determined by the potential that land offers to farmers, developers or other 'land managers'. HS2 may either adversely or beneficially affect the land resource by impairing or enhancing the use for which it is designated or by increasing its potential for productive use.
- 7.6.5 Potential adverse effects would occur on agricultural land, especially those areas classified as grades 1 and 2, based on the physical characteristics of the land and the limits these impose upon its agricultural uses. Much of the land between London and the West Midlands is agricultural. Grade 1 land is found in pockets throughout the area, with the bulk of it in the very eastern part of the area, in Bedfordshire and south of Oxford. Grade 2 land is more widely scattered but with clear bands occurring along the western scarp edge of the Chilterns, along the river valleys of Aylesbury Vale and in broad bands around the fringes of Birmingham.
- 7.6.6 HS2 may also affect the development potential of land, making it either more or less desirable to develop. This may be a direct effect; for example through the location of a station, which would present opportunities for development. It may equally be indirect; for example, by freeing capacity on other lines, such as the WCML, which may have adverse

or beneficial implications for those communities served by the classic network. (See also Section 6.5).

- 7.6.7 Where development potentially increases as a result of HS2, this may have secondary effects on other objectives; for example imposing pressures on natural or cultural resources or bringing about increased car use. Such cumulative or secondary issues (see *Appendix 1*) have been considered by the AoS.
- 7.6.8 Green belt land is considered under sustainable consumption and production since in the UK it is principally a policy for controlling urban sprawl and coalescence of urban areas⁹⁸.
- 7.6.9 **Future baseline:** Areas proposed as a focus for development in LDDs, RSs and national government reports have already been referred to above. These would involve further development on greenfield land, some of which is high-quality agricultural land.

Minerals

- 7.6.10 Numerous areas are safeguarded for their mineral deposits. River sands and gravels are found, in varying quantities, accompanying every major river system in the UK as they are formed by the natural processes of flooding and sea level change that have affected drainage basins throughout time. There are major quarried deposits on the western side of the Chilterns in Buckinghamshire and Oxfordshire, and around the eastern outskirts of Birmingham, as well as more scattered deposits in Warwickshire.
- 7.6.11 Limestone deposits occur within a band that runs north-east from the Cotswolds, including areas in north Oxfordshire and west Northamptonshire. There are small outcrops of igneous rock in Leicestershire which, because they are well placed to serve markets in the south-east, are of economic importance out of proportion to their relatively small size, accounting for over 30% of total igneous rock production in Great Britain. These deposits are generally on the northern edge of the area between London and the West Midlands.
- 7.6.12 **Future baseline:** Mineral extraction will continue in the future. For instance, the South East Plan calls for the delivery of 13.25 million tonnes per year (1 million from Buckinghamshire, 1.82 from Oxfordshire) plus 1 million tonnes of crushed rock per year from Oxfordshire⁹⁹; and the West Midlands Regional Strategy calls for 5.8 million tonnes of crushed rock (0.9 from Warwickshire) and 10.1 million tonnes of sand and gravel (1 from Warwickshire, 0.5 from West Midlands County) per year¹⁰⁰.

Materials and waste

- 7.6.13 Material use and waste generation would arise as a function of the proposed railway's design, location and associated landtake. The railway would require bulk materials, such as concrete, aggregate and steel, and would give rise to waste materials, including both inert spoil and hazardous waste.
- 7.6.14 A longer HS2 route would require more bulk products such as concrete and steel, and involve more land take. Equally, areas of more varied topography, such as the rolling Warwickshire landscape, could require more extensive structures, such as viaducts, embankments and tunnels. The flat Aylesbury Vale on the other hand would present fewer engineering challenges.
- 7.6.15 Requirements for tunnelling in particular have significant implications for materials, and cost, as well as for the spoil management and disposal which imposes its own pressures on the land resource.

⁹⁸ CLG (1995) Planning Policy Guidance 2: Green Belts

⁹⁹ Policy M3 of Government Office for the South East (2009) The South East Plan: Regional Spatial Strategy for the South East of England

¹⁰⁰ Policy M2 of Government Office for the West Midlands (2008) Regional Spatial Strategy for the West Midlands.

- 7.6.16 **Future baseline:** Generally, the appraisal has assumed that all extant land and minerals resources, as recorded in relevant land use planning documents at the time of writing, would remain active up to and during the assessment years.
- 7.6.17 Annual landfill requirements are expected to decrease in the future, in response to efforts to reduce, reuse and recycle waste. For instance, the South East Plan calls for 9.21 million tonnes of landfill in 2008, dropping to 4.51 million tonnes in 2026¹⁰¹. However, new landfill sites will still be required, as will new waste management facilities which may introduce new constraints to HS2 in the future.

7.7 Existing sustainability problems and sensitive areas

Summary of issues

- 7.7.1 In summary, the main existing sustainability problems in the area between London and the West Midlands are:
- CO₂ emissions by road and air transport and power generation;
 - ongoing development pressures on the landscape, green belt, historic and cultural resources, tranquility, biodiversity and agricultural resource;
 - unfavourable condition of parts of the Mid Colne Valley SSSI and Helmdon disused railway SSSI; and of the whole River Blythe SSSI;
 - general low attainment of good ecological status by rivers and lakes, particularly around Birmingham, Coventry, Leamington Spa and Aylesbury;
 - flood risk on the River Colne west of London, the River Ray around Bicester, the River Thames west of Aylesbury, the River Cherwell and Oxford Canal north and east of Banbury, the River Avon south of Warwick and Leamington Spa and east of Coventry, and the River Tame east and north of Birmingham;
 - poor air quality in parts of London and Birmingham, and in a few locations along the proposed HS2 route;
 - relatively high noise levels in much of London and the West Midlands conurbation, and along the motorways and main roads between them;
 - deprivation in the Euston area, Milton Keynes, north-east of Coventry, and Birmingham centre; and
 - ongoing mineral extraction and waste disposal, with consequential environmental and social impacts.

Sensitive locations

- 7.7.2 Some of the key sustainability issues will be relevant to the scheme as a whole, such as those related to greenhouse gases, economic prosperity and air quality (for impacts resulting from modal shift). Other key sustainability issues will be more location specific, but in general terms may be distinguished according to whether they are in a rural or urban setting.
- 7.7.3 In urban locations the main challenges for HS2 moving forward would be those relating to people and the communities they live in. These include:
- health and equality issues around Euston and Washwood Heath, Birmingham;
 - noise (where existing noise levels may be high and therefore exacerbated by HS2 pushing it above significance thresholds) and vibration;

¹⁰¹ Policy W13 of Government Office for the South East (2009) The South East Plan: Regional Spatial Strategy for the South East of England.

- air quality around stations (particularly where air quality is already poor);
- direct impacts on property, where the urban fabric may be dense and therefore susceptible to impact from demolition;
- health and equality, especially for locations with relatively high levels of deprivation; and
- townscape and historic resources, including a high incidence of listed buildings and conservations areas.

7.7.4 The areas where some or all of these issues are most prevalent are Euston; Old Oak Common and the area to its west, including suburbs of London in North Ealing, Ruislip, Wembley, and Greenford; the approach to Birmingham (Castle Bromwich, Bromford, Castle Vale, Vauxhall, Saltley and Gilson); and central Birmingham around the proposed terminus.

7.7.5 In rural areas, the main sustainability challenges include:

- landscape and the features from which its character derives;
- susceptibility of communities to noise and visual impacts;
- historic resources, particularly scheduled monuments, registered parks and gardens and historic battlefields;
- biodiversity and the habitats on which it depends;
- water resources, including river catchments and rivers;
- areas of high tranquility, due in particular to rural isolation and low noise; and
- soil and land resources, including agricultural land, green belt and minerals sites.

8 Sustainability of the HS2 proposed scheme

8.1 Introduction

8.1.1 This section reports the results of the AoS. Findings are reported in turn for each of 18 key sustainability issues as follows. They should be read in conjunction with the AoS framework and detailed plans, contained in Volume 2 to the main report.

Reducing greenhouse gas emissions and combating climate change

- 1: Climatic factors and adaptability
- 2: Greenhouse gases

Natural and cultural and resource protection and environmental enhancement

- 3: Landscape
- 4: Cultural heritage
- 5: Biodiversity
- 6: Water resources
- 7: Flood risk

Creating sustainable communities

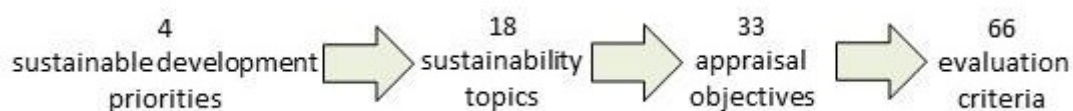
- 8: Air quality
- 9: Noise and vibration
- 10: Community integrity
- 11: Accessibility
- 12: Health and well-being
- 13: Security and safety
- 14: Economic prosperity
- 15: Economic welfare

Sustainable Consumption and Production

- 16: Soil and land resources
- 17: Waste generation
- 18: Resource use

8.1.2 Full details of the appraisal information are contained in the AoS framework for the proposed scheme contained in *Volume 2*. The framework is structured around the evaluation criteria developed for the AoS that underlie the objectives. The cascade of increasingly more in depth analysis of options is illustrated by **Figure 25**. The evaluation criteria used in the frameworks for the appraisal of the proposed scheme include some criteria not used at Stage 3 (see *Appendix 1*), for which information was unavailable or which did not directly affect the sifting process.

Figure 25 – The cascade of increasing appraisal detail



- 8.1.3 A considerable amount of work has been undertaken to date to ensure that any potentially adverse effects of HS2 are kept as low as practicable, and that a proposed scheme has been defined that is ahead (often well ahead) of numerous alternatives. However, HS2 would be a substantial piece of engineering and, although its benefits and opportunities are clear, a number of adverse effects would also arise and these would require further consideration as designs are developed. Mitigation to date has focused on the big issues of avoiding and, to some extent, minimising impacts through careful scheme alignment. However, there remains scope to implement further mitigation and some of the adverse impacts reported here could be reduced or avoided altogether through application of more detailed mitigation proposals commensurate with an increased level of design. Identification of mitigation options would be one of the key functions of EIA should the project proceed.

8.2 Climatic factors and adaptability

Overview

- 8.2.1 The proposed scheme would support the objective of improving the resilience of the rail network to extreme weather events brought about by predicted climate change. The future climate in Britain over the next 50 years or so, when HS2 could be in operation, is likely to be different from now – with generally hotter, drier summers and warmer, wetter winters combined with a possible increase in extreme weather events.
- 8.2.2 Increased rainfall is likely to be a key outcome of climate change. The principal ways that this could affect the scheme would be through increased episodes of flooding and through increased risk of landslip during flooding events. Areas at risk of flooding¹⁰² and land vulnerable to landslip have therefore provided proxies for considering this issue; flood risk in particular has been important in determining where viaducts would be needed to raise the track above potential flood levels.
- 8.2.3 To help ensure the climate resilience of HS2, it would be designed, built and operated to take account of projected impacts of climate change over the scheme's operational lifespan. In particular, in areas already likely to flood now and increasingly so in the future, HS2 would be constructed on low viaduct. Additional protection would be given to particularly vulnerable parts of the network such as tunnel entrances and electricity supply locations. Were the scheme to be taken forwards, opportunities would be sought for active environmental gain with respect to these issues. Furthermore, by setting new standards, any future investment in other rail infrastructure would be expected to at least meet these same standards resulting in wider benefits from the network as a whole.

Flood risk to HS2 due to climate change

- 8.2.4 Climate change predictions indicate that the incidence and severity of flooding will increase. The Environment Agency has determined that the impact of climate change flooding will be a +20% increase in fluvial (river) flood levels.
- 8.2.5 The AoS determined the length of the proposed route through land predicted to flood more frequently than 1 in every 100 years (Flood Zone 3¹⁰³), and land predicted to flood less frequently than 1 in 100 years but more frequently than 1 in 1000 years (Flood Zone 2¹⁰⁴). About 16km of the surface route (some 7% of its total length) would cross Flood Zone 3, all of which is susceptible to increased incidents of flooding due to climate change. The

¹⁰² This objective considers how changes in climate (in particular increased flood risk) might impact the operation of the recommended scheme. The effect that the presence of HS2 might have in terms of flood risk to people and property is covered in Section 7.8, Flood Risk.

¹⁰³ Flood Zone 3 includes areas that regularly flood (flood plains) or that are at high risk of flooding (deemed by the Environment Agency to be a greater than a 1 in 100 year event)

¹⁰⁴ Flood Zone 2 is land in higher ground that flood more often than 1 in 1000 years, and includes all land within Flood Zone 3 (as categorised by the Environment Agency).

outline design of the proposed scheme assumes that all of this would be on viaduct to ensure its protection from flood events.

- 8.2.6 The proposed route would also cross a total of about 19km of Flood Zone 2 land. Although consideration of one in 1000 year events is usually far in excess of the flood design criteria for this type of infrastructure, it serves as a rough measure of resilience to the effects of climate change. Practical considerations may be to allow sections of the line to flood during less frequent flood events, but on critical sections where the consequences of flooding are particularly severe, such as at the entrance to tunnel sections or around electrical feeder stations, the standard of protection would be raised to reduce any residual risk to an acceptable level.

Landslip risk

- 8.2.7 There are no cuttings proposed within areas identified as having significant landslip potential; but some 63km of cutting would traverse areas with moderate landslip potential¹⁰⁵. Although this presents a risk to the scheme, it is something that can be mitigated through engineering measures such as shallow cutting slopes or reinforced cutting faces.

Other possible risks

- 8.2.8 There are other aspects of railway operation, particularly in terms of safety hazards, identified as being weather and climate related. Further climate change therefore has the potential to increase the system's susceptibility to weather related hazards¹⁰⁶ and detailed design of HS2 would need to accommodate these where practicable. Scenarios may include:
- Reduced rain: reduced summer rainfall and increased summer temperatures may lead to settlement of structures.
 - Wind: anticipated increased incidence of high winds could be significant if it reaches threshold levels at which this affects the railway, for example through overhead line damage, impact on vehicle stability and tree-fall.
 - Temperature: anticipated increased incidence of extremes in temperature could be significant if it reaches threshold levels at which this impacts on the railway, for example through potential rail buckling or overheating of equipment.
 - Lightning: not considered likely to be a major issue but the associated electromagnetic interference could have implications for increased risk.
 - Vegetation: various risks associated with vegetation include leaf-fall related risks and fallen trees. Efforts directed towards vegetation management are expected to be able to address these risks.

¹⁰⁵ British Geological Survey (2002) National Landslide Database and Landslide Hazard Assessment of Great Britain

¹⁰⁶ Rail Safety and Standards Board (April 2003) Safety implications of weather, climate and climate change

Summary of generic mitigation measures for climate resilience

Incorporated mitigation:

- Design assumes that all sections of proposed surface route that cross Flood Zone 3 would be on viaduct (track raised on piers) to ensure its protection.

Mitigation options:

- On critical sections of the proposed route such as tunnel entrances, consideration to be given to increasing flood protection to deal with 1 in 1000 year events.
- Adopting highly permeable construction form, such as numerous culverts or viaduct, across all Flood Zone 2.
- Where cuttings would cross areas of moderate landslip potential, engineering to ensure protective measures, such as shallow cutting slopes or reinforced cutting faces.
- Detailed design to consider implications of rising temperatures; e.g. measures to mitigate against settlement to structures or rail buckling.
- Detailed design to consider how potential for wind damage to infrastructure assets could be reduced to a practicable minimum.
- Vegetation management processes that reflect changing climate may be required in the long term.

8.3 Greenhouse gases

Overview

- 8.3.1 The construction of the proposed scheme would result in greenhouse gas emissions from its construction and the requirement for new rolling stock. However, the magnitude of these impacts is over-shadowed by the range in uncertainty associated with operational impacts. Sensitivity analysis indicates that a reduction in carbon emissions for the proposed scheme could be achieved, although this would require an assurance that reductions in domestic air travel due to HS2 are secured, and that any landing and take-off slots potentially freed at airports as a result of this modal shift were not subsequently used by carriers to operate wholly new more carbon-polluting international services. It would also require strong delivery of policies to reduce the carbon intensity of electricity generation. A fuller presentation of the appraisal of greenhouse gas emissions is presented in *Appendix 2*.
- 8.3.2 Extending the scheme north of Birmingham would increase the opportunity for modal shift from air to rail and the scheme could, therefore, become more supportive of the objective to reduce UK greenhouse gas emissions, subject to any reductions in air travel due to HS2 being secured. Current work to develop options north to Manchester and Leeds will include further appraisal of greenhouse gas emissions.
- 8.3.3 The appraisal of the impact of the proposed scheme on UK greenhouse gas emissions has focused on:
- operational carbon: associated with the net emissions of carbon due to the operation of the scheme and changes in the extent of road, rail and air travel using an appraisal period of 60 years; and
 - embedded carbon: associated with the construction of the scheme and manufacture of the rolling stock required for its operation.
- 8.3.4 Taking all of these potential outcomes into account, it is not possible to say with certainty whether HS2 would result in an increase or a decrease in CO₂. Using the main assessment scenario (see 8.3.13), at worst, over 60 years HS2 could result in an overall increase in carbon emissions of approximately 24 million tonnes; at best it could result in an

overall decrease of approximately 28 million tonnes. However, whichever scenario takes shape, the contribution of HS2 would be insignificant when compared to wider transport emissions in the UK, particularly from road vehicles.

8.3.5 These are discussed below having first set out the key drivers upon which the overall carbon emissions of the project would depend in practice.

Key drivers to reduce carbon emissions

8.3.6 With limited information available at this time on construction methods and materials and only preliminary output available from the demand model to determine operational net emissions, the focus in this section is to identify where the greatest reductions in carbon emissions may be expected and what effect these reductions would have in assessing the proposed scheme. In their likely order of importance to the net carbon footprint of HS2, these would be as follows:

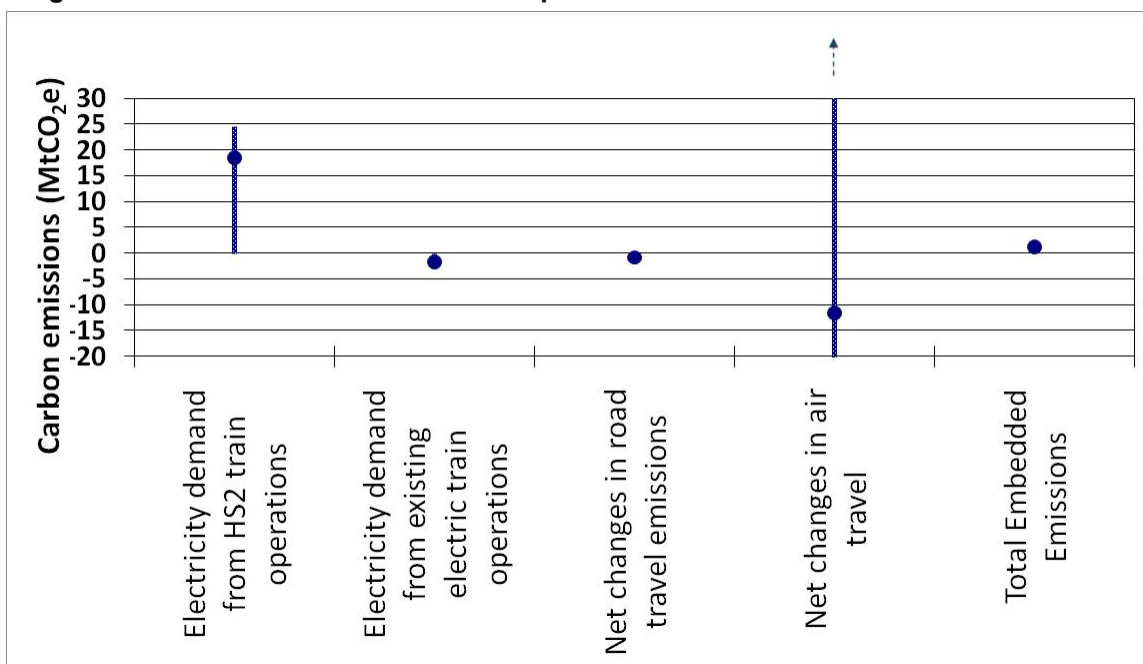
Primary issues:	<p>The greatest potential benefit for HS2 in terms of carbon emissions would be associated with people using it in preference to air travel. This benefit would only be realised if any reduction in air passenger numbers results in reduced numbers of flights. This study considers three scenarios, ranging from the most optimistic to the worst case, with a no change scenario in between.</p> <ul style="list-style-type: none"> • The most optimistic scenario assumes that the total number of journeys shifting from air to HS2 would be divided by the number of seats on the average domestic flight to derive the total reduction in the number of domestic flights. The important assumption is then made that the freed up landing and take-off slots at UK airports would remain unused, resulting in a net reduction in carbon emissions. • The worst case scenario is that HS2 would result in freed up landing and take-off slots which are then used up to meet demand for entirely new international flights, resulting in a net increase in carbon emissions. The magnitude of this potential net increase in emissions has not been quantified at this time as further analysis is required to determine the additional carbon emissions associated with projected international travel demand. • The no change scenario assumes the reduction in passenger numbers on any individual flight would not be sufficient for the airline to discontinue the service and hence, aviation emissions remain unchanged against the baseline.
Secondary issues	<p>The UK Government is committed to reducing the carbon intensity of electricity generation by 2050, to between 14% and 40% of that achieved today. This would have the effect of reducing both embedded and operational emissions from HS2, reducing the change in emissions associated with a shift from existing electric rail to HS2 and increasing the change in emissions associated with a shift from road to HS2 and air to HS2. The UK Low Carbon Transition Plan outlines how the UK will cut emissions from electricity generation and other sectors¹⁰⁷. The most optimistic and worst case scenarios were also considered, with the most optimistic scenario being 100% use of renewables and nuclear to generate electricity and the worst case being no change from the current carbon intensity.</p>

¹⁰⁷ Other papers published in tandem with the Transition Plan include The Low Carbon Industrial Strategy, The Renewable Energy Strategy and Low Carbon Transport: a Greener Future.

Tertiary issues	<p>The increased use of recycled materials in construction (e.g. steel, the development of new blends of concrete that are less carbon intensive and use of existing techniques to optimise efficiency of construction) would reduce the embedded carbon emissions.</p> <p>A revised route alignment to minimise tunnel sections would reduce embedded carbon emissions.</p> <p>Any changes to the proposed stopping pattern would also impact upon load factors, modal shift and generated traffic.</p>
Quaternary issues	<p>The aviation industry continues to work to reduce the carbon intensity of air travel by increasing passenger loading, using lighter, more fuel efficient aeroplanes and developing aviation fuels blended with bioethanol. A key incentive for this is the inclusion of the aviation sector within the EU Emissions Trading Scheme, which will theoretically cap carbon emissions from flights entering and departing the EU at the average emissions between 2004 and 2006. These measures would have the effect of reducing the emissions associated with a shift from air to HS2.</p> <p>The UK Government is committed to reducing the carbon intensity of motor vehicles, through promotion of more efficient, smaller engine vehicles, blending of bioethanol in petrol and diesel, and electric vehicles. This would have the effect of reducing embedded emissions from HS2 (or that part linked to construction traffic) but would reduce the change in emissions associated with a shift from road to HS2. Government mechanisms for the reduction of emissions from motor vehicles include: improving the fuel efficiency of vehicles; reducing the fossil carbon content of transport fuel; increasing the care that people take over fuel consumption while driving; and promoting adoption of hybrid and electric vehicles.</p>

8.3.7 The carbon emissions for the proposed scheme, including operational and embedded carbon, highlighting the key policy drivers are illustrated in **Figure 26**. This shows the degree of uncertainty in predicting how the factors that affect the HS2 carbon footprint would change in the future, with the emissions due to HS2 energy demand and from net changes in air travel showing the greatest degree of uncertainty and potential for variation. The two most important determinants of the scheme’s carbon performance – the impact on modal shift from air to rail and the carbon efficiency of power generation – are also two of the most uncertain.

Figure 26 – Net carbon emissions from operational and embedded sources



Previous studies

- 8.3.8 A study in 2007 by Booz Allen Hamilton and Temple Group for the DfT¹⁰⁸ demonstrated that a key determining factor for carbon efficiency of high speed rail was the geographical scale of such an initiative (city to city routes). The construction (embedded) carbon element was expected to be substantial, and only where significant modal shift (from air to rail) was possible, was a net carbon reduction (embedded carbon less operational carbon) achieved. Routes options from London to Birmingham and London to Manchester were found to make a net contribution to carbon emissions, as the operational carbon savings achieved through modal shift would not compensate for the construction related carbon emissions. Routes from London north to Scotland would reduce net contributions to climate change where sufficient modal shift was achieved.
- 8.3.9 A more recent analysis by the Association of Train Operating Companies (ATOC) for Greengauge 21¹⁰⁹ has found significant carbon benefits associated with high speed rail. The ATOC report argues that the carbon advantage of high speed rail over other methods of travel is likely to improve over time and therefore concerns about the carbon impact of rail at higher speeds needs to be put into context. In particular, its carbon advantage per passenger-km over new (conventional combustion engine) cars would remain at least three times greater. Moreover, there is an argument that higher quality journeys are enjoyed on high speed rail compared to air travel, with significantly less disruptions associated with security checks, boarding, etc, as well as greater potential for wireless communications and use of IT equipment. This may drive modal shift more from air to high speed rail than simply accounting for differences in journey time¹¹⁰.
- 8.3.10 Further studies include those carried out by Network Rail¹¹¹, where work demonstrated the significant net benefit of high speed rail services over equivalent conventional services in terms of energy consumption and carbon emissions (see Section 7.3).

Operational carbon

- 8.3.11 Net emissions of CO₂ (taking account both of HS2 emissions and any indirect changes in wider emission levels that result from the introduction of any new service, particularly associated with modal shift) are extremely uncertain, as has been explained earlier. For the AoS, two scenarios have been used that employ different methods and different assumptions. These are described in *Appendix 2*.
- 8.3.12 Electricity generators are in the EU emission trading scheme (EU-ETS), and from January 2012, the aviation sector will also be included within it. In theory, therefore, any increase in emissions from these sectors would need to be allowed for by savings made elsewhere across the EU economy. However prediction of absolute emissions is provided here to clarify the impact of HS2 in its own right.
- 8.3.13 **Table 3** summarises the key elements to each of the two scenarios, labelled A and B. Fundamentally, Scenario A (the main assessment scenario) uses extremes in order to establish a middle figure that represents one possible situation; Scenario A has been used to generate the carbon figures more widely used by HS2 Ltd in its published material. Scenario B varies these assumptions, so that a range of possible emission figures is generated to represent other possible situations.

¹⁰⁸ DfT (2007) Estimated Carbon Impact of a New North-South Line. Report by Booz Allen Hamilton and Temple Group

¹⁰⁹ Greengauge 21 (2009) Energy consumption and CO₂ impacts of High Speed Rail: ATOC analysis for Greengauge 21

¹¹⁰ http://business.timesonline.co.uk/tol/business/related_reports/europe_by_train/article6921715.ece

¹¹¹ Network Rail (2009) Comparing environmental impact of conventional and high speed rail

Table 3 – Scenario A and B definitions

Primary source	Scenario A assumptions	Scenario B assumptions
Net changes in air travel	From a maximum reduction in domestic flights, with no re-use of freed up slots, to no change in domestic flights	From a maximum reduction in domestic flights, with landing /take-off slots either not re-used or re-used for international flights
Electricity demand from: <ul style="list-style-type: none"> • HS2 train operations; and • existing electric train operations 	Carbon intensity from zero (100% renewables and/or nuclear) to that achieved today	Carbon intensity of electricity is reduced to between 14% and 40% of that achieved today
Net changes in road transport emissions	Range in emissions reflect variations in speed associated with reduced vehicle kilometres travelled	Range in emissions reflect variation in speed and introduction of new vehicles, including electric vehicles

- 8.3.14 In terms of electricity use by HS2, increased carbon emissions from electricity generation would arise under both scenarios. Scenario A, predicts carbon emissions over 60 years in the range 0 to 24.6 MtCO₂e. Scenario B predicts carbon emissions over 60 years between 13 and 24 MtCO₂e.
- 8.3.15 Considering impacts from modal shift of car to rail, both scenarios forecast a slight reduction in carbon emissions over 60 years. Scenario A predicts a net carbon emission reduction of between -0.8 and -2.2 MtCO₂e. Scenario B predicts net carbon emission reduction of between -0.7 and -1.3 MtCO₂e.
- 8.3.16 These emissions are overshadowed, however, by the range in uncertainty associated with the potential for net changes in emissions from air travel, as illustrated earlier in **Figure 26**. Scenario A assumes that any freed landing and take-off slots resulting from displaced domestic flights would remain vacant. Under the most optimistic situation of Scenario A, which sees all relevant domestic flights displaced by HS2, the estimated net *reduction* in air travel related carbon emissions would be around -23.2 MtCO₂e over 60 years. Scenario B uses the same best case as Scenario A, but uses a worst case of freed up slots being taken by entirely new international (and potentially long-haul) flights (i.e. not transferred services from other airports). In this case, a net increase in carbon emissions would occur. In practice, however, the effects would be more complex; for example, freed slots could be re-filled by flights from other, less attractive, airports either in the UK or Europe; in this case carbon impacts would depend on how these other vacated slots were used. The introduction of new flights within vacated slots might even reduce the need for interconnecting flights within Europe.

Embedded carbon

- 8.3.17 The proposed scheme would require construction of twin tracks over some 225km including tunnel sections for about 29km. This is estimated to require some 1.4 million tonnes of concrete and about 0.22 million tonnes of steel in addition to a range of other materials. Carbon emissions associated with the manufacture and transport of these materials has been estimated, along with potential construction site activity (e.g. tunnel boring machine). The embedded carbon of the proposed scheme is estimated to be 1.2 MtCO₂e (between the range 0.29 to 2.12) about of which 20-25% arises from tunnelling. There is a significant range of uncertainty at this time, reflecting the limited information available in terms of construction methodology, for example, but also highlighting the opportunity to reduce embedded carbon through selection of materials, particularly concrete and steel.

8.4 Landscape and townscape

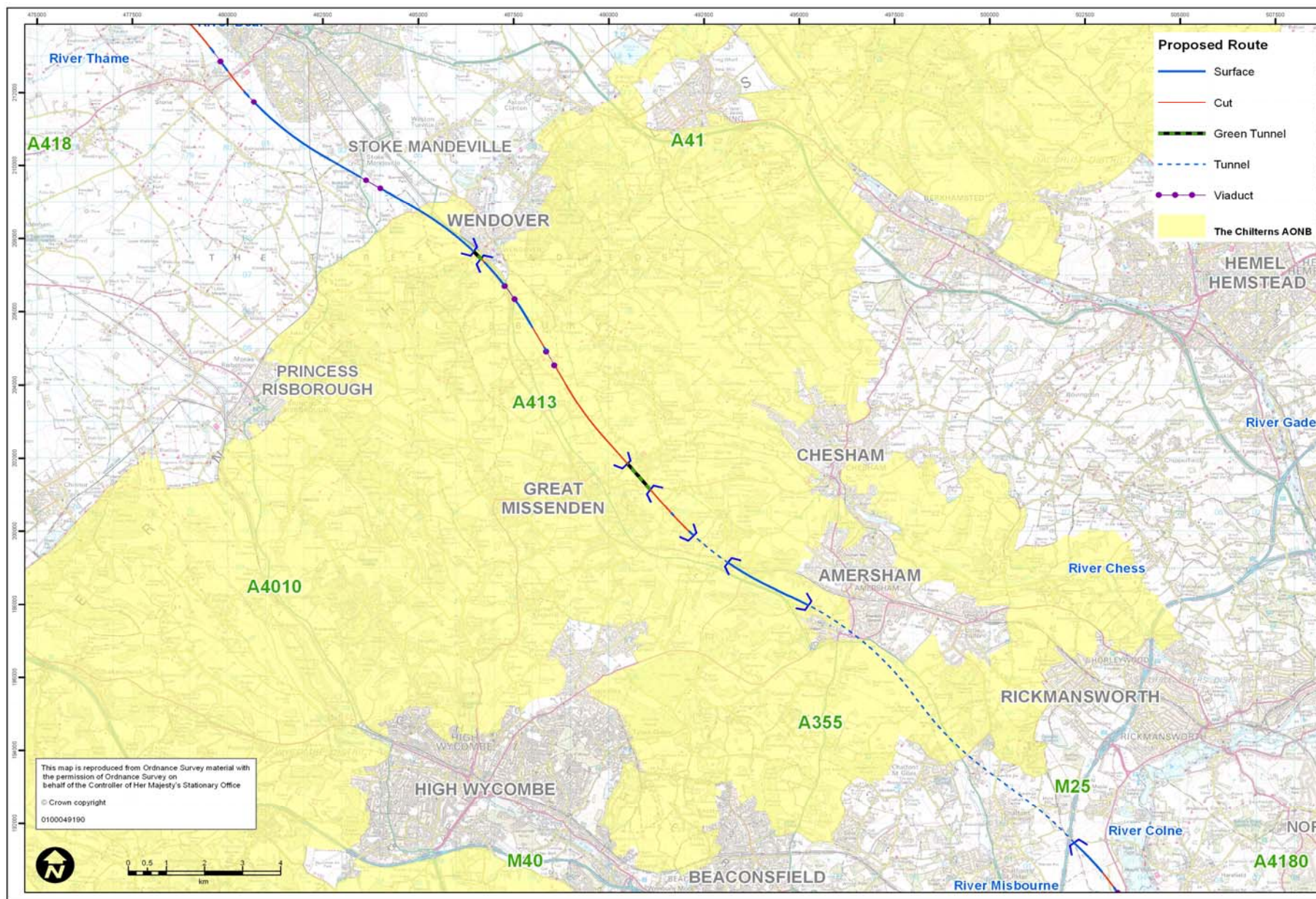
Overview

- 8.4.1 The proposed scheme would result in adverse impacts on landscape character, although much has been done to reduce the potential severity of these through rural areas. Many of the landscape impacts would stem from the proposed route through the Chilterns, although other relatively remote areas in Northamptonshire and Warwickshire would also be adversely affected. The further reduction of these impacts as far as is practicable would be a key aspect for ongoing design. Realignment has been made to take the proposed line further from settlements, such as Mixbury and Brackley. The lowering of the proposed alignment in places has also helped to reduce its potential visual impact, along with the introduction of green bridges, where covering over lengths of route in cutting would help to maintain the continuity of the landscape and screen views of the railway; for example past Amersham and Little Missenden, and at South Heath, Chipping Warden and Burton Green. A number of potential impacts remain, but many of those identified for the March 2010 preferred scheme have been avoided or substantially reduced. Through the Chilterns, of the 20.5km of railway that passes through the AONB all but 2km is either in tunnel, in cutting and/or alongside the A413 main road. Extensive tree planting, as well as the creation of planted earth bunds would help to screen further views and integrate the railway into the landscape.
- 8.4.2 The high level nature of the AoS has focused the attention of landscape appraisal on designated features, as well as, at a preliminary level, on tranquility as defined within the CPRE study (see Section 7.5.25). Later assessment as part of EIA would include a detailed landscape character appraisal, which would help to guide further design modification that might be required; for example through areas of sensitive but undesignated landscape in Warwickshire. It would also help to identify specific features of local landscape significance that might warrant protection.
- 8.4.3 Townscape impacts would result from various works particularly at Euston, in West London between Old Oak Common and West Ruislip, and in Birmingham. However, there would be good opportunities at the station locations to create outstanding new structures and spaces that would enhance the townscape settings.

Landscape

- 8.4.4 Appraisal of landscape principally considered the implications of the proposed scheme on designated landscape resources. Impacts on the landscaped grounds of country estates are addressed under cultural heritage.
- 8.4.5 A considerable focus of design work has been on the crossing of the nationally significant landscape of the Chilterns AONB as shown in **Figure 27**. The AONB extends for some 75km between Hitchin in the north and the River Thames north of Reading in the south and therefore presents a major challenge to any feasible high speed route alignment between London and the West Midlands. Given the sensitivity of the AONB in this area the development of the proposed route has sought to integrate the line within the landscape as far as practicable. Some 6.5km of the route would be in tunnel and in the northern part of the Chilterns over 5km of the surface route would be within an existing transport corridor, running alongside the A413 arterial valley. In total, around 9km of the surface route would be in cutting and therefore fully or partially hidden from many views. At this stage of design development, the length of surface route (including cutting) through the AONB is about 14km and adverse impacts on the character of this area would occur. But revisions to the scheme design have reduced the magnitude and it would be possible with further earthworks to provide bunds (earth banks) and false cuttings that would further conceal the alignment.

Figure 27 – The Chilterns AONB



- 8.4.6 Outside the Chilterns, adverse impacts on landscape would affect more remote and tranquil parts, such as the rolling hills around the Northamptonshire-Warwickshire border, between Edgcote and Ladbroke, and the valley views around Long Itchington and Offchurch in Warwickshire. As with the route through the Chilterns, further design has helped to reduce the impacts predicted for the March 2010 preferred scheme at locations around Brackley, Southam and Stoneleigh, and detailed design would seek to further reduce impacts, supported through the findings of landscape character appraisal.
- 8.4.7 The potential impact of the proposed scheme on tranquility has been considered through visual inspection of the route overlaid on the tranquility map (see **Figure 24**). This suggests that the most tranquil areas potentially affected by the scheme would be north-west of Aylesbury between Waddesdon and Twyford in Buckinghamshire; and between Greatworth in Northamptonshire and Ladbroke and Southam in Warwickshire. (See also Section 8.10.25, which considers tranquility from a noise perspective).
- 8.4.8 No other nationally designated and protected landscape resources would be significantly affected, although lesser impacts would affect some regional resources, namely various country parks (Denham, Bayhurst Wood, Sheldon and Kingfisher country parks and Kingsbury Water Park) from which views of the proposed scheme would be possible. A number of woods would also be affected (see Section 8.6.6).

Townscape

- 8.4.9 Appraisal of townscape considered the implications of the proposed scheme for the coherence and distinctiveness of townscape resources, and for strategically important views and key vistas. No architectural design concepts are yet in place for any of the key structures, and on that basis the potential impacts have assumed a reasonable worst case. There is substantial scope to deliver townscape benefits with effective architectural treatment of stations and other structures. In particular, the existing Euston station is of little architectural merit and its replacement could offer potential for substantial improvement. Equally, a number of townscape impacts assume a degree of demolition that may well be avoided or substantially reduced in practice, although certain demolitions, most notably the existing station concourse building and the disused carriage shed at Granby Terrace, could help to enhance the townscape character if undertaken as part of a wider redevelopment of the area. The new station concourse would offer opportunities to create a more open route through an area severed by the existing building.
- 8.4.10 Both the London and Birmingham termini would be located within areas whose townscape is characterised by some notable architectural heritage. The new Euston station would require a number of demolitions on Cardington Street and Melton Street including some prominent buildings. The proposals would require landtake, including the majority of St James Gardens, and would abut the historically significant Euston Square Gardens, which lie within the Bloomsbury Conservation Area. Proposals for the replacement of open space lost at St James Gardens would be a consideration within the joint ambition for the Euston area between HS2 Ltd and the London Borough of Camden (see 8.16.12).
- 8.4.11 Plans for the HS2 station have been devised to preserve the Grade II* listed 194a Euston Road and, in particular, to maintain the frontage of the conservation area adjacent to the Euston Road. As discussed in 6.5.10, the London Borough of Camden proposes to use any new station at Euston as a springboard for wider regeneration of the area and as a core part of its masterplan. This would be expected to yield substantial improvements through the redevelopment of more run-down parts around the existing station.
- 8.4.12 The new buildings and compounds which would need to be constructed over the intervention/ventilation shafts for the London tunnels would give rise to some visual impacts for nearby residents, but the sites are generally amidst other industrial land uses and close to existing railway infrastructure. In the Chilterns, there is greater scope to vary the location of shaft site compounds. The areas currently proposed have been selected to limit

environmental impact but further work would be undertaken to refine these locations and layouts.

- 8.4.13 Connection with the Curzon Street terminus in Birmingham would also require a number of demolitions and pass through an area, in Freeman Street and Seymour Street, of limited industrial heritage and townscape quality, as much of its integrity has been lost. The route would also intersect a small section of the Warwick Bar Conservation Area and would have adverse impacts on the setting of this area. However, as with Euston, Birmingham Curzon Street station lies in an area proposed for major redevelopment. The regeneration of Eastside is a fundamental civic ambition and is a key part of the City Council's Core Strategy (see 6.5.17). The proposed terminus could be integral to positive townscape change.
- 8.4.14 At Old Oak Common, the London Borough of Hammersmith and Fulham also views HS2 as a potential major catalyst for regeneration, and has plans to use the transport interchange to launch substantial residential and commercial/industrial redevelopment (see 6.5.12), with significant, largely beneficial, implications for the townscape.
- 8.4.15 West of Old Oak Common the new surface route would run on the trackbed of the existing railway along the Northolt corridor. The proposed widening of the rail corridor has been kept as narrow and within the existing railway corridor as far as possible, through the use of retaining walls. A number of locations along the route would require the demolition of buildings. These are dispersed along this route section and would affect small numbers of residential properties to the east of West Ruislip station.

8.5 Cultural heritage

Overview

- 8.5.1 The proposed scheme would adversely affect a number of archaeological assets, historic buildings and historic landscapes. Considerable work has been undertaken since March 2010 to mitigate impacts on the designated parks and gardens that would have been affected by the March 2010 preferred scheme. Potential impacts at Shardeloes, Hartwell House (see above) and Stoneleigh are now significantly reduced as are those affecting the 18th century grounds of Edgcote House, although at the latter a scheduled monument would now be adversely affected. Grim's Ditch scheduled monument would also be physically impacted by the proposed scheme, as it was by the March 2010 preferred scheme.

Archaeology

- 8.5.2 The appraisal of archaeological assets considered impacts on world heritage sites and scheduled monuments. No world heritage or other internationally important sites would be affected by the proposed scheme. Two scheduled monuments would be physically impacted by the route:
- Grim's Ditch in the Chilterns, west of South Heath. Grim's Ditch is a name shared by a number of Iron Age bank and ditch earthworks across the chalk uplands of southern England. The proposed scheme would remove some 23m of the ditch at this location.
 - Remains of a Roman-British Villa within the grounds of Edgcote House. This impact results from realignment to reduce impacts on views from the Grade I listed Edgcote House and on the ornamental lake, that would have resulted from the March 2010 preferred scheme. The proposed scheme would affect about 1.5ha of the monument, resulting in landtake to around a third of the designated site.
- 8.5.3 Where these sites cannot be avoided, some remedy could be achieved through excavation and record, involving a phased programme of archaeological work. This would need to be agreed with English Heritage.

- 8.5.4 Five scheduled monuments lie within 350m of the proposed scheme and would potentially have their settings adversely affected.

Historic buildings

- 8.5.5 The historic importance of buildings is determined, at a national level, through their grading by the relevant statutory agency. The proposed scheme has been aligned so as to avoid any potential direct impacts on Grade I buildings. One Grade II* building, the Department of Health and Social Security building at Euston and associated railings at 194a Euston Road, lies immediately adjacent to the proposed new station concourse, but careful alignment has ensured that this would be avoided. However, 194a Euston Road would be very close to the new station and, as it is attached to the Grade II listed 9 Melton Street which would be demolished, 194a Euston Road would require very careful protection.
- 8.5.6 A second Grade II* building, Park Farmhouse at Hampton-in-Arden, is close to the proposed car park for Birmingham Interchange Station. Construction would need to be carefully managed to minimise potential impacts on this building. Impacts on the setting of this building would however remain.
- 8.5.7 Eleven Grade I and twenty six Grade II* listed buildings lie within 350m of the proposed scheme and would potentially have their settings affected. This could be a positive change at Euston (seven and fourteen buildings respectively); and in central Birmingham (one and four buildings respectively). At Birmingham Curzon Street station, the Grade I listed former British Rail Goods Office would be situated about 25m from the HS2 platforms, so direct impacts are avoided but there would be impacts on its setting. However its current setting is poor and there would be opportunities for its enhancement.
- 8.5.8 A number of Grade II listed buildings would be affected. Fifteen would potentially be physically impacted including six at Euston and three by the Birmingham terminus at Curzon Street. A Grade II listed barn at Lavender Hall Farm in Berkswell would be likely to be demolished, with potential adverse impacts on the settings and context of the Grade II* listed Lavender Hall farmhouse.

Historic landscapes

- 8.5.9 Three Grade II* Registered Parks and Gardens would be physically impacted by the proposed scheme, but the impacts are all substantially less than would have resulted from the March 2010 preferred route. A green bridge covering the cutting north of Shardeloes would now largely screen views from the grounds, which have already been severed by the A413. At Hartwell House near Aylesbury, eastwards realignment by 75 to 85 metres would largely preserve the integrity of the landscaped grounds. Although still passing through the registered park, the route would affect ground that has already been remodelled and planted in recent years. The linear view from Hartwell House, which would have been significantly affected by the March 2010 preferred scheme, has now been largely avoided. The realignment has taken the scheme away from Hartwell House. This would place the line at the northern end of the avenue at a point where the existing ground level is generally higher and the avenue has been replanted in recent years. This would put the line in a deeper cutting and, with the removal of some newer avenue trees plus ground re-modelling, effective screening could be provided.
- 8.5.10 Re-alignment and lowering of the proposed route has reduced the degree of severance of the historic parkland at Stoneleigh near Kenilworth, which would now be largely avoided. The proposed route would be closer to the Grade II* listed and scheduled Stare Bridge, although well screened from it by woodland. The connection between and bridge and Stoneleigh village would, however, be maintained having been potentially severed by the March 2010 preferred route.

Figure 28 – The proposed route would run between Hartwell House and Aylesbury [HS2 Ltd]



- 8.5.11 Two Grade I Registered parks (The Regent's Park and Waddesdon Manor) lie within 350m of the scheme and could be subject to adverse impacts on setting, although this is unlikely.
- 8.5.12 Two larger areas of landscape considered within Natural England's Landscape Character Assessment to be of potential regional importance in historic terms, and traversed by the proposed scheme, comprise the Northamptonshire Uplands and the Chilterns.

Summary of generic mitigation measures for landscape, townscape and cultural heritage

Incorporated mitigation:

- Significant efforts have been made to mitigate potential impacts of the published scheme, particularly through better integration with landform. The section of the proposed line through the Chilterns has been lowered into tunnels and cuttings where reasonably practicable to do so, and the proposed route aligned to tie in with existing transport corridors. These have now been augmented by re-threading the proposed route past and through sensitive locations, further lowering of the route in places, and the introduction of 'green bridges'. This has been described further in Section 3.
- The development of the proposed route alignment and landtake requirements in urban areas have sought to reduce the impact on townscape to a practicable minimum; in particular attention has been given to townscape and listed buildings. In rural locations, the development of the proposed route alignment has sought, where possible, to reduce impacts on known landscape, townscape and heritage features and to seek landscape and visual integrity in listed parks and gardens. Examples of recent changes affecting registered parks and gardens have already been given.
- The known location and extent of archaeological sites and monuments has been taken into account in developing the recommended scheme and the alternatives.

Mitigation options:

- The appraisal has been undertaken without architectural design being in place with respect to form, massing and finishes. Adverse townscape impacts could be avoided or minimised and benefits could emerge on the basis of effective architectural treatment of structures such as viaducts and stations.
- Where practicable, the vertical alignment could be adjusted to avoid any identified deposits of archaeological significance.
- Refinement of route alignment to further utilise existing topography and land use features to screen views of route would be explored wherever practicable.
- Further design would consider the potential for additional earthworks to provide bunds and false cuttings to integrate the railway into the landscape and make substantial use of spoil from tunnels and cuttings along the route.
- Consideration could be given to the provision of replacement planting to mitigate landscape and visual impacts, especially those that occur during construction. In particular, the introduction of some two million trees along the rail corridor, as part of a general landscape mitigation strategy, would help to screen views and integrate the scheme within the landscape.
- Opportunities would be identified to introduce new planting and to promote high quality architectural treatment of civil structures.
- Tree retention could be adopted as a design principle where practicable and restrictions on working space could be imposed to avoid loss of trees. Where tree loss is unavoidable, replacement tree and shrubs could be planted close to their original location.
- Where vulnerable historic structures overlie a proposed tunnel, their structure and condition would be determined to give an indication of the risk of impact from settlement so that protective measures could be implemented.
- Measures to control visual impacts of the construction works would be implemented as part of a wider environmental management system that includes stipulating a code of practice for construction.

8.6 Biodiversity

Overview

- 8.6.1 Early route development has managed to avoid potential impacts on most designated habitats and sites. The proposed scheme would adversely affect some habitats along the route, although the design has sought to limit these. Sites of international importance would be avoided and impacts on nationally designated sites, limited, both due to the proposed route chosen and through adoption of mitigation within the design. Revisions to the March 2010 preferred scheme would result in avoidance of impact at Long Itchington and Ufton Woods SSSI, but would result in a new impact to Helmdon Disused Railway SSSI. There could be minor landtake at Sheephouse Wood SSSI, although further design would seek to minimise this risk.
- 8.6.2 Were the project to progress, continued design would seek to further protect habitats and wildlife, and opportunities would be sought to create new habitat and build on existing habitat, for example by extending or linking habitats along the route. Impacts on and protection of named protected species, along with wildlife communities generally, would be a consideration of EIA.

International and national sites

- 8.6.3 The proposed scheme would not affect sites of international importance (see the HRA screening report at HRA Screening Report, *Appendix 4.1*), although this would continue to be monitored were the design to be progressed. It would adversely affect some sites of national importance, although these would be very limited owing to careful scheme alignment. Scheme revisions have seen the lengthening of the proposed tunnel beneath Long Itchington and Ufton Woods near Southam, such that impacts on this SSSI are now almost wholly avoided. However, south of Radstone, realignment of the March 2010 preferred scheme to take the proposed route away from settlements results in it crossing in cutting the southern end of the Helmdon Disused Railway SSSI.
- 8.6.4 The proposed scheme would also cross the southern and western-most part of the Mid Colne Valley SSSI on a viaduct, but effects on the site and particularly open water habitats are likely to be limited by the alignment of the route. The proposed scheme would also be within 25m of Sheephouse Wood SSSI south of Steeple Claydon, potentially involving minor landtake. It would cross the River Blythe SSSI on viaduct; but it is likely that a perpendicular crossing of the river would not require footings in the channel.

Regional and other sites

- 8.6.5 A number of regionally protected sites would potentially be affected, some involving habitat loss. These have been identified where data sources were freely and readily available. Examples of potentially affected sites include Sites of Metropolitan Importance in London, namely the Mid Colne Valley and Perivale Wood (also a Local Nature Reserve). Other sites identified elsewhere on the proposed route include Wormwood Scrubs and Little Wormwood Scrubs near Old Oak Common, Northmoor Hill Wood west of the River Colne, Glebeland Lake near Steeple Claydon, and Crackley Wood near Kenilworth. Adelaide Road nature reserve in Camden would be physically impacted by the proposed intervention shaft.
- 8.6.6 Although about a third of the proposed route through the Chilterns would be in bored tunnel (some 6.5km out of 20.5km), there would be localised loss of woodland habitat north of Amersham at Keepers Wood, Mantles Wood, Dunham Farm, Sibley Coppice and at Farthings Wood. A large area of wet woodland (North and South Cubbington Woods north-east of Leamington Spa) and smaller blocks of lowland deciduous woodland would be crossed by the route. In total, up to 19 ancient woods could be subject landtake, although further design work would seek to avoid and minimise these impacts.

Summary of generic mitigation measures for biodiversity

Incorporated mitigation:

- Wherever practicable, potential impacts would be mitigated through choice of route alignment and placement of line in tunnels and on viaducts.
- As far as is reasonably practicable, the proposed route alignment has been developed to avoid large areas of open water to minimise adverse operational effects on birds.
- Routes would be aligned to avoid designated habitats as far as possible; for example the proposed route has been placed in tunnel to avoid impacts on Long Itchington and Ufton Woods SSSI near Brackley.
- Use of clear span bridges would minimise impact on routes for river-based fauna and allow riparian plant habitat to remain in place. Crossing of rivers has been designed wherever practicable to ensure no footings would be in the channels themselves and that there would be minimal shading.
- Incremental impact on sensitive areas would be reduced to a practicable minimum by placing the route within or adjacent to existing transport corridors, wherever possible.

Mitigation options:

- Improve the water/land corridor and provide a buffer from any damaging adjacent land uses.
- Protection and/or translocation of impacted areas of important habitat together with the creation of new areas of improved habitat.
- Provision of replacement planting to mitigate ecological impacts, particularly those that would occur during construction. In particular, the planting of some two million trees as part of wider landscape mitigation proposals could have significant benefits for wildlife particularly coupled with wider habitat creation within the rail corridor.
- Where habitat impacts are identified, compensation could be made through optimising habitat management of site.
- Consideration could be given to the creation of linkages between woodlands and other designated areas to create new green corridors.
- Potential for habitat degradation could be avoided through measures to protect tributaries during construction and by ensuring that bridge design and construction methods have minimal impacts on habitats or the movement of important species.
- Mitigation measures for landtake and fragmentation impacts could be considered where they occur along the proposed route.
- The proposed route alignment offers opportunities for reinstating hedges and ponds and watercourse improvements which would improve local sites close to the proposed route and create linkages between existing habitats.
- Establish a fund for the management and enhancement of key sites within a nominal buffer as per the Channel Tunnel Rail Link countryside initiative, which effectively resulted in the creation of extensive new habitat. A grant scheme could then be used to fund particular initiatives; for example, where compensatory land may be required for habitat creation and translocation.
- Measures to control ecological impacts of the construction works would be implemented as part of a wider environmental management system that includes stipulating a code of practice for construction.

Improvement opportunities

- 8.6.7 As well as potential landtake from designated habitat, the proposed scheme also offers potential to improve nature conservation resources; for example through reinstating hedges and ponds and improving watercourses in the vicinity of the route. There would potentially be numerous opportunities to bring about local improvements to particular sites alongside the scheme. The route would also provide a green corridor and could assist with linking

existing habitats that are currently more vulnerable on their own. This would look in particular at creating, extending and linking BAP habitats, habitat for BAP species and habitats referred to in Natural England's Natural Area Profiles. It would also seek to buffer any nearby designated sites from the impacts of HS2.

- 8.6.8 Experience from HS1 indicates that these measures can be successfully implemented. Ecological mitigation on HS1 included the creation of some 230ha of woodland, 25ha of new woodland or translocated ancient woodland soils, 370ha of grassland, 80ha of wildflower meadow, 40km of hedges, seven ponds and two wetlands¹¹².

8.7 Water resources

Overview

- 8.7.1 Considerable work has been done to avoid potential impacts on water resources such as rivers, streams, lakes and underground water supplies (aquifers). But such resources are widespread between London and the West Midlands and are difficult to avoid completely. The proposed scheme could adversely affect both surface water and, in particular, groundwater resources. A process of very careful design and appropriate mitigation would be undertaken with a view to reducing impacts to a practicable minimum. Experience from other rail projects, in particular HS1, shows that these issues can be effectively addressed. River crossings and a few river diversions present a particular challenge. Equally, sections of the route in tunnel and cutting through strategic aquifers and areas of vulnerable and sensitive groundwater would need to be carefully designed, planned and built with considerable attention to mitigating impacts on these key resources.

Surface water

- 8.7.2 The appraisal considered potential impacts on river catchments and direct impact on rivers and other water bodies. The scheme would affect an extensive river catchment area. The design assumes that any overland flow affected by the scheme would be collected by filter drains and piped to convenient crossing points such as culverts and bridges. It would be important to ensure that any such mitigation did not itself introduce secondary impacts through concentrating the rate of discharge into rivers at single points (with an associated potential increase in erosion), so altering the characteristics of river morphology with a possible adverse effect on river quality.
- 8.7.3 The proposed scheme would make 112 river crossings. There would also be 12 crossings of navigable canals and 11 crossings of lakes or reservoirs. These would be designed to avoid adverse effects as far as practicable, but would require careful design and construction. However, five of the river crossings may require major river diversions (affecting catchments of more than 50km²) in order to mitigate potentially more severe effects. These comprise the River Colne over 275m; the River Cole over 200m; the River Tame at two locations over 2,000m and 1,300m respectively; and the River Rea for 250m.
- 8.7.4 A further eight crossings may require diversion of a minor river (affecting catchments of less than 50km²). Diversion of any main river would potentially have significant effects on river morphology and riparian habitat, and hence the quality of the river as a whole as specified in the Water Framework Directive.
- 8.7.5 One of the major river crossings presents a potential benefit, namely the realignment of the River Tame. Currently canalised beneath the M6, HS2 would require that approximately 1.3km of its length be realigned adjacent to Parkhill Wood. The realignment would move this section of the river into a new channel, which would be open to sunlight and could be designed to have a more natural profile and course, with vegetated river banks.

¹¹² Channel Tunnel Rail Link. *Delivering Environmental Excellence*.

- 8.7.6 Assuming any crossings of lakes and reservoirs are constructed using best practice techniques, they should not have a direct effect on the water resource. Care would also be needed to minimise any effects on their use for recreation.

Groundwater

- 8.7.7 The appraisal of groundwater impacts has considered the length of proposed cutting or tunnelled route through source protection zones (catchments where sources of groundwater are vulnerable to contamination) and through underground water-bearing rock or aquifers.
- 8.7.8 Overall, the proposed scheme potentially requires cut or tunnel through 4.9km of the most vulnerable SPZ1 and 14.7km through the slightly less vulnerable SPZ2, most of which occurs within the Colne Valley. Where SPZs are affected, it would be necessary to employ specialised boring and construction techniques to minimise the risk of pollution and to mitigate the effects of obstructing the groundwater flow regime.
- 8.7.9 The Water Framework Directive classifies aquifers in terms of how much water they provide (good or poor potential yield) and the quality of this water (good or poor chemical quality). Aquifers of poor-yield potential or poor chemical quality are unlikely to be of strategic importance as a water resource. However if the aquifer can provide large volumes of good chemical quality, it is likely to be of strategic importance. Tunnelling or cutting through such a strategic aquifer would potentially have a significant adverse effect on the water resource and must be carefully controlled to minimise risks.
- 8.7.10 The proposed scheme potentially involves cut or tunnel through 34.5km of 'good-quality and good-yield' aquifer, as well as 27.5km through aquifer of either 'good-quality (poor-yield)' or aquifer of 'good-yield (poor-quality)'. The good-yield, good-quality aquifer is particularly prevalent along the section of route between Brackley and the Coventry/Kenilworth Gap. Specialist excavation and construction techniques to protect the aquifer and ensure that the natural flow of groundwater is maintained are commonly applied to works of this nature.

8.8 Flood risk

- 8.8.1 Consideration of flood risk addresses the potential flood impacts of the proposed scheme on other people. Potential impacts of flooding on HS2 infrastructure have been considered under climatic factors and adaptability, but the two are closely related.
- 8.8.2 The proposed scheme crosses a total of about 16.2km of the highest risk Flood Zone 3 with 24 major river crossings. Flood Zone 3 represents land which is expected to flood more frequently than once in 100 years. It is preferable to avoid any development within the flood plain, both to protect flood capacity (the space where flood water can safely accumulate) and control flood risk to wider infrastructure and housing, as well as to protect the new development itself (see Climatic Factors and Adaptability).
- 8.8.3 Despite the potential for a significant adverse impact, in most cases it should be possible to mitigate any flood risk issues through design, adjusting vertical track alignment and designing river crossings so that they would have a minimal effect on flood flow. It may also be possible, in cases where the consequences of occasional flooding are relatively low, such as fields, parks or rural areas, to accept a small increase in the risk of flooding locally to avoid disproportionate costs of mitigation. The proposed scheme crosses floodplains of major rivers at numerous locations, but always on viaduct or bridge to minimise flood risk.

Summary of generic mitigation measures for water and flood risk

Incorporated mitigation:

- Wherever practicable, development in a flood plain would be avoided or minimised and this would be carried through to detailed scale when considering individual sites.
- Major river crossings would typically be clear span viaduct structures to reduce impacts on flood plain, river morphology and water quality to a practicable minimum.
- Rather than use culverting for long river sections, diversions have been proposed which present better opportunities to incorporate channels with soft banks, planted with indigenous flora and generally improving habitats for wildlife.

Mitigation options:

- If culverts are necessary, they would be designed to reduce erosion to a practicable minimum and animal underpasses would be provided to enable species movement.
- Consideration would be given to the use of special boring and construction techniques to minimise the risk of aquifer pollution and to avoid obstruction of groundwater flows in SPZs. In many cases, cuttings or tunnel could be designed to be above or below the aquifer.
- During construction, methods such as ground freezing could be used to prevent pollutants entering the aquifer.
- Consideration could be given to elevating track alignment in places of particular flood risk and to the design of surface crossings to reduce impediments to flood flows to a practicable minimum.
- Level for level compensation of flood plain storage could be considered to preserve capacity and maintain flood characteristics.
- Sustainable drainage systems (SUDS) could be applied on both the tracks and for supporting infrastructure. Typical systems include use of permeable paved areas especially for car parks and stations; use of green roofs, rainwater harvesting and greywater recycling on supporting infrastructure and buildings; use of soakaways to manage runoff; and development of swales and ditches which could also provide green corridors for wildlife.
- Measures to control water and flood impacts from construction would be implemented as part of a wider environmental management system that includes stipulating a code of practice for construction.

8.9 Air quality

- 8.9.1 Most air quality impacts would arise as a result of mode shift, with people using trains in preference to cars. The extent that this would happen has not been determined in detail, although preliminary demand model outputs indicate that there is the potential for some shift from road to rail (onto both HS2 and the WCML). However, the reduction in the number of road trips is not expected to be significant when considering overall traffic flows on the wider road network. Any reduction in road traffic relative to overall flows is likely to be too small to have any measurable effect on air quality.
- 8.9.2 The HS2 termini and Old Oak Common station would be located in areas that currently have air pollution problems, and are declared air quality management areas (AQMAs) by local authorities (although ongoing programmes to improve air quality may have rectified this by the time HS2 services would commence). However, with good public transport connections, there is no reason to believe that car trips to and from these stations would increase significantly and result in air quality impacts.
- 8.9.3 HS2 trains would be electric and would not be a direct source of pollutants; air quality impacts at the power stations used to generate additional electricity for HS2 would not be significant.

- 8.9.4 Potential impacts from construction (from dust for instance) are reported under *Health and well-being*, Section 8.13, although some specific dust mitigation measures are identified below.

Summary of generic mitigation measures for air quality

Mitigation options:

At this stage, mitigation options that have been considered are for alleviation of construction impacts. These impacts are addressed under Section 8.13 on *Health and well-being*, but key mitigation measures for air quality are listed below. More detailed measures would be developed at a later stage in order to effectively manage construction impacts. Measures to control air quality impacts from construction would be implemented as part of a wider environmental management system that includes stipulating a code of practice for construction.

There would be an adherence to the principles and mitigation methods as determined by best practicable means (BPM). For example, site planning would include the use of barriers around the boundary of the worksite, use of waterborne and rail transport if practicable, and the use of real time dust monitoring. Dust from construction traffic would be managed by washing and cleaning vehicles leaving sites, covering all loads, and reducing construction traffic to a practicable minimum.

8.10 Noise and vibration

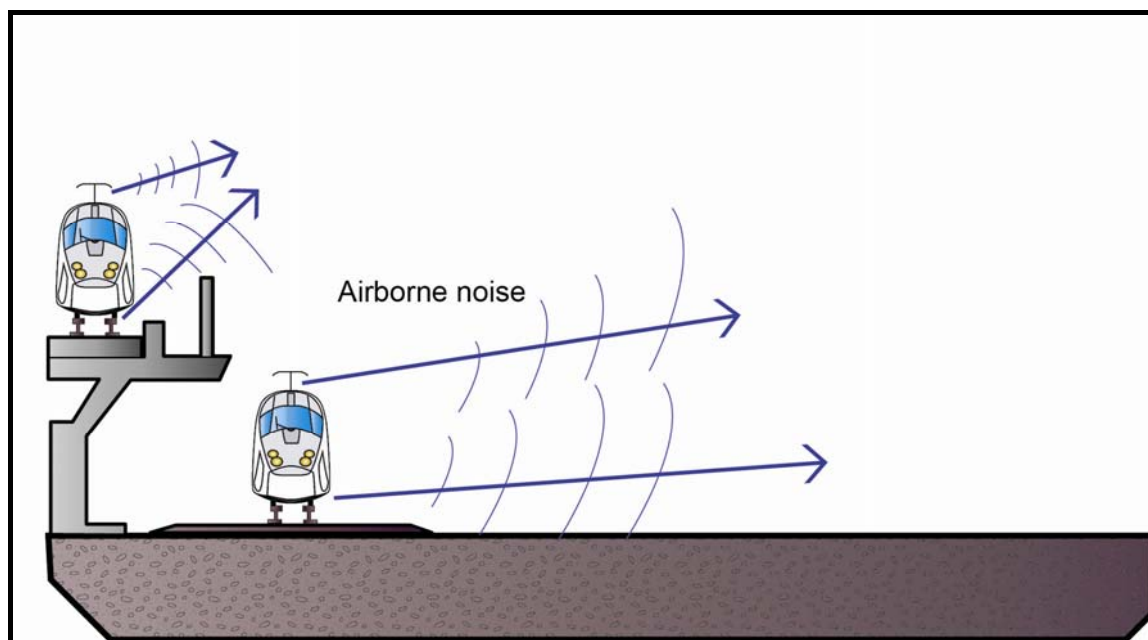
Overview

- 8.10.1 Recent scheme modifications have resulted in a number of changes to reduce potential environmental impact. These have already been described elsewhere (see Section 3), but in summary they include green bridges and new or deeper cuttings, as well as re-alignments away from certain settlements, such as Mixbury, Brackley, Greatworth and Ladbroke. In other places, such as Southam, Cubbington, Whittington and Huddlesford, the changed alignment could increase potential impacts, necessitating consideration of additional mitigation.
- 8.10.2 The noise appraisal has taken these alignment changes into account. Assumptions about the potential HS2 services to be provided by HS2 Ltd have been used, including a maximum permitted operating speed of 360kph. The appraisal has also accommodated emerging findings of research into the noise impacts of high speed trains.
- 8.10.3 The appraisal has focused on operational airborne noise at residential areas. Airborne noise at other sensitive locations, construction noise, vibration and ground-borne noise have been appraised at a commentary level only. All of these matters would be considered in greater detail, including determination of 'significant effects', as part of EIA were the project to be taken forward. Further details of the noise and vibration appraisal are contained in *Appendix 5.4*.

Types and sources of operational noise

- 8.10.4 Operational 'airborne' noise from high speed trains comes from a number of sources:
- mechanical noise from motors, fans and ancillary equipment on the train; this tends to be the dominant source at low speeds;
 - 'rolling' noise from wheels passing along the rails; this usually dominates at higher speeds, up to 300kph; and
 - aerodynamic noise from general air flow around the train body and the airflow around the pantograph and wheel areas (bogies), which starts to become prevalent at the highest speeds (over 300kph).

Figure 29 – Airborne noise from railways



Approach to appraising operational noise

- 8.10.5 A high level appraisal of the proposed route has been carried out which is consistent with the overall AoS approach. Consequently, the approach developed for the airborne noise appraisal of the proposed route involved predicting noise levels on clusters of residential properties and potential impacts at a community level. The DfT's WebTAG method was used during the optioneering and route selection phase and these results have been captured in *Appendix 6*. A WebTAG appraisal was also carried out for the proposed route (see *Volume 2* of the AoS).
- 8.10.6 Specific appraisal criteria were defined to help inform the design of the proposed route through noise assessment, namely:
- dwellings potentially exposed to 'high average' noise levels, i.e. greater than or equal to $73\text{dB}_{\text{L}_{\text{Aeq},18\text{hr}}}$;
 - dwellings that could qualify for noise insulation, based on the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996); and
 - dwellings that could have a noticeable (although not necessarily significant) increase in 'average' daytime railway noise levels, defined as having a rail noise level of $50\text{dB}_{\text{L}_{\text{Aeq},18\text{hr}}}$ or more¹¹³ with an increase in existing noise levels greater than or equal to $3\text{dB}_{\text{L}_{\text{Aeq},18\text{hr}}}$ ¹¹⁴.
- 8.10.7 Findings were reported for operational noise levels, assumed to occur between the hours of 6am and midnight.
- 8.10.8 The HS2 noise model has been developed using noise prediction software which implements the UK railway noise calculation methodology (Calculation of Railway Noise 1995), with some important changes set out in *Appendix 5*, due to the strategic nature of the appraisal and high speed considerations. This relies on:

¹¹³ 50dB(A) is based on a World Health Organisation threshold, below which few people would be expected to be 'moderately annoyed'.

¹¹⁴ 3dB is a just perceptible change in total noise over an assessment period.

- assumed noise levels of high speed trains, based on the noise levels of currently operating high speed trains¹¹⁵ together with noise level requirements for new trains from European specifications¹¹⁶;
- the number and length of HS2 trains;
- maximum operating speed of the trains based on speed profiles for different sections of the proposed route, as supplied by HS2's engineering team;
- existing rail noise levels based on published government noise maps; and
- details on the proposed route alignment, including proposed embankments, cuttings, tunnels and viaducts, within the context of the surrounding landscape.

8.10.9 Given the strategic nature of the appraisal at this stage, the following should be taken into account:

- No site noise measurements were included in the appraisal; impacts represent estimates of the change in the rail noise. Existing railway noise levels have been based on published government noise maps. As a result, specific local impacts could vary from those reported here and represented in the noise maps included in Volume 2.
- The screening effects of buildings were accommodated in the model, but this was based on general screening attenuation from built up areas and did not take account of any individual buildings. Specific local screening effects have not, therefore, been determined.
- Noise levels, and therefore potential impacts, were identified at locations that represented groups of one or more dwellings. Locations of dwellings were identified using OS data.

Mitigating operational noise

8.10.10 The appraisal of the proposed route has involved a phased approach. Initially it considered the inherent noise-reducing effects of the alignment, such as cuttings and tunnels. This identified locations where, despite these alignment characteristics, additional mitigation would be considered necessary. These 'candidate areas for mitigation' took account of clusters of dwellings impacted in any one area according to the three criteria (i.e. potentially high noise levels; noise insulation requirements; and noticeable noise) and used professional judgement (based on current research) to establish the likely effectiveness of potential mitigation measures.

8.10.11 Although the potential benefits of this mitigation assume London-West Midlands services only, the candidate areas were selected on the basis of assumed future high speed services extending to Leeds and Manchester. This would ensure that mitigation of the scheme is future-proofed should the northward extension of HS2 take place.

8.10.12 Should the scheme be progressed, a more detailed noise assessment would be carried out as part of an EIA in order to identify the likely significant noise effects and establish possible specific measures to mitigate or reduce such effects.

8.10.13 The assumed noise reductions of the scenario using additional indicative mitigation drew on the knowledge and experience of the engineers and acoustic specialists, to give confidence that the approach was robust and the results reasonable. The mitigation methods assume that reduced noise levels were realistic and achievable through use of standard techniques; these include trackside noise barriers, low barriers close to the track

¹¹⁵ Gautier, P.-E., Létourneaux, F., & Poisson, F. (2007). High Speed Trains External Noise: A Review of Measurements and Source Models for the TGV Case up to 360km/h. SNCF, Innovation and Research Department, France.

¹¹⁶ Commission Decision of 21 February 2008 concerning a technical specification for interoperability relating to the 'rolling stock' subsystem of the trans-European high-speed rail system (notified under document number C(2008) 648) (2008/232/CE).

on viaducts, or treatment of the track itself, such as tuned absorbers attached to the rails. The principal assumptions are set out below.

- At operation, there would be a 3dB reduction in noise emissions at source based on the anticipated noise control improvements in the next generation of high speed rolling stock.
- Noise reduction would be equivalent to that achieved by use of 3m high noise barriers (or bunds) at all candidate areas for mitigation, or at viaducts, by 2m high barriers; noise-absorbent barriers have been assumed throughout. Selection of the most appropriate and effective mitigation techniques to be deployed at each location would be determined based on a detailed appraisal of local conditions and engineering feasibility.
- Properties likely to be demolished have been excluded from the numbers presented in **Table 4**, whereas those 'at risk' of landtake or others possibly eligible under the Exceptional Hardship Scheme have been included in the numbers reported.

Predicted operational noise

- 8.10.14 The potential noise impacts identified at this stage of the project should be seen as an estimate only and would be refined further as part of the EIA process at a later stage, should the scheme be progressed. The appraisal has examined a particular mitigation scenario, which is one of many that could be developed. It does, however, provide a reasonable basis to appraise what is likely to be achievable in terms of noise mitigation.
- 8.10.15 In some instances mitigation associated with HS2 may itself provide screening to existing noise from a road or railway, so that HS2 noise barriers could provide additional benefit to the local community; for example along the Northolt corridor.

Table 4 – Proposed route airborne noise appraisal findings

	High noise levels ¹		Noise Insulation Regulations ²		Noticeable noise increase ³	
	Additional mitigation	No mitigation ¹¹⁷	Additional mitigation	No mitigation	Additional mitigation	No mitigation
Old Oak Common to West Ruislip	<5	<50	~80	~1,300	~650	~6,700
West Ruislip to Aylesbury	<5	<5	<20	<30	~1,450	~8,700
Aylesbury to Brackley	<5	<10	<20	<20	~350	~1,300
Brackley to Kenilworth-Coventry gap	<5	<10	<20	<20	~350	~1,100
Kenilworth-Coventry gap to Berkswell rail station	<5	<5	<10	<20	~70	~200
Berkswell rail station to Middleton and Birmingham spur	<5	<10	<20	<40	~1,700	~5,700
Middleton to WCML	<5	<10	<10	<20	~200	~750
Total	~10	~70	~150	~1,400	~4,700	~24,300
¹ Dwellings potentially exposed to high HS2 noise levels; see 8.10.6 ² Dwellings potentially qualifying for noise insulation under the Noise Insulation Regulations; see 8.10.6 ³ Dwellings potentially exposed to a noticeable noise increase; see 8.10.6						

¹¹⁷ Assumes only the attenuation provided through route alignment in cutting and tunnel.

- 8.10.16 A summary of the predicted potential noise impacts is given in **Table 4** above, with estimated numbers of dwellings shown both with and without additional mitigation.

HS1 Connection

- 8.10.17 A connection to HS1 would include a new tunnelled section of line from Old Oak Common to Camden. Potential vibration and ground-borne noise impacts are addressed below.
- 8.10.18 Where the line would come out of tunnel in Camden, it would connect to the existing North London Line for a small section of track between Camden and Kings Cross St Pancras station. It is assumed that three HS2 trains per day in each direction would run on this connection. The current service pattern for the section of track above ground is approximately 108 trains per day in each direction. The addition of three HS2 trains per day would have a negligible effect on daytime noise exposure $L_{Aeq,18hr}$ from this section of line, and consequently no noise impacts are predicted.

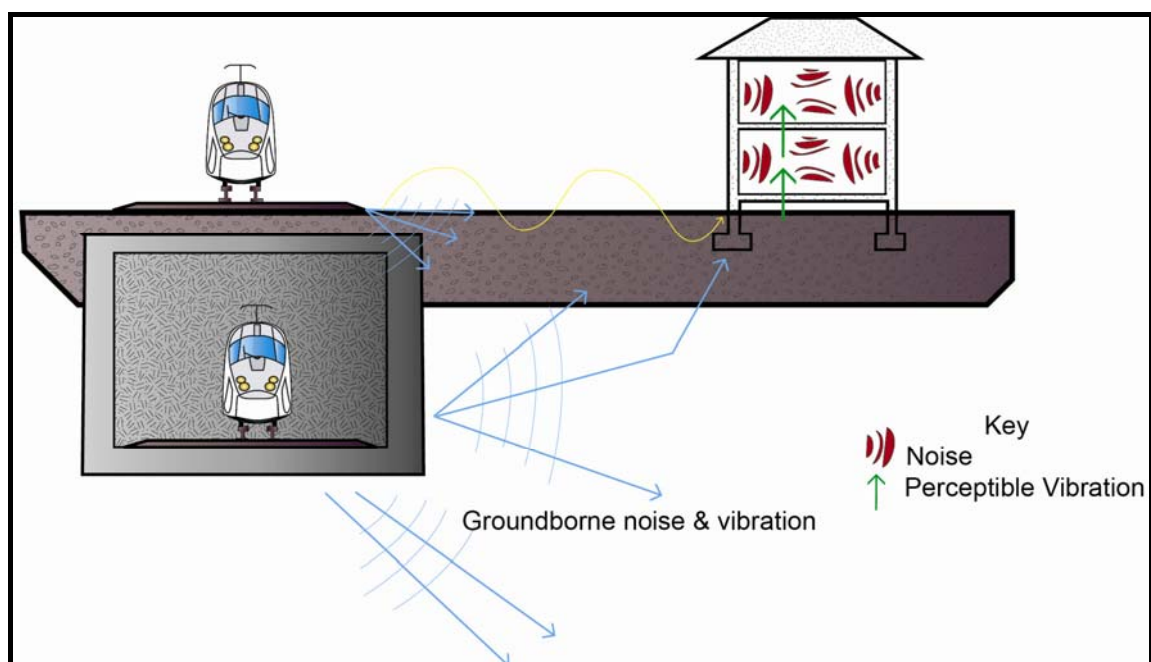
Modal shift

- 8.10.19 Preliminary demand model outputs indicate that there would be potential for some modal shift from road to rail (both on to HS2 and the WCML). However, any reduction in the number of road trips is not expected to be significant when considering overall traffic flows on the wider motorway network.

Operational ground-borne noise and vibration

- 8.10.20 Vibration is generated in the ground by the passage of trains, whether at surface or in tunnel. The manifestation of these effects at properties depends on a number of factors including the speed of the trains, the design of the railway, the distance from the route, the composition of the ground through which the vibration propagates, and the design of the receiving building. Vibration may be perceptible or affect certain sensitive equipment. Audible ground-borne noise is sound generated inside a building by vibration. These are illustrated in **Figure 30**.

Figure 30 – Ground-borne noise and vibration from railways



- 8.10.21 In general terms, airborne noise is the principal noise impact from surface railways, with ground-borne noise and vibration the main impact from underground railways. The

principal sections of tunnel on the proposed scheme would be between Euston and Old Oak Common and through parts of the Chilterns.

- 8.10.22 Experience from HS1 and international guidance¹¹⁸ suggests that, *without* any mitigation, ground-borne noise and vibration impacts from HS2 could occur up to 100m from London tunnels and up to 200m from country tunnels, the difference reflecting the attenuating effects of London Clay and the relatively slower line speeds through London. However, HS1 has also shown that such potentially significant effects can be mitigated.
- 8.10.23 With mitigation similar to HS1 through London (for example, the use of ballast track with under ballast mats or high performance slab track) or through equivalent techniques, ground-borne noise and vibration impacts would not be expected in residential areas in London, especially given the relatively slow line speeds. An initial search of non-residential receptors considered particularly sensitive to noise and vibration around the proposed tunnel alignment has identified some potentially affected uses such as research facilities and a television studio. These locations would require further consideration if the project progresses.
- 8.10.24 Likewise for the Chilterns tunnels, HS1 and other international high speed rail experience suggest that potential vibration and ground-borne noise impacts could be avoided and HS2 Ltd is committed to ensuring that no significant effects arise.

Tranquility and quiet areas

- 8.10.25 The WebTAG noise sub-objective states that tranquility is to be taken into account in the assessment of impact under the landscape sub-objective. A tranquility map produced by the CPRE and Northumbria University is presented at **Figure 24**, which has used noise amongst a number of other considerations, to identify tranquil areas. Identification of England's quiet areas within urban areas (agglomerations) is currently under investigation by Defra.
- 8.10.26 The Environmental Noise Regulations (England) 2006 require the identification of quiet areas for agglomerations. This requirement relates only to identifying quiet areas in large agglomerations and, as such, does not provide any protection for quiet areas in open country or smaller populated areas.
- 8.10.27 Impacts on tranquillity and quiet areas would be considered in more detail as part of the EIA, should the scheme be progressed further.

Additional considerations

- 8.10.28 The AoS has predicted potential impacts based on a consideration of HS2 within the context of existing rail noise. There are other sources of existing noise, such as road, aircraft and industrial, that give rise to existing high noise levels and that have not been considered at this stage. Consideration of these other sources could alter the identified potential impacts, and in general, impacts would be likely to be lower than identified here.
- 8.10.29 Noise from proposed HS2 stations and depots has not been appraised at this stage. Stations could give rise to additional noise impacts from trains entering and leaving the stations, public address systems, ventilation systems and local road traffic. Noise impacts from depots could arise from trains entering and leaving, as well as from fixed and mobile maintenance equipment and building services. Past experience has shown that the majority of these impacts could be avoided or minimised to a large degree through the use of effective planning and design and other noise mitigation measures.

¹¹⁸ U. S. Department of Transportation Federal Railroad Administration HMMH Report No. 293630-4:High-Speed Ground Transportation Noise and Vibration Impact Assessment (Harris Miller Miller & Hanson Inc., October 2005)

- 8.10.30 Tunnel ventilation shafts could also give rise to noise impacts. Forced ventilation systems would be required although these would operate only in the event of an emergency or testing. Otherwise, the main potential noise source at the surface would be from the passage of trains due to pressure relief and train pass-by noise. However, experience from HS1 and the Jubilee Line Extension indicates that impacts could be avoided if vent shafts were to be built with appropriate mitigation. The approach to HS2 tunnel shaft noise would build on this experience and best practice for noise control.
- 8.10.31 Construction noise has not been appraised at this stage, but measures to control noise from construction would be implemented as part of a wider environmental management system that includes stipulating a code of practice for construction.
- 8.10.32 All of these further potential noise impacts would be assessed in more detail as part of the EIA, should the scheme be progressed further.

8.11 Community integrity

Overview

- 8.11.1 The appraisal of potential impacts on community integrity has been considered by estimating the numbers of properties which may need to be demolished or affected by landtake, as well as by the risk of isolation (where the route of HS2 would potentially provide additional enclosure to a residential area already bounded by roads and existing railways). These impacts are also considered for people living in deprived areas, who might be disproportionately affected by them.
- 8.11.2 Refinement of the March 2010 preferred route has mitigated a number of previously identified impacts, either through re-routing the proposed alignment away from communities, or by introducing green bridges over sections of cutting to maintain the physical integrity of a settlement. These refinements are described in detail in Section 3, but would benefit settlements such as Little Missenden, Amersham, South Heath, Mixbury, Turweston, Brackley, Greatworth, Chipping Warden, Ladbroke, Southam, Stoneleigh, Stareton and Burton Green.

Demolitions

- 8.11.3 The most significant area of property demolition along the proposed route would occur at the Euston terminus. In London at the Regent's Park Estate, a predominantly council-owned housing estate, approximately 190 dwellings in four apartment blocks would require demolition for the redevelopment of Euston station, resulting in a significant effect on the community. A further 170 dwellings would have their living conditions potentially affected by proximity to the railway. HS2 Ltd would be committed to working closely and at an early stage with the London Borough of Camden and the GLA and with community groups, residents' associations and affected residents generally to ensure that effective arrangements are in place to meet the housing needs of those affected by demolition of these dwellings, and to help to address wider impacts on the local community. Some 25 further dwellings and 20 commercial premises located in Euston, Melton, Cobourg and Drummond streets, would also require demolition.
- 8.11.4 An estimated 19 demolitions, including seven dwellings, would be required to construct the vent shaft at Alexandra Place West.
- 8.11.5 Residential demolitions could occur at Wells House Road adjacent to Old Oak Common where approximately 25 dwellings would be at risk of demolition from shallow tunnels to the west of the railway lands. It may be possible to avoid these demolitions, but residents may need to vacate properties while construction was underway.

- 8.11.6 Between Old Oak Common and West Ruislip approximately 15 dwellings may need to be demolished alongside the rail corridor. These would be located principally in an area west of the Hanger Lane gyratory system and east of West Ruislip.
- 8.11.7 There would be a number of other demolitions, at various locations along the proposed route, in particular at Wendover (estimated at seven dwellings), Kenilworth (estimated at four dwellings), and Burton Green (estimated at three dwellings). At Washwood Heath in Birmingham, the construction of a new rolling stock depot would require the demolition of around 30 dwellings, as well as the loss of a number of commercial premises. A similar approach to Euston would be undertaken here, involving close working between HS2 Ltd and Birmingham City council, as well as with local residents and businesses, to help to minimise disruption to this community.
- 8.11.8 The approach to Birmingham Curzon Street station would require demolition of a newly built student accommodation complex. Although the complex is for short-term accommodation it does house some 750 student units.

Islanding

- 8.11.9 The proposed route would result in 15 areas at risk of isolation, affecting some 75 dwellings (including those at risk of demolition). Access would still be maintained for all of these dwellings however they would be bounded by new major transport infrastructure. The majority of the dwellings that would be affected are situated in the Hampton-in Arden and Water Orton areas, where approximately 40 and 30 dwellings respectively would be affected. These are already subject to significant levels of physical isolation from existing infrastructure, such as M42, M6 and A446. The proposed route would, however, traverse or enclose these areas still further.

Impacts on deprived areas

- 8.11.10 The appraisal also considered whether some communities affected were also deprived (i.e. areas classified as being amongst the 20% most deprived in the UK), and which therefore potentially contained communities more vulnerable to discrimination and social exclusion. As described above the proposed redevelopment of Euston station would be likely to require the demolition of significant numbers of dwellings, the majority of which are council owned. Most of these dwellings are situated in Regent's Park Ward, one of the 20% most deprived areas in England and characterised by a population that is younger than the borough average and has a significantly higher Bangladeshi population (15% as compared with 6.3% for Camden as a whole). As described above, HS2 Ltd is committed to working closely with local government, and with community groups, residents' associations and affected residents generally to ensure effective arrangements to meet the housing needs of those affected by demolition, and to help to address wider impacts on the local community.
- 8.11.11 The proposed rolling stock depot at Washwood Heath in Birmingham would be situated in an area amongst the 10% most deprived in the UK and contains higher than average proportions of black and Asian communities in relation to the borough average. It would require the demolition of around 30 residential dwellings and up to 11 commercial or community facilities. Close working between HS2 Ltd and the local authority and local residential and business community would be undertaken here to help to ensure the sensitive management of this issue.

Figure 31 – Aerial view of Euston station showing Regent's Park Estate [HS2 Ltd]

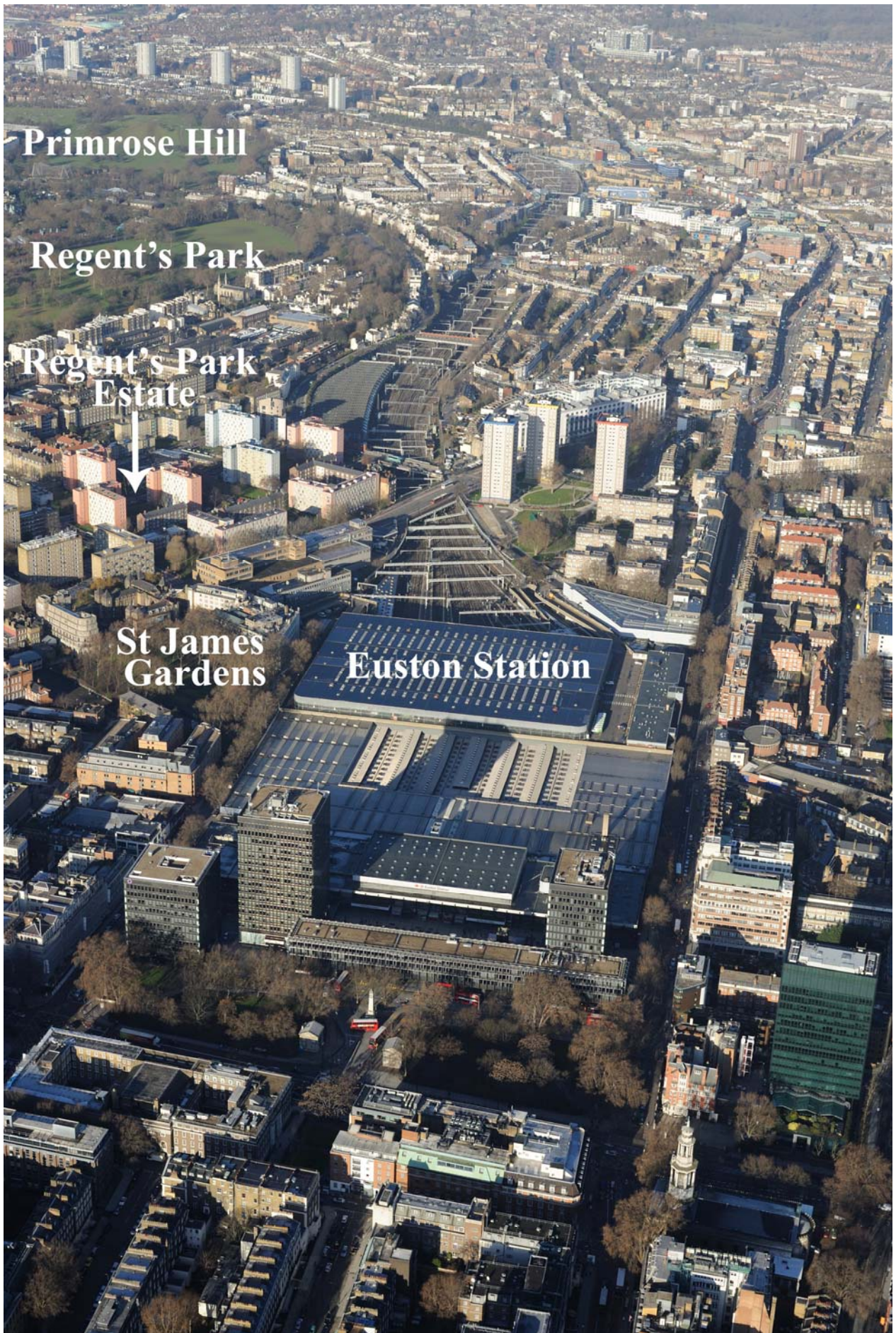


Figure 32 – Aerial view of the area around the proposed Washwood Heath rolling stock depot site [HS2 Ltd]



8.12 Accessibility

Overview

- 8.12.1 HS2 would make a major contribution to improved accessibility by public transport. It would also provide a new transport connection at existing public transport nodes in London and Birmingham. Impacts, both positive and negative, on pedestrian access would be limited, although the scheme would present opportunities to build in effective links with existing pedestrian and cyclist networks.

Public transport

- 8.12.2 A significant proportion of the UK population would have access to the HS2 network from day one, either direct through HS2 stations or through connections from and to the WCML. This would benefit the populations of London, Birmingham, Liverpool, Manchester and Glasgow.
- 8.12.3 The construction of HS2 would release capacity on the WCML. This would enable an increase in the frequency of services which would increase commuting opportunities into Birmingham from the Coventry corridor, including Canley, Berkswell, Marston Green, Lea Hall and Stechford. The number of fast trains per hour on the WCML to London during peak hours would also increase, as would the number of fast trains into Birmingham International and Birmingham New Street. There would also be an increase in the number of services between Milton Keynes Central and London Euston.

Public transport interchange

- 8.12.4 The development of new HS2 stations would present an opportunity to improve existing interchange arrangements. These impacts are dependent on the detailed design of the scheme, but could include the provision of enhanced passenger facilities, better information for travellers via frequent announcements and timetable displays, greater station staff presence, and other aspects to improve the interchange experience.
- 8.12.5 Existing public transport interchange would improve and new interchanges would be created as a result of the proposed scheme. In particular:
- Euston – interchange connectivity would be improved to domestic rail, bus and underground rail services;
 - Old Oak Common - interchange connectivity would be improved to domestic and international rail and underground rail services, and aviation via Crossrail;
 - Birmingham Interchange - interchange connectivity would be improved to aviation, bus and rail services; and
 - Curzon Street - interchange connectivity would be improved to rail, bus and proposed metro services.
- 8.12.6 The interchange benefits at these locations would be maximised through the coordination of timetables to reduce the risk of passengers missing their connections. Enhanced services at WCML stations would also affect overall improvements in public transport interchange.
- 8.12.7 HS2 rolling stock and facilities would be designed to be fully accessible for people with reduced mobility. At minimum they would comply with the Equality Act 2010 and, in particular, the duties relating to the provision of services set out in Part 3 of and Schedule 2

to that Act. Rolling stock would be built in compliance with the requirements of the Railways (Interoperability) Regulations 2006¹¹⁹.

Pedestrian access and open land

- 8.12.8 The potential severance and/or diversion of strategic footpaths, bridleways, nature trails and cycle paths severed and/or requiring diversion was considered. There would be 27 footpaths (as identified from OS maps) potentially affected, along with six local cycle routes, seven national cycle routes, and one national trail. Although access would be maintained in most cases, it may be temporarily disrupted during construction.
- 8.12.9 One area of Registered Common Land, in the Colne Valley, would be subject to landtake from HS2, along with one area of public access (around 15m) intersected.

8.13 Health and well-being

Overview

- 8.13.1 Effects on people's health and well-being, both beneficial and adverse, would potentially result secondarily from other impacts – chiefly environmental impacts, property impacts (homes) and socio-economic impacts (jobs). The appraisal has not included a full health impact assessment (HIA), since proposals are not sufficiently refined or agreed at this stage to allow this. An HIA would typically consider each of the 18 sustainability issues included in the AoS, reflecting the influence each could have on human health and wellbeing. This section has, however, focused on those impacts that would potentially affect health and wellbeing most immediately. It refers only to the risk of impacts on health and wellbeing, and by and large only where these impacts might be experienced by defined groups of people rather than by individuals.
- 8.13.2 The programme of route refinement during 2010 has mitigated a number of potential impacts at particular settlements along the route; see for example sections 8.4.15 and 8.11. A comprehensive consultation programme will be undertaken to ensure that the public fully understand these potential changes and proposed mitigation. It will also record any further concerns that may be raised. Specific measures have also now been put in place to allay some issues; for example an Exceptional Hardship Scheme has been set up to assist in the sale of properties affected by HS2 proposals.

Potential beneficial effects

- 8.13.3 Beneficial effects that would potentially improve health and well-being relate to improvements in accessibility (Section 8.12) and changes in economic prosperity and welfare (respectively sections 8.15 and 8.16). HS2 would benefit people directly through the faster journeys it would offer between London and Birmingham; it would enhance the public transport system generally by providing new interchange opportunities (see 8.12.5); and it would bring about new journeys on the WCML due to the capacity released on this line. Journeys would be expected to be more enjoyable, as they become quicker and less crowded. All of these benefits could have secondary benefits for health and well-being.
- 8.13.4 Economic benefits relate essentially to jobs, but also to regeneration. HS2 would create jobs through the construction of the railway and rail vehicles, and later through the operation of trains, stations and maintenance facilities. The money spent by these companies and their workforce would support other jobs in supply businesses and at local shops and services. Business centres would expand as companies benefited from enhanced transport. Further benefits would result from agglomeration where an

¹¹⁹ S.1. 2006/397, as amended. Regulation 4B requires rolling stock used for the carriage of passengers on a high-speed rail system to comply with the technical specifications for interoperability (TSI) relating to persons with reduced mobility set out in the Annex to Decision 2008/164/EC of the European Commission of 21st December 2007, or any amended version of it or any TSI which replaces it,

increasingly concentrated business community is nurtured by the close presence of partners, brokers, customers and suppliers.

- 8.13.5 Regeneration around stations, with associated local employment opportunities, would also potentially have secondary benefits for health and well-being, especially where existing communities have high levels of deprivation as at Euston, Old Oak Common and Curzon Street. Wider benefits would arise if such stations increased the overall appeal of the surrounding area for investment and increased development. Opportunities for enhanced commuter services on the WCML could support regeneration at some stations, such as Northampton.
- 8.13.6 Impacts on physical health would derive from the potential for HS2 to encourage a healthier lifestyle (for example, through more active travel options). At this stage there is little information about the likelihood of people using active travel to access new stations. Of the four new proposed stations, three are at, or are connected with, existing stations and so would benefit from the facilities already in place. There is opportunity to encourage active travel; for example through provision of bicycle lock-up and storage facilities and new cycle path access, and through provision of pedestrian walkways and connections to existing walkways.

Potential adverse effects

- 8.13.7 Adverse effects on health and well-being could arise from other environmental impacts, were they sufficiently extreme to bring about indirect health effects on their own, or where they act in combination. There is insufficient information currently to ascertain the degree of risk to health from such impacts and HS2 Ltd would consider it a priority to implement sufficient mitigation, both during construction and operation, to ensure that such impacts were avoided where possible.
- 8.13.8 Consideration of combined impacts during construction has used, as a proxy, the number of properties within 100m of the proposed rail corridor. In total, residents at approximately 7,400 dwellings located within 100m of the edge of the route corridor would be at relatively higher risk during construction of disturbance from noise, dust, visual impact and light spillage. HS2 Ltd would prioritise use of control measures and best practice to ensure that impacts from construction activity, such as noise or dust, were kept as low as reasonably possible. Along the route, the areas with the highest residential concentrations are the western suburbs of London in North Ealing, Ruislip, Wembley, and Greenford; the outskirts of Birmingham along the Birmingham spur at Castle Bromwich, Bromford, Castle Vale, Vauxhall, Saltley and Gilson; and central Birmingham at Nechells Green and Bordesley. In addition construction of Euston and Birmingham termini and an interchange station at Old Oak Common would give rise to higher risks of impact during construction. Although most of these locations lie alongside existing rail and road corridors and within noisy urban environments where people would be expected to be habituated to some degree to higher levels of noise.
- 8.13.9 Appraisal of potential health risks from an operational HS2 has considered both single issues such as demolitions or operational noise, and clusters of lesser impacts; for example noise combined with demolition and greater difficulty in accessing services.
- 8.13.10 One location where there would be a relatively higher risk of impact is around Euston station. The scheme would require the demolition of a number of buildings (residential, commercial and community: see Section 3 and *Demolitions*, above), which would present risks to well-being of the existing community, including those from minority ethnic backgrounds (see EqIA screening report, *Appendix 4.2*) and those with a high level of dependencies on local services or social infrastructure. A commitment to careful and sensitive management to ensure that this impact was minimised would be required. Plans for the improvement and development of this area have been proposed by the London

Borough of Camden¹²⁰ (see also 6.5.10), which would lead to wider improvements in the area, so assisting the mitigation of the potentially adverse impacts associated with the proposed scheme.

- 8.13.11 Of the other issues, noise impacts (presented at section 8.10) could also influence health and well-being, although considerable work has been undertaken to ensure that the highest noise levels would be mitigated for all but about 10 dwellings. Noise findings were reported using the DfT's WebTAG method, which relies on daytime operational noise levels only; this approach is deemed appropriate since HS2 would operate predominantly during daytime hours. The noise criterion used for the identification of daytime noticeable noise increases in the assessment is consistent with the current European Guidance¹²¹. The daytime noise appraisal has identified priority locations which were considered candidate areas for mitigation. The application of this mitigation would also benefit those with the potential to experience night noise effects.
- 8.13.12 Particularly sensitive receptors in terms of health would be facilities that house the more vulnerable sectors of the community, such as schools and other education facilities, and hospitals. These would be assessed individually during future design stages.

Health inequalities

- 8.13.13 The proposed scheme would not significantly affect, either positively or negatively, health inequalities because:
- access to existing health services and facilities would be maintained;
 - there are unlikely to be any large-scale impacts to people's health; and
 - major permanent impacts resulting in significant additional isolation or severance would be avoided (especially given recent scheme refinements – see Section 3).
- 8.13.14 Impacts on deprived areas would be localised to two main locations: around London Euston and along the Birmingham spur at Washwood Heath (see EqlA Screening Report, *Appendix 4.2*). At these locations, any loss of access to health services or facilities would be mitigated.

¹²⁰ LB Camden (2009) Euston: a framework for change. supplementary planning document

¹²¹ EEA Technical report No 11/2010 Good practice guide on noise exposure and potential health effects

Summary of generic mitigation measures for community, accessibility, health and well-being

Incorporated mitigation:

- Numerous scheme refinements to mitigate impacts on communities as described in 8.11.2.
- All access routes across the proposed scheme would be maintained in the long term where feasible, including roads, footpaths, cycle routes, pedestrian walkways. Disturbance during the construction period would be reduced to a practicable minimum.

Mitigation options:

- Where community impacts are anticipated, notably at Euston and Washwood Heath, HS2 Ltd would work closely with local authorities and with local people, businesses and community representatives to help to ensure that issues are managed sensitively.
- Measures to control impacts of the construction works would be implemented as part of a wider environmental management system that includes stipulating a code of practice for construction.
- Mitigation against noise and other impacts, as outlined in specific sections above, would be put in place to mitigate potential impacts on health.
- Opportunities to minimise impacts on accessibility would be considered during further design, particularly in areas affected by demolition, severance or isolation.
- Opportunities could be considered to enhance facilities for cyclists and pedestrians to encourage, amongst other things, healthier lifestyles.
- Consultation would be undertaken with residents of affected communities, including those identified as vulnerable, living within a deprived area.

8.14 Security and safety

- 8.14.1 Until the detailed design is finalised it is not possible to assess impact on crime and fear of crime. However, the stations, footbridges and other pedestrian access areas would be designed in accordance with the principles of Secured by Design¹²². Particular attention would be needed in this respect for new rail underpasses and overbridges which would need to be long given the potential width of the rail corridor.
- 8.14.2 Preliminary demand model outputs indicate that there is the potential for some modal shift from road to rail (both HS2 and released capacity). However, the reduction in the number of road trips is not expected to be significant when considering overall traffic flows. The resultant shift may lead to a small reduction in the number of road traffic accidents from some existing motorways but would be unlikely to have any measurable effect on road traffic accident rates in general.

Summary of generic mitigation measures for security and safety

Mitigation options:

- Stations, footbridges and other pedestrian access areas would be designed in accordance with the principles of Secured by Design.

¹²² <http://www.securedbydesign.com/>: the official UK Police flagship initiative supporting the principles of 'designing out crime'

8.15 Economic prosperity

Overview

- 8.15.1 Economic prosperity relates to impacts on business competitiveness across the UK economy, considering how transport improvements potentially reduce costs to businesses and hence lead to higher business output or GDP. It also refers to impacts on economic output brought about by bringing towns, cities and their constituent businesses and commuters closer together, creating wider market competition and changing employment patterns.
- 8.15.2 The proposed scheme could enhance economic competitiveness, support economic growth and both maintain and improve employment opportunities.
- 8.15.3 In enhancing economic competitiveness, potential benefits to businesses have been valued at around £11.0 billion¹²³ over a 60 year period¹²⁴. These would result from the large reductions in journey time that HS2 could bring and the high numbers of passengers on the WCML that would shift to HS2 to take advantage of faster journey times. Additional benefits would also be expected from the use of the released capacity on the WCML to provide new local and regional services, although the value of these has not yet been calculated.
- 8.15.4 Business trips that originate in London could account for around 34% of total benefits. The next major group of beneficiaries could be trips originating in the North West (23%) and the West Midlands (24%), with trips originating in the South East and Scotland receiving business user benefits from HS2 of 8% and 5% of total benefits respectively. Other regions could make up the remaining 7%. The pattern of benefits could reflect the potential journey time savings offered by HS2 and the number of passengers forecast; however, the way that benefits actually flow through the economy is difficult to predict.
- 8.15.5 The proposed scheme could also support economic prosperity by enhancing business productivity in other ways, referred to by the DfT as 'wider economic impacts'. They could include:
- increasing productivity as a result of firms locating in proximity to each other around HS2 stations, known as "agglomeration";
 - producing additional economic activity as a result of HS2's lowering of business travel costs by creating faster journeys (known as 'output change in imperfectly competitive markets'); and
 - expanding the labour market for businesses.

Permanent operational employment and construction jobs

- 8.15.6 The scheme is expected to provide 1,500 permanent operational jobs, including an estimated 250 at Euston, 90 at Old Oak Common, 250 at the maintenance depot at Calvert, 300 at the rolling stock depot at Washwood Heath and 120 at Birmingham Curzon Street station. An estimated 9,000 jobs would also be created during construction. For the operational employment, it is not clear at this stage what proportion represents new job opportunities in the rail sector.
- 8.15.7 HS2 would displace a number of businesses and associated jobs; for example at Washwood Heath and Old Oak Common. However, it is likely that many of these displaced jobs would be re-established elsewhere. Close working between HS2 Ltd, local councils

¹²³ All economic case figures provided by HS2 Ltd, as presented in the Economic Case for High Speed Rail: The Y network and HS2 (London-West Midlands).

¹²⁴ Net Present Value, 2009 prices

and local businesses would be undertaken to help to reduce the potential for adverse impacts on those affected.

Agglomeration

- 8.15.8 Large benefits typically arise when a transport scheme expands labour markets for firms in the services sectors, and when it provides for specialised manufacturing industries to locate in close proximity to other similar firms, key markets and suppliers (“market agglomeration”). Although the objectives and design of HS2 high speed services do not explicitly provide for either of these, new services making use of released capacity on classic lines would enhance urban connectivity in the areas around London and Birmingham, so enhancing market agglomeration. The calculation of wider economic benefits that could result from this, using HS2 demand and appraisal models, values these benefits at £3.0 billion over a 60 year period¹²⁵.

Output change in imperfect markets

- 8.15.9 In practice, any given area is not as competitive as it would be in a perfectly competitive world. This could be to the detriment of a given area or the economy as a whole. However, under these circumstances, a transport scheme which reduces transport costs for business (i.e. by creating faster journeys) can generate additional economic activity.
- 8.15.10 In a simplified approach, it was assumed that these benefits (known as ‘changes to output in imperfectly competitive markets’) are measured as approximately 10% of business user benefits. These have been calculated as being potentially worth around £1.0 billion over a 60 year period¹²⁶.

Effects on labour markets

- 8.15.11 DfT guidance identifies two ways in which transport can create wider economic benefits by expanding labour markets.
- The first calculates the extent to which a transport improvement reduces commuting costs and encourages people to join the labour market. Given that HS2 would provide long distance services, this is expected to have little bearing on people’s decisions to join the labour force. However, the additional local and regional services that would use released capacity on the WCML would be expected to have a small positive benefit on labour markets. Modelling by HS2 Ltd has identified potential positive benefits associated with increased labour force participation, though these would be minor compared to other sources of economic benefits.
 - The second looks at the longer term dynamics associated with land use change. These occur as people decide to change where they live and work in response to changes to the transport system.
- 8.15.12 Predicting the ways in which people and businesses could respond to changes in accessibility resulting from HS2 is uncertain¹²⁷. Changes to the transport system would not drive these dynamics on their own; they depend, for example, on the ways in which transport changes integrate with local development plans and strategies. They are also influenced by the nature of competition between cities and the wider regions.
- 8.15.13 There are many other factors in addition to transport accessibility that people and businesses would take into account when making land use decisions. For households, this can relate to the price of housing, and proximity to relatives, friends and places of employment, as well as to health and education facilities and other amenities. Businesses

¹²⁵ Net Present Value, 2009 prices

¹²⁶ Net Present Value, 2009 prices

¹²⁷ Much of this uncertainty would remain even when land use transport interaction (LUTI) forecasting techniques are applied.

would consider the location of their markets and suppliers when making location decisions. In many cases, business decisions about where to locate would be constrained by social and lifestyle factors that are important for their staff. Most fundamentally, however, businesses would want to locate in areas where there is access to sufficient labour catchments; this can be supported by improved transport accessibility, but there are other important factors, such as whether the local labour force possesses the skills required.

- 8.15.14 If HS2 were to create changes in accessibility that induced people and businesses to relocate to areas in London, Birmingham, Manchester, Edinburgh and Glasgow, as well as other HS2 destinations, then this could enhance agglomerations and wider economic growth in those areas. It could also support the regeneration of economically deprived areas in those cities, which is of particular importance for centres such as Birmingham, which has significant deprivation in areas close to the proposed new station.
- 8.15.15 It is important also to consider some secondary effects that could result from such land use change. The benefits of attracting people and businesses to locate around HS2 station locations in London and Birmingham could come at the expense of other parts of the UK. Although, the dynamics are difficult to predict, there are many ways in which the Government can provide alternative support to other areas. Expectation of a northwards extension of HS2 to Manchester and Leeds could help to sustain the regeneration of other connected cities in the UK.

Potential development and employment impacts at each station

- 8.15.16 While complex wider dynamics and net impacts have not been modelled at this stage, potential development and employment impacts have been modelled for the proposed HS2 stations, as described below. It is expected that, overall, labour market impacts associated with HS2 would be positive, reflecting the wider economic benefits the scheme could generate.
- 8.15.17 For Euston, it is estimated that HS2 could increase net office development in the Euston catchment by 20,000m² (equivalent to 1,400 jobs). Retail space could increase by 16,000m² (equivalent to 700 jobs). There could also be a net increase of 290 residential units as a result of HS2, providing accommodation for around 700 people. There would also be a net loss of industrial floor space of 2,000m² or approximately 50 jobs. In total the net additional employment within the catchment area due to HS2 would be likely to be in the region of 2,000 jobs.
- 8.15.18 For Old Oak Common, the introduction of HS2 (and an interchange with Crossrail) would be expected to catalyse the comprehensive regeneration and development of the area north of the canal, providing employment, residential and retail space in place of existing industrial land. Future floor space calculations of employment space assume that the existing light industrial floor space would be replaced by a new office/biomedical hub reflecting the aspirations of the local authority and other stakeholders.
- 8.15.19 It is estimated that, for the Old Oak Common catchment, HS2 could deliver 300,000m² of office space (equivalent to 21,300 jobs) as well as 30,000m² of retail space (equivalent to 1,300 jobs), 10,000m² of educational space (equivalent to 150 jobs) and 4,300 residential units to house around 10,400 people. This would be at the expense of some 100,000m² of industrial land that is equivalent to 2,780 jobs. The net impact could be around 20,000 additional jobs. The types of jobs available in this area would change from being predominantly industrial blue-collar jobs to office-based white-collar jobs, leading to more employment in finance, insurance or public sector industries and less employment in the manufacturing or distribution sectors.
- 8.15.20 Around the proposed Birmingham Interchange, most development potential is for the office market. Permitted schemes have an estimated 230,000m² of expansion space, which could preclude new space in the green belt land. On current activity levels, it has been assumed that only around 93,000m² of the permitted space might be built out, with

additional turnover of tenants in the already built stock. With HS2, it has been assumed that twice this amount could be forthcoming.

- 8.15.21 It has been assumed that within the NEC complex, which is excluded from the green belt, there could be small parcels of development land released for new schemes. Furthermore, if the airport runway is extended and passenger numbers grow in accordance with forecasts, then the potential for hotel requirements in the area generally is likely to increase.
- 8.15.22 It is estimated that HS2 could deliver an additional 47,000m² of office space (equivalent to 3,300 jobs), 600 hotel beds (equivalent to 300 jobs), 1,000m² of retail (equivalent to 50 jobs) and 10,000m² of leisure space (equivalent to 100 jobs). No residential units would be developed and some 8 hectares of open space would be lost. The net impact would be approximately 3,750 additional jobs.
- 8.15.23 For the proposed Birmingham Curzon Street station catchment, it is estimated that HS2 could enable an additional 75,000m² of office space (equivalent to 5,300 jobs), 10,000m² of retail space (equivalent to 450 jobs), 400 hotel beds (equivalent to 200 jobs), 10,000m² of educational space (equivalent to 150 jobs) and 10,000m² of leisure space (equivalent to 130 jobs). There would also be an additional 1,000 residential units with capacity for around 2,400 people. This would be all at the expense of 55,000m² of industrial area which equates to 1,500 jobs. The net impact could therefore be in the order of 4,730 additional jobs.

Overall findings

- 8.15.24 HS2 high speed services would bring direct benefits to businesses arising from the faster journey times they would offer, that are valued at some £11.0 billion over 60 years. They have the potential to encourage businesses to locate near each other in proximity to the stations. This effect, known as market agglomeration, is estimated to add £3.0 billion to the direct benefits. This does not include the benefits that would arise from the additional services provided as a result of released capacity on the WCML, which would deliver benefits by enhancing labour catchments for firms in both London and Birmingham. Benefits associated with opening up areas to wider competition and wider markets are expected to be significant (adding a further £1.0 billion to total benefits). Labour market impacts are expected to be smaller but positive; however, land use changes over time may magnify the expected benefits along the WCML. Labour market impacts may be enhanced by any agglomeration impacts. The attraction of globally mobile activity due to enhanced international connections reinforces the likelihood that HS2 would generate wider economic benefits.
- 8.15.25 In supporting planned employment growth in London and the West Midlands, the potential for some 30,000 jobs around the High Speed stations (2,000 at Euston; 20,000 at Old Oak Common; 3,800 at Birmingham Interchange and 4,500 at Curzon Street) has been forecast. In addition, the scheme is also expected to provide 1,500 permanent jobs and around 9,000 construction jobs. For the operational employment, it is not clear at this stage what proportion would represent new job opportunities in the rail sector.

8.16 Economic welfare

Overview

- 8.16.1 Economic welfare relates to direct impacts on consumers, particularly faster journeys for people travelling to work or for other personal journeys such as leisure and education (which can be translated into a monetised value), and local development and regeneration impacts.
- 8.16.2 The proposed scheme would strongly support the objectives of improving people's economic welfare and regenerating deprived areas. There are some areas where the

proposed scheme would impede planned developments, although the existing plans could be amended and there is some evidence that this is already happening; e.g. at Birmingham Eastside.

- 8.16.3 In supporting wider economic welfare growth, total consumer user benefits were estimated as being equivalent to around £6.4 billion over a 60 year period¹²⁸, primarily due to anticipated high demand in the leisure market for long distance trips along the WCML. An additional £0.4 billion of economic benefits would derive from fewer road accidents and improved air quality, both associated with the expected reductions in car traffic. Overall, this represents a large benefit commensurate with a highly supportive assessment, reflecting the large journey time savings that HS2 would offer and the high levels of underlying leisure demand on services between the major centres of London, Birmingham, Manchester, Liverpool and Glasgow. Benefits are expected to increase with further work to refine the modelling of services that utilise the released capacity on the WCML.
- 8.16.4 The presence of HS2 stations adjacent to areas of deprivation would be likely to provide modest opportunities for employment for local residents. Wider benefits could arise if such stations increase the overall appeal of their vicinities for investment and increased development; for example, increased use of the Euston site through growth of HS2 traffic, including potential use of HS2 to access Heathrow, is likely to have positive benefits for current plans to regenerate Euston.
- 8.16.5 Furthermore, the release of capacity on the WCML, which would be expected to provide opportunities for enhanced commuter services, could complement existing plans for regeneration. Northampton and Milton Keynes, in particular, are identified as locations for future growth and regeneration; better connections with London would assist this.
- 8.16.6 Perhaps the best regeneration opportunity could come from a station at Old Oak Common. The interchange between HS2 and Crossrail, as well as other services, along with the increased connectivity such a hub could provide for neighbouring areas, could offer significant opportunities for regeneration.
- 8.16.7 More broadly, it is important to note that most regeneration benefits can only be realised in the context of a broader regeneration strategy for the relevant locations. These need to address wider social issues, such as housing, the built environment, skills and crime. Reliance on HS2 stations in isolation would be unlikely to succeed as the core of any objective to promote regeneration. It is encouraging therefore that for each of the areas concerned, the relevant local authority recognises the potential for HS2 to be a catalyst for regeneration and in some cases already has plans in place for that regeneration to occur. More detail on the potential impacts on some key development sites is provided below.

Euston terminus

- 8.16.8 Key to the proposed scheme's potential impacts on regeneration are the effects at Euston. Overall the scheme has the potential to have a number of positive effects on the local community through its catalysis of regeneration and development of the area.
- 8.16.9 Euston is an area with particularly deprived communities. It also has a poor-quality environment and sense of place particularly in and around Euston Station. Consequently, the Euston Station site is designated in the London Plan as an Opportunity Area and is subject to supplementary planning guidance produced by Camden Council¹²⁹.
- 8.16.10 Two development sites included in the Euston Planning Framework SPD would be physically impacted and potentially prejudiced by the proposed redevelopment of Euston

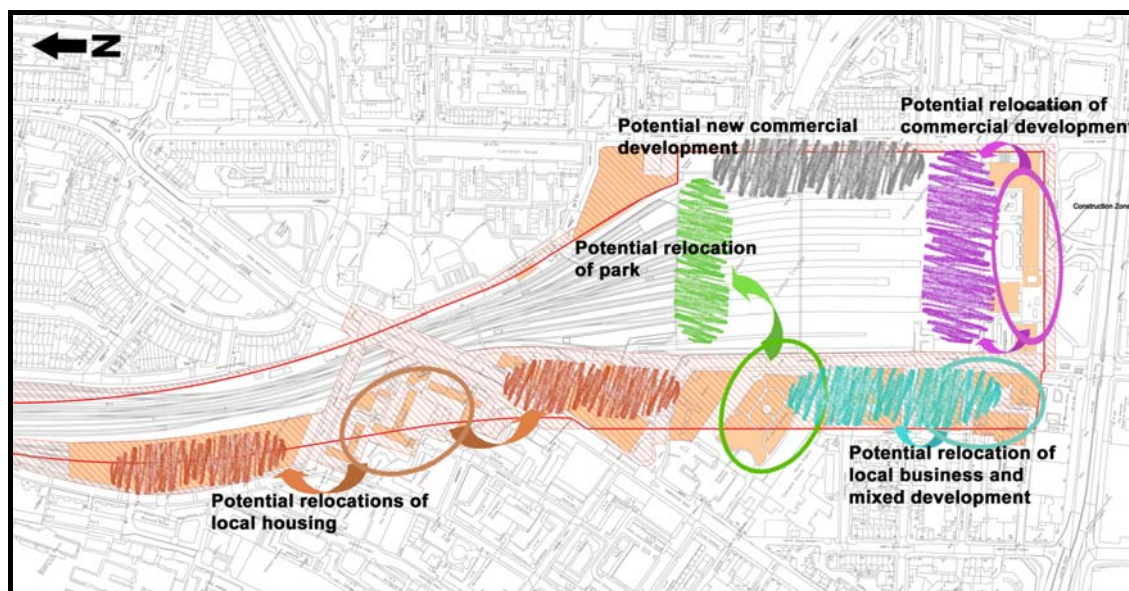
¹²⁸ Net Present Value, 2009 prices

¹²⁹ LB Camden (April 2009) Euston Planning Framework SPD

Station, namely Granby Terrace carriage shed and the former BHS depot site on Hampstead Road.

- 8.16.11 In contrast, other development sites included in the SPD, notably the national Temperance Hospital on Hampstead Road and the Euston Police Garage on Drummond Crescent, would be likely to come forward and benefit from the redevelopment of Euston Station.
- 8.16.12 Measures to account for the loss of public housing and other land uses are not determined at this stage. One possible concept is provided here for illustrative purposes (see **Figure 33**). This incorporates over-station development to include commercial, public housing, open space and access. HS2 Ltd is committed to engagement from the outset and has a desire to involve all relevant parties to ensure that consultation is inclusive, relevant and transparent, that the impacts of its proposals are minimised, and the benefits of the proposals are maximised, both for the travelling public and for those who live and work in the Euston area. HS2 Ltd intends to work closely with the London Borough of Camden and the GLA with the intention of agreeing a joint ambition for the Euston area. This will include engagement with local people, businesses and community representatives affected by the proposals, providing the framework for consultation in this part of London.

Figure 33 – Euston terminus mitigation plan drawing



- 8.16.13 HS2 is likely to have a significant positive effect on the regeneration of the area in the immediate vicinity of Euston station, including rental and capital values. However, it is not likely that HS2 would be a significant catalyst for development in the wider Euston area because the market would, in the normal course of development activity, seek to maximise the density in this prime central London location, regardless of an HS2 station.
- 8.16.14 Based on a high level planning review of the proposed station footprint and a review of the proposed and existing development activity around the station, potential over station development, probably comprising a mixed use of office, residential, retail and leisure accommodation, has been assumed. It would be likely to be restricted in height due to strategic viewing corridors.
- 8.16.15 HS2 could increase net office development in the Euston catchment by 20,000m², retail space could increase by 16,000m², and there could also be a net increase of 290 residential units as a result of HS2, providing space for around 700 people. There could also be a net loss of industrial floor space of 2,000m².
- 8.16.16 Development around Euston station would not necessarily provide employment benefits to residents in the immediate area because the skills required for the attracted jobs may not

be available within the local community. Generally, jobs around Euston would be taken by people from within London's travel to work area.

- 8.16.17 Given the low proportion of owner occupied households in the Euston catchment, many of the benefits from increased land values would accrue to non-residents. Nevertheless, given these overall regeneration impacts the scheme would be expected to help towards a more sustainable future for the area and its economy in line with the objectives of the SPD.

Old Oak Common

- 8.16.18 Old Oak Common comprises industrial and vacant land and lies within one of London's growth corridors – the 'Western Wedge'. The site is 'land locked' within existing rail networks. The Grand Union Canal also runs through the centre of the site to the east and west.
- 8.16.19 Residents of Old Oak ward are considered to experience significant deprivation compared to other parts of the country. Old Oak Common together with Willesden Junction fall within one of West London's Opportunity Areas known as Park Royal (London's largest industrial site) as identified within the London Plan and is subject to a draft Planning Framework produced by the GLA in 2008. Increasing access by public transport is a key aim of Opportunity Areas such as this. The strategic importance of Park Royal in maximising future economic and employment opportunities in this area of London is reinforced in a study undertaken for GLA, LDA, SEEDA and SEERA called *The Western Wedge*¹³⁰.
- 8.16.20 Given its location amidst existing transport infrastructure, the location of a proposed HS2 interchange at Old Oak Common, which would serve Crossrail (so providing connectivity with central London, Canary Wharf and Heathrow), would present a major regeneration opportunity. This would be likely to catalyse other redevelopment projects in West London, as well as creating a number of different employment opportunities.
- 8.16.21 Future floor space assumptions have been based on the masterplan options prepared for LB Hammersmith & Fulham in September 2009, and assume a mid-point growth scenario. In all scenarios it is assumed that the Old Oak Common Depot, North Pole Depot and the proposed Crossrail sidings would remain in rail-related use and not be located elsewhere. The introduction of HS2 would provide an opportunity for regeneration on land north of the Grand Union Canal currently occupied by industrial accommodation. It is estimated that, for the Old Oak Common catchment, HS2 could deliver 300,000m² of office space, 30,000m² of retail space and 4,300 residential units to house around 10,400 people. This is at the expense of some 100,000m² of industrial land.
- 8.16.22 The types of jobs available in this area could change from being predominantly industrial blue-collar jobs to office-based white-collar jobs, leading to more employment in finance, insurance or public sector industries and less employment in the manufacturing or distribution sectors.
- 8.16.23 The redevelopment of Old Oak Common as a strategic rail interchange site could help meet the target for the Park Royal Opportunity Area, which is to accommodate 11,000 new jobs over the next 20 years. Furthermore, one of the objectives of the Sustainability Appraisal prepared for the council's framework document is:
- “to stimulate regeneration and urban renaissance that maximises benefit to the most deprived areas and communities and to improve efficiency in land use through the sustainable reuse of previously developed land and existing buildings”.*
- 8.16.24 Overall an HS2 interchange station at Old Oak Common would present a major regeneration opportunity for West London and could help deliver other planning aspirations such as development in and around Willesden Junction.

¹³⁰ GLA (Aug 2000), *The Western Wedge*. SDS Technical Report 14

Proposed line of route

- 8.16.25 The proposed route passes approximately 2km west of Aylesbury which forms part of the Milton Keynes/Aylesbury Vale Growth Area as defined in the South East Plan. Within this, Aylesbury is identified as a regional hub and centre of significant change and is proposed for additional housing. Although the area would not be expected to benefit from the presence of HS2, neither, at 2km distance, would it be expected to be adversely affected by it.
- 8.16.26 No other impacts on strategic growth and regeneration areas are anticipated within the area between London and the West Midlands.

Birmingham Interchange

- 8.16.27 The immediate catchment area of the proposed station has a small local population that contributes a significant proportion of the employment at the NEC and airport. Therefore any additional development here is likely to impact on a far wider catchment area.
- 8.16.28 The proposed HS2 station could influence future development in an area extending out to the existing M42 corridor, which predominantly runs south-west between junctions 6 and 4, and where a number of large existing business parks have been developed with future space for expansion. The existing stock in this location is office-led; there are few residential properties and industry and warehousing is concentrated around the M6 corridor in lower cost areas of the Birmingham conurbation to the north.
- 8.16.29 Given that permitted schemes along the M42 corridor already have an estimated 230,000m² of expansion space, capacity for yet further expansion in the green belt would be limited. However, the office market has been slow in the last two years. In better economic times, with an HS2 Interchange station in existence, developers may be prepared to build speculatively again. On current activity levels, it is assumed that, without HS2, only around 93,000m² of the permitted space might be built out, with additional turnover of tenants in the existing stock.
- 8.16.30 There could also be small parcels of development land released for new schemes. There is a current application for a gaming licence for a mixed use scheme on a 1.5ha plot. With around 20ha of car parking land in the north-east corner of the NEC site that is under-used for most of the year, and where other small hotel developments have recently been built, this might mean other similar sized schemes for hotel and leisure could happen. If the airport runway is extended and passenger numbers grow in accordance with forecasts, then the potential for hotel requirements in the area generally is likely to increase.
- 8.16.31 It is estimated that HS2 could deliver an additional 47,000m² of office space, 1,000m² of retail and 10,000m² of leisure space. No residential units would be developed and 8ha of open space would be lost.
- 8.16.32 There is significant potential for development within the boundaries of the NEC, which could be catalysed by HS2. Further development around the Birmingham Interchange station that cannot be accommodated within the NEC footprint would potentially conflict with Solihull MBC policy on development within green belt land.

Birmingham Curzon Street

- 8.16.33 The proposed Birmingham Curzon Street station and its approach over some 2km would be developed on an area of land that is predominantly cleared space and largely vacant, much of the traditional employment and industrial uses having left this area some years ago. The route towards the station would have a direct impact upon a number of warehouses, and a student accommodation complex, part of the new development known as Curzon Park which borders the eastern end of Curzon Street, would be lost within the

station throat. Around Curzon Street the area is dominated by surface car parks, fragmented townscape and poorly defined green spaces.

- 8.16.34 Birmingham Curzon Street station would fall within part of the development area known as Birmingham Eastside. A number of other high density mixed developments are proposed to be located around a new linear park, formed by an eastward extension of Park Street Gardens, running parallel with Curzon Street. Many of these proposals have been developed over recent years and are now at an advanced stage of planning and design. The station and approach would impact the planned residential development at Curzon Street which forms part of a 130,000m² mixed scheme, as well as proposals for Birmingham City University north of Fazeley Street, where an academic institution is proposed.
- 8.16.35 Although the Curzon Street station would have a serious short-term impact on development proposals and the Eastside development strategy, in the longer term the area could be restructured around the new high speed terminal to provide high density city centre commercial and mixed use development.
- 8.16.36 The assessment of floor space assumptions (with and without HS2) was broadly based on the masterplan options and known permitted schemes. Some schemes, notably City Park Gate, Curzon Park and Birmingham City University (BCU) Campus would be unable to be developed in accordance with their permissions due to the proposed route of HS2. Therefore a scaled-back version of the mixed use schemes was assumed, and in the case of BCU, a relocation to the Eastside Locks site (at the expense of the existing proposed scheme) was assumed. It is expected that HS2 would catalyse redevelopment of the area south of the railway.
- 8.16.37 HS2 could, it is estimated, enable an additional 75,000m² of office space, 10,000m² of retail space, 400 hotel beds and 10,000m² of leisure space. There could also be an additional 1,000 residential units with capacity for around 2,400 people. These developments would replace 55,000m² of existing industrial area. This station would serve most of Birmingham's central employment area.

Figure 34 – Aerial view of the area around the proposed Curzon Street station site R_[HS2 Ltd]



8.17 Soil and land resources

- 8.17.1 The appraisal has considered potential impacts on land resources in terms of agricultural land, minerals resources and green belt. Given its passage through large areas of countryside, the proposed scheme would inevitably have adverse impacts through its occupation and severance of areas of farmland. Around London and Birmingham it would also sever green belt. It would, however, also make productive use of some former industrial areas and other brownfield sites.
- 8.17.2 The proposed scheme would potentially cross just over 20km of Grade 2 agricultural land involving land severance and landtake totalling approximately 211ha, although probably less in practice. Further work would be undertaken during later design stages to maximise the extent of agricultural land that could remain in production. No Grade 1 agricultural land would be affected.
- 8.17.3 There would be no impacts on minerals resources. However, a 9ha landfill site, south-east of Calvert, would potentially be physically affected by the scheme.
- 8.17.4 A total of 85km of green belt would be traversed by the proposed route, largely within the Colne Valley, in the Chilterns south-east of Aylesbury, through much of Warwickshire and through Solihull, although this would not result in substantial loss or isolation of green belt land. The only significant impact on green belt would be likely to arise around the Birmingham Interchange Station, where an area would be required to accommodate the proposed station and associated facilities.
- 8.17.5 Potential benefits would accrue from the productive use of former landfill sites. Sixteen such sites, of just under 146ha in total, would be crossed by the proposed scheme, with associated landuse benefits. A number of other 'brownfield' sites (such as former industrial areas) would potentially be brought back into productive use, but these have not been identified at this stage.

Summary of generic mitigation measures for soil and land resources

Incorporated mitigation:

- Landtake requirements for the proposed route have been reduced to a practicable minimum and impacts on surrounding landuses have been considered when developing the alignment.

Mitigation options:

- The potential for contamination would be assessed at points along the proposed route where appropriate to ensure risks to adjoining areas were reduced to a practicable minimum.
- As far as practicable, landtake for construction would be minimised.

8.18 Waste generation

- 8.18.1 An estimated total of 1.8 million cubic metres of spoil would potentially be generated by tunnelling. This assumes that a balance is otherwise achieved on surface sections between cuttings and embankments.
- 8.18.2 Spoil would be reused to construct embankments and other earthworks and landscaping along the route. The project would also actively seek reuse of spoil outside the project, providing it for other development projects or schemes in need of such materials.

Summary of generic mitigation measures for waste

Mitigation options:

- Generation of excavated materials and waste would be minimised through efficient materials resource management.
- HS2 Ltd would seek to re-use as much spoil as possible within the scheme design, for embankments and landscape proposals. Opportunities would be sought to use any surplus spoil within other schemes and proposals; disposal to landfill would be used as a last resort.
- Where residual disposal is required, licensed landfill sites would be used and transport distances minimised as far as is practicable.
- Construction practices would be the subject of a site waste management plan which would be developed at an appropriate point in the project.
- Where appropriate and practicable, offsite fabrication would be employed to reduce onsite waste generation.

8.19 Resource use

- 8.19.1 HS2 would, like any major project, require thousands of tons of steel and concrete. However, the project would manage the design and construction of the scheme in such a way that this demand would be reduced as much as practicable. This would be key in helping to improve its overall sustainability.
- 8.19.2 Ongoing appraisal of resource use would take account of the proposed scheme's potential to make more efficient use of resources and to re-use materials, such as demolition waste.
- 8.19.3 At this stage the type and quantity of individual materials to be used is uncertain, and for this reason the evaluation criteria in the AoS framework have been assessed as unknown. This is something that would be explored further during ongoing design. In general it is expected that the proposed scheme would include a commitment to using sustainable materials, such as low carbon cement, recycled steel and aggregates, re-used spoil, and sustainable timber. This would depend on a number of considerations, including technical requirements for different structures (tunnel lining, viaducts and track slab), availability and commercial considerations. Mechanisms for achieving other environmental criteria in relation to material specification would need to be delivered, where practicable, through contractual specification and procurement policy.

Summary of generic mitigation measures for resource use

Mitigation options:

- Subsequent stages of design development would continue to focus on the potential to use sustainable materials such as low carbon cement, recycled steel and aggregates, re-used spoil and sustainable timber.
- Contractual specification and procurement policies would be used to drive sustainable material choices.

8.20 Impacts from released capacity

New service opportunities

- 8.20.1 By taking some of the non-stopping services off the WCML south of Lichfield, and freeing up seats on existing services, significant capacity would be released on this section of the route, which could be used for expansion of existing and new services. Up to 11 additional paths in each direction every hour throughout the day would be created depending on stopping patterns and train speed differences. This could be used by a reconfigured

WCML service, including both remaining long distance services and increased freight and commuter/suburban traffic.

- 8.20.2 In terms of long distance services, HS2 Ltd has modelled an altered service pattern which would complement the classic-compatible HS2 services, and preserve fast classic trains for certain intermediate stations. The opportunity has been taken to propose re-establishing regular connections from the north to the growth areas on the southern part of the WCML, particularly Milton Keynes. Broadly speaking, these remaining services fall into five categories:
- London – Birmingham – Wolverhampton (– Liverpool);
 - London – Crewe – Glasgow;
 - London – Crewe;
 - London – Stoke – Manchester; and
 - London – Chester – North Wales.
- 8.20.3 The capacity which would be released by HS2 would also presents opportunities for commuter/suburban services on the way into Birmingham (along the WCML Coventry corridor) and into London.
- 8.20.4 For commuter capacity into London, HS2 Ltd has modelled a substantially improved service for Milton Keynes, Northampton and Rugby, as well as additional services to commuter towns closer to London. Under these assumptions, Milton Keynes would receive an additional seven non-stop services to London in the peak hour, with five further stopping services. These changes would help to support the substantial housing growth expected within the Milton Keynes/South Midlands Growth Area.
- 8.20.5 For commuter capacity into Birmingham, the removal of some of the Euston services along the Coventry Corridor would provide the opportunity to achieve a better separation of short-distance local journeys and inter-urban journeys, providing a more regular and frequent service with improved journey times for both. The service assumptions also allow the diversion of a cross country service via Coventry and Birmingham International. The enhanced service to Birmingham International would also improve rail connections to HS2 via the Interchange station for locations along that rail corridor.
- 8.20.6 In terms of freight modelling, the WCML is Britain's key trunk route for rail-borne freight, with over 50% of rail freight passing on the WCML during some part of its journey. The release of additional capacity on the southern section of the WCML would also cater for growth in the freight markets, particularly serving the distribution centres and intermodal terminals of central England. The proposed additional passenger services on the WCML would make use of some of the released capacity, but scope would remain for additional freight paths to be added, according to market demands.

Potential secondary impacts

- 8.20.7 Potential new passenger services introduced to utilise released capacity on the WCML may result in other secondary impacts, some positive and some negative. Some of these have already been described, particularly in respect to socio-economic impacts. They could result from modal shift, where people use the WCML services in preference to their cars, as well as from secondary development that grows up around the WCML stations in response to the transport and economic opportunities that arise. They could also result directly from the new journey opportunities that are introduced. **Table 5** summarises these and other potential secondary impacts.

Table 5 – Summary of potential secondary impacts and effects resulting from released capacity on the WCML

Sustainability issue	Principal impact	Potential secondary impacts
Reducing greenhouse gas emissions and combating climate change		
1: Climatic factors and adaptability	None	N/A
2: Greenhouse gases	Modal shift (car to train)	Benefit: reduced CO ₂ emissions
	Modal shift (freight to train)	Benefit: reduced CO ₂ emissions
	Secondary development	Adverse: increased CO ₂ from generated car trips
Natural and cultural and resource protection and environmental enhancement		
3: Landscape	Secondary development	Benefit or Adverse: increased pressures on landscape and townscape resource
4: Cultural heritage	Secondary development	Adverse: increased pressures on historic townscapes and other features resource
5: Biodiversity	Secondary development	Adverse: increased pressures on ecological resource
6: Water resources	Secondary development	Adverse: increased pressures on water resources
7: Flood risk	Secondary development	Adverse: increased pressures on flood capacity
Creating sustainable communities		
8: Air quality	Modal shift (car to train)	Benefit: reduced pollution
	Secondary development	Adverse: increased local pollution at affected stations and at secondary development if these generate additional vehicle trips
9: Noise and vibration	Modal shift (car to train)	Benefit: reduced road traffic noise
	Secondary development	Adverse: increased local pollution at affected stations and at secondary development if these generate additional vehicle trips
10: Community integrity	Improved train services	Benefit: effects are related to economic welfare and improved accessibility (see below)
11: Accessibility	Improved train services	Benefit: improved journey opportunities from stations currently less well served Benefit: improved journey opportunities for areas with lower levels of car ownership
12: Health and well-being	Secondary development	Benefit: new health and leisure facilities established Benefit: improved journey ambience through reductions in overcrowding
13: Security and safety	Modal shift (car to train)	Benefit: potential for reduced road traffic accidents
14: Economic prosperity	Improved train services	Benefit: business user benefits Benefit: enhanced market agglomeration Benefit: increased connectivity to labour catchments and access to labour markets
15: Economic welfare	Improved train services	Benefit: consumer user benefits Benefit: support for planned development Benefit: support for regeneration and growth
Sustainable Consumption and Production		
16: Soil and land resources	Secondary development	Adverse: increased pressure on soil and land resources
17: Waste generation	Secondary development	Adverse: increased waste arisings
18: Resource use	Secondary development	Adverse: increased use of material resources

8.21 Summary of impacts on geographical basis

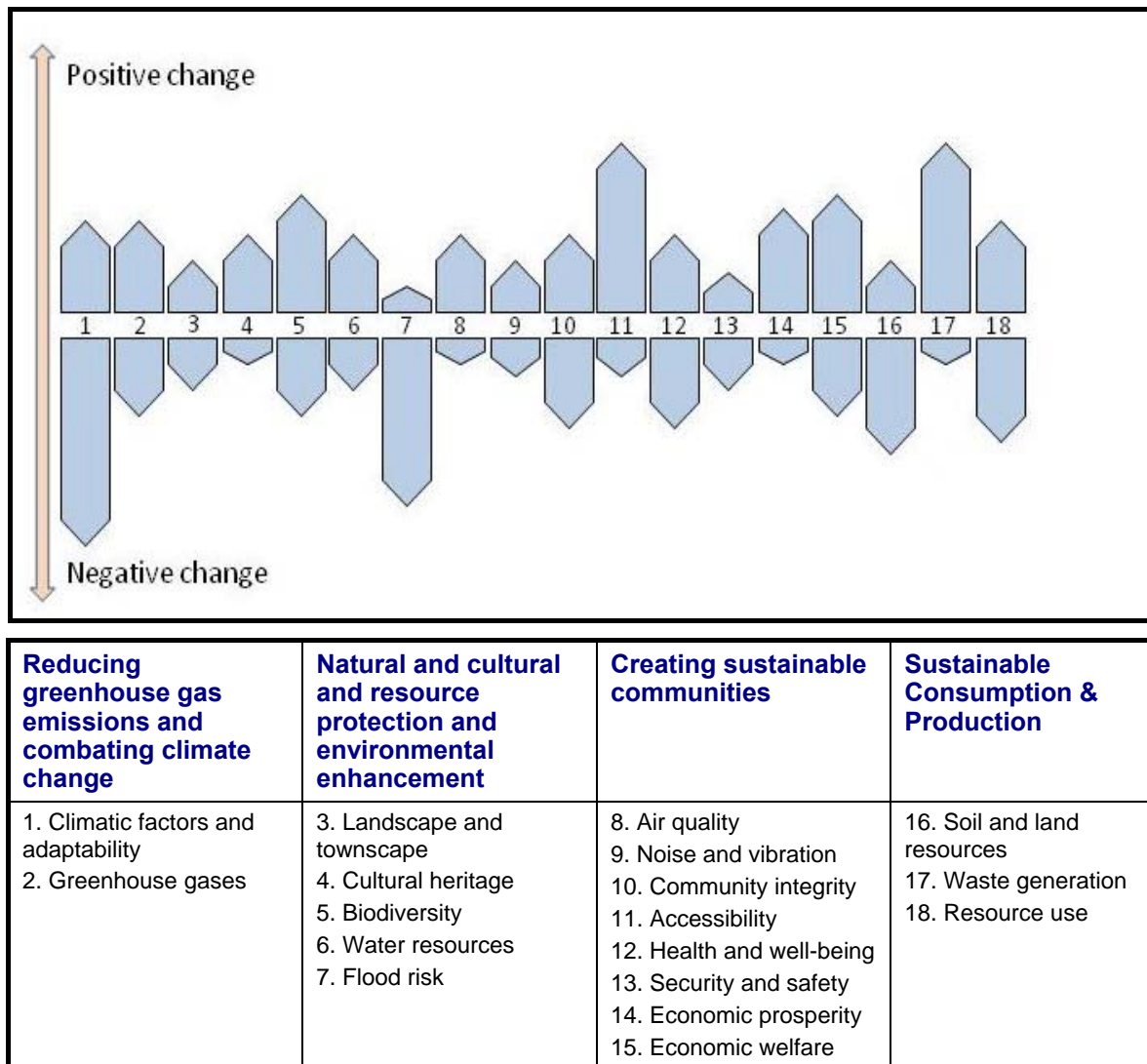
- 8.21.1 A summary of how the various impacts of HS2 would be expected to be distributed geographically is presented in *Volume 2*. This shows a summary table that has been prepared by assessing all of the evaluation criteria under each of the 18 sustainability issues and 33 core sustainability objectives (as set out in *Appendix 1*), and applying the highest rating for each issue. Where both positive and negative impacts would be experienced, these are both noted.

8.22 Appraisal of cumulative impacts

The Future baseline

- 8.22.1 Cumulative impacts consider impacts from HS2 in combination with other changes that could take place between now and the future. The extent that the current baseline (at 2010) would be different to future baselines at given points (namely 2017, 2026 and 2040) would depend on the sustainability issue under consideration (see Section 7.2) and the influence of drivers such as policy, economics, climate, population and time. This baseline change may be beneficial (positive) or adverse (negative); it would probably involve components of both. The change is uncertain and complex. The assumption that the AoS makes about the future baseline is set out in Section 7. However, this belies a greater degree of complexity.
- 8.22.2 An illustration of how positive and negative change might equally contribute to the future baseline, against each of the 18 AoS key issues is shown in **Figure 35**. This shows for example that climatic factors (1), flood risk (7) and soil and land resources (16) might be expected to get worse or decline in quality over time and by relatively large amounts. Landscape (3), cultural heritage (4) and people's security and safety (13) might be expected to change very little over the same general time frame. Whereas people's ability to get where they want to be (accessibility, 11) and the quantities of waste generated (17) would be expected to improve greatly. In some cases, the positive and negative changes may cancel each other out; for example, emissions of greenhouse gases would increase from some sources and decline from others, resulting overall in levels (in the UK at least) being stabilised and eventually reduced.
- 8.22.3 These situations may not transpire, but current projections would suggest that these are reasonable assumptions. These 'natural' changes provide the backdrop against which any potential impacts from HS2 have been described. In practice, however, increasing demand is likely to create a need over the next twenty to thirty years for additional capacity to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. Were HS2 not progressed then other transport improvements could be required, such as enhancements to the strategic road network, provision of additional runway capacity to serve increased flight demands, or provision of a new conventional speed railway. These scenarios are not addressed here.

Figure 35 – Possible scenarios for baseline change in absence of HS2 or other alternative major transport enhancements



Predicted impacts

- 8.22.4 **Table 6** shows the predicted cumulative impacts of HS2, other development schemes and the future baseline.
- 8.22.5 Key cumulative adverse effects would potentially include impacts on landscape and flood capacity, with development pressure, particularly in rural and suburban areas having a strong influence on this. The cumulative adverse impact on the noise environment is also likely to be a factor where HS2 and other developments, particularly road schemes, could act in combination.
- 8.22.6 The key cumulative positive effects would include those of enhancement of public transport and public transport interchange, and those relating to employment and wider economic growth, support for planned development and support for regeneration. These would be realised largely in urban areas.
- 8.22.7 Overall, HS2 in combination with other plans, schemes and actions would be likely to have a negligible impact on climate change, predominantly adverse impacts on natural and cultural resources; and both adverse and beneficial impacts on sustainable consumption and production, and on sustainable communities, with economic and transport benefits being its most marked contribution to the latter.

Table 6 – Cumulative impacts with projected baseline change

	Likely impact of proposed HS2	Likely change between the current baseline and the future baseline	Likely cumulative impacts
Reducing greenhouse gases and combating climate change			
Improving resilience of rail network to extreme weather	+	0	+
Reducing UK greenhouse gas emissions	+/-	+	+
Natural and cultural resource protection and environmental enhancement			
Maintain and enhance existing landscape character	--	-	--
Maintain and enhance existing townscape character	0	0	0
Preserve and protect archaeological assets	-	0	-
Preserve and protect historic buildings	-	-	-
Preserve and protect historic landscapes	-	-	-
Maintain and enhance biodiversity	-	-	-
Protect surface water resources	-	0	-
Protect groundwater resources	-	-	-
Conserve and enhance capacity of floodplains	-	-	--
Creating sustainable communities			
Maintain and enhance local air quality	U	+	+
Maintain and enhance the local noise environment	--	-	--
Maintain the local vibration environment	-	0	0
Maintain and enhance community integrity	0	-	0
Maintain and enhance pedestrian access	0	+	+
Maintain and enhance public transport access	+	+	++
Maintain and enhance public transport interchange	+	+	++
Maintain and improve mental well-being	0	0	0
Maintain and improve physical health	0	+	+
Reduce health inequalities	0	0	0
Contribute to the reduction of road traffic accidents	0	0	0
Protect against crime and fear of crime	U	0	0
Support economic competitiveness	++	U	++

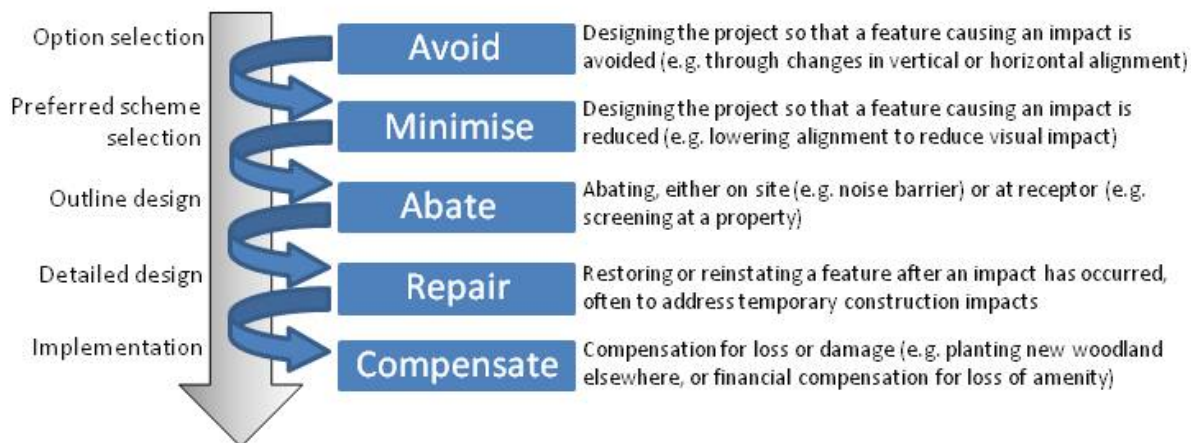
	Likely impact of proposed HS2	Likely change between the current baseline and the future baseline	Likely cumulative impacts
Support wider economic growth and maintain and enhance employment opportunities	++	U	++
Support wider economic welfare growth	++	U	++
Support planned development.	-	++	++
Maintain and enhance Regeneration	+	++	++
Sustainable consumption and production			
Maintain and enhance land resources	-	-	-
Encourage the use of brownfield sites	+	+	+
Prevent and minimise waste generation	-	+	+
Conserve and protect primary material resources.	-	-	-
<p>- - Highly unsupportive of objective</p> <p>- Unsupportive of objective</p> <p>0 Neutral</p> <p>+ Supportive of objective</p> <p>++ Highly supportive of objective</p>			

9 Mitigation and monitoring

9.1 Mitigation

- 9.1.1 The AoS has established key design principles and supported the options sifting process. It has also identified potential adverse effects and helped guide refinements in the route alignment, as well as the introduction of specific mitigation features, such as tunnels and green bridges.
- 9.1.2 Different general types of mitigation are set out within a mitigation hierarchy, illustrated in **Figure 36**. The different types are shown in order of preference, with avoidance the most preferred and compensation the least preferred. The opportunity to apply each of these types of mitigation tends to vary with the stage in the scheme life cycle. At the earliest stages, and well before any designs are fixed, potentially adverse impacts may be avoided; for example by rejecting a damaging option in favour of a benign one. As scheme design increases in detail, flexibility to change it would decrease and alternative mitigation strategies become appropriate. In the latest stages of the project lifecycle, with any design fixed and agreed, mitigation might only be possible by providing compensation for an adverse impact that is otherwise deemed unavoidable. EIA would be fundamental in helping to establish the need for further mitigation and in determining the potential form of this.
- 9.1.3 In the development of HS2 proposals to date, mitigation has focused on avoiding impacts (mostly through option selection and through the use of tunnels and changes in horizontal and vertical alignment) and, to some extent, minimising impacts; for example through reducing the width of the proposed rail corridor within sensitive environments to minimise landtake.

Figure 36 – The mitigation hierarchy



- 9.1.4 Since the publication of HS2 proposals in March 2010, various refinements to the design have been undertaken. These refinements are described within the text boxes in Section 3. They have almost all been undertaken to incorporate environmental mitigation, by way of small changes in alignment (avoidance and minimisation) or introduction of particular mitigation features, such as green bridges (abatement). Further opportunities to abate, repair or compensate for potential impacts would be sought in later stages of scheme development if HS2 progresses further.
- 9.1.5 Consultation will identify additional opportunities to mitigate the impact of any scheme. Once consultation has been completed, further design would commence and the engineers would further refine the scheme. This work would carefully consider issues that were raised in consultation, and would work to further reduce impacts on the environment. An EIA would then be undertaken which would provide a further opportunity to incorporate mitigation within the design.

9.2 Monitoring

- 9.2.1 HS2 Ltd would monitor the significant environmental effects of the implementation of the project in order to identify at an early stage unforeseen adverse effects, and to be able to undertake appropriate remedial action. Unforeseen effects are often interpreted as being underlying assumptions that turn out to have been incorrect or outside the context of the appraisal, for instance about population changes or economic growth.
- 9.2.2 In particular, EIA would identify the significant residual effects of HS2 (after mitigation measures have been incorporated) and set in train the process by which they could be monitored as part of the routine project planning process. This includes impacts on landscape/townscape, historic and archaeological heritage, biodiversity, water resources, flood risk, air quality, noise and vibration, health, security, land use, waste generation and resource use.
- 9.2.3 HS2 could also have some national level impacts; and some of the assumptions on which it is based could affect the development of future rail lines (conventional as well as high speed) in the UK. Going forward, a monitoring programme could be established which would address these strategic impacts and define mechanisms for dealing with them.

