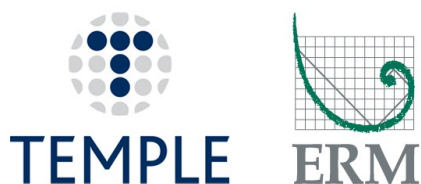


**High Speed Rail: Consultation on the route from the
West Midlands to Manchester, Leeds and beyond**

Sustainability Statement

**Volume 1: main report of the Appraisal of
Sustainability**

A report by Temple-ERM for HS2 Ltd



July 2013



High Speed Rail: Consultation on the route from the West Midlands to Manchester, Leeds and beyond

Sustainability Statement

Volume 1: main report of the Appraisal of Sustainability

A Report for HS2 Ltd

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This report was commissioned by, and prepared for HS2 Ltd by Temple Group Ltd and Environmental Resources Management ('The Consultant'). The findings and conclusions set forth in this report represent the best professional judgment of the Consultant based on information made available to it. The Consultant has relied on, and not independently verified, data provided to it by such sources and on secondary sources of information cited in the report.

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VOLUME 2 – MAPS FOR THE SUSTAINABILITY STATEMENT

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- E8 Access**
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- E10 Waste**
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- E12 Air Quality**



Executive summary

Overview

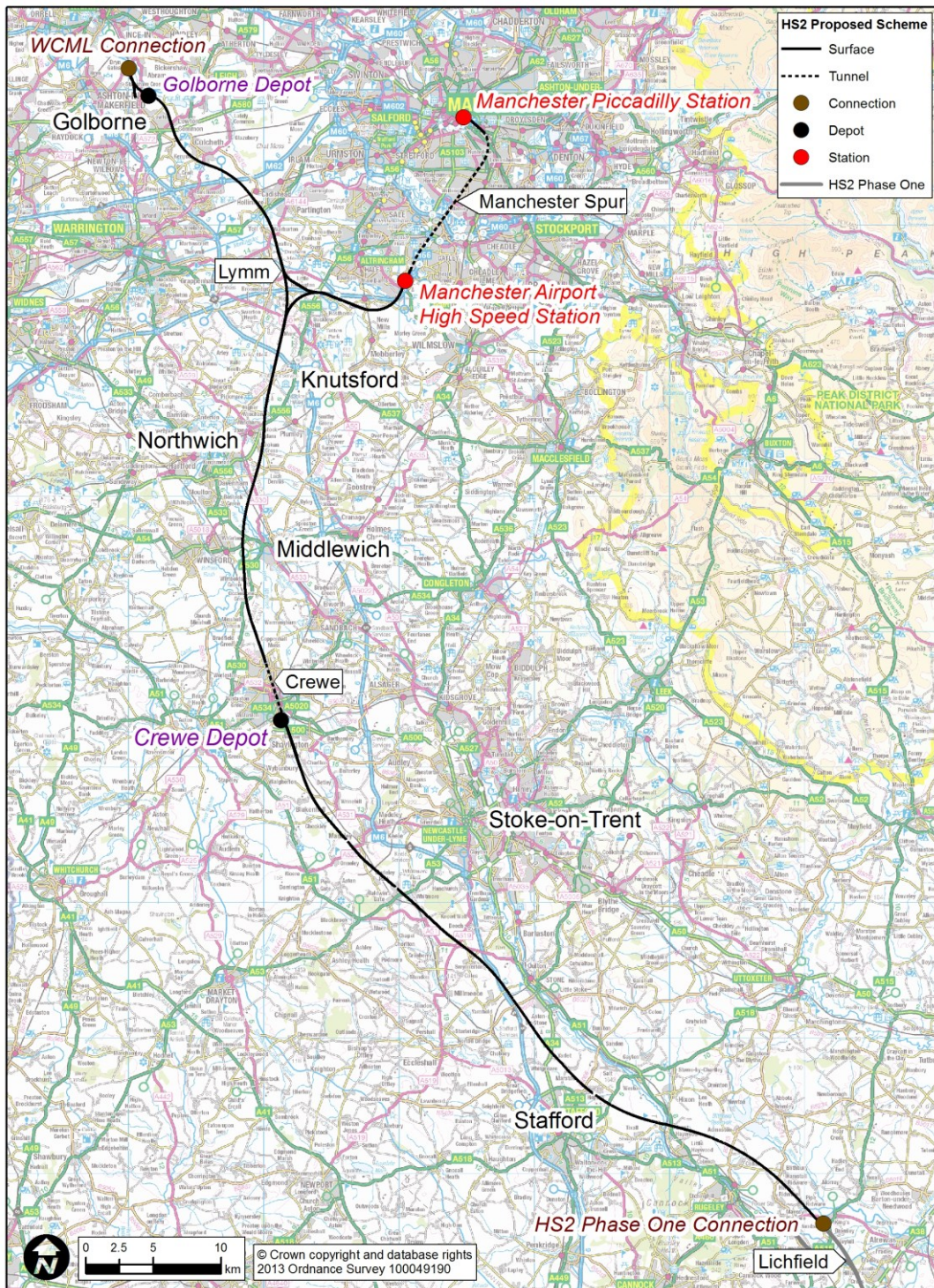
- i. The HS2 proposed scheme has emerged from over two and a half years of option development, selection and refinement, supported throughout by an Appraisal of Sustainability (AoS). The Sustainability Statement describes the contribution of the AoS together with its findings. Following an introduction (Section 1) and a brief description of the scheme (Section 2), the report sets out the process that has supported the evolution of the scheme proposals (Section 3). The scope of the AoS is described in Section 4, and the descriptions of the main impacts of the proposals, both positive and negative, are presented in sections 5-7. Section 8 outlines how the proposals will continue to be developed and assessed. A series of supporting appendices are available on-line at the at the [HS2 Phase Two document library](#)¹
- ii. In summarising the main potential impacts of the proposed scheme, this executive summary runs south to north along each leg in turn. It highlights the most important impacts passing first along the western leg and then the eastern leg. A more detailed Environmental Impact Assessment (or EIA) of the scheme will be undertaken in due course that incorporates any changes following public consultation. At that point, further mitigation measures will be incorporated into the design, and many of the potential impacts that are predicted at this stage will be reduced or avoided.

Western Leg: Lichfield to Crewe

- iii. The western leg would connect with Phase One to the north-east of Lichfield. It would cross the wide Trent Valley on viaduct, affecting character and views within this landscape. It would then drop into cutting for most of the way to the north-east outskirts of Stafford. The alignment was devised to avoid impacts on the European protected Pasturefields Salt Marsh Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI), as well as on Hopton Battlefield and the Cannock Chase Area of Outstanding Natural Beauty. A short tunnel was introduced to help minimise potential impacts at Hopton. The alignment through this area would occasionally emerge from cutting to cross over watercourses and roads and these sections could be prominent. For example an embankment would affect the landscape between the villages of Colton and Stockwell Heath; and where the route crosses the Trent for the second time, noise and visual impacts would affect some residents at Great Haywood and users of its local marina.
- iv. From Stafford, the route would remain in cutting for most of the way northwards to Stone, where a bridge crossing over the M6 would give rise to visual impacts at Swynnerton. North of Swynnerton, a series of refinements were introduced to both simplify engineering and reduce potential environmental impacts. At Whitmore Heath a tunnel was introduced to minimise impacts on the village. Further north towards Madeley, the route was moved west and lowered to include a tunnel to reduce potential demolitions at Madeley, as well as noise and visual impacts on its Conservation Area. This change also avoided direct impacts on Hey Sprink Ancient Woodland, the Grade II Listed Hey House and a cemetery south of Madeley.

¹ <http://www.hs2.org.uk/phase-two/route-consultation/document-library>

Proposed scheme: western leg



- v. The route would come alongside the West Coast Main Line (WCML) to the west of Madeley and this would help to limit environmental impacts through this area. However, the valley landscape north-west of Whitmore would be affected by landtake from much of the prominent and ecologically important Whitmore Wood Ancient Woodland. The crossing of a strategic abstraction point for public drinking water would require measures to ensure that this water supply is preserved.
- vi. Approaching Crewe, the proposed depot would be adjacent to the existing Basford sidings. Together with the elevated cross-over of the WCML, this would affect the

local landscape character. Residents in the area north of Chorlton would be subject to noise and visual impacts, albeit within an area already influenced by the WCML and from a revised design, which has seen the scheme moved to the far side of this existing railway. The route would then enter tunnel beneath Crewe, ensuring that potential impacts are minimised.

Western Leg: Crewe to Lymm

- vii. Having emerged from tunnel through the northern outskirts of Crewe, the route would affect the setting of the Scheduled medieval moat at Minshull Vernon, although the route would still be alongside the WCML at this point. It would then diverge from the WCML and head northwards between Winsford and Middlewich across the open flat landscape of the Cheshire Plain. A viaduct, necessary to cross the River Dane and historic Trent and Mersey Canal, would affect their character and setting to some degree. A cutting immediately north of this would pass through the Bostock landfill, necessitating careful design and construction to ensure contamination and other risks are addressed.
- viii. The route would remain on embankment as it passes east of Northwich. However, the area is quite sparsely settled and noise and visual impacts would be limited to small settlements such as Lostock Green and Lostock Gralam. Winnington Wood and Leonard's and Smoker Wood are both Ancient Woodlands in the valleys east of these villages that would be directly affected, as would Wincham Brook, potentially requiring some diversions to the river channel.
- ix. Passing west of the Mere SSSI (part of the Midland Meres and Mosses Ramsar site), the design has been devised to ensure impacts are avoided on this internationally significant habitat.
- x. A spur to Manchester (see below) would diverge from the main route at this point. The delta junction and routes northwards would result in impacts on the landscape in this area, and would affect views for residents in Hoo Green and Hulseheath. The setting of the Grade II Listed Ovenback Cottage near High Legh would be affected.

Western Leg: Lymm to Golborne and the WCML

- xi. The alignment northwards was carefully selected to avoid impacts on the historic parkland and setting of Dunham Massey. The route would be within cutting as it enters the Bollin Valley, and it would continue in cutting for some way northwards. It would then rise onto a viaduct around 30m above the Manchester Ship Canal in order to maintain its navigability. The viaduct and embankments either side would greatly affect the landscape character of the area, as well as the views of residents in villages such as Hollins Green and Glazebrook. Noise impacts are predicted around Hollins Green.
- xii. Passing south of Holcroft Moss SSSI (part of Manchester Mosses SAC), the route has been designed to avoid impacts on this European protected habitat. The route would then cross the edge of Risley landfill site, again necessitating careful design and construction to ensure contamination and other risks are addressed.
- xiii. The route would enter cutting for much of its remaining passage south of Culcheth and on to Lowton, helping to minimise risks of noise and visual impacts. The route would pass through the Taylor Industrial Estate south of Culcheth, demolishing an estimated 17 properties. The Grade II Listed Old Rectory on Newchurch Lane would be demolished. Continuing through a gap between Lowton and Lowton Common, east of Golborne, the route would result in five residential demolitions as well as visual impacts.

- xiv. The route would pass west of Pennington Flash Country Park and, with the proposed train depot at Golborne, would result in visual impacts for users of the park and the Leeds and Liverpool Canal, as well as local residents. The open countryside between Golborne and Abram would become fragmented. Early design work within this environmentally sensitive location has ensured that direct impacts on Abrams Flashes SSSI would be avoided, although the risk of disturbance or pollution at the site would need to be carefully monitored and mitigated. The Grade II* Listed Lightshaw Hall would sit within the depot footprint and although direct impacts would be avoided, the building's setting would be greatly changed, as would that of the nearby Grade II Listed Byrom Hall.

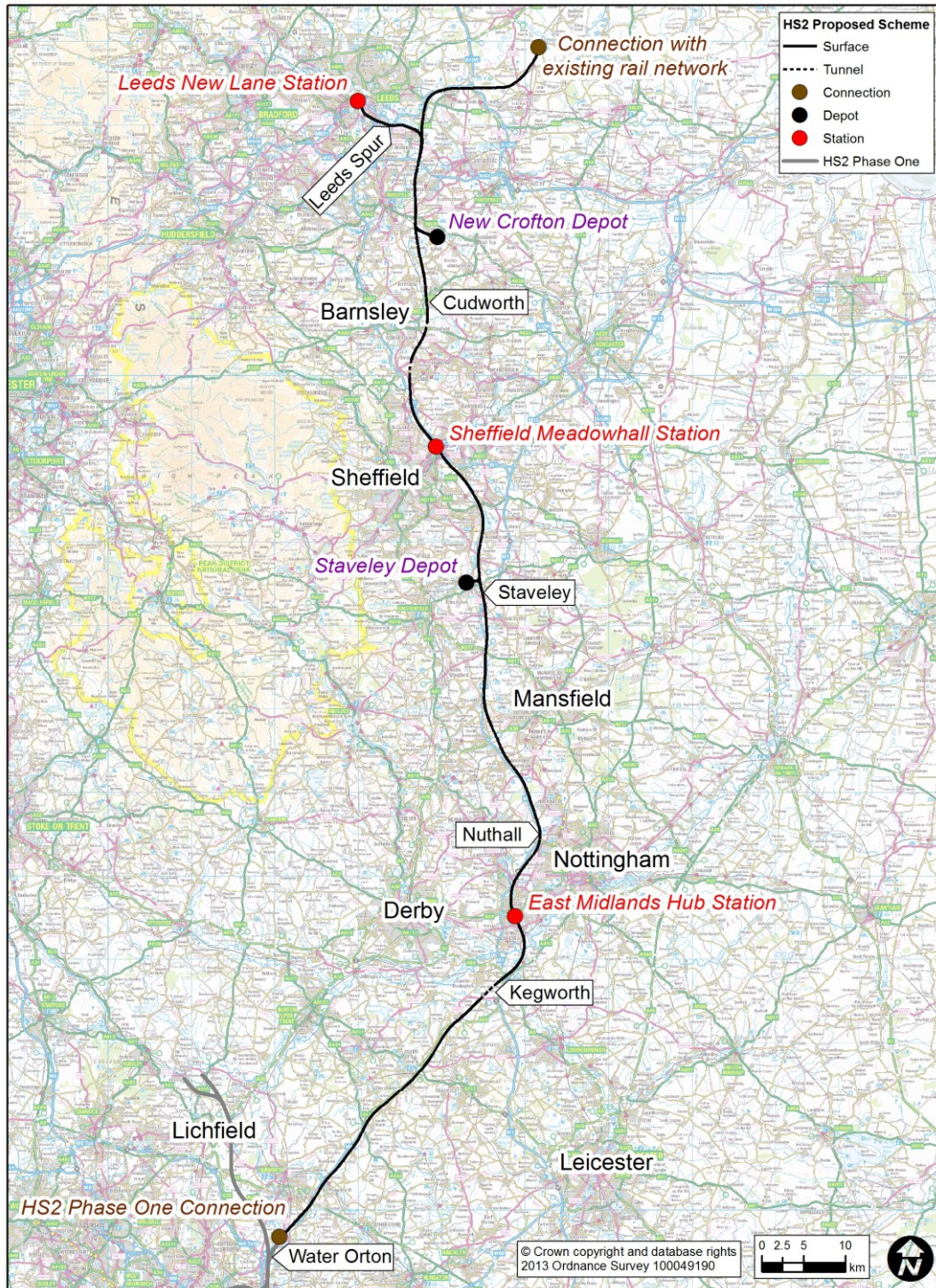
Western Leg: The Manchester spur

- xv. Having diverged from the main route, the Manchester spur would cross over the A556 and then pass close to the north of Rostherne Mere National Nature Reserve and Ramsar site. Careful design would ensure that impacts on this internationally significant habitat are avoided; further measures to minimise the risk of bird disturbance could be integrated through landscaping in the area. The southern edge of Hancocks Bank Ancient Woodland would be crossed by the scheme.
- xvi. The route would remain just south of the M56, avoiding impacts on the historic Tatton Park. It would then turn northwards under the M56 to pass west of Manchester Airport. The route and a new HS2 station would result in an estimated 15 residential demolitions, as well as visual impacts. The Grade II Listed Buckhall would be demolished, although the existing setting of this building has become degraded. The area around the airport is likely to be developed over future years, and HS2 would support this growth, enhancing the employment opportunities in the area. It would also greatly enhance accessibility within the region by linking with existing transport, including rail, the Metrolink, roads, as well as the airport itself.
- xvii. Potential impacts through much of Manchester would be avoided as the route passes into tunnel for several kilometres beneath Wythenshawe, Northenden, Withington, Rusholme and Longsight. It would emerge at West Gorton and although within an existing rail corridor, it would necessitate some 22 residential demolitions. However, a proposed housing development may affect the number of demolitions required. This will be determined when design details of the housing scheme and Phase Two are developed.
- xviii. The new HS2 station at Manchester Piccadilly would provide substantial opportunities to support growth and development within the centre of Manchester: it is estimated that between about 30,000 and 43,000 jobs could be supported by HS2 owing to the transport opportunities it would bring to an area with abundant space for development. The station would require the demolition of 48 residential properties, but in the long term it could support between about 3,000 and 4,000 new houses. The Government and HS2 Ltd will work with Manchester City Council to ensure the plans for a new station maximise the opportunities for this part of the city and the wider area.
- xix. Visually the new station would be expected to fit well alongside the existing Piccadilly Station, although there would be some impact on the Grade II Listed train shed at the station and on the character of the station and Whitworth Street Conservation Area.

Eastern Leg: Water Orton to Kegworth

- xx. The eastern leg would diverge from Phase One to the east of Water Orton. The route would come alongside the M42 and remain within this transport corridor, largely within cutting, for the next 40km, so helping to limit potential impacts. However, noise impacts are likely to affect residents at villages along the route including Kingsbury, while an estimated six dwellings would need to be demolished at Whateley.

Proposed scheme: eastern leg



- xxi. River crossings would require an elevated alignment, and at these locations impacts would be more likely. For example, the crossing of the Tame Valley near Kingsbury and of the Anker Valley near Polesworth would result in some visual impacts at country parks in these locations, although the route was aligned here to ensure that direct impacts on Alvecote Pools SSSI would be avoided.
- xxii. Further north near Measham, the route would bridge the River Mease, a European protected habitat. Extensive consultation with Natural England and the Environment Agency has helped produce a design that avoids impacts on this river and its key species. The Grade II Listed Meer Bridge at Measham may be demolished. Further design is likely to ensure that viaduct piers avoid this structure, although its setting would be adversely affected by the viaduct passing over it. Noise impacts would affect residents at Measham. The proposed viaduct over Gilwiskaw Brook at Packington may require channel works to ensure its flows are properly maintained.
- xxiii. The route would remain alongside the A42 as far as the village of Worthington, at which point a bridge would carry the railway over the road. South of Tonge, the embanked route would affect the landscape setting of the historic village and would affect views from local roads towards Breedon on the Hill. The route would continue west of Diseworth before entering tunnel to go under East Midlands Airport. The tunnel has been lengthened from earlier designs to avoid the proposed East Midlands Gateway: Strategic Rail Freight Interchange development.

Eastern Leg: Kegworth to Nuthall

- xxiv. Having emerged from tunnel, the route would rise onto a long viaduct to carry it over the Soar Valley. This would affect the landscape character of the valley, although within a context already affected by roads and power lines. The route would pass through Red Hill between the Soar and Trent valleys. The below-ground remains of a Scheduled Roman site would be directly affected, and prior investigation would be required to determine how physical impacts could be avoided or minimised. A direct impact on the prominent wooded riverside bluffs at Thrumpton would affect the setting of its Conservation Area, and intrude into skyline views from the Trent Valley. The long viaduct across the valley would exacerbate the landscape impact and would need to be carefully designed.
- xxv. The route would descend from viaduct along the Erewash Valley, between Long Eaton and Beeston, giving rise to noise impacts, as well as a number of residential and commercial demolitions: an estimated six dwellings would be demolished at Long Eaton, with a further six south-west of Toton. The proposed (East Midlands Hub) station would be located immediately north of this. HS2 could support between 1,500 and 1,600 jobs around the station, but could initiate greater local economic growth. The station is designed to incorporate existing rail services ensuring good local links with Nottingham, Derby and Leicester; and growth of the Nottingham tram network is likely to see extensions of the tram to the high speed station in the future. The approach to the East Midlands Hub would lie partly within Flood Zone 3 and may require flood defences.
- xxvi. At Sandiacre, just north of the station, the proposed viaduct would intrude into a traditional floodplain landscape of open meadows and woodland. The route would then align along the east side the M1 and would remain largely within this transport corridor for the next 38km. Noise impacts would affect some residents at Sandiacre and Stanton Gate. At Strelley, careful routing and a cut and cover tunnel would limit potential landscape and visual impacts, and while cutting would affect the setting of a Scheduled medieval moat and fishpond, the alignment would

help preserve its character and links with Strelley Hall and the church. The route past Nuthall would result in an estimated five residential demolitions, as well as noise impacts.

Eastern Leg: Nuthall to Staveley

- xxvii. North of Nuthall, the alignment would remain alongside the M1 to avoid direct impacts on Sellers Wood and Bulwell Wood SSSIs, although Ancient Woodland at New Farm Wood and Watnall Coppice would be crossed by the scheme. East of Selston the crossing of Bogs Farm Quarry on viaduct would be the scheme's only direct impact on a SSSI. Further design work would seek mitigation through avoiding landtake and hydrological impacts, although shading impacts may remain. The setting of a group of Scheduled medieval fishponds south of Annesley Woodhouse would be affected as the scheme passes on embankment.
- xxviii. The route would diverge temporarily from the M1 near Pinxton, South Normanton and Huthwaite and there would be a high viaduct crossing of the River Erewash. Visual impacts are possible in this area, although otherwise the route would be generally in cutting and well-separated from the main settlements. Seven residential demolitions would be required at Langton Hall.
- xxix. Proposals through the historic landscape past Hardwick Hall, Stainsby, Heath, Sutton Scarsdale and Bolsover have been extensively re-worked to ensure the proposed scheme's close association with the landform and the M1 motorway. However, the amalgamation of prominent historic features and landscapes makes the area sensitive to change, and some impacts would prevail, including effects on the setting of the Scheduled Monument at Stainsby, demolition of the remains of the Grade II Listed Heath Old Church and loss of character to the registered parkland around Hardwick Hall and setting of Hardwick Old Hall.
- xxx. Diverging from the M1, the proposed route would follow the Rother Valley up to Sheffield within a valley that already provides a pathway for linear infrastructure. The route would pass through the edge of Erin landfill site, which would require careful design to ensure contamination risks are addressed.
- xxxi. The proposed depot at Staveley and viaducts across the River Doe Lea would be prominent features around Staveley resulting in visual impacts for users of Canal Marina and some local residents. However, in the area to the east of Staveley, the wooded valley would help to prevent wider impacts from the viaducts required for the spur connections to the mainline. The more southern of two viaducts within the Doe Lea floodplain may require small diversions of the river at two crossing points.
- xxxii. Noise impacts from the proposed scheme as it passes east of Staveley, would affect some residents at Poolsbrook, Netherthorpe, Woodthorpe and Mastin Moor.

Eastern Leg: Staveley to Cudworth

- xxxiii. Passing along the densely settled corridor of the Rother Valley, there would be a need to demolish an estimated nine dwellings at Renishaw, and noise impacts would affect some residents in Renishaw, Killamarsh and Beighton. The attractive flood meadow landscape on the eastern edge of Eckington and Renishaw Park Conservation Area would be bisected by an embankment, although the park itself, with good screening from trees at its edge, would not be greatly affected by views.
- xxxiv. Between Renishaw and Catcliffe the River Rother would be crossed at a number of locations, particularly between Beighton and Treeton, where some river diversions could be required. In addition, a stream at Beighton may need to be

realigned, and crossings of the Chesterfield Canal, which is undergoing restoration over a nine mile stretch, may require realignment of the canal in some places.

- xxxv. North of Beighton, noise impacts from the proposed scheme would affect some residents at Swallownest, Woodhouse and Treeton.
- xxxvi. Entering the southern outskirts of Sheffield, the elevated route would converge with the M1. It would give rise to visual impacts for some residents facing the route, and noise impacts would affect some residents at Tinsley, Wincobank, Blackburn and Shiregreen.
- xxxvii. Much of the valley through this area is earmarked for future development, with schemes associated with the Sheffield Enterprise Zone, the Waverley New Community south of Catcliffe, and the Meadowhall Quadrant masterplan around the proposed HS2 station. The route and station would cross some of these proposed areas, but by close working between HS2 Ltd and stakeholders, there could be opportunities for HS2 to support some of these developments. With this in mind, it is estimated that HS2 could support between 4,000 and 5,400 jobs around the station, as well as between 250 and 300 new homes by improving links with other cities, and integrating with existing transport schemes in Sheffield and across the region. However, an estimated 60 residential demolitions (comprising 49 at South Tinsley and eleven at Wincobank) would be required in order to locate HS2 in this area.
- xxxviii. Sheffield Meadowhall Station may require some channel works to the River Don and would largely occupy Flood Zone 3; vehicle access to the station would be impaired during flood events, although the elevated line and platforms would be unaffected.
- xxxix. North of the proposed station, the route would require some channel and bank works, and possible diversions to Blackburn Brook. The route would bear east in cutting, passing through several blocks of Ancient Woodland east of Chapelton, and resulting in both landscape and ecological impacts. It would pass beneath the M1 and continue in deep cutting before passing in tunnel beneath Hoyland.
- xl. North of Hoyland the route has been aligned to avoid impacts on the Scheduled Monument at Wombwell. But cuttings through the hills and woodland on the slopes of the Dove Valley near Worsbrough would cause ecological impact, and a viaduct over the river would affect the character of the landscape and result in local visual impacts. Noise impacts would affect some residents on the valley slopes east of Barnsley.
- xli. The route would cross the edge of Stairfoot landfill, necessitating careful design and construction to minimise contamination and other risks. A tunnel would take the route beneath Ardsley before it emerges across the wooded Dearne Valley. The proposed embankment across Cudworth Dyke would require diversion of this watercourse. Some visual and noise impacts are likely for residents overlooking the route in Cudworth and the north-east edge of Barnsley. The route would require the demolition of a Grade II Listed chimney, although this now sits in a much degraded setting.

Eastern Leg: Cudworth to Ulleskelf and the ECML

- xlii. The route would use a mixture of cutting and embankment through the undulating terrain north of Cudworth as far as the edge of Wakefield. Elevated route sections are likely to cause noise impacts at dwellings facing the route in Royston, although refinements to the route through this area have lessened potential impacts at

Royston. Landscape impacts would be likely where the route passes between the reservoirs at Cold Hiendley, and visual impacts would affect recreational users.

- xl.iii. The proposed train depot at New Crofton and elevated rail connections to it would give rise to some landscape and visual impacts, but in an area already strongly affected by railway lines. Noise impacts are predicted at Crofton.
- xl.iv. Passing east of Wakefield, the route would cross the Welbeck landfill site, again necessitating careful design and construction to minimise contamination and other risks. Crossing the Calder Valley, the route would be quite distant from most viewpoints, although visual impacts would affect residents at Methley Lanes where the route bridges the M62. The viaduct and embankments across the Aire Valley would be prominent but landscape and visual impacts would tend to be localised within a generally wooded area.
- xl.v. Local landscape impacts would affect the small river valley west of Swillington and the attractive wooded farmland landscape near Garforth. However, by closely following the M1 between Swillington and Micklefield, largely in cutting, potential impacts have been greatly reduced.
- xl.vi. East of the A1(M), the route would be generally well-accommodated within the undulating wooded farmland, and few impacts are likely. The route alignment was moved south to avoid a number of potential impacts on people and environmental features, including Towton Battlefield. A small number of residents on the western and northern outskirts of Church Fenton would have visual impacts.

Eastern Leg: The Leeds Spur

- xl.vii. The spur into Leeds would diverge from the main route just south of the Aire Valley.

Aerial view west towards Leeds, along the Aire Valley past Woodlesford



- xlvi. A Grade II Listed road bridge over the Aire and Calder Navigation at Swillington would be demolished, although it is likely that further refinement in design could avoid this. The route would be on viaduct passing alongside and across the River Aire, potentially requiring diversions to the river in two places at Woodlesford. The viaduct would be a prominent structure that would affect the landscape character of the valley and give rise to visual and noise impacts on residents in Woodlesford who overlook the valley to the north and east, as well as to recreational users of the valley (including the Rothwell Country Park) and the Aire and Calder Navigation.
- xlix. The route would pass beneath the M1 into the industrial eastern fringe of Leeds and impacts would be relatively few along this section. Farnley Wood Beck would need to be diverted.
- i. Given the excellent transport links provided by the high speed services and other regional connections, as well as the availability of development land, HS2 would be expected to support between about 13,000 and 20,000 jobs and between 1,700 and 2,400 homes around the proposed station. In addition, an HS2 station located close to the city centre could support regeneration in this area. The Government and HS2 Ltd will work with Leeds City Council to ensure the plans for a new station maximise the opportunity to regenerate this part of the city.
- ii. The new station building would be broadly in keeping with the larger existing buildings in the area and visual impacts would be generally limited. However, the proposed high level pedestrian link from the new station to the existing Leeds City Station would give rise to visual impacts and could disrupt the townscape of the Granary Wharf waterside area which forms part of the Canal Wharf Conservation Area. The setting of the Grade II* Listed river lock and retaining walls and the former Leeds and Liverpool Canal and Company Warehouse, as well as the Grade II Listed Victoria Bridge would be affected. Detailed design would seek to resolve these concerns and integrate the link with the historic townscape.

Route wide issues

Carbon emissions

- iii. The carbon assessment will be completed in due course, as it relies on data from the economic case, work on which is underway at the time of writing. The assessment of potential carbon dioxide emissions from HS2 (both Phase One and Phase Two) will take account of emissions resulting from HS2's construction and operation over its lifetime, compared with any reductions in emissions due to people switching to high speed rail services from other, more carbon polluting, transport modes. Calculation of this net carbon footprint will rely on a host of factors and assumptions, a great number of which are outside the immediate influence of HS2, such as the way power for the trains is generated.
- iiii. In advance of the full carbon report, a number of points are clear at this stage:
- The greenhouse gas emissions from HS2 will be a fraction of those from the transport sector as a whole, and from the UK in general.
 - Rail transport, and high speed rail in particular, is known to be one of the most carbon efficient forms of transport when measured per passenger kilometre.
 - A large share of the carbon emissions from HS2 would fall within the EU Emissions Trading System, which caps greenhouse gas emissions from many sources across the EU. This means much of the HS2 carbon

footprint may not contribute to a net increase in emissions in the EU, as they would be offset elsewhere.

- There is scope for HS2 to reduce its carbon footprint by integrating low carbon materials and technologies into the way it is built and operated.

Climate resilience

- liv. Consideration of the resilience of the proposed scheme to the wider effects of climate change will be addressed in due course as part of the EIA. However, HS2 Ltd is committed to ensuring this resilience is considered within the design: one of the seven themes of its Sustainability Policy (see [Appendix B.4](#)) is to: “Build a network which is resilient for the long term and seek to minimise the combined effect of the project and climate change on the environment”.

Safety and security

- lv. The safety appraisal will be completed in due course, as it relies on data from the economic case. HS2 could have a positive impact on safety, as relatively more dangerous journeys by car are replaced by much safer rail journeys on HS2 potentially resulting in a lowering of fatalities. Rail travel statistics also show significantly lower major injury rates compared to roads. The net change in injury levels would be a balance between any potential reduction in injury due to people switching to from road to rail and potential increase in injury due to new long distance high speed rail journeys by passengers who do not currently make that journey by road.

Wider economic issues

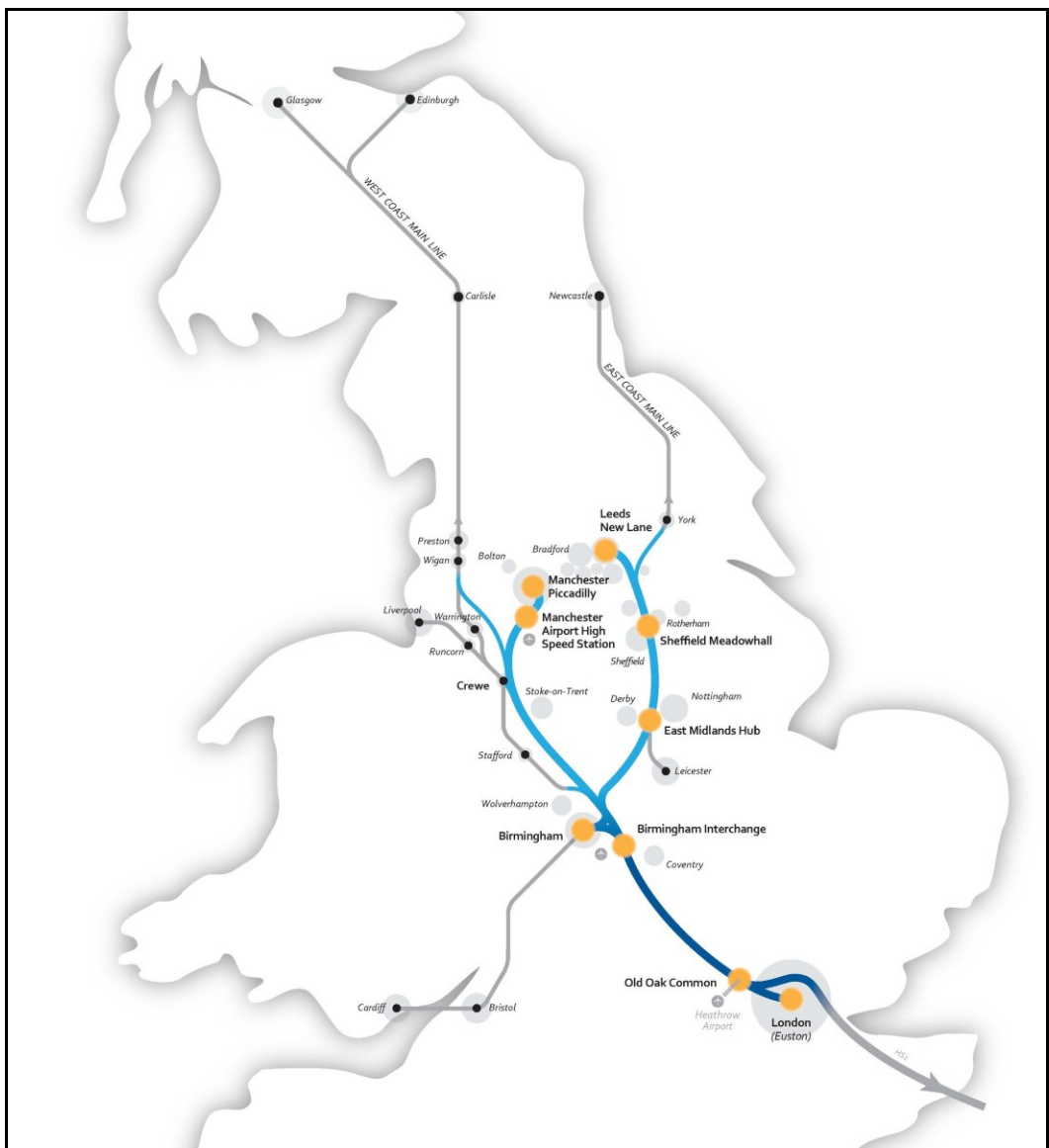
- lvi. HS2 would represent a major transformation in the UK rail network and capacity, and a significant public investment in national infrastructure. Such projects have the capacity to transform areas, driving longer-term shifts in economic performance and potentially altering the shape of economic geography.
- lvii. The potential benefits from HS2 would result from:
- Improved access to markets, with businesses having better access to a wider range of potential customers, suppliers, and labour.
 - Increased trade and competition, with new opportunities for increased trade and competition between local and regional markets, as well as for wider export.
 - Change in business behaviour leading to potential efficiency gains.
 - Improved employment opportunities, by giving more people access to a wider range of jobs.

1. HS2 and the sustainability agenda

1.1. The Sustainability Statement

1.1.1. This Sustainability Statement describes the extent to which the Government’s proposed scheme for Phase Two of High Speed Two (HS2) supports objectives for sustainable development. It has been prepared by Temple-ERM to assist with public consultation by explaining the potential sustainability benefits and adverse impacts of the proposals, as well as to explain how sustainability has helped support the scheme selection and design. The statement supplements and supports the main consultation document, *High Speed Rail: Investing in Britain’s Future - Consultation on the route from the West Midlands to Manchester, Leeds and beyond*.

Figure 1-1 - The HS2 network, Phase One and Two



1.2. HS2 and the Phase Two proposed scheme

- 1.2.1. HS2 is the Government's proposed high speed railway linking London with Birmingham, Manchester and Leeds. Proposals for Phase One of HS2, between London and the West Midlands, are well advanced. The Government plans to deposit a hybrid bill with Parliament by the end of 2013, through which it will seek the necessary powers to construct and operate Phase One.
- 1.2.2. Phase Two is at an earlier stage of development. Under instruction from the Government, HS2 Ltd has, since autumn 2010, been looking at options to extend the proposed Phase One network from the West Midlands along separate legs to connect new stations at Manchester and Leeds (the former via a new station at Manchester Airport; the latter via new stations in the East Midlands and South Yorkshire) with each leg then joining the existing rail network. During this time HS2 Ltd and its consultants have devised, appraised and sifted several hundred options for routes, stations and depots.
- 1.2.3. Options to link HS2 directly with Heathrow were also considered during this time. The Government is awaiting the outcome of the Airports Commission review of airports before progressing these further at this stage.
- 1.2.4. By early 2012, a small number of options remained that were considered to best meet the remit for HS2 in terms of passenger demand, cost, engineering complexity, journey time and sustainability. From these, the Government selected an initial preferred scheme, the announcement of which (in January 2013) initiated a period of informal engagement with relevant local authorities and MPs by the Secretary of State for Transport and HS2 Ltd. A small number of further refinements were made to the initial scheme, which has been accommodated in the proposed scheme that is the subject of this report and of public consultation.

1.3. HS2 and sustainability

- 1.3.1. HS2 Ltd's priority for sustainable design is emphasised and articulated through its Sustainability Policy (contained in [Appendix B.4](#)).

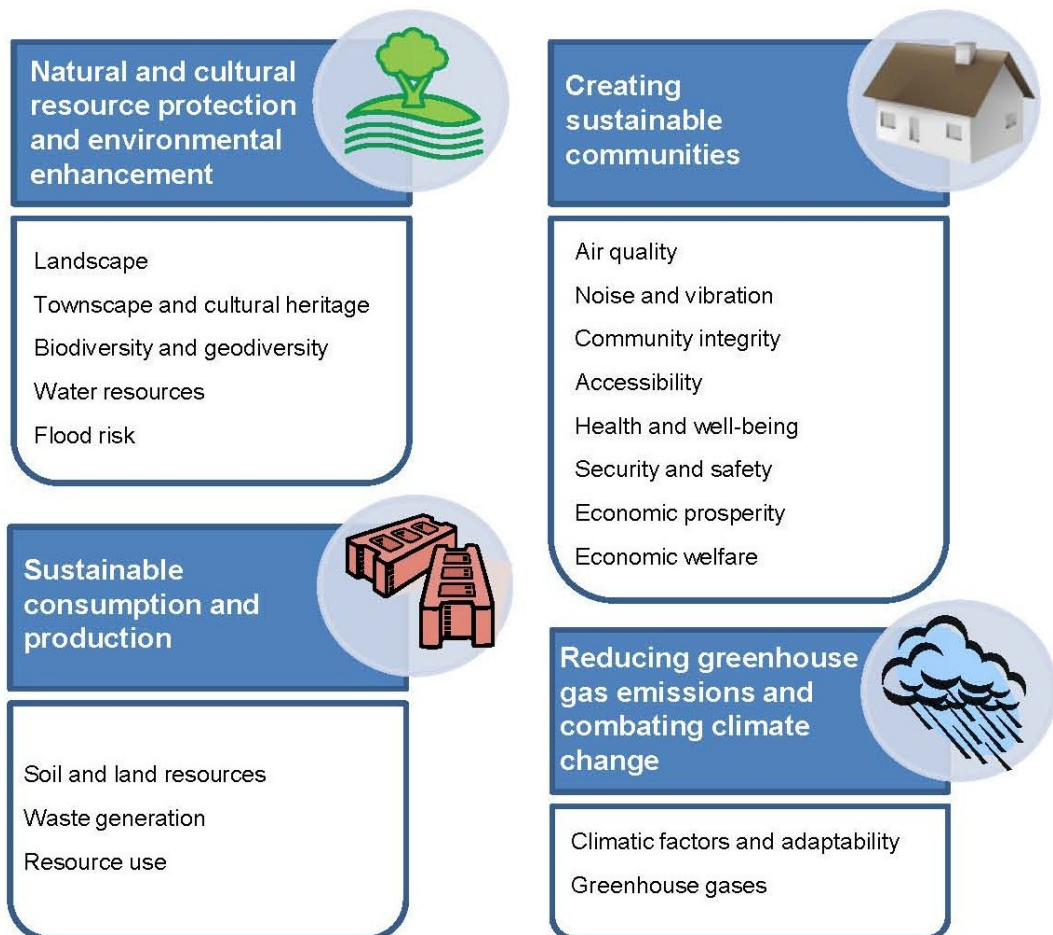
The seven themes of the HS2 Sustainability Policy

- **Growth and regeneration** - Support sustainable economic development and the localism agenda for regeneration.
- **Environmental change** - Seek to avoid significant adverse effects on communities, business and the natural, historic and built environment. Minimise impacts where they occur and deliver enhancements as far as practicable to ensure there is no net loss to the natural environment.
- **Skills and employment** - Improve skills, jobs, education and the economy through our investment along the length of the route. Act as a driver for improvements in the sustainability of the engineering and construction sector. Promote diversity, openness and fairness.
- **Climate change** - Minimise the carbon footprint of HS2 as far as practicable and deliver low carbon long distance journeys that are supported by low carbon energy.
- **Resilience** - Build a network which is resilient for the long term and seek to minimise the combined effect of the project and climate change on the environment.
- **Resources and waste** - Source and make efficient use of sustainable materials, maximise the proportion of material diverted from landfill and reduce waste.
- **Integrated transport** - Engage with stakeholders to create seamless transport links with other modes and ensure accessibility for all.

- 1.3.2. The policy stresses HS2 Ltd’s commitment to develop “*an exemplar project*”, and to “*limit [the project’s] negative impacts through design, mitigation and by challenging industry standards, [while looking] for environmental enhancements and benefits*”. The seven themes used by the policy as a basis for realising HS2’s ambitions are also addressed by the Appraisal of Sustainability (AoS), which is the process used to appraise and report on the sustainability performance of the Phase Two proposals throughout their development.
- 1.3.3. The AoS is broadly the same as that used in developing the Phase One proposals and uses the same appraisal methods. Some of the topic titles used in this report vary from those in the Phase One AoS Report, but the appraisal scope and methods remain largely unchanged from that earlier work.

1.4. The purpose and scope of the Appraisal of Sustainability

- 1.4.1. Using 18 sustainability topics², each under one of four headings (derived from [government sustainability priorities](#)), the AoS has provided a systematic review of the scheme proposals, informing both their design and the selection of options.



- 1.4.2. The AoS process was devised to cover the range of sustainability topics in a way that enabled appraisal and comparison of large numbers of options. It accommodated a preliminary level of design while also allowing an increasing depth of analysis as design detail increased and options were discarded. It also

² The topic headings used in this Sustainability Statement vary in a few cases from the 18 AoS topics in order to aid readability and to bring in line with some assessment categories used for the Phase One EIA.

incorporated a suite of related appraisal techniques, ensuring compliance with regulatory requirements. The AoS approach was agreed at an early stage with statutory consultees including Natural England, the Environment Agency and English Heritage. Further detail on the AoS process is presented in [Appendix B.1](#).

- 1.4.3. The AoS is not a substitute for Environmental Impact Assessment (EIA), which will follow in due course. Once a route has been confirmed following public consultation and further appraisal, an EIA of that preferred scheme will commence. The EIA will involve a more in-depth examination of that preferred scheme, taking account of a wider range of environmental information derived from, amongst other things, continued engagement with relevant organisations and a programme of detailed environmental field surveys. An Environmental Statement (reporting the findings of the EIA) will accompany a hybrid bill, which will be used to seek the powers to construct and operate Phase Two.

1.5. Engaging the public

- 1.5.1. The Department for Transport (DfT), assisted by HS2 Ltd, is undertaking public consultation for Phase Two between July 2013 and January 2014. To assist in this consultation, the *Sustainability Statement* has been published alongside several other documents to explain more about the Phase Two proposals and their potential beneficial and adverse impacts.
- 1.5.2. In order to help facilitate public consultation, local information events will be held at various locations near to the Phase Two proposals. These information events will provide an opportunity to explain more about the project, especially to people living near the routes. HS2 Ltd will have specialists on hand who will be able to provide more details about the scheme and how its design will be progressed. The HS2 team will answer questions about the potential impacts of the scheme, clarify uncertainties and listen to people's comments and concerns. Sound demonstrations will be available at the exhibitions, which will allow people to experience how high speed trains may sound in certain locations along the proposed route.
- 1.5.3. Refinements to the scheme design are likely to be proposed during the course of this consultation and may be adopted where appropriate, subject to further AoS work and other considerations. Any changes will be included within the Secretary of State's decision on a preferred scheme. Following a later EIA, and continued consultation, further measures to mitigate potential impacts will be included within the design that will form part of the proposals included within the hybrid bill deposited with Parliament.

2. Scheme description

2.1. Introduction

2.1.1. This section provides a summary description of the proposed scheme. The engineering reports³ contain a more detailed description along with plans and profiles, showing both a detailed map of the route as well as an indication of its vertical height or depth along the alignment. The section includes some overview maps; a more detailed view of the route is available in the accompanying [Volume 2 maps](#) that show the route in relation to key sustainability features.

2.2. Western leg route, stations and depots

Overview

2.2.1. The proposed scheme for the western leg would comprise about 150 km (94 miles) of new railway, including the main route up to and past Manchester, the spur into Manchester Piccadilly Station and the connection with the WCML near Golborne. This would comprise the following mix of alignments.

| Alignment | Length (km) |
|------------|-------------|
| At Grade | 16.8 (11%) |
| Tunnel | 17.6 (12%) |
| Cutting | 55.8 (37%) |
| Embankment | 45.9 (30%) |
| Viaduct | 14.3 (10%) |

2.2.2. Of this, an estimated 33km (just over 20% of the above ground route) would be within 150m of an existing major transport route (A-road, motorway or railway). The main route would connect at its southern end with Phase One at Fradley, to the north-east of Lichfield, and at its northern end with the WCML at Bamfurlong, to the north of Golborne. A connection to the WCML would also be provided south of Crewe. A spur to Manchester, off the main route, would include a new high speed station at Manchester Airport and a new terminus station adjacent to the existing Manchester Piccadilly Station. Two depots would also be required, one south of Crewe for use in maintaining the railway infrastructure, and one near Golborne for stabling, preparing and maintaining the rolling stock.

As noted above, more detailed drawings of the proposed scheme are available in the engineering reports and may be viewed on-line at the [HS2 Phase Two document library](#)⁴.

Description

2.2.3. The route would commence at Fradley about 2.5km to the north-east of Lichfield, continuing north-westwards from the Phase One alignment at the proposed Streethay Junction. It would enter the Trent Valley as it passes to the north-east of Handsacre on a long viaduct. Maintenance loops would be required, and

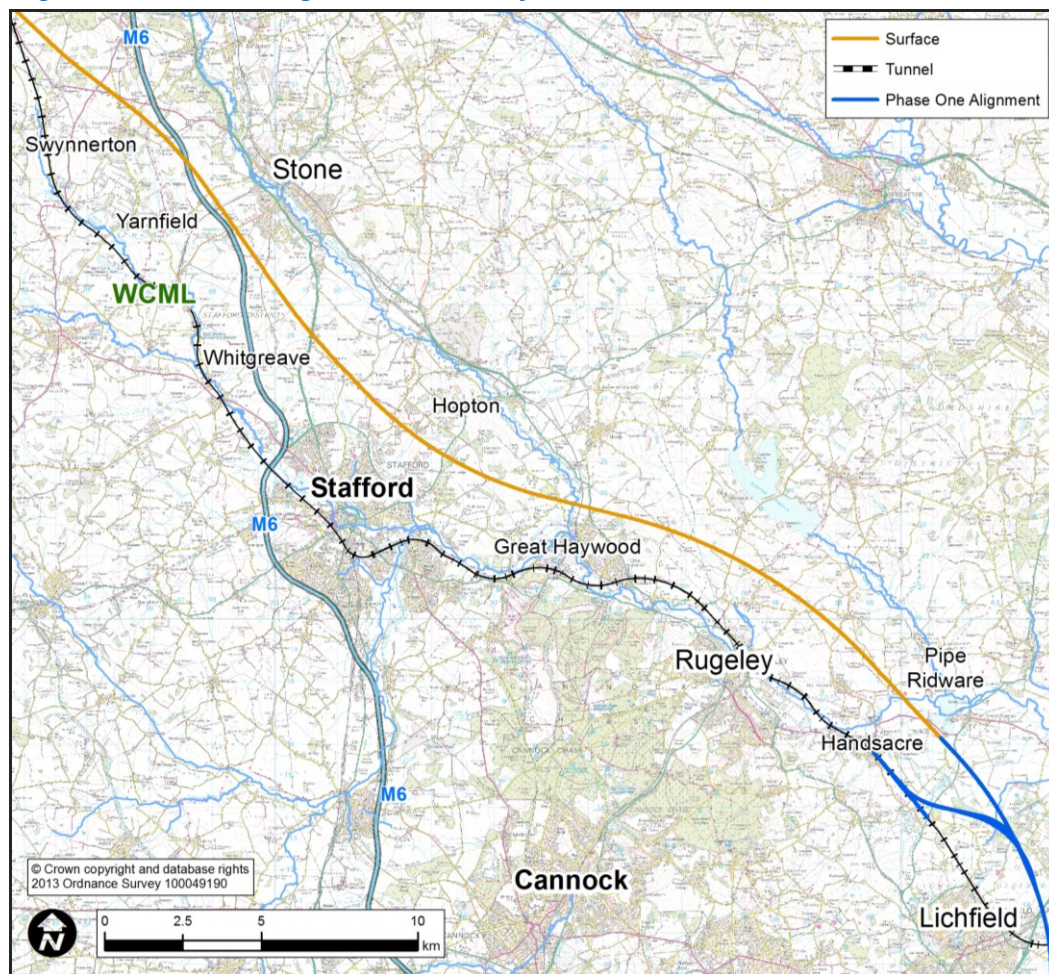
³ *West Midlands to Manchester Route Engineering Report and the West Midlands to Leeds Route Engineering Report.*

⁴ <http://www.hs2.org.uk/phase-two/route-consultation/document-library>

indicative locations for these have been proposed in the vicinity of Pipe Ridware. They would comprise two sections of track either side of the main route, each about 1.4km long⁵. The route would pass north-west through the hills east of Colton that separate the Trent and Blithe valleys, before bearing westwards across the Trent Valley again to the north of Great Haywood.

- 2.2.4. The route would continue past the northern edge of Stafford and just south of Hopton. Turning north-west, it would then run alongside the M6 for about 5km. The route would pass over the M6 to the north of Yarnfield and continue past the eastern side of Swynnerton.

Figure 2-1 - Western leg: Lichfield to Swynnerton



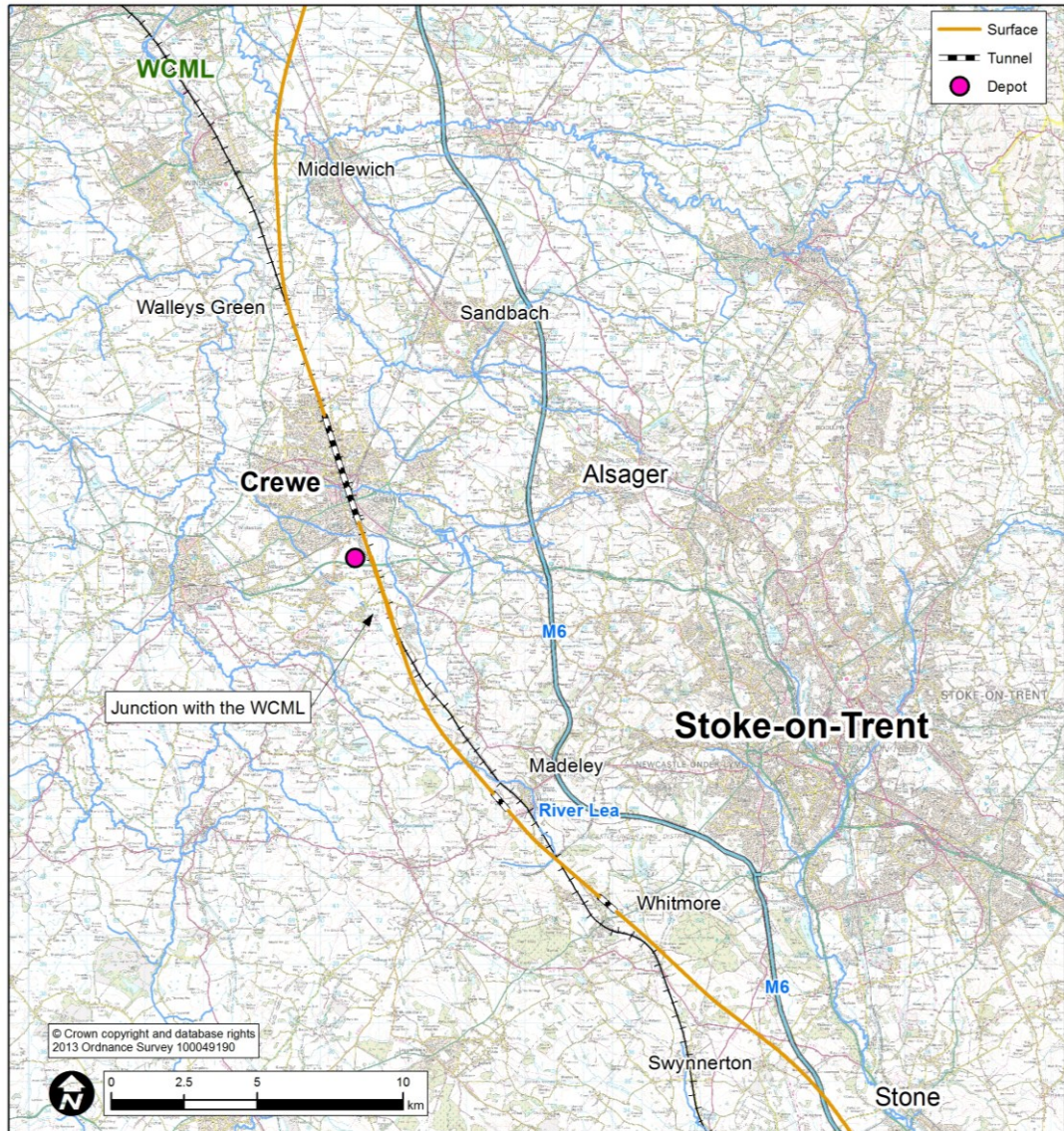
- 2.2.5. The route would cross the Meece Brook Valley before cutting through the hills west of Whitmore, including a short tunnel, and entering the valley of the River Lea. It would pass west of Madeley in tunnel, before aligning with the WCML and then remaining along its west side for several kilometres. Passing to the west of Chorlton, it would approach the south of Crewe where a new junction with the WCML would be introduced to allow classic compatible HS2 trains (see Section 2.4) access to Crewe Station and onward connections to serve Liverpool and stations en route, as well as Warrington and North Wales.
- 2.2.6. A depot for use in maintaining the HS2 railway infrastructure is proposed on the southern edge of Crewe. It would provide a central store and supply point for

⁵ These have not been designed or appraised at this stage.

engineering material, as well as facilities for rail plant maintenance and rescue and recovery locomotives.

- 2.2.7. The HS2 route would enter a tunnel beneath Crewe for just under 4km. A ventilation shaft allowing tunnel ventilation, as well as emergency access and evacuation would be required. An indicative location for this is proposed west of Middlewich Street. This would be visible as a shaft head house building typically about 5m high (similar to a one-storey house), situated within a compound of some 550m² in area⁶, although designs can be varied according to the needs of the locality.

Figure 2-2 - Western leg: Swynnerton to Middlewich



- 2.2.8. The route would emerge from tunnel through the town's northern outskirts, alongside the WCML and would maintain this path as far as Walley's Green where the two railways would diverge, with HS2 bearing north across the expansive river crossed landscape of the Cheshire Plain. The route would pass between Winsford and Middlewich and continue north, requiring a series of embankments and

⁶ This has not been designed or appraised at this stage.

bridges or short viaducts to carry it over the rivers and roads that criss-cross the area.

- 2.2.9. The route would pass villages on the eastern edge of Northwich, such as Lostock Green and Higher Wincham. It would pass over the M6 before splitting – the main route continuing north and a spur to Manchester city centre bearing east at Hoo Green.
- 2.2.10. The main route would pass under the M56 and then use embankments and viaducts as the land dips into the Bollin Valley and the farmed former mosslands around the southern edge of Greater Manchester. The route would begin to bear north-west, with a high viaduct required over the Manchester Ship Canal to permit sufficient clearance for shipping.

Figure 2-3 - Western leg: Middlewich to Golborne and spur to Manchester



- 2.2.11. The main route would continue on embankment for several kilometres as it passes close to Glazebrook, past Holcroft Moss and over the M62. The route would bear west as it passes the southern edge of Culcheth in cutting and in a disused rail corridor, before turning north once again to pass between Golborne and Leigh. It would connect with the WCML north of Golborne at Bamfurlong, the junction

allowing onward connection with stations further north including Wigan, Preston, Lancaster, Glasgow and Edinburgh. A rolling stock depot is proposed immediately south of this junction. It would be used for stabling, inspection, repair, cleaning and light maintenance of trains.

- 2.2.12. The spur into Manchester would bear east at Hoo Green passing to the north of Rostherne Mere, largely in cutting, parallel and to the south of the M56. It would pass between Ashley and Tatton Park before bearing north beneath the M56. A new station, providing an interchange at Manchester Airport and serving the surrounding area, is proposed at Davenport Green, west of the airport. It would mostly sit within an open box structure much like the current HS1 station at Stratford.
- 2.2.13. The route would continue north in cutting alongside the M56 before entering tunnel for some 12km beneath southern Manchester. Four ventilation shafts over the tunnel are likely to be required⁷. Indicative surface locations for these are proposed near junction 3A of the M56; adjacent to the Withington golf course off the Palatine Road in the Mersey Valley; at the corner of Lapwing Lane and Palatine Road in Didsbury; and close to the corner of Whitworth Lane and Old Hall Lane in Rusholme. Each would have surface infrastructure similar to that described for the Crewe ventilation shaft. The route would re-surface at West Gorton and follow an existing rail corridor into Manchester Piccadilly, where a new terminus station would be constructed adjacent to the existing station.
- 2.2.14. There would also be a 6.5km section of connecting line south of Dunham Park that would enable empty trains to move between the Manchester terminus and the rolling stock depot at Golborne.

2.3. Eastern leg route, stations and depots

Overview

- 2.3.1. The proposed scheme for the eastern leg would comprise about 185km (115 miles) of new railway, including the main route up to and past Leeds, the spur into Leeds New Lane Station and the connection with the East Coast Main Line (ECML). This would comprise the following mix of alignments.

| Alignment. | Length (km) |
|------------|-------------|
| At Grade | 7.3 (4%) |
| Tunnel | 9.7 (5%) |
| Cutting | 75.1 (41%) |
| Embankment | 60.0 (32%) |
| Viaduct | 32.7 (18%) |

- 2.3.2. Of this, an estimated 74km (about 40% of the above ground route) would be within 150m of an existing major transport route (A-road, motorway or railway). The main route would connect at its southern end with Phase One at the Hams Hall Junction near Water Orton, and at its northern end with existing railway that links with the East Coast Mainline (ECML) south of York. A spur would connect with a new terminus station in Leeds city centre. Two further stations would be included on the main route: the East Midlands Hub at Toton, near Nottingham and Sheffield Meadowhall Station. Two depots would also be required, one north of Staveley for

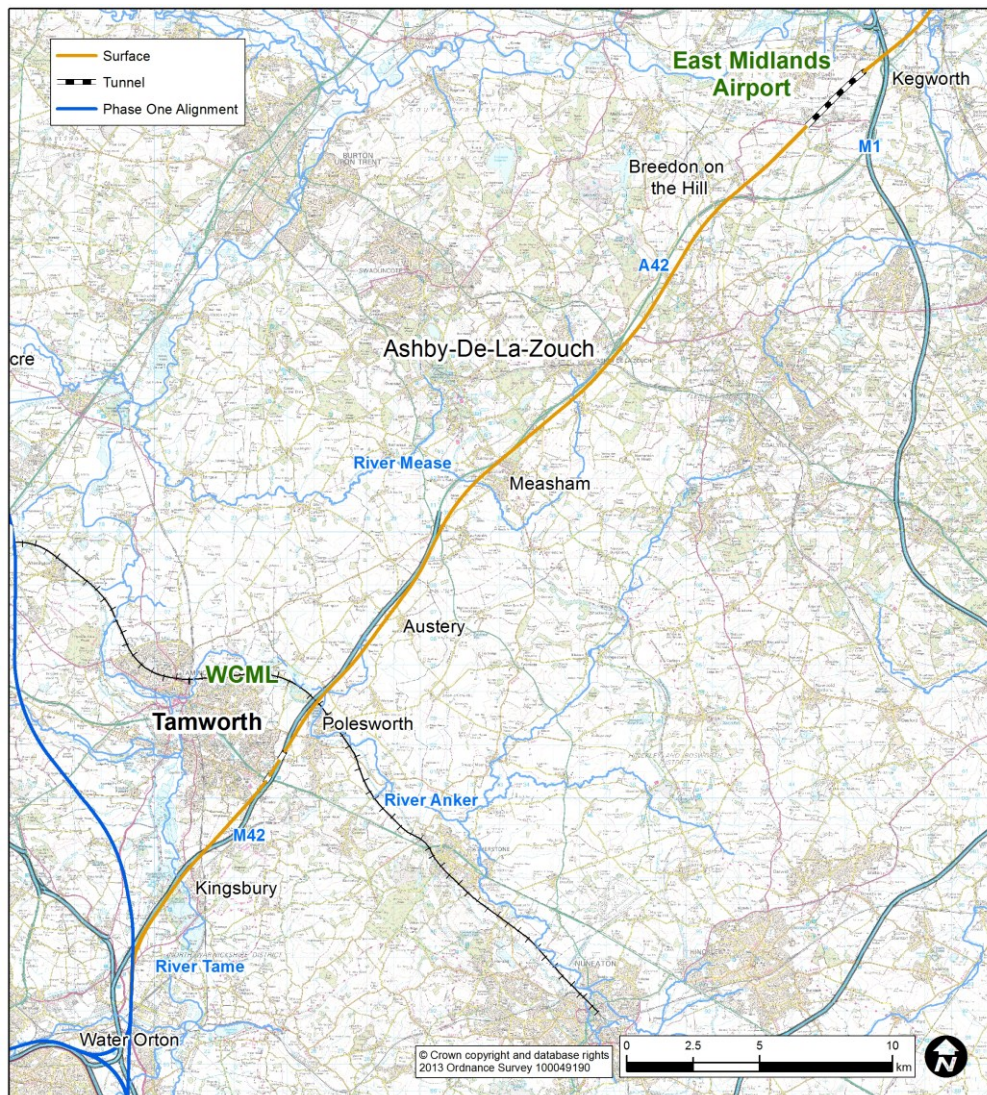
⁷ These have not been designed or appraised at this stage.

use in maintaining the railway infrastructure, and one south of New Crofton for stabling, preparing and maintaining the rolling stock. More detailed drawings of the proposed scheme are available in the engineering reports and may be viewed on-line at the [HS2 Phase Two document library](#).

Description

- 2.3.3. The route would diverge north-eastwards from the Phase One alignment north-east of Water Orton. It would pass close by or alongside the M42 and A42 for about the next 40km past Kingsbury, Tamworth, Austrey, Measham and Ashby-de-la-Zouch; it may require works affecting these major roads and their junctions at several locations. Viaducts or bridges would carry the route over the valleys of the rivers Tame, Anker and Mease, but much of this section of the route would otherwise be within cutting.

Figure 2-4 - Eastern leg: Water Orton to East Midlands Airport

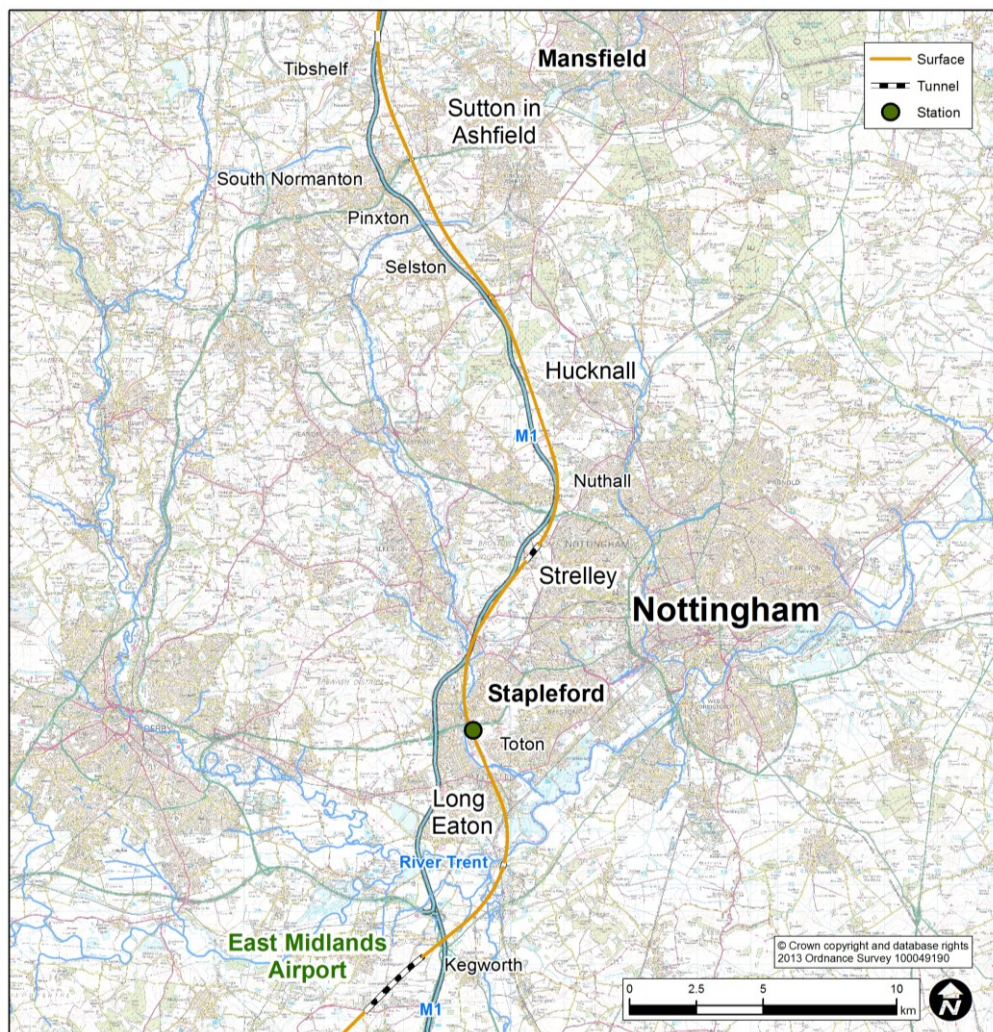


- 2.3.4. At Breedon on the Hill the route would diverge from the A42, continuing north-eastwards still in cutting, before entering tunnel for a little under 3km. The length of the tunnel under East Midlands Airport was extended to pass beneath the proposed East Midlands Gateway: Strategic Rail Freight Interchange. It is likely that the longer tunnel would require a ventilation shaft over the tunnel. An

indicative surface location for this is proposed on the boundary between the airport and proposed freight terminal.

- 2.3.5. Emerging from tunnel, the route would rise over the M1 and then mostly use viaduct as it crosses the broad floodplains of the rivers Soar and Trent for some 5km. At this point, the route would bear north and then north-west as it enters the Erewash Valley through Long Eaton and the Nottingham suburb of Toton. The HS2 East Midlands Hub Station, which would incorporate national rail platforms, would be built at Toton alongside an existing rail freight yard. Integration of the national rail lines into the station would require works to the existing rail lines at Long Eaton and Toton and at a few other locations, although these are still to be determined in detail through further close working with relevant parties, including Network Rail. Indicative locations for maintenance loops of similar dimensions to those on the western leg are proposed in the vicinity of Toton⁸.

Figure 2-5 - Eastern leg: East Midlands Airport to Tibshelf



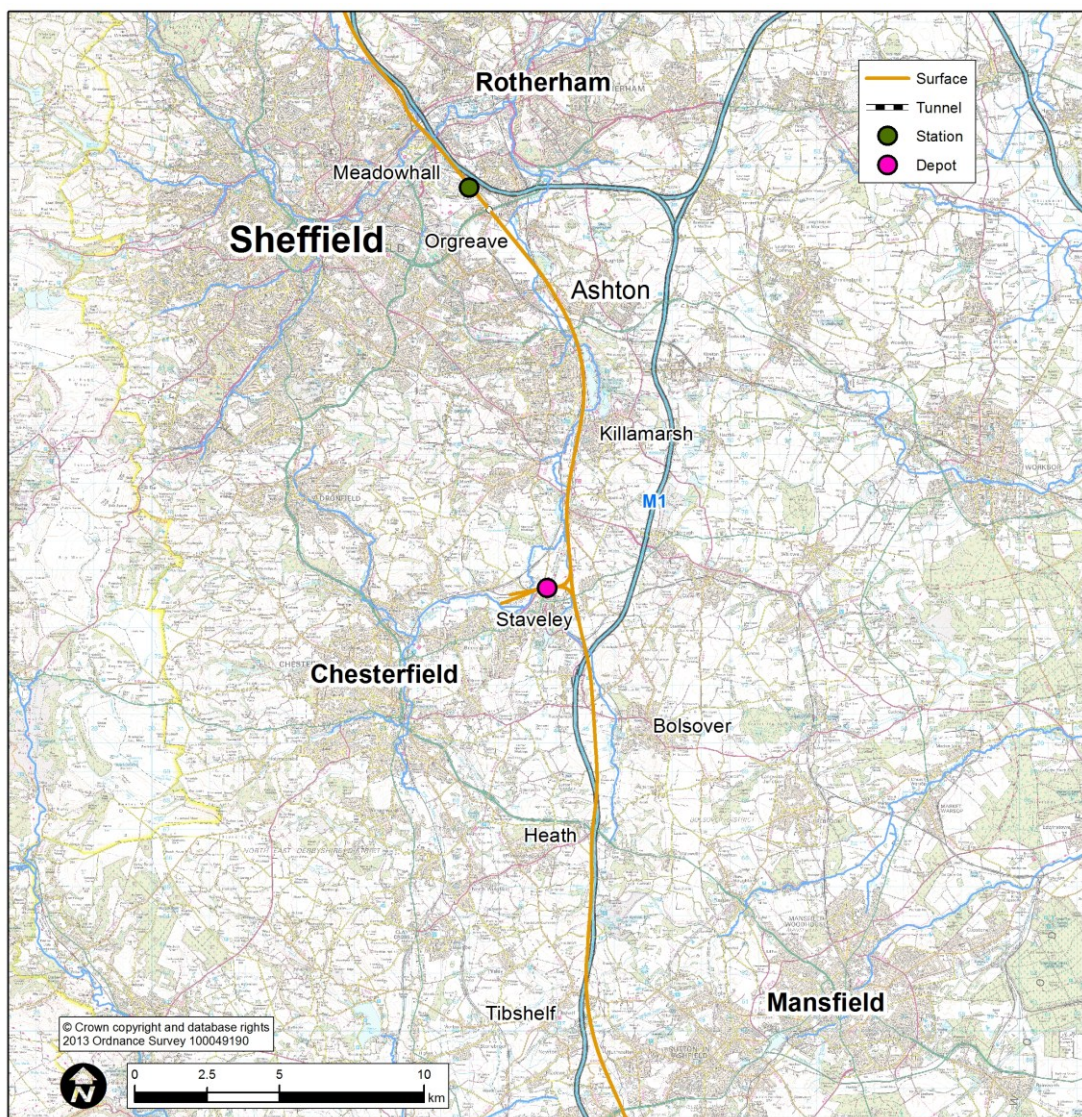
- 2.3.6. The route would continue along this largely industrialised valley as far as Stapleford where it would then bear north-east alongside the M1. The route would run close to the motorway for much of the next 38km as it leaves Toton and passes the settlements of Strelley, Nuthall, Hucknall, Selston, Pinxton, Sutton-in-

⁸ These have not been designed or appraised at this stage.

Ashfield, Tibshelf, Heath and Bolsover. Modification to the M1 and some of its junctions may be required at certain locations.

- 2.3.7. South of Staveley the M1 bears to the north-east, while the HS2 route would continue northwards along the Rother Valley. A depot for use in maintaining the HS2 railway infrastructure is proposed north of Staveley. Like the proposed Crewe Depot on the western leg, it would provide a central store and supply point for all engineering material and would provide facilities for rail plant and maintenance rescue and recovery locomotives.
- 2.3.8. The route would continue along the Rother Valley for several kilometres past Renishaw, Killamarsh and the south-east suburbs of Sheffield. Where the Rother Valley widens around Orgreave, the route would rejoin the corridor of the M1, passing through the industrial corridor between Sheffield and Rotherham. An HS2 station would be built at Meadowhall, elevated alongside the M1.

Figure 2-6 - Eastern leg: Tibshelf to Sheffield

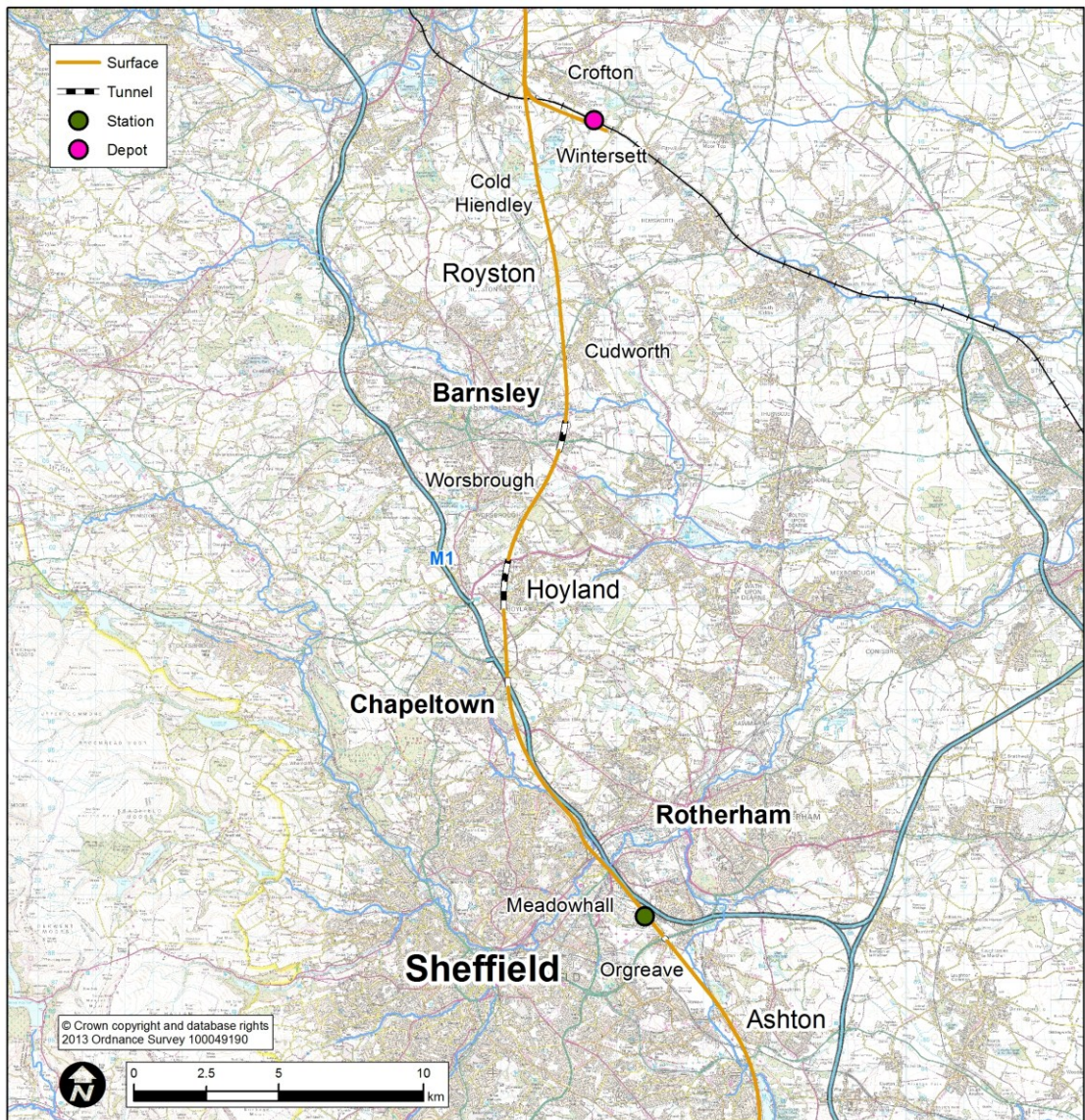


- 2.3.9. At Chapeltown the route would cut through the wooded slopes alongside the M1 before diverging from the motorway, bearing north-east past Hood Hill. The undulating terrain would require alternating cuttings and embankments for several kilometres, while tunnels would take the route beneath Hoyland and then Ardsley on the eastern edge of Barnsley. Having passed west of Cudworth in an existing

rail corridor, the route would enter the flatter terrain north of Royston and then pass between Winterset and Cold Hiendley reservoirs.

- 2.3.10. A rolling stock depot is proposed south of New Crofton. Like the proposed Golborne Depot on the western leg, it would be used for stabling, inspection, routine repairs, cleaning and light maintenance of trains.
- 2.3.11. North of Winterset the route would be elevated to cross a series of railway lines before passing scattered settlements amidst the farmland east of Wakefield, using cuttings and embankment to cross the undulating terrain. Viaducts would carry it over the rivers Calder and Aire and the Aire and Calder Navigation north of Normanton and Altofts. At this point the route would split - the main route continuing north and a spur to Leeds city centre bearing west.

Figure 2-7 - Eastern leg: Sheffield to Winterset

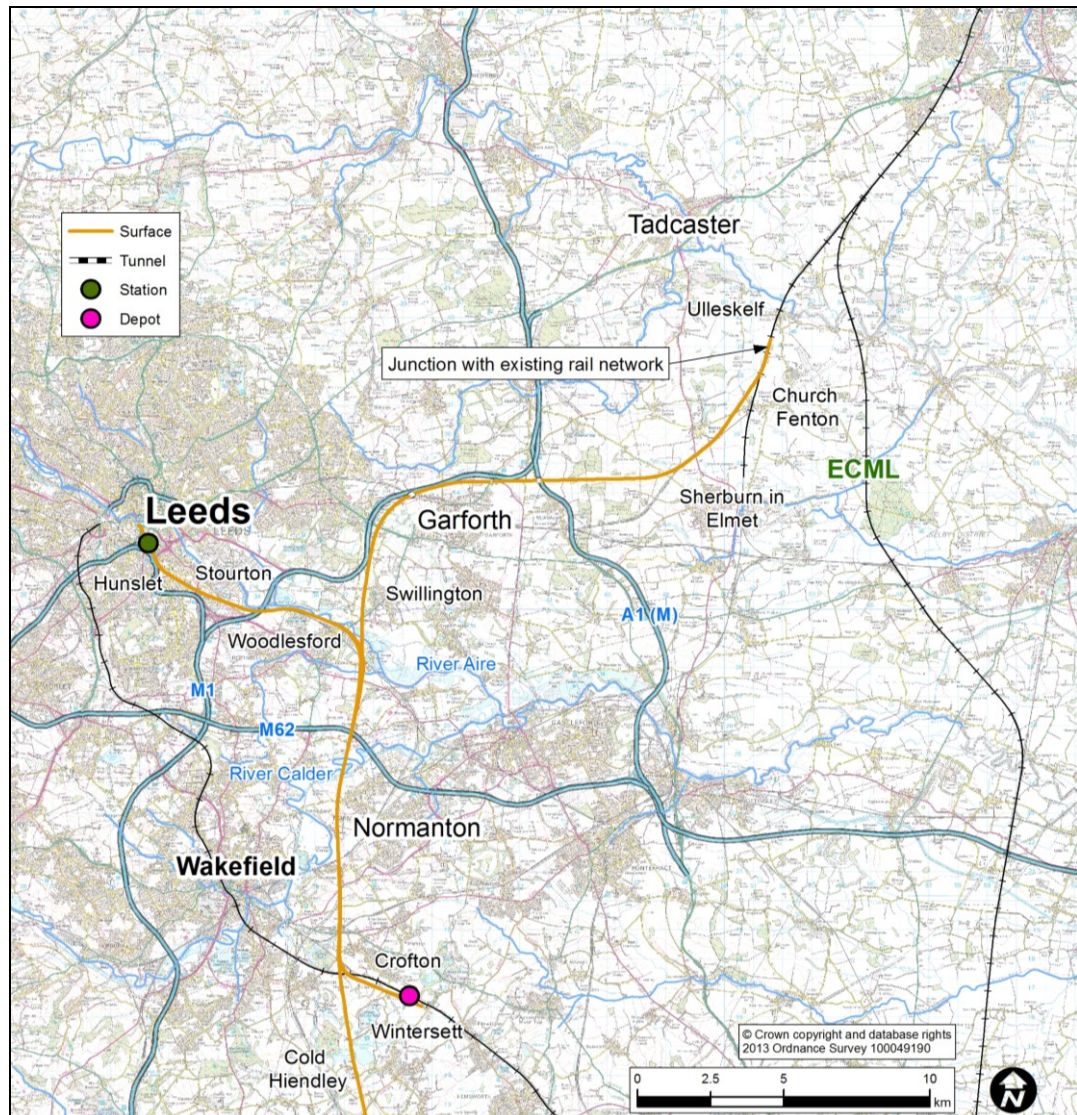


- 2.3.12. The main route would pass Swillington before bearing east to join the corridor of the M1 north of Garforth. It would pass beneath the A1(M) just south of its junction with the M1, and then predominantly use cutting and embankment through undulating and wooded farmland before bearing northwards once again to the north of Sherburn in Elmet. It would then rise onto a long viaduct and connect into the section of existing railway between Church Fenton and Ulleskelf, which joins

the ECML, allowing onward connection with stations further north including York, Newcastle and Edinburgh.

- 2.3.13. The spur into Leeds would diverge from the main route at Woodlesford and bear west on viaduct along the Aire Valley north of Woodlesford. It would drop into cutting to pass beneath the M1 and then continue alongside the Normanton to Leeds railway through the industrial areas of Stourton and Hunslet, just north of the M621. The spur would continue in cutting into Pottery Field before rising into an elevated station at New Lane in Leeds city centre.

Figure 2-8 - Eastern leg: north of Winterset, including Leeds spur and ECML connection



2.4. Trains, services and journeys

- 2.4.1. Phase Two services are currently expected to start in 2032/33. All services on the Phase Two route would use high-speed trains only, operating at a maximum of 360kph (225mph) at day one of operation, although the railway has generally been designed to accommodate trains up to 400kph (250mph).

- 2.4.2. In order to serve both HS2 stations and destinations further north, two types of train would be required, namely:
- “HS2 Captive” standard high speed train, running only on the HS2 route.
 - “Classic-compatible” high-speed train, which would run on the HS2 route, but also serve destinations accessed via the WCML at Crewe and Golborne and via the ECML south of York.
- 2.4.3. Both types of trains would typically be of units totalling 200m in length, and capable of being doubled to 400m. The trains are expected to have 550 seats on the 200m long trains and double that (i.e. 1,100) for the 400m trains, with the railway designed to take up to 18 trains per hour in each direction.
- 2.4.4. It is expected that services would operate from 5am to midnight Monday to Saturday and 8am to midnight on Sunday, with maintenance and engineering activities undertaken at other times.

2.5. Power supply

- 2.5.1. HS2 trains would draw power from overhead lines. These require feeder stations with connections to the National Grid 400kV network located approximately every 55km. The locations for these have not been determined at this stage.
- 2.5.2. In addition to feeder stations, smaller autotransformer stations would be required at approximately 11km intervals. Each would require a small area of land adjacent to the route.

2.6. Construction

- 2.6.1. The way the scheme would be constructed has not yet been determined in any detail. Construction site locations, access routes, working methods and detailed programmes will be defined in due course and will be considered within the scope of the EIA. A general overview of the main elements and overarching approach to construction is given below.

Duration

- 2.6.2. Following Royal Assent of the Phase Two hybrid bill, there would be a period to prepare for construction; for example for land to be acquired and contracts let. Construction itself would take up to nine years, although in most places, the split of construction packages would determine the exact duration of construction and in most cases this is likely to be much less than the maximum. This period of construction would include a period of testing from early 2031, with Phase Two expected to open in 2032/33.

Construction sites

- 2.6.3. In the same way as works are being planned for Phase One, it is assumed that the Phase Two proposals would be divided up into a number of construction packages; for example, for route lengths of 20-30km or for major structures, such as stations or long viaducts. Each works package would require a main construction site with good direct connections to the main road or rail network. The site would typically contain the main offices and parking areas, some limited accommodation, stores and storage areas, plant yards and testing laboratories.
- 2.6.4. Vehicle access within the work package area would be via a haul road built alongside the route and connected with the main work site. Minor roads may need to be used for short periods and this would be agreed in advance with the local

authority. Where access along the route is interrupted by major road crossings or by tunnel construction, preventing end to end movement, one or more satellite construction sites may be required.

- 2.6.5. In certain packages, such as major viaducts, there may be an additional area for pre-casting concrete structures, containing casting beds, a ready-mix concrete plant, storage areas and cranes.
- 2.6.6. In addition to these main sites, there would be smaller sites, largely within the permanent landtake area, to serve specific structures, such as cut and cover tunnels, viaducts and bridges.

Working hours

- 2.6.7. General working hours (aside from tunnel boring, which is likely to be a 24 hour operation) would be between 8am and 6pm on weekdays (excluding bank holidays) and between 8am and 1pm on Saturdays. HS2 Ltd would require its contractors to adhere to these hours for each site as far as possible.

Controlling environmental impacts

- 2.6.8. In line with the approach agreed for Phase One, HS2 Ltd would require all of its contractors to comply with an environmental management regime, which will be defined within a number of core documents, namely:
 - a Code of Construction Practice (CoCP);
 - various environmental management strategies (covering for example excavated materials, noise and vibration, waste, and traffic); and
 - local environmental management plans, which would apply management strategies specific to a particular area, taking into account the particular sensitivities of the environment and communities in that area.
- 2.6.9. These documents will define how construction must be undertaken in order that the adverse impacts of the works on people and the environment are kept to a practicable minimum. They will be drafted in parallel with the EIA, which will ensure they accommodate the measures and controls that are pertinent to the specific works and the areas they affect.
- 2.6.10. The CoCP will contain strategic control measures and standards to be implemented throughout the construction process. It will evolve through time so that it can remain responsive to the changing design and to the requirements of stakeholders. As an indication of what the CoCP would look like and what it will address, [a draft CoCP](#) has been prepared for Phase One⁹.

2.7. Associated and enabling works

- 2.7.1. A number of other works would be necessary to enable HS2 to be built and to allow it to operate effectively. These have not been appraised in any detail as part of the AoS scope (and are not reported in the Sustainability Statement), but will be addressed in due course by the EIA. Associated works that are necessary to allow HS2 to operate effectively would include:
 - 'Off-line' railway infrastructure comprising any potential works to allow (classic compatible) high speed trains to run on the existing network (e.g. junction alternatives).

⁹ <http://www.hs2.org.uk/draft-environmental-statement/document-library>

- ‘On-line’ railway infrastructure required to fulfil HS2’s objectives and remit, such as new maintenance loops and classic platforms at the East Midlands Hub. Provisional locations for maintenance loops are reported at sections 2.2.3 and 2.3.4.
- Tunnel ventilation shafts. These provide for ventilation, as well as for emergency access and evacuation. Indicative locations for these have been proposed over the Crewe, Manchester and East Midlands Airport tunnels.
- Road connections providing new highway access to HS2 stations and other infrastructure.
- Infrastructure works to serve HS2 directly, such as power supply (overhead line connections to National Grid transmission lines and associated sub-stations and autotransformers), drainage and utility connections to stations.
- Mitigation measures. The EIA will identify a number of specific mitigation measures to address potentially significant environmental effects. For example, landscape works, including bunds and tree planting; areas of habitat creation; and flood compensation or protection schemes.

2.7.2. There would also need to be numerous enabling works, involving moving existing infrastructure to make way for HS2. These would comprise:

- Modifications to the existing road network to allow for the construction of HS2. They would include some major road realignments, such as sections of the M1, as well as smaller road works to reconnect routes crossed by HS2.
- Modifications to the existing rail network to allow for the construction and operation of HS2.
- Utility diversion, such as gas mains, sewers, water mains, electricity cables and phone cables.
- Watercourse diversions. The AoS has identified the need for these, although details are yet to be agreed with the Environment Agency.
- Demolitions. The AoS has identified the potential need for these on the proposed scheme. In some cases demolished facilities would need to be replaced at alternative locations, although this would be resolved directly by affected parties through compensation.

3. Evolution of the Phase Two proposed scheme

3.1. The go-ahead for HS2

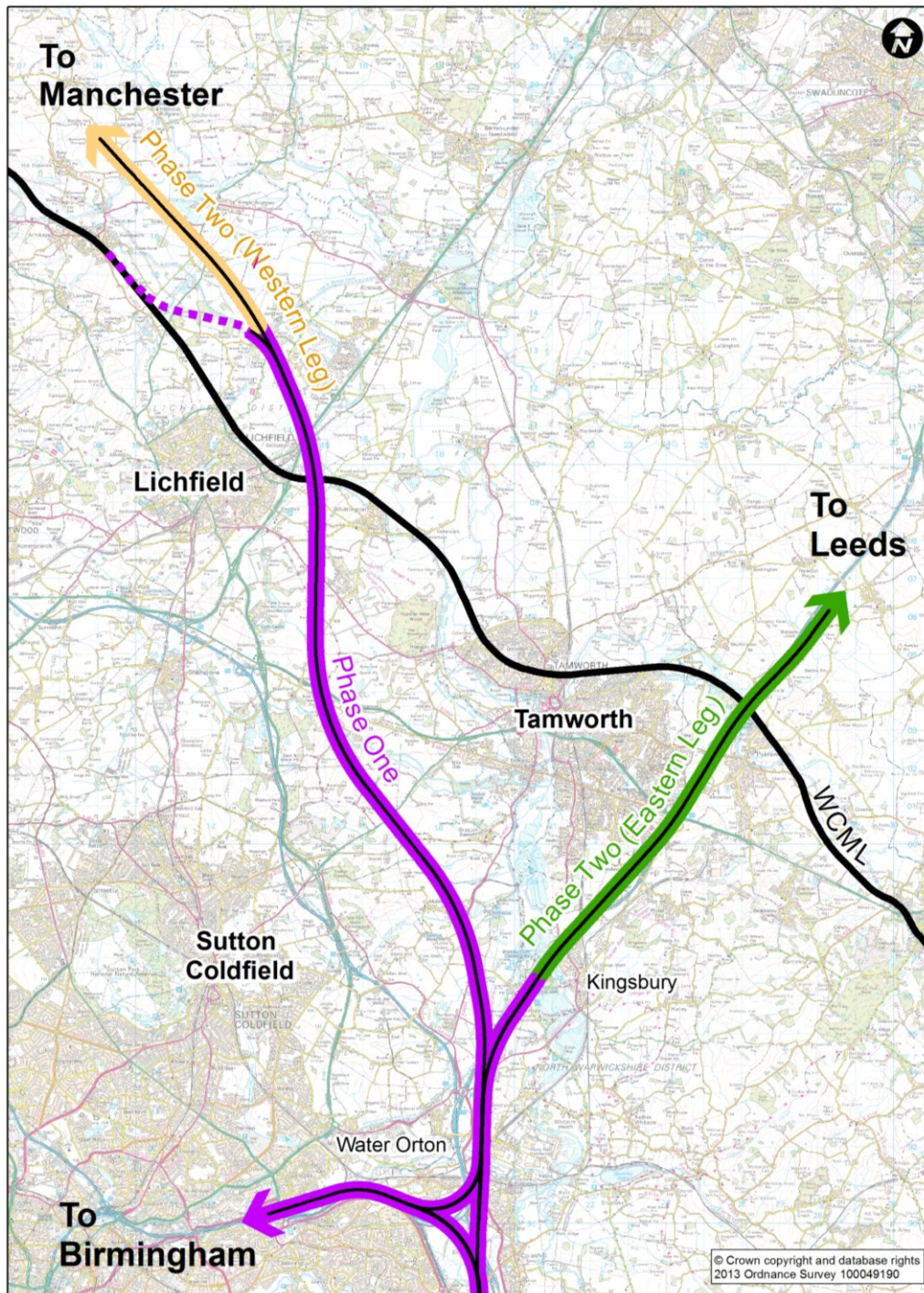
- 3.1.1. In January 2012 the Government announced it would proceed with plans to develop HS2. In the command paper, [*High speed rail: Investing in Britain's future - decisions and next steps*](#)¹⁰ the Government identified high speed rail as key to addressing escalating capacity pressure on the railways and growing demand for rail travel, and endorsed its potential to help promote national economic growth and support the Midlands and the North to fulfil their economic potential.
- 3.1.2. Initial demand modelling in 2010 had identified three possible network configurations to the north of Birmingham, referred to, according to their shapes, as the Inverse A, Reverse S and Reverse E. The Inverse A option was considered to offer the best opportunity for meeting demand and to provide the optimum balance between journey time and capacity, and therefore formed the basis for subsequent network development and the current 'Y network' proposal.
- 3.1.3. Within the 2012 command paper, the Government confirmed development of the 'Y network', to provide direct high capacity, high speed links between London, Birmingham, Leeds and Manchester, with intermediate stations in the East Midlands and South Yorkshire.
- 3.1.4. The 2012 command paper also confirmed the Government's intention of developing HS2 in two phases: Phase One between London and the West Midlands and Phase Two between the West Midlands and both Manchester and Leeds. The proposed route for Phase One was announced within the 2012 command paper, following public consultation during 2011. Assent will be sought from Parliament for Phase One, and its construction is expected to start around 2017 with services commencing in 2026.
- 3.1.5. The remainder of this section summarises the process that has led to the Phase Two proposed scheme. Additional information on the alternatives considered, with references to the documents where they are described in greater detail, is provided at [Appendix B.2](#).

3.2. The Phase Two brief

- 3.2.1. Under the remit set by Government, HS2 Ltd started to consider options for the Phase Two stations and routes in October 2010. At that time, the requirement to link with Manchester and Leeds determined, broadly, where the terminus locations would be, while the emerging options for the Phase One proposals in the West Midlands, though yet to be agreed, were determining where the Phase Two routes could commence from. The requirement for intermediate stations in the East Midlands and South Yorkshire provided some orientation for the eastern leg. But otherwise, there remained countless possible alignments for meeting the remit.

¹⁰ <https://www.gov.uk/government/publications/high-speed-rail-investing-in-britains-future-decisions-and-next-steps>

Figure 3-1 - The Phase One route determined broadly where the Phase Two legs commenced

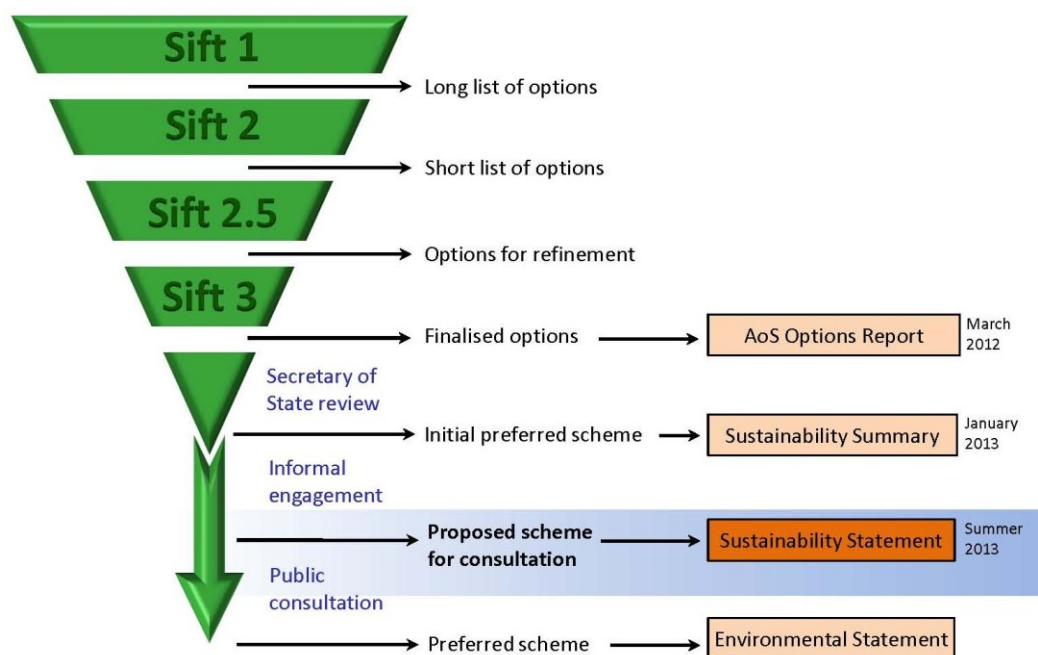


3.3. Sifting the options

3.3.1. The approach to determining and appraising the many possible routes for Phase Two followed that used for Phase One, where a sequence of sifts, starting from an initial long list, reduced the number of options being considered. At the end of each sift, a series of internal meetings were held at which the HS2 Ltd Executive Team were briefed on the various advantages and disadvantages of the options. Sustainability and engineering considerations, together with cost and journey time information, were presented at these meetings.

- 3.3.2. A similar approach was adopted for stations, but with passenger demand, and planning and development information considered in place of journey time. Relevant local authorities and transport bodies attended the sift meetings for station options and provided context on strategic transport and planning objectives. As a result, the Executive Team were able to decide which route and station options to progress through each stage.
- 3.3.3. Over 18 months and using four main sifts, several hundred route options (comprising well over 10,000 miles of route), over 160 station options and almost 90 depot options were proposed, appraised and sifted down to a relatively small number of options that were presented to Government in March 2012.

Figure 3-2 - Work over two and a half years has led to the Phase Two proposed scheme



- 3.3.4. The sequence of sifts and the achievement of each one in terms of reducing the number of options, while better defining the design detail, are summarised below. [Appendix B.1](#) provides detail on the AoS method applied through each sift.

3.4. Route option sifting

Sift 1: option long listing

- 3.4.1. At the outset, in autumn 2010, a long list of route options was drawn up by HS2 Ltd. This drew on a review of any existing proposals, an internal review of possible route locations, and discussions with industry and other stakeholders. The long list comprised indicative route corridors rather than specific alignments.
- 3.4.2. Options were proposed within different geographical sections, which were reviewed against HS2's objectives for enhancing passenger capacity, creating faster journeys, encouraging modal shift, improving connectivity, and supporting regeneration and growth. Appraisals of demand, engineering, operational feasibility, cost and major sustainability impacts (i.e. most important strategic designations) were then undertaken. Options presenting obvious and significant operational difficulties or impacts that were considered to be particularly adverse were dismissed; others were included on the long list, which was progressed to Sift 2.

Sift 2: option short listing

- 3.4.3. The next phase of work took place between December 2010 and April 2011. Design details comprised route centrelines plotted onto Ordnance Survey (OS) mapping. Vertical alignments (height and depth) and the locations of junctions and rail switches and crossings were not considered except where it was thought that they could greatly influence the horizontal alignment of the route. This level of detail allowed consideration of general landtake impacts and proximity to people.
- 3.4.4. Sift 2 compared geographical groups of options to determine relative preferences, taking account of, amongst other things, sustainability performance, which was examined at a greater level of detail at this stage. This drew on a more refined level of examination of the long list of almost 500 route options.

Sift 2.5: selecting options for refinement

- 3.4.5. The next stage of sifting took place between May 2011 and October 2011. It used a more developed project specification that included:
- horizontal alignments and alignment geometry;
 - vertical alignments including cut depths and fill heights;
 - earthworks profiles; and
 - structures including tunnels, viaducts and retained cuttings.
- 3.4.6. Sifting relied on the same system of grouped comparisons that had been employed at Sift 2, but drew on more detailed appraisal findings, involving consideration of more issues and a greater depth of analysis.
- 3.4.7. The options that emerged from Sift 2.5 were largely those to be proposed to the Government in March 2012 (see Section 3.7). However, some refinement of the alignments was undertaken at the next sift to reduce or mitigate certain impacts.

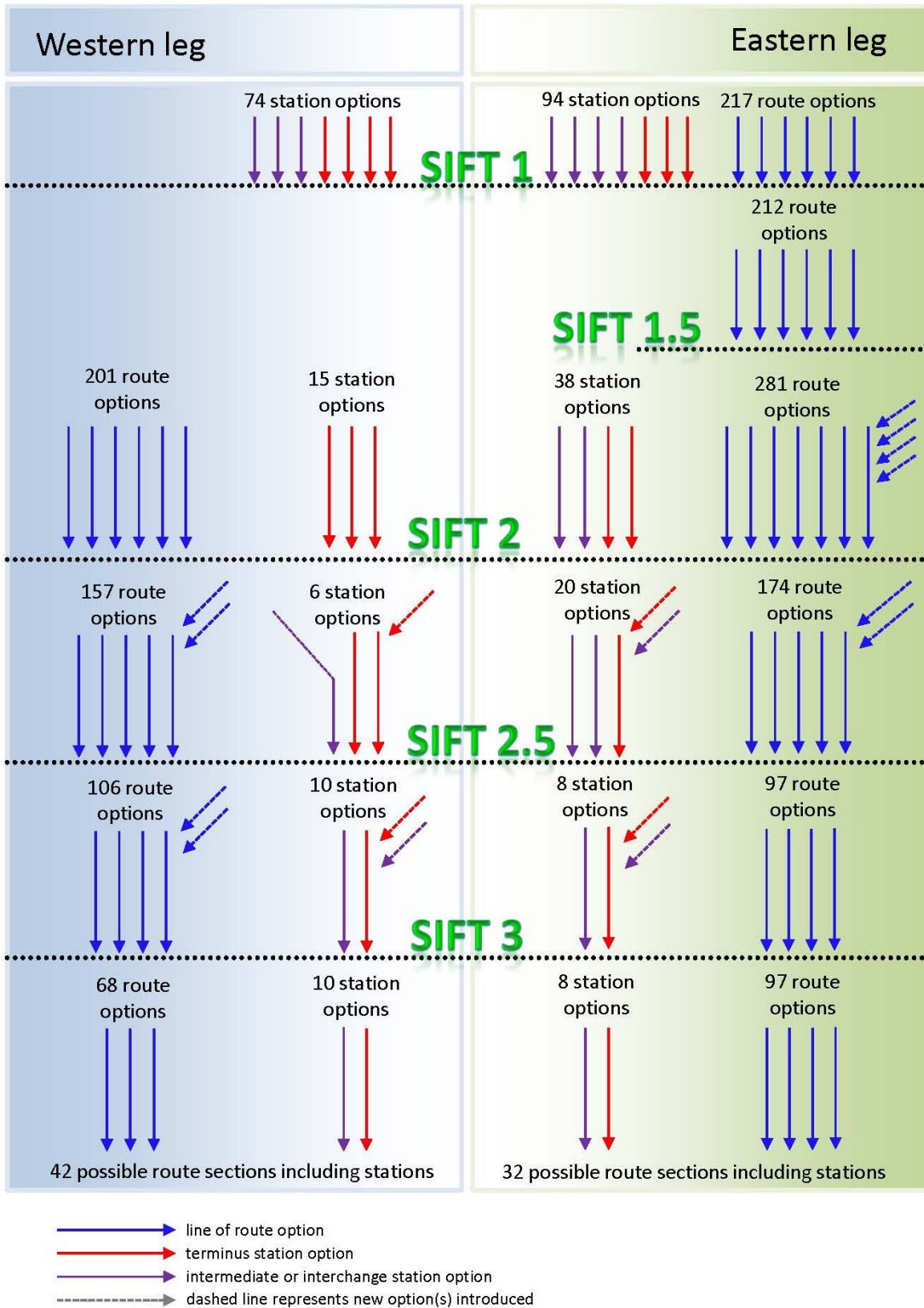
Sift 3: finalising options

- 3.4.8. At the commencement of Sift 3 in November 2011, the AoS team worked with the project engineers to provide a log of key impacts. Where practicable, the alignments were revised, either horizontally or vertically, and structures such as green tunnels, viaducts or cuttings were introduced to mitigate potential adverse impacts. Other refinements were made on the basis of cost reductions or simplified engineering. A few less favoured options were removed at this stage, but the majority were taken forward and presented to the Government. This is discussed further in Section 3.7.

3.5. Station sifting

- 3.5.1. The sifting of station options followed the same general approach, timetable and sequence of sifts and used the same AoS support as the route options. Potential station locations were identified by HS2 Ltd prior to Sift 1 through analysis of Ordnance Survey (OS) maps and aerial photographs. Knowing the general size and shape of a basic station footprint, sites were selected on the basis of evident development space and connectivity with the national rail network. Subsequent discussions with stakeholders including relevant local authorities, passenger transport executives, the Highways Agency and Network Rail, helped to expand the list of sites, which then entered Sift 1.

Figure 3-3 - Through successive sifts emerged the options that were presented to Government in March 2012



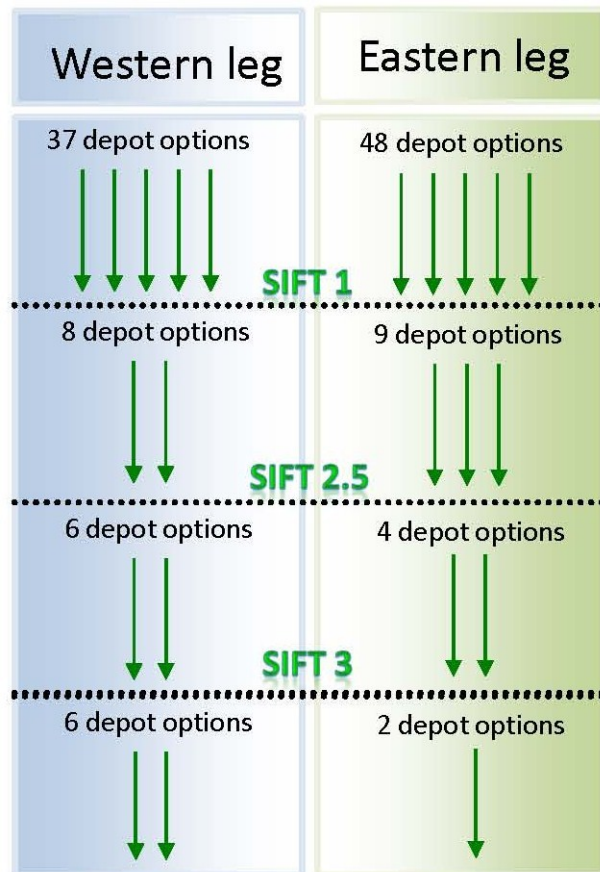
Note: Given the scale of the geographical area, the Leeds long list of routes emerged from two Sift 1 stages rather than one. Conversely the smaller number of Manchester route options proceeded directly to a Sift 2 appraisal, without prior Sift 1 analysis.

3.5.2. During Sift 2, the engineering team undertook a separate review to confirm the feasibility and suitability of remaining sites, as well as to identify further potential locations. For sifts 2, 2.5 and 3, continued consultation with the stakeholders ensured that development planning and wider strategic objectives were considered in any decisions about station choice. As well as the HS2 Executive Team, sift meetings included these stakeholders who were therefore engaged in the station option selection process.

3.6. Depot sifting

3.6.1. The development and sifting of depot options took place between October 2011 and January 2012. It involved a similar approach to the route and station sifts, although the short-listing (Sift 2) stage was omitted, as Sift 1 was successful in reducing the number of options to a manageable level that were then subject to a more detailed appraisal at Sift 2.5 and Sift 3.

3.6.2. From Sift 3 emerged six depot options on the western leg (two infrastructure maintenance depots and four rolling stock depots), and single proposals for an infrastructure maintenance depot and a rolling stock depot on the eastern leg.



3.7. The options reported to Government in March 2012

3.7.1. The route, station and depot options that emerged from Sift 3 were presented to Government in March 2012¹¹. They were grouped into different geographical sections, with any route option in one group capable of linking with any route option in the next.

3.7.2. In this way there were 42 possible route sections on the western leg (including stations) and 32 possible route sections on the eastern leg (including stations).

¹¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/68981/options-for-phase-two-of-the-high-speed-rail-network-appraisal-of-sustainability.pdf

Figure 3-4 - Since autumn 2010, hundreds of options have been considered through each of the four sifting phases, both for routes on the western leg via Manchester.

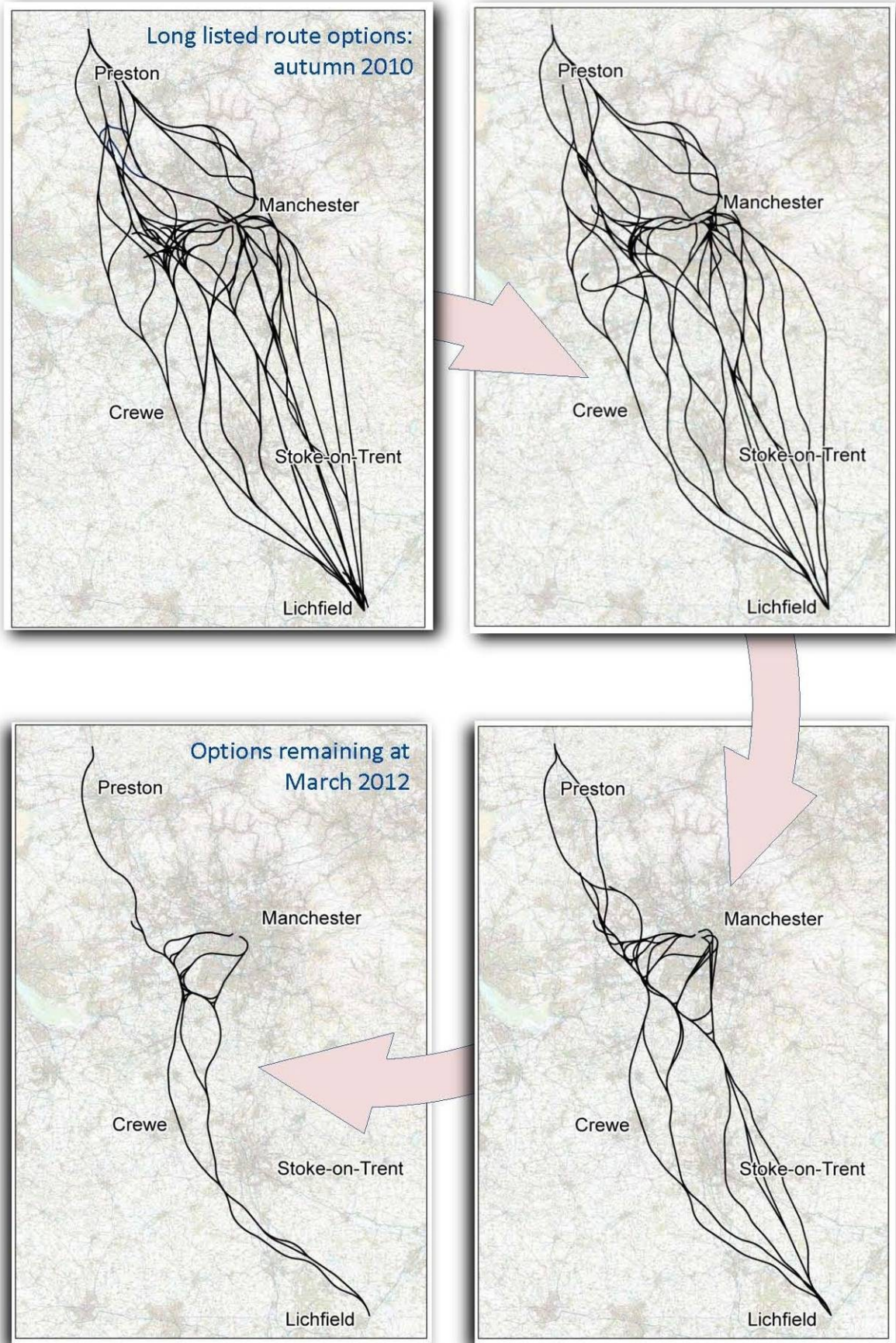


Figure 3-5 and routes on the eastern leg via Leeds.

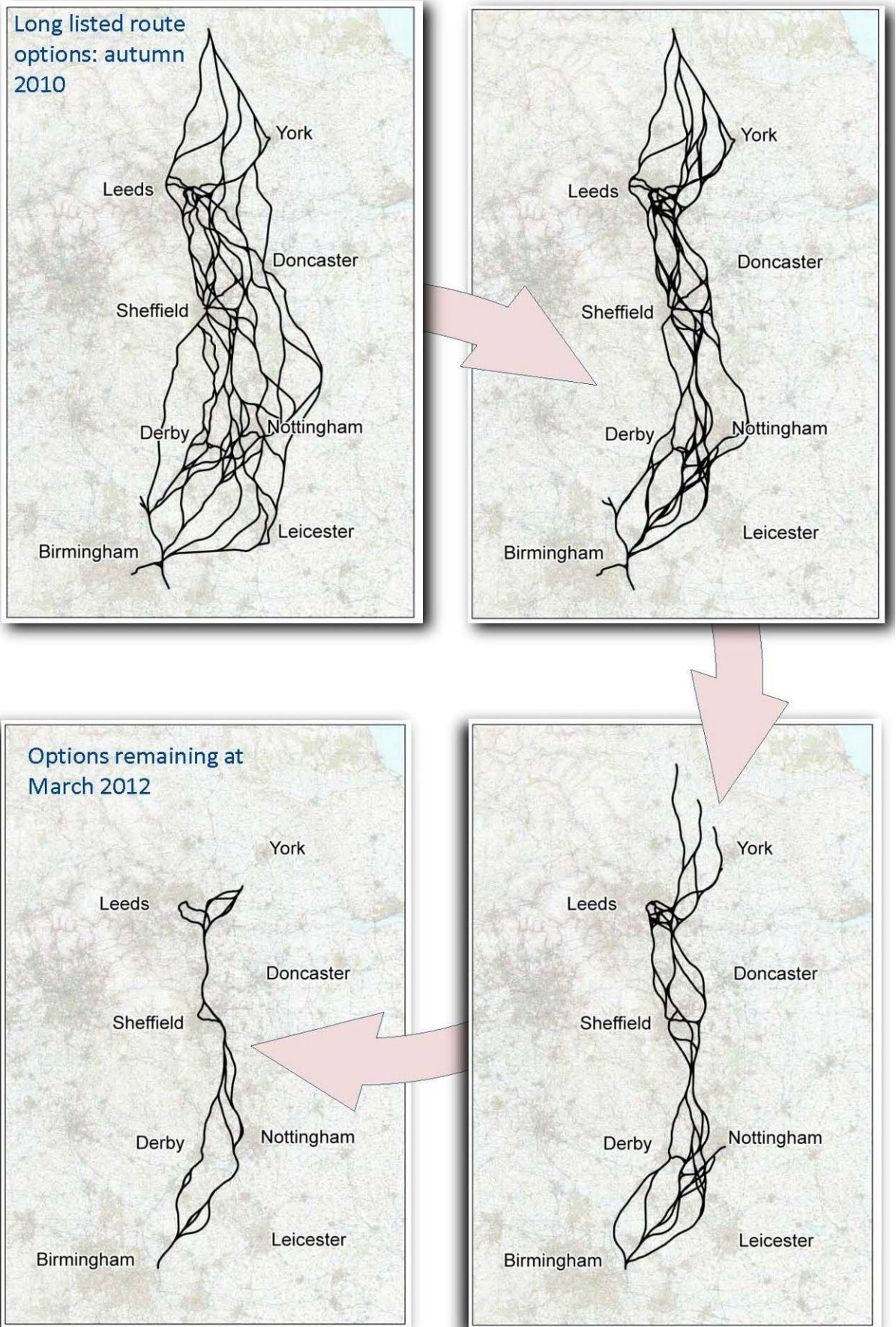


Figure 3-6 - Western leg options presented to Government in March 2012

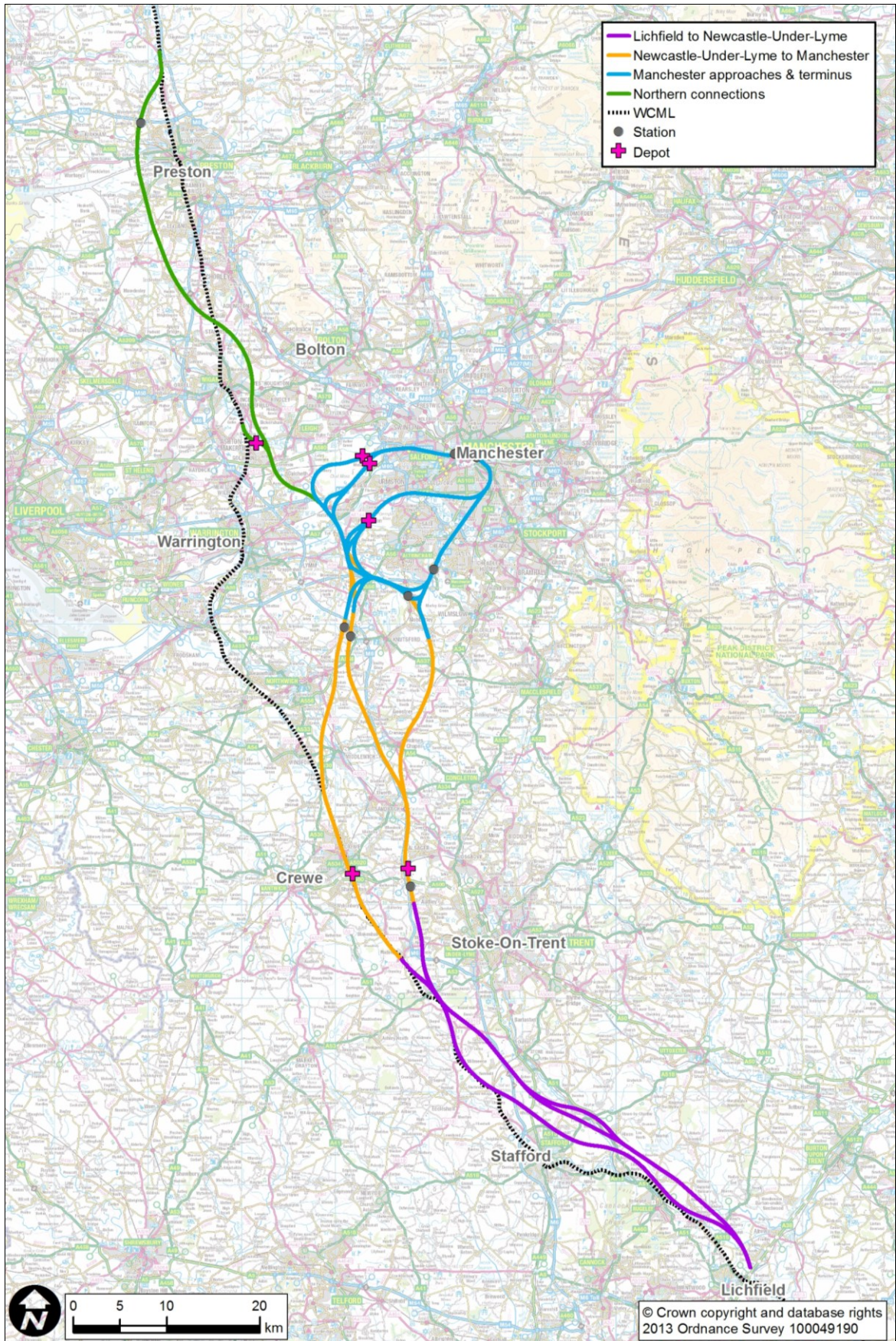
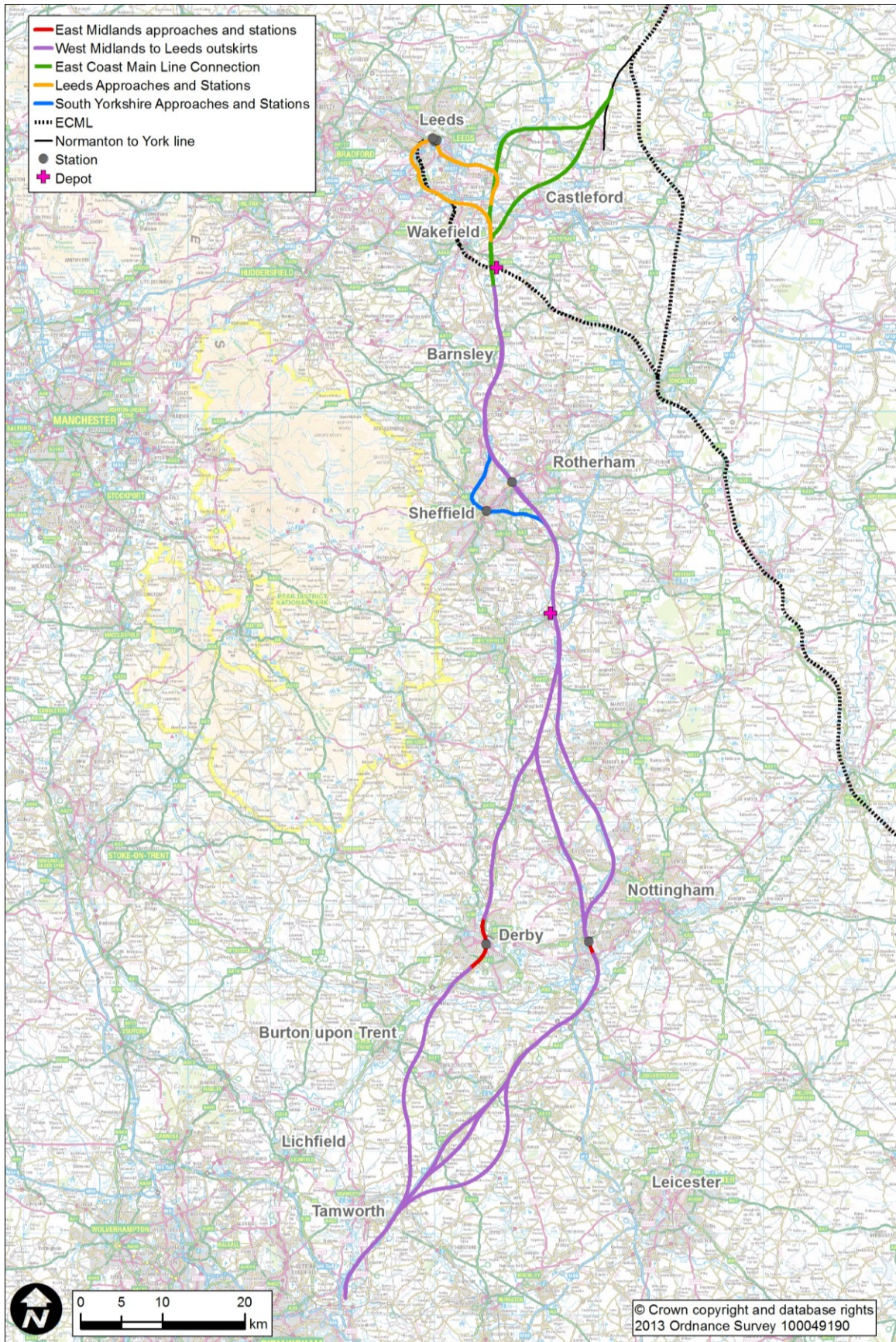


Figure 3-7 - Eastern leg options presented to Government in March 2012



- 3.7.3. Each route section option was considered broadly acceptable by HS2 Ltd in terms of operational, cost and sustainability performance. Some performed better for certain issues, while others represented a balance across all considerations. The location of stations was a key strategic decision. The station options presented to Government comprised:
- for the western leg, three terminus options in Manchester and seven intermediate or interchange station options at various locations, including three for Manchester Airport.
 - for the eastern leg, three terminus options in Leeds, two intermediate station options in the East Midlands (at Toton and Derby) and two intermediate station options in South Yorkshire (Sheffield Meadowhall and Sheffield Victoria).
- 3.7.4. Station locations were important drivers for some route options. In other cases, sustainability issues were the key considerations behind alternative routes; for example the selection of a route south of Pasturefields Salt Marsh to ensure impacts were avoided on this European protected habitat.
- 3.7.5. Against this background, the options were presented to the Government by HS2 Ltd in March 2012, accompanied by supporting information within the document: *Options for phase two of the high speed rail network*, along with other information on engineering, cost and risk. The key potential sustainability impacts of the options were addressed within *Options for Phase Two of the high speed network, Appraisal of Sustainability*. These documents are available on the government website¹².
- 3.7.6. During summer 2012, the Government held a series of meetings with political and economic leaders from the cities and regions that could be served by Phase Two to gauge their opinions of the proposals. Focusing on the station options rather than route options, and undertaken in confidence to prevent the risk of widespread blight for residents and communities, these events helped the Government obtain an initial view on how HS2 could support development and regeneration aspirations.
- 3.7.7. In addition, the Secretary of State for Transport visited areas potentially affected by the proposals in order to both better understand the options and, where necessary, to request further work from HS2 Ltd to reconsider aspects of the route. Certain changes were made to the route options as a result of these visits¹³.

3.8. The initial preferred scheme

- 3.8.1. An *initial preferred scheme* was announced in January 2013, and was described within the Government's command paper, [*High Speed Rail: Investing in Britain's Future - Phase Two: The route to Leeds, Manchester and beyond*](#). The sustainability impacts of this initial preferred scheme are contained in [*HS2 Phase Two Initial Preferred Scheme, Sustainability Summary*](#) that was published alongside the command paper.
- 3.8.2. The announcement of the initial preferred scheme initiated a period of informal engagement to explain the proposals and outline the next steps. Ministers met with MPs affected by the Phase Two route, station and depot options, while HS2

¹² <https://www.gov.uk/government/policies/developing-a-new-high-speed-rail-network>

¹³ A separate report produced by HS2 Ltd (*Selecting an initial preferred scheme for phase two: refinement work since March 2012*) sets out these changes.

Ltd engaged with local authorities affected by the line of route, as well as with key environment and heritage organisations. A small number of refinements were made to the initial preferred scheme partly as a result of these discussions, resulting in the development of the proposed scheme that is the subject of this report. The main refinement to the western leg was the change in the connection point with Phase One. On the eastern leg the main refinements included the extension of the tunnel under the proposed [East Midlands Gateway: Strategic Rail Freight Interchange](#) and the realignment of the route through Meadowhall, as well as a change in the connection point with Phase One.

3.9. Post-consultation: developing the preferred scheme for EIA

- 3.9.1. On the basis of feedback received during consultation, a number of possible refinements to the scheme proposals are likely to be put forward. These would then be subject to further appraisal in order that the relative advantages and disadvantages can be determined and given full consideration. Where a decision is made by the Government to adopt a change, based on advice from HS2 Ltd, then this will be taken into the design and would then form part of the preferred scheme that will be the subject of EIA.

4. Describing sustainability impacts

4.1. Scope, method and mitigation

- 4.1.1. The key potential sustainability impacts of the proposed scheme are described for the western leg in Section 5 and for the eastern leg in Section 6, running in a south to north direction. The scheme wide impacts are presented in Section 7. This section provides some introductory context. For each of the sustainability topics it describes what the AoS has covered and how the appraisal has been undertaken. The order in which the topics are addressed reflects a general grouping of impacts on people, impacts on the environment and impacts on land and material resources.
- 4.1.2. The AoS method was devised to provide a sound basis for both comparing scheme options during the earlier stages of scheme development, and then for reporting the principal impacts of the scheme leading into consultation. A more detailed understanding of environmental effects will be based on the later EIA.
- 4.1.3. The kinds of mitigation that could be applied at the next stage of design on Phase Two can be seen through the EIA work on Phase One, as directed by HS2's [Sustainability Policy](#). Rather than replicate these principles in this document, they are set out within Section 6 of Volume 1 of the [Phase One draft ES](#). This describes the range of measures and policies that will be considered as the Phase One EIA proceeds. These measures are principally of three types:
- mitigation that is provided through the planning and design of the Proposed [Phase One] Scheme, such as through variation in horizontal and vertical alignment, or use of bridges, tunnels and retained cuttings;
 - mitigation that requires physical features, such as noise barriers, landscaped mitigation or balancing ponds; and
 - mitigation that comprises further measures or policies to address specific topics, which are set out for each topic in Section 6.4 onwards of Volume 1 of the Phase One draft ES.
- 4.1.4. In addition to design and policy measures, mitigation of construction impacts would be provided through the application of an environmental management regime that includes the CoCP (see also Section 2.6 of this document). Key relevant aspects of the CoCP are also described in Sections 6.4 onwards of Volume 1 of the Phase One draft ES.
- 4.1.5. The Phase Two AoS has concentrated on the potential long term and permanent impacts of the proposed scheme, resulting from landtake and operation of the railway and its infrastructure. Details of construction are yet to be developed; the impacts that are likely to occur temporarily over the construction period will be addressed in due course by the Phase Two EIA. However, the general temporary construction impacts that are likely to take place are summarised below, based on the approach to [construction](#) developed by HS2 Ltd and summarised in Section 2.6.

4.2. Temporary construction impacts and their mitigation

- 4.2.1. Construction activities will be a source of concern to many people along the route. At this stage, the details on how Phase Two would be built have not been developed. Once a preferred scheme is confirmed following consultation, construction proposals will be defined including, amongst other things, location of

construction sites, activities, types of equipment, routes for construction traffic and expected duration of different work elements. The impacts of these proposals will be assessed by the EIA.

4.2.2. The construction period will be the time when many of the scheme's impacts will be most evident as the proposals result in immediate changes to the environment and to the *status quo*. At this stage, the main potential temporary adverse impacts expected during construction would be:

- temporary landtake for construction sites;
- noise from construction activity;
- views of construction sites, lighting and equipment;
- additional road traffic, particularly due to lorries;
- dust generated at construction sites and along the trace; and
- pollution to surface and groundwater and other changes to flows.

4.2.3. HS2 Ltd is committed to managing potential construction impacts and reducing disruption to communities, businesses and the environment in ways that reflect the very best practice used by the construction industry. As noted above and in Section 2.6, a [CoCP](#)¹⁴ has been developed for the Phase One proposals in order to define the principles for mitigating potential impacts from things like noise, dust, lighting, traffic, river crossings, disturbance to wildlife or disruption to buried archaeology. It will form the basis for more detailed local environmental management plans that reflect the needs of specific areas. The CoCP would continue to be used throughout construction of Phase One and will help inform the CoCP that would be developed for Phase Two in the equivalent stage in the process. In this way, HS2 Ltd is confident that many of the impacts that could arise will be effectively controlled.

4.2.4. The remainder of this section outlines the approach taken in appraising and reporting the potential long term and permanent impacts of the scheme.

4.3. Planning and development

4.3.1. The AoS has focused on potential changes to the existing environment. However, to address possible future sites and particularly future developments built along the route between now and the time that construction of Phase Two would begin, HS2 Ltd commissioned a review of major development proposals along the route. This study has reviewed major proposals for all types of development, including residential development of 100 or more dwellings or a site area of one hectare or more; other developments with floorspace of 5000m² or more or a site area of one hectare or more; major infrastructure schemes, including highways schemes; and major minerals and waste management sites (including both new and extended sites).

4.3.2. The review considered local planning policy allocations within adopted and emerging development plan documents. It considered commercial proposals within masterplan documents, development briefs and consultation documents. It considered live (but as yet undetermined) planning applications registered by the local planning authority or Planning Inspectorate. And it considered extant planning consents, where the consent is granted but development is yet to have commenced or be completed.

¹⁴ <http://www.hs2.org.uk/draft-environmental-statement/document-library>

- 4.3.3. Sections 5.2 and 6.2 identify those major development sites on the western and eastern legs that would be crossed or otherwise impinged by the proposed scheme.
- 4.3.4. For the sites potentially affected by Phase Two, HS2 Ltd would seek to work with the relevant local authority and the affected developers or promoters to determine how potential impacts might best be managed and how potential opportunities could be realised and maximised.
- 4.3.5. Through a co-ordinated approach, HS2 stations could have beneficial effects for some other development proposals (see Section 4.4) by making them more accessible. These opportunities were explored in discussion with the relevant local authorities. The implications for residential and commercial development, in terms of houses and jobs, are considered below.

4.4. Employment and housing

- 4.4.1. Significant investment in HS2 stations could have profound effects on the surrounding areas, as people and businesses take advantage of new opportunities arising from the transformation in connectivity. Using methods for similar appraisal work undertaken for the Crossrail project in London, the AoS estimated the likely number of jobs and houses potentially supported by HS2 in the area immediately around proposed stations.
- 4.4.2. The appraisal cannot predict the extent to which a high speed rail station could itself effect transformation in an area, where no such major development proposals exist currently. In all probability, there are likely to be wider socio-economic benefits in terms of the additional jobs and commuter trips that would be generated as a result of introducing a high speed station. However, these have not been quantified. What the AoS has focused on is the potential for HS2 to “unlock” and bring forward development sites that are already proposed, uplift the capacity of these proposals, and support higher density development, including tall buildings.
- 4.4.3. The amount of development that could be stimulated by HS2 with the introduction of a new station is based on the anticipated net additional floorspace of commercial development and residential development within a catchment¹⁵ of the proposed station over the subsequent 25 years, estimated for scenarios both with and without HS2 to determine the difference.
- 4.4.4. Information on the property market and potential future development has drawn on a variety of source material including published policy and guidance; relevant strategic planning documents; local planning information and assumptions; and existing property, retail and employment data and studies. In addition, the appraisal included discussions with local authorities and used the appraisal team's knowledge of local areas.
- 4.4.5. Findings in sections 5.3 and 6.3 are described for each station in terms of HS2's potential support for additional jobs and dwellings (housing units). The numbers reported would represent new jobs and houses occurring within the catchment area of the HS2 stations, some of which might have occurred irrespective of HS2 but in other areas, and some of which would be entirely due to HS2: the proportion of each is not possible to quantify with any degree of certainty.
- 4.4.6. In addition, sections 5.3 and 6.3 provide estimates of the likely number of jobs displaced due to potential demolition of commercial and industrial properties

¹⁵ A catchment of 1km was used for central urban areas; a catchment of 2km was used for less built-up areas.

around stations and depots. These jobs would potentially be accommodated elsewhere in the region, and as such are expected to be displaced rather than lost. Although it is considered most likely that displaced jobs would be taken up in the local area, the AoS has taken a conservative position by accommodating the jobs displaced within an overall net figure for jobs supported.

- 4.4.7. Section 7.6 includes HS2 Ltd's latest estimates for the numbers of permanent jobs required to operate trains, stations and depots on the Phase Two network. The number of operational jobs is based solely on those apportioned to the Phase Two scheme, accepting that in practice many people, such as drivers and maintenance staff, would work across the full HS2 network (Phases One and Two). Estimates are also provided for the number of construction jobs required during the peak of construction.
- 4.4.8. The AoS has not addressed the potential wider economic impacts expected to result from the potential transformational effects of HS2. However, these are subject to separate assessment by HS2 Ltd, which is summarised in Section 7.5. The findings of the socio-economic appraisal ([Appendix C](#)) which supports the AoS has no bearing on the reported HS2 economic case, which follows a prescribed methodology for that specific purpose.

4.5. Property and community integrity

- 4.5.1. The AoS considered the physical impacts of HS2 on property in terms of potential demolitions. Using plans showing the proposed scheme footprint, counts have been made of the number of residential properties, community facilities, industrial properties and commercial properties that would potentially be demolished by the proposed scheme. These counts adopted a slightly amended method at stations from that used for the initial preferred scheme (and reported in January 2013), relying instead on the most up-to-date postal address data rather than on previous land use surveys. As a result of this and refinements made to the initial preferred scheme, the numbers differ slightly from those reported in January.
- 4.5.2. In addition, the report addresses the potential for the route to cause severance and/or isolation of residential communities. Severance could occur when settlements are divided by the route, leaving some people separated from certain community facilities. Isolation could occur where areas become enclosed between the route and other existing infrastructure (such as motorways or railways) or large linear features, such as main rivers. In most cases, wherever roads would be crossed by the scheme or its construction, access would be maintained¹⁶; however, a perception or sense of isolation or severance could still affect residents.
- 4.5.3. All potential occurrences of demolition, isolation or severance are reported at sections 5.4 and 6.4, along with impacts on certain community facilities, such as country parks. Further details on the methodology for the appraisal of community integrity are available in *Appendix E.7 Community Integrity*, which is available online at the [HS2 Phase Two document library](#).
- 4.5.4. Given the long time-scale for constructing HS2, the Government has introduced a discretionary (i.e. not required by law) Exceptional Hardship Scheme (EHS). Under the EHS, residential, agricultural and small business owner-occupiers whose properties may be affected by the construction or operation of the proposed route, and who can demonstrate that they satisfy the criteria of the scheme, are able to apply to have their properties bought by the Government at their full un-

¹⁶ The form of this access is yet to be determined (see Section 2.7)

blighted value. This is the first step in providing compensation to those directly affected by HS2: it is designed to be an interim scheme which will, in time, be replaced.

- 4.5.5. In addition to appraising direct property impacts, the number of dwellings within 100m of the above ground route is reported as a representation of the number of people at greater risk of construction disturbance, although, as stated earlier, the construction details and associated mitigation are yet to be developed.
- 4.5.6. The AoS also looked at the route's impact on tranquility. Tranquility is a complex concept that can perhaps best be summarised as "getting away from it all". Examples of factors affecting tranquility include proximity 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. The AoS looked at the most tranquil areas (those amongst the 20% most tranquil based on the CPRE maps). However, the proposed route goes through none of these areas.

4.6. Access issues

- 4.6.1. A fundamental purpose of HS2 is to improve access and capacity by getting people to where they need to be more quickly, efficiently and in larger numbers. To do this most effectively it is important that the proposed scheme provides an interchange hub with other transport systems, including roads, railways, airports, cycleways and footpaths. The AoS included a review of the interchange opportunities at stations. These are reported in a regional context, looking at the major transport arteries within Greater Manchester, West Yorkshire, South Yorkshire and the East Midlands. The report also considers the local context, addressing the availability of conventional train, bus, coach, tram and road services within a 1km catchment of the stations, as well as the provision for pedestrian and cycling links to the nearest residential areas.
- 4.6.2. An assessment of impacts on the road and rail networks, including potential changes in local road traffic (especially during construction) will be addressed in due course by the EIA.
- 4.6.3. The AoS also reviewed the potential crossing of certain public rights of way. Where the scheme or its construction would potentially sever rights of way, new crossings or temporary access would be provided where practicable, subject to discussions with local authorities. Not all such potential impacts have been identified; however, any named long distance footpaths potentially affected have been recorded.
- 4.6.4. Potential impacts from the loss of recreational access were also appraised in terms of length of route crossing National Trust land, open access land and country parks. Impacts are described in sections 5.5 and 6.5. Further details on the appraisal of access issues are available in *Appendix E.8 Access*, which is available on-line at the [HS2 Phase Two document library](#).

4.7. Noise and vibration

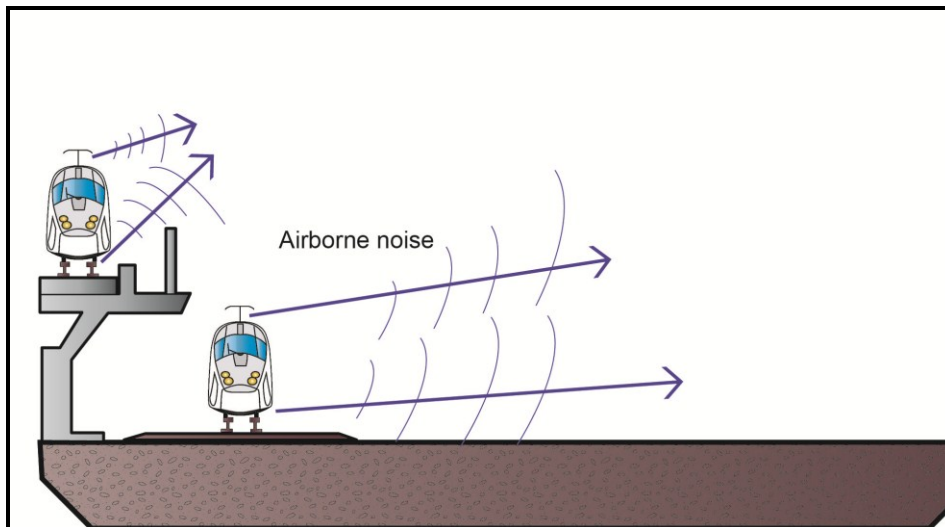
Overview

- 4.7.1. The AoS has used a computer-based noise model to predict potential airborne noise impacts on dwellings due to noise from trains on the railway. Construction noise and vibration (including ground-borne noise), and airborne noise at other sensitive locations are described at a commentary level only.
- 4.7.2. Once a preferred scheme is in place, a more detailed assessment will take place as part of the EIA. This will draw on a programme of baseline noise surveys to report on the predicted noise changes and absolute noise levels at individual properties. However, the information presented in the Sustainability Statement is commensurate with the level of design information available and will provide a good indication of where noise impacts might be expected, and what those impacts might be. Noise impacts are described in sections 5.6 and 6.6. Further details on the appraisal of noise and vibration are available in *Appendix E.6 Noise and Vibration*, which is available on-line at the [HS2 Phase Two document library](#).

Types and sources of operational noise

- 4.7.3. Airborne noise from high speed trains comes from a number of sources:
- mechanical noise from motors, fans and ancillary equipment on the train, which tends to be the dominant source at low speeds;
 - rolling noise from wheels passing along the rails, which is predominant at higher speeds; and
 - aerodynamic noise from general air flow around the train body and the air flow around the pantograph and wheel areas, which starts to become prevalent at the highest speeds, over 300kph.

Figure 4-1 - Airborne noise from railways



Approach to appraising operational noise

- 4.7.4. The airborne noise appraisal predicted levels of railway noise on groups of dwellings occurring over 18 hours (between 6am and midnight, when HS2 services would largely operate¹⁷). Three different appraisal criteria have been used to indicate the potential noise impact:
- Dwellings potentially exposed to **'high HS2 average' noise levels**, i.e. greater than or equal to 73dB_{L_{Aeq,18hr}}.
 - Dwellings that could **qualify for noise insulation** based on the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996.
 - Groups of dwellings that could have a **noticeable (although not necessarily significant) increase** in 'average' daytime railway noise levels, defined as having a noise level of 50dB L_{Aeq,18hr} or more¹⁸ and a change in existing rail noise levels of 3dB L_{Aeq,18hr}¹⁹ or more. The implication of a noticeable noise increase could be quite different for different people, as human response to noise is variable depending on the level; whereas some may be disturbed by it, others may barely notice it.
- 4.7.5. The HS2 noise appraisal incorporates noise predictions using methods set out in DfT's Technical Memorandum for the Calculation of Railway Noise. This uses assumed noise levels of high speed trains, based on the noise levels of currently operating high speed trains²⁰ together with noise level requirements for new trains from European specifications²¹. It then builds in the:
- number and length of HS2 trains;
 - maximum operating speeds, based on speed profiles for different sections of the proposed route;
 - existing rail noise levels based on published government noise maps;
 - details of the proposed route alignment, including proposed embankments, cuttings, tunnels and viaducts, within the context of the surrounding landscape; and
 - screening effects of buildings along the route, based on general screening attenuation.
- 4.7.6. The approach has predicted potential impacts based on a comparison of HS2 and other existing rail noise only.

¹⁷ This 18 hour measurement is a standard period used in noise appraisal. Although HS2 services would likely start at 5am, this would not make any material difference to the results.

¹⁸ 50dB(A) is based on a World Health Organisation threshold, below which a few people would be expected to be 'moderately annoyed'.

¹⁹ 3dB is a noticeable change in total noise over an assessment period.

²⁰ 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.

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

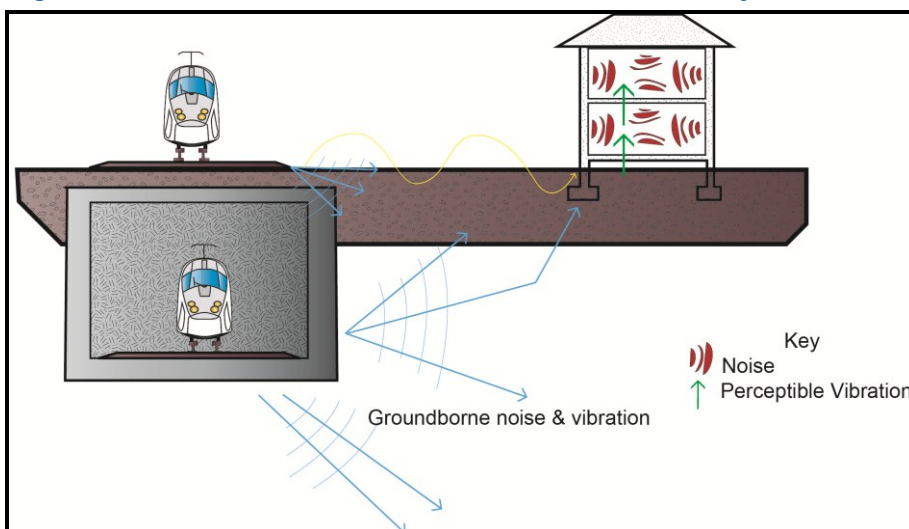
Mitigating operational noise

- 4.7.7. 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 may be necessary. These 'candidate areas for mitigation' took account of clusters of dwellings impacted in any one area according to the three noise impact levels described above (i.e. high noise levels, noise insulation requirements and noticeable noise).
- 4.7.8. The appraisal used professional judgement of the engineers and acoustic specialists to determine the feasibility and likely effectiveness of potential mitigation measures, including trackside noise barriers, low barriers close to the track on viaducts, or treatment of the track itself, such as rail dampers. The principal assumptions are set out below.
 - Improvements will have been made in noise control for the new generation of trains in line with recommendations in current European standards.
 - Noise reduction would be equivalent to that achieved by use of 3m high noise-absorbent barriers at all candidate areas for mitigation, or at viaducts by 2m high noise-absorbent barriers. Proposals for the most appropriate and effective mitigation techniques to be deployed at each location (for example, using bunds that give additional landscape mitigation) would be outlined during the EIA based on a detailed appraisal of local conditions and engineering feasibility.
- 4.7.9. The later noise assessment for the EIA would identify specific mitigation measures and likely significant residual noise effects.

Operational ground-borne noise and vibration

- 4.7.10. Vibration is generated in the ground by the passage of trains, whether at surface or in tunnel. Ground-borne noise is low frequency noise that is generated inside a building as a result of vibration. The manifestation of these impacts at properties, where it may be perceptible or affect certain sensitive equipment, 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.

Figure 4-2 - Ground-borne noise and vibration from railways



- 4.7.11. Experience from HS1 and international guidance²² suggests that potentially significant effects from ground-borne noise and vibration can be mitigated. With mitigation similar to the resilient track forms developed for HS1 or through equivalent techniques, significant ground-borne noise and vibration effects could be avoided and HS2 Ltd is committed to ensuring that no significant residual effects arise.

Additional considerations

- 4.7.12. 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 industry that have not been considered at this stage, but which would in practice moderate the relative effects of HS2 train noise. Consideration of these other background noise sources could alter the identified potential impacts and in general, impacts are likely to be lower than identified here as any increases in noise attributable to HS2 may be less noticeable.
- 4.7.13. 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, 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.
- 4.7.14. 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 can be avoided if ventilation shafts are built with appropriate mitigation incorporated within the structure. The approach to HS2 tunnel shaft noise would build on this experience and best practice for noise control.
- 4.7.15. 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 including adherence to measures that will be set out in the CoCP (see Section 2.6).
- 4.7.16. All potential noise impacts will be assessed in more detail as part of the EIA.

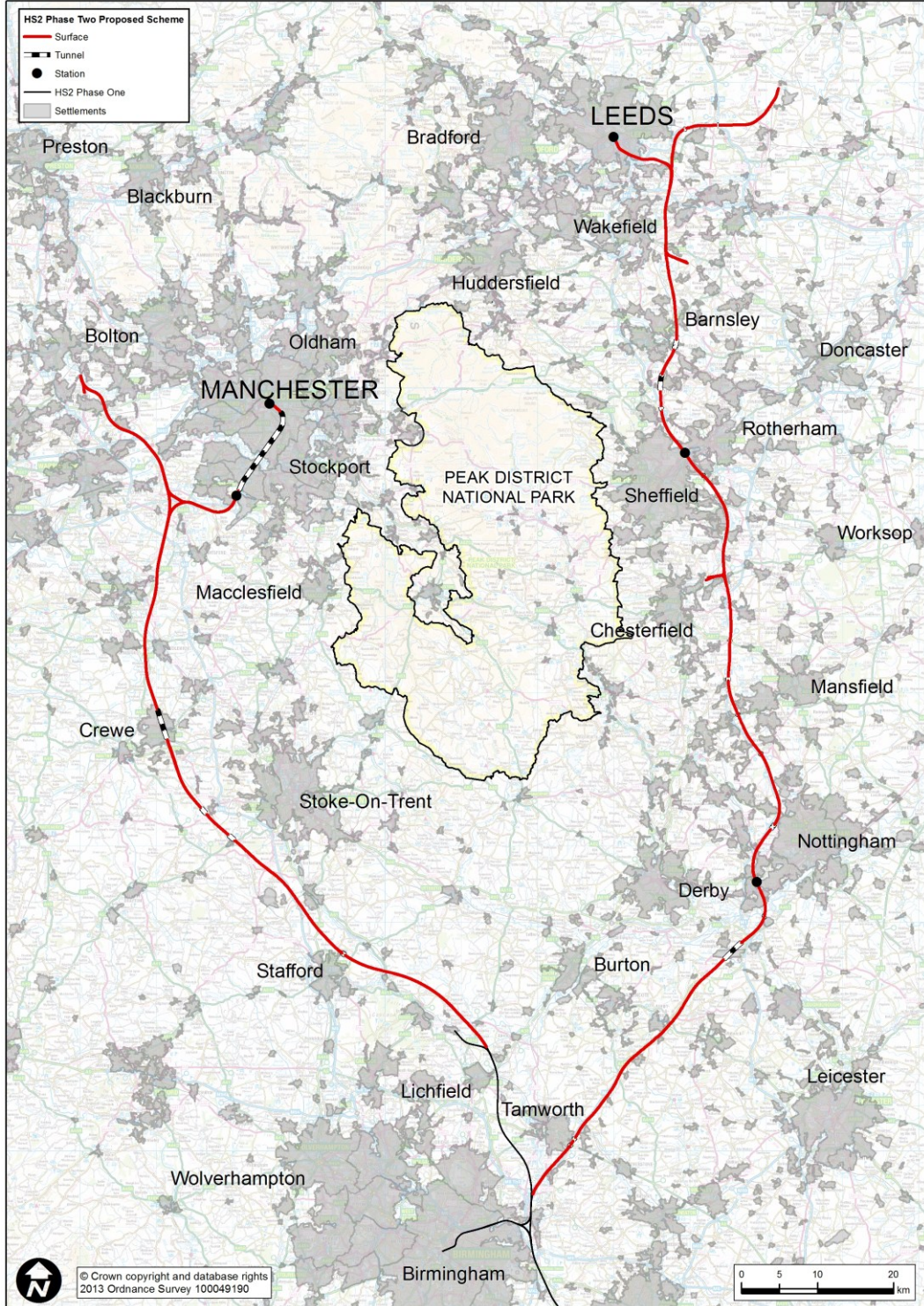
4.8. Air quality

- 4.8.1. HS2 trains would be electric and would not emit pollutants directly. Generation of electricity to supply the grid from which HS2 would draw its power would give rise to emissions. However, these emissions are not expected to increase with time as the use of renewables and other low-carbon power-generating technologies increases, with benefits for general air quality as well as climate change.
- 4.8.2. Air quality impacts could also arise as a result of mode shift, with people increasingly using trains in preference to cars. As road vehicles give rise to more emissions of nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}) and dust compared with electric trains, mode shift to high speed trains would potentially

²² 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)

have beneficial impacts on air quality in some locations. Emissions from road vehicles are also expected to reduce over time as they become more efficient and powered by cleaner technologies. The air quality impacts of mode shift have not been determined as part of the AoS.

Figure 4-3 - Main areas of population



4.8.3. HS2 could also affect air quality locally, around stations as a result of increases in road traffic or the generation of traffic on new routes accessing HS2 stations. The Sustainability Statement identifies situations where there is a potential for

generated road traffic due to HS2 to affect areas with existing air quality problems. These areas, called air quality management areas (AQMAs), have levels of certain pollutants that are expected to exceed stated national objectives. Estimated vehicle trip generation due to HS2 will be considered as part of the EIA, although this report provides a general commentary on potential impacts in sections 5.7 and 6.7. Further details on the appraisal of air quality are available in *Appendix E.12 Air Quality*, which is available on-line at the [HS2 Phase Two document library](#).

- 4.8.4. Potential impacts from construction, such as from dust or emissions from construction traffic, are not considered at this stage. Mechanisms to control these potential impacts would be set out in and rigorously applied through the CoCP (see Section 2.6).

4.9. Health, well-being and equality

- 4.9.1. The AoS included separate analyses of potential impacts on health and well-being, and on equality. Impacts are described in sections 5.8 and 6.8. Further details on the appraisal of health and well-being are available in *Appendix E.9 Health Analysis*, which is available on-line at the [HS2 Phase Two document library](#).
- 4.9.2. Consideration of potential health and well-being impacts has involved making a qualitative assessment of the potential health effects and vulnerabilities along the route of the proposed scheme. In the absence of a single agreed method, the approach has followed guidance and methods set out by the National Institute of Clinical Excellence (NICE) and the World Health Organisation as internationally recognised standards.
- 4.9.3. The analysis has used local authority and counties 2012 health profiles and has drawn on mapped indices of multiple deprivation (IMD) health data along the route. Against this baseline, the health appraisal has taken AoS conclusions on the potential impacts of noise, visual impact, air quality and employment to identify where these could have secondary implications for health. Potential impacts have been validated where possible through recourse to publicly available data (where available) on the health impacts of other rail projects including HS1.
- 4.9.4. A full Health Impact Assessment (HIA) of the direct and indirect health effects (positive and negative) and the significance of those health effects is expected to be undertaken following consultation on the proposed route, so that this can inform the development of the scheme taken forward for consent. A key part of any future HIA will be stakeholder engagement and taking account of any concerns raised by stakeholders as well as the implications for health identified in this report.
- 4.9.5. A separate equality analysis (see [Appendix A](#)) has been undertaken to indicate the extent to which groups vulnerable to discrimination and social exclusion may be differentially affected by the proposed scheme. It identifies the equality groups (referred to as people with protected characteristics or PPCs) to be considered and indicates the potential for adverse and beneficial effects, either from the scheme as a whole or at specific locations.
- 4.9.6. Equality impacts will tend to result from a greater sensitivity to impacts such as changes in access, noise, property demolition, isolation and severance, employment and job displacement. The equality analysis has therefore drawn on the wider findings of the AoS in order to determine where equality impacts might occur. This includes impacts relating to changes in access to affordable housing, access to community and healthcare facilities, access to faith-related facilities, access to public transport, playspace provision, noise impacts on learning, isolation and marginalisation, unemployment, and shortage of accessible housing.

4.10. Safety

- 4.10.1. The appraisal of safety has been the subject of an associated study. This study relies on data from the economic case, which is being revised at the time of writing. At this stage, the Sustainability Statement sets out the principal factors affecting HS2's safety performance in terms of potential fatalities and major injuries.
- 4.10.2. The AoS will consider implications for safety by taking initial predictions for numbers of people either switching to HS2 from other transport modes or using HS2 where they would not previously have taken long-distance journeys, and considering how this might affect fatality and injury rates knowing the relevant average fatality and injury rates for the different modes of transport.
- 4.10.3. Transport statistics used to calculate the fatality and injury rates are produced independently by the DfT²³. They provide statistics and averages in the UK for the last 10 years. Impacts can be described in terms of changes in annual fatalities and injuries; this is addressed for the scheme as a whole in Section 7.4.

4.11. Landscape and visual impacts

- 4.11.1. The proposed scheme would cross landscapes that differ in terms of their characteristic patterns and scale of landform, vegetation, land use and built development. These characteristics determine the sensitivity of the landscape, as well as its capacity to accommodate different forms of built development. An understanding of the landscape has drawn on existing information on landscape character prepared by Natural England, as well as on more specific studies by local authorities. The potential landscape impacts of the proposed scheme have been appraised against this background, initially by studies of maps and aerial photographs, and supplemented by site visits at the stations and along the lines of routes.
- 4.11.2. The AoS also considered the potential visual impacts of the scheme, taking account of who is likely to see it and how these views could affect their 'visual amenity'. Visual impacts take account of the landscape impacts (described above), but also of more direct changes, either resulting from the obstruction of or intrusion into views by different HS2 structures, or the creation of new views where existing landscape features are removed or altered. Visual impacts are described in terms of these qualitative changes, as well as in terms of the likely sensitivity of people to visual impact and their opportunity to experience visual impact.
- 4.11.3. The sensitivity of people to visual impacts can only be presumed, and is categorised by groups. Residents are generally assumed to be the most sensitive group, as they tend to have a strong interest in what they see and a prolonged exposure to views. Users of recreational open space and footpaths are equally assumed to be a sensitive group.
- 4.11.4. The AoS also took account of statutory landscape designations, although the proposed scheme follows a route that avoids all direct impacts on these areas, and is sufficiently distant from them to ensure that impacts on views on those potentially affected (namely, the Peak District National Park and Cannock Chase Area of Outstanding Natural Beauty (AONB)) would be insignificant.

²³ <https://www.gov.uk/government/organisations/department-for-transport/series/road-accidents-and-safety-statistics>

4.11.5. Impacts are described in sections 5.9 and 6.9. These are based on a scheme design without additional mitigation included. With continuing design development, increasingly detailed proposals for mitigating impacts will be developed including refinements to the route, use of earthworks to help screen views and proposals for planting. In line with the approach for Phase One, the landscape proposals would form part of an integrated design approach for the proposed scheme that integrates the engineering requirements of landscape, noise mitigation, ecology, agriculture, cultural heritage and open space. Further details of this approach are contained in Volume 1 to the [Phase One draft ES](#). Further details on the appraisal of landscape and visual impacts are available in *Appendix E.1 Landscape*, which is available on-line at the [HS2 Phase Two document library](#).

4.12. Cultural heritage

4.12.1. Cultural heritage comprises three key areas collectively known as heritage assets. These are:

- archaeological and palaeo-environmental remains (including geological deposits that may contain evidence of the human past);
- historic landscapes; and
- historic buildings and the built environment.

4.12.2. A range of designations are used to reflect the relative significance of these different assets.

4.12.3. Nationally important archaeological sites and monuments can be given legal protection by being placed on a list, or 'schedule' by the Secretary of State for Culture, Media and Sport, with support from English Heritage. Significant battlefields are listed by English Heritage on a Register of Historic Battlefields, although they are not subject to the same statutory protection as scheduled monuments.

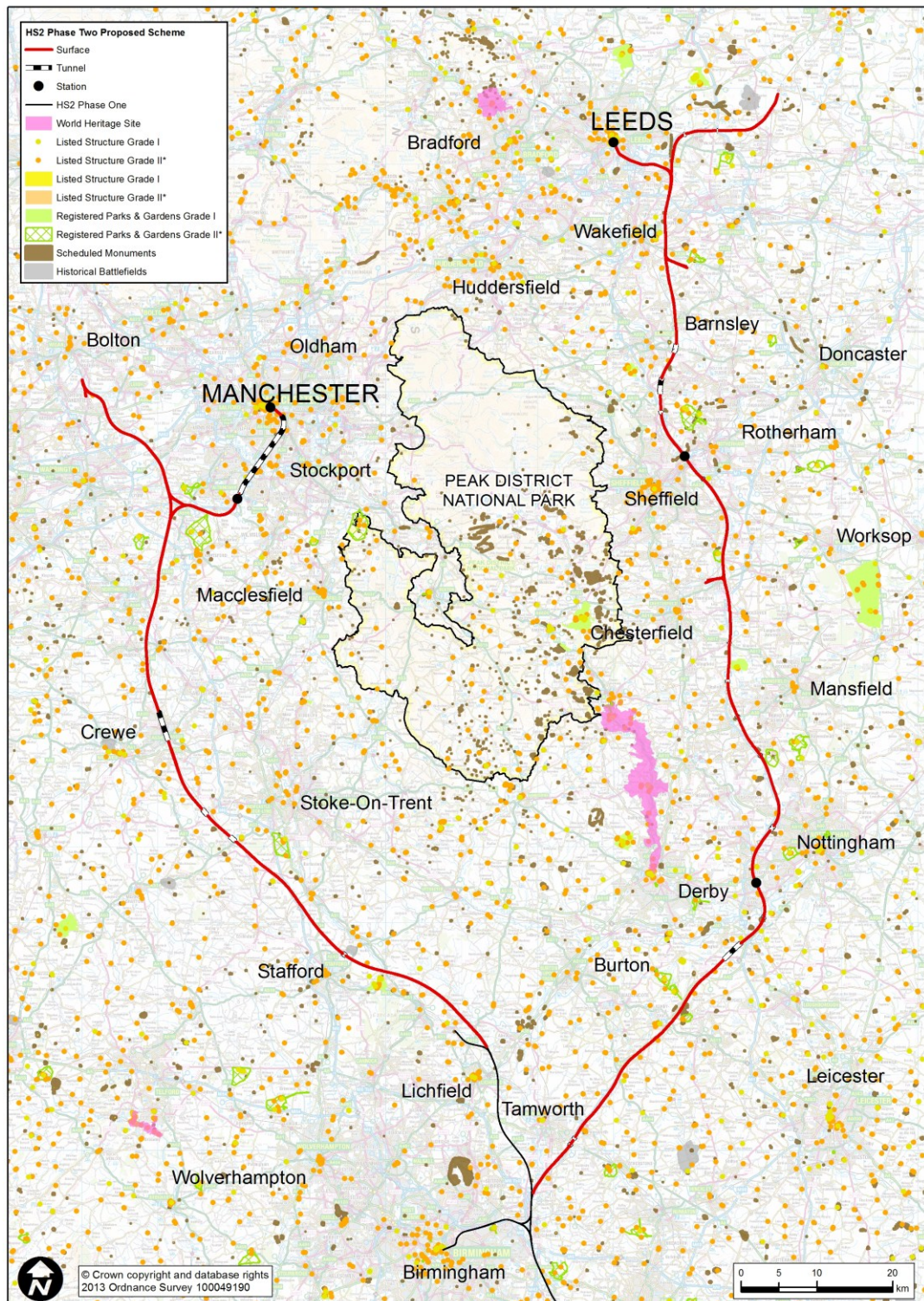
4.12.4. Nationally important buildings and structures are listed by virtue of their architectural and historic interest. Listings are further divided into Grade I, Grade II* and Grade II according to a decreasing degree of importance and interest. A separate Register of Historic Parks and Gardens uses a similar hierarchy of listing. These include gardens, grounds and other planned open spaces, although these areas are not subject to the same statutory protection as Listed Buildings.

4.12.5. Finally, where an area is considered to have special architectural or historic interest, the preservation or enhancement of which is desired, it may be designated a Conservation Area by the local planning authority.

4.12.6. The AoS considered designated statutory and non-statutory heritage assets, both in terms of direct physical impacts and potential effects on their settings. National lists, registers and schedules of such assets held by English Heritage were reviewed, and Conservation Area information was obtained from local authority websites. This information was examined against the proposed scheme plans and profiles. Where potential impacts were identified, an inspection of OS maps and aerial photos helped to establish the possible degree of impact. A number of site visits were made to verify the potential impact of the proposed route on designated assets, focusing in particular around the proposed stations. Visits to key sites with English Heritage helped to refine route options and inform selection. Impacts are described in sections 5.10 and 6.10. Further details on the appraisal of cultural heritage impacts, and those on archaeology are available in *Appendix E.2 Built*

Heritage and Appendix E3. Archaeology, which are on-line at the [HS2 Phase Two document library](#).

Figure 4-4 - Key historic designations



4.12.7. In addition to the designated assets considered as part of the AoS, there is a wealth of other heritage assets. These assets include archaeological sites, features and remains including palaeo-environmental deposits, which may be of national importance, but which lack designation as such having not been formally assessed or having not yet been designated for other reasons.

- 4.12.8. Other assets include historic buildings (some of which may be locally listed), and historic landscape features. The landscape appraisal (see above) has considered prevailing elements from historical land uses where these are influential in affecting landscape character. Information on these other features, which have not been considered by the AoS, is held on a number of data sources, including local authority Historic Environment Records and local archives.
- 4.12.9. Research into known non-designated assets will be carried out as part of the EIA, alongside work to identify the potential archaeological interest of affected areas. Work for the EIA will include, where possible, field investigation to inform the assessment and to determine mitigation. Consultation with English Heritage and local authority archaeologists and conservation officers will be undertaken as part of that work.

4.13. Biodiversity and wildlife

Statutory designations

- 4.13.1. There is a hierarchy of designations providing protection by law or policy to those habitats that are of higher value for biodiversity. The most important sites for biodiversity are collectively referred to as Natura 2000 sites, which effectively include Special Areas of Conservation (SACs - best representing the range and variety of habitats listed in the European Habitats Directive), Special Protection Areas (SPAs - the most important habitats for rare and migratory birds listed in the Habitats Directive) and Ramsar sites (wetlands designated under the Convention on Wetlands of International Importance). A number of these sites occur in the vicinity of the route and earlier route options. An extensive screening exercise, with the close involvement and guidance of Natural England and the Environment Agency, was undertaken to determine the likelihood of impacts, influence option choice and allow for refinement in design. The Habitats Regulations Assessment (HRA) screening included surveys sufficient for this purpose. As a result all adverse impacts on these areas would be avoided.
- 4.13.2. Other key designations considered by the AoS include Sites of Special Scientific Interest (SSSIs), which represent the best examples of the UK's flora, fauna, geological or physiographical features; and National Nature Reserves (NNRs), which accommodate the most important natural and semi-natural ecosystems. The AoS appraised the proposed scheme's potential incursion into these sites, as well as considering the risk of indirect effects, through, for example, disturbance or hydrological impacts.

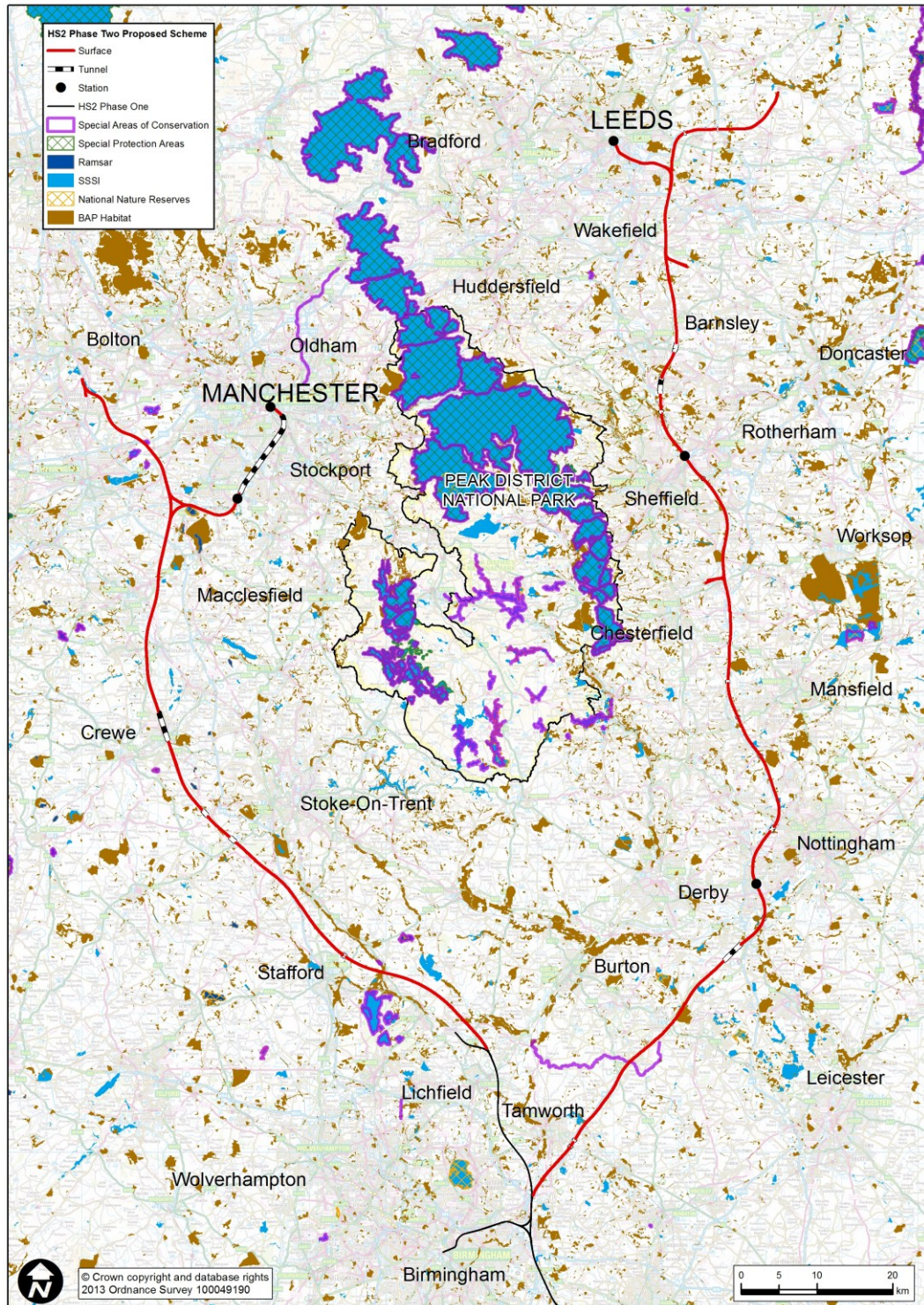
Non-statutory designations

- 4.13.3. Section 41 of the Natural Environment and Rural Communities Act 2006 required the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The 56 habitats and 943 species include all of those identified in the UK Biodiversity Action Plan (UK BAP), which have been used by the AoS. The list is used to guide decision-making bodies in implementing their duty under the Act to have regard to the conservation of biodiversity in England when carrying out their normal functions. The AoS has drawn on revised (2013) data for these sites from Natural England and Joint Nature Conservation Committee (JNCC) which has resulted in a change in the number of areas from that reported in the January 2013 Sustainability Summary (see Section 3.8).
- 4.13.4. The AoS has also recorded sites identified in the Ancient Woodland Inventory, as well as Local Nature Reserves and Wildlife Trusts reserves, where these are

publicly referenced. Impacts are described in sections 5.11 and 6.11. Further details on the appraisal of biodiversity and wildlife are available in *Appendix E.4 Biodiversity*, which is available on-line at the [HS2 Phase Two document library](#).

- 4.13.5. There is very limited information relating to specially protected and rare species provided in site designation accounts. Reference to species records held by county biological records and use of detailed survey and assessment of these species will be undertaken at the EIA stage.

Figure 4-5 - Key ecological designations



Ecology within landscape strategies

- 4.13.6. A number of strategic landscape management tools integrate ecological matters with wider landscape considerations. For example, Natural Area (NA) profiles, National Character Areas (see Section 4.11.1) and Living Landscape Strategies. NA profiles were devised by English Nature (now Natural England) as a tool for nature conservation planning at the landscape level. They reflect the distribution of wildlife and natural features, underpinned by geology and land use patterns. National Character Areas are currently being updated to include information on landscape character, biodiversity (including an inventory of Habitats of Principal Importance) and ecosystem services and are likely to replace the NA profiles in the future. However, as this has not yet been completed, the AoS has used NA profiles to convey the potential strategic ecological impacts of the proposed scheme.
- 4.13.7. At the EIA stage a package of mitigation and enhancement measures will be developed (in consultation with Natural England and other wildlife organisations) to address the impacts on habitats and species. These measures would seek to address both the direct impacts on designated sites, and to reflect the wider strategic ecological priorities of affected Natural Areas, (or the updated National Character Areas). Profiles for these areas contain a series of ecological objectives or opportunities to, for example, reinforce fragmented woodlands, re-establish hedgerows, or restore, create and manage grazing marsh. These objectives will help to shape both mitigation strategies for HS2 and to support, where appropriate, any wider programmes of enhancement or compensation (such as Living Landscape Strategies or Community Forests). They may also be coupled with initiatives on ecosystem services, which could be introduced in the future.

Opportunities would be sought for habitat creation, such as this pond alongside HS1



4.14. Water resources and flood risk

Water Framework Directive

- 4.14.1. The Water Framework Directive (WFD) is European Union legislation (2000) brought into UK law in 2003 with a requirement to first assess the chemical and ecological status of water bodies across the UK and then to prepare River Basin Management plans to achieve good ecological and chemical status for all water bodies. Under this legislation, Great Britain is obliged to meet targets for the ecological and chemical status of water bodies over the course of the next 15 years, with key dates in 2015, 2021 and 2027. Consequently any proposed works which could influence the hydro-morphology, ecology or water quality of any classified water course requires an assessment under the WFD to demonstrate how any adverse impacts will be mitigated and, where possible, the status of the water body enhanced in order to achieve the required good status targets. The WFD assessment is a detailed process requiring a lot of data, and consequently its formal consideration is beyond the scope of the AoS. However, the AoS has included preliminary work that will be formative to more detailed WFD studies. The next phase of work will need to carry out a screening assessment of all crossings of surface and groundwater bodies in order to determine which of the crossings will be subject to a WFD assessment and where necessary to make recommendations for the early collection of data.

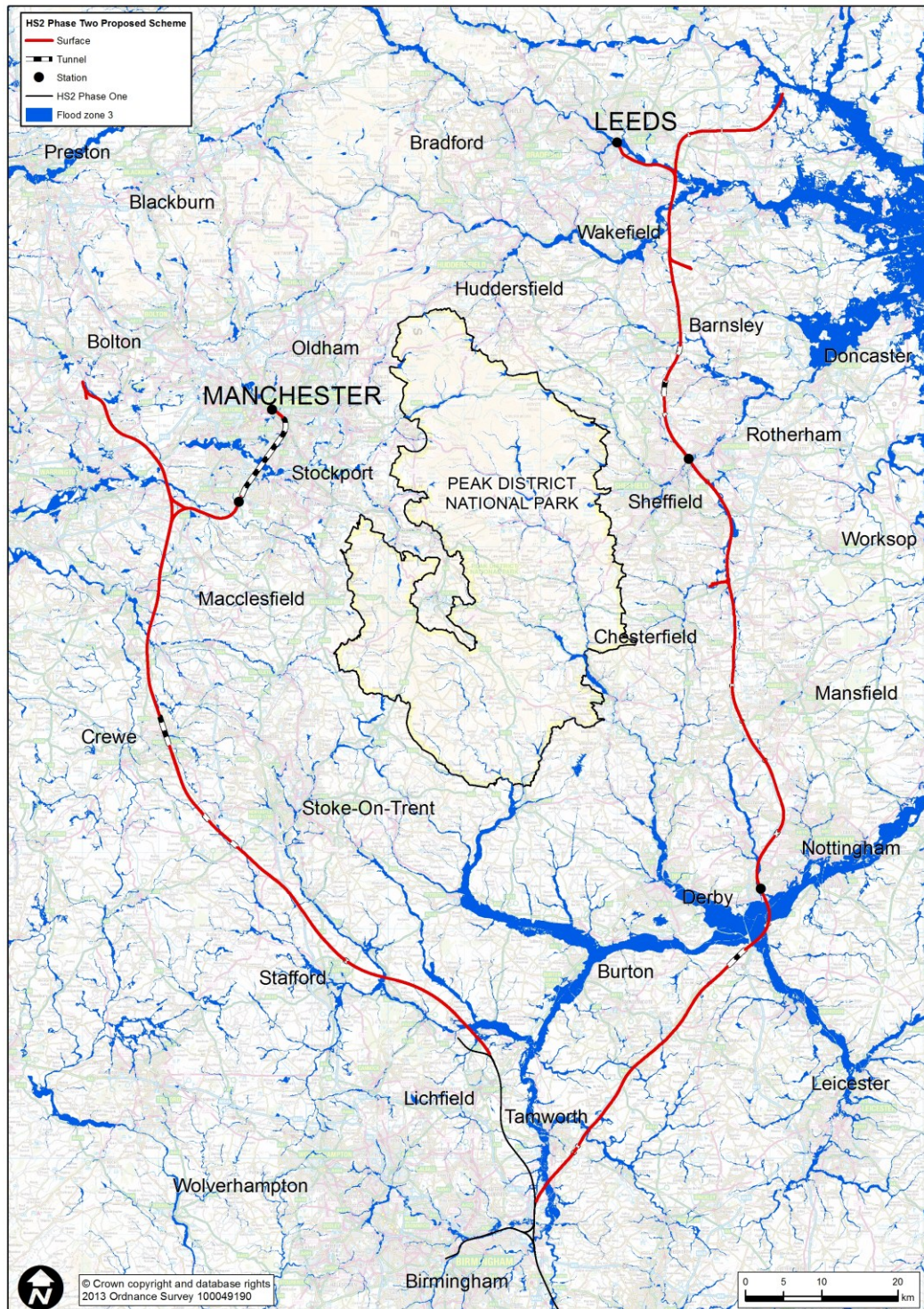
Watercourse diversions

- 4.14.2. The proposed scheme would cross a network of watercourses of varying size, from small drainage ditches to nationally significant rivers. In some places, the route would run parallel to river valleys and alongside or above river channels. This may necessitate a diversion or modification to the river channel to avoid obstructing both normal (base) flows and flood flows, especially where these could increase flood risk or result in secondary ecological effects. The engineering teams have worked closely with the AoS water specialists to avoid, where practicable the need for such diversions. Further solutions will continue to be explored, and this will include discussions with the Environment Agency, Internal Drainage Boards and Lead Local Flood Authorities.
- 4.14.3. At the EIA stage, any potential river diversions that are still likely to be required will be subject to a detailed assessment (including hydraulic modelling) to determine the measures needed to meet legal and planning policy standards. Where diversions are required, they will be undertaken in accordance with the usual requirements for main river diversions, as specified by the Environment Agency. Opportunities for environmental enhancement will also be explored, particularly in cases where there may be opportunities to improve the WFD status in line with the 2027 targets.
- 4.14.4. The rivers potentially affected are described in sections 5.12 and 6.12, categorised as being either major rivers or minor rivers, depending on whether their catchment areas are respectively greater than or less than 50km² at the point of the crossing. A further category of medium watercourses has also been introduced for watercourses with a catchment area of less than 50km², but which are either identified as Environment Agency Main Rivers or are associated with an area of flood risk (see below) as shown on Environment Agency Flood Zone Maps.

Flood risk

- 4.14.5. The Environment Agency maps highlight areas of flood risk alongside watercourses with a catchment size of 4km² or more and for smaller catchments with a history of flooding.

Figure 4-6 - Flood zone 3



- 4.14.6. The proposed scheme could exacerbate flood risk where it crosses these flood zones by obstructing flood flows and reducing flood storage capacity, so potentially affecting the severity and frequency of flooding upstream. The design of these

crossings and the construction methods used are therefore key design considerations. The least obstructive form of construction for floodplain crossings is viaduct, and at this stage, viaducts have been assumed for all sections where the route centreline lies within Flood Zone 2 (areas at risk of flooding on average more than once in every 1,000 years), except where tunnels exist.

- 4.14.7. In some cases, this has resulted in viaducts of significant length where, in practice, there may be alternative solutions that do not increase flood risk. For example, partial lengths of embankment (or embankments with culverts) incorporating appropriate embedded mitigation, may be equally effective where a floodplain is already crossed by other embankments for existing roads and railways. As well as being cheaper, this may have a number of benefits for reducing potential noise and visual impact, and for ecological enhancement, as well as helping manage the cut/fill balances.
- 4.14.8. A more detailed examination of flood risk will be undertaken in due course. This will include a review of the alignment height relative to flood water levels in order either to guide refinements in alignment or to establish the most appropriate structures to convey watercourses over or under the track. The Sustainability Statement identifies all occasions of floodplain crossings over 100m in length.
- 4.14.9. The AoS has not addressed in detail risks to HS2 infrastructure from flooding, although the vertical alignment is generally designed to be at least 1m above the expected 1000-year fluvial water level. Flood risk to HS2 infrastructure will be considered in due course as part of the detailed design and in parallel with the EIA. The more detailed assessment will also look at other flood risk issues including groundwater flooding, failure of reservoirs, flooding from sewers and surface water flooding.

Groundwater

- 4.14.10. Impacts on groundwater have been considered according to the strategic importance of aquifers and how vulnerable they are to pollution. The most important aquifers are ones that support large abstractions for potable (drinkable) water supply.
- 4.14.11. Source Protection Zones (SPZs) define the catchment areas for strategic potable water supplies. Three zones (SPZ1, SPZ2 and SPZ3) are defined according to the travel time of a potential pollutant from a point in the groundwater catchment to the abstraction point, with the inner zone closest to the abstraction point termed the most sensitive SPZ1 (groundwater travel time of less than 50 days). Potential impacts, where the route would cut across these SPZs are reported in sections 5.12 and 6.12.
- 4.14.12. The AoS has also appraised the potential for impacts on the groundwater regime within the SPZs by plotting rudimentary geological profiles and groundwater levels along the proposed route based on information inferred from British Geological Survey (BGS) borehole data and maps.
- 4.14.13. At the EIA stage, where development is proposed within a SPZ, the impacts will need to be assessed and supported by relevant detailed ground investigations (subject to access) and groundwater risk assessments. These will be scoped as part of the EIA in collaboration with the Environment Agency to establish both the baseline conditions and the magnitude of any likely impact. Appropriate mitigation will then be incorporated in the design and construction methodology in order to avoid any permanent impact on the groundwater abstraction. This mitigation might involve one or a combination of different solutions in order to ensure that the quality and quantity of groundwater available at the abstraction point are

preserved, and the requirements of the Environment Agency and ultimately the WFD are adhered to.

- 4.14.14. Other licensed uses for non-potable groundwater abstraction, which include agricultural and industrial uses, can also be critical to the industries that use them, some of which may be strategic infrastructure. Although generally less critical than potable groundwater, at least from a water quality perspective, works with the potential to impact them will need to be considered in detail and mitigated appropriately. At this stage, the AoS has considered the key examples of these, which are reported in sections 5.12 and 6.12
- 4.14.15. The AoS also included a preliminary appraisal of groundwater (as well as surface water) risk of impact to SSSIs in support of the ecological appraisal. Further details on the appraisal of water impacts are available in *Appendix E.5 Water*, which is available on-line at the [HS2 Phase Two document library](#).

4.15. Carbon emissions

- 4.15.1. The assessment of carbon emissions (and greenhouse gas emissions generally) is the subject of an associated study. The carbon assessment relies on data from the economic case, which is being revised at the time of writing. Consequently with this work in progress, the carbon report will be published later in the year. At this stage, the Sustainability Statement sets out the principal factors affecting HS2's contribution to the UK carbon agenda. The carbon report will present the carbon assessment for HS2 as a whole, since Phase Two would not operate in isolation of Phase One. The carbon assessment will address two principal elements, operational emissions and embedded emissions of carbon dioxide. The contributions of each will be calculated for the full construction periods and an assumed 60 year operational lifetime.
- 4.15.2. Embedded emissions will take account of the carbon emissions that would be produced in the manufacture of the materials used to build and operate HS2. For example: from the use of bulk materials within construction, such as steel, concrete and aggregate; from elements of the electrification system, such as copper and aluminium; from the manufacture of rolling stock; from transport of construction materials to construction sites; and from transport of excavated material to disposal destinations.
- 4.15.3. Operational emissions will take account of emissions for which HS2 would be directly responsible during operation, namely due to the power consumption by HS2 trains. But they will also take account of other changes that result from people changing their travel choices. These will include the net change in emissions arising from HS2's overall impact on conventional train services (which is a combination of displaced services and new services). They will also include changes in emissions due to HS2 displacing current road passengers and air passengers.
- 4.15.4. Emissions from each of these elements of the scheme will be calculated using a combination of activity data²⁴ and emissions factors²⁵. The results will be presented in million tonnes of carbon dioxide equivalent (MtCO₂e).

²⁴ Activity data refers to the estimates for things like kilometres travelled, passengers displaced or tonnes of materials that go to make up the HS2 scheme.

²⁵ Emission factors account for the relationship between the quantity of greenhouse gases emitted and an emission-generating activity, for example the number of grammes of CO₂ emitted for each kilometre travelled on an electric train.

- 4.15.5. Activity data for the embedded carbon will rely mostly on engineering assumptions. For the operational carbon affected by things like HS2 annual travel distances and displaced road vehicle distances, quantities will be provided from HS2's demand models.
- 4.15.6. Emissions factors for embedded carbon will use values taken from standard literature relating to the manufacture or transportation of materials. For operational carbon, the values of key emissions factors (for example for electricity generation) will be projected forward at five year intervals over the time period to the 2090s, through the use of future carbon scenarios. This is probably the most uncertain factor, as it is difficult to predict how things will change over time. For example, how much future grid electricity will rely on renewable generation, or how 'clean' future cars and aircraft will be.

4.16. Climate resilience

- 4.16.1. The climate will change as a result of the accumulation of carbon dioxide and other greenhouse gases in the atmosphere. The most recent projections for the effect of these changes are contained in the UK Climate Change Projections (UKCP09)²⁶. The UKCP09 projections are presented for three different future scenarios representing High, Medium and Low greenhouse gas emissions, and contain information on historically observed climate data as well as climate projections. Although no single definite view of the future is possible, UKCP09 shows a range of possible outcomes and the probability of each outcome, based on how much evidence there is for different levels of future climate change.
- 4.16.2. Analysis underway for the Phase One EIA is adopting a set of assumptions for future levels of greenhouse gas emissions within UKCP09 to define a context for an assessment of HS2's resilience to climate impacts. Future climatic attributes projected under this scenario include: hotter, drier summers; warmer, wetter winters; increases in annual average temperature; more very hot days; more very intense downpours of rain; increase in frequency of storms and high winds.
- 4.16.3. For HS2 this could mean increased risks from flooding, landslip, ground settlement, storm damage, high summer temperatures, and changes in vegetation, all of which could have implications for HS2 operations. These are addressed generically in Section 7.3. Information on flood risk is provided at sections 5.12 and 6.12.

4.17. Land use resources

- 4.17.1. The intrinsic value of land to farmers or other 'land managers' was considered by the AoS. Potential effects on farmland would occur where agricultural land is lost or becomes inaccessible through severance. Defra's Agricultural Land Classification system classifies agricultural land into five grades based on the physical characteristics of the land and the long-term limits these impose on its agricultural uses. The AoS has considered impacts of the scheme in terms of the areas of the highest quality land (Grades 1 and 2) that may be affected by HS2, although the strategic nature of these maps deters appraisal of agricultural land quality at a local scale.
- 4.17.2. The AoS also appraised environmental impacts related to land designated for waste disposal, including active landfill sites. Impacts related to these represent both an environmental risk in terms of the potential contamination pathways that could be created, and a loss of key municipal services. Impacts related to disused

²⁶ <http://ukclimateprojections.defra.gov.uk/21678>

landfill sites are also reported. A preliminary risk profile was determined for each landfill affected, with higher risks identified based on the type and length of crossing, the size of the landfill and its recorded contents. Any crossings of landfill sites would be designed and undertaken to ensure that risks from contaminated materials are fully mitigated.

- 4.17.3. The AoS also considered potential impacts on green belt in terms of lengths crossed by the route and areas of potential landtake at stations and depots. Green belt was introduced throughout England in 1955 as a means of restricting urban growth around major cities and towns. HS2 could be viewed adversely in relation to green belt if it is considered to conflict with the open and contiguous character for which a green belt is designated, particularly where it forms a new 'edge' that might encourage new infill development.
- 4.17.4. Finally, the AoS has identified mines and quarries that could be directly affected by the proposed scheme, based on a current OS data set.

4.18. Excavated material and waste production

- 4.18.1. Material and waste would arise from demolition and construction activities as well as the operation of the proposed scheme. Tunnelling would be the principal source of excavated material, but quantities will depend also on the extent and the depth of cuttings used for surface sections (itself a response to the need for environmental mitigation, as well as topographical constraints). HS2 Ltd has estimated quantities of excavated materials, but this is based on preliminary designs in advance of any potential landscaping proposals or noise bunds alongside the line. These would benefit from having a ready supply of excavated material, so reducing the costs and disruption of imports from further afield.
- 4.18.2. The general principle for HS2 would be to balance materials taken from cuttings and tunnelling with those required for embankments and filling. Where surplus material arises, HS2 Ltd would explore opportunities to make beneficial use of this on environmental improvement projects and other developments where appropriate before considering landfill. It is envisaged that Phase One will use the majority of its excavated materials within earthworks and wider landscaping proposals.
- 4.18.3. Material and waste will also arise from demolition and construction activities. Potential waste quantities have not yet been determined, but the financial and environmental incentives to avoid these will be a strong driver to minimising them.
- 4.18.4. HS2 Ltd will seek to avoid impacts on contaminated land, but where it is unavoidable, for example where excavation through landfill is required, HS2 would implement best practice measures to minimise risks to the environment and avoid disposal off-site. These measures would be set out within site waste management plans (which would cover all waste arisings, both hazardous and non-hazardous). The AoS has identified potentially contaminated areas (and associated generation of hazardous waste) at active and disused landfill sites. There are also other sources of potentially contaminated material, which would be considered as part of an EIA and at later stages prior to the commencement of construction; for example at industrial sites.
- 4.18.5. Operational wastes would comprise maintenance waste, particularly at depots (principally concrete, ballast, and steel, as well as fuels, oils, chemicals, spent mechanical and electrical components and vegetation) and waste from passengers (principally food packaging, newspapers, magazines etc.). Further details on the appraisal of waste impacts are available in *Appendix E.10 Waste*, which is available on-line at the [HS2 Phase Two document library](#).

4.19. Material resource use

- 4.19.1. This report records estimated tonnages of bulk building materials, namely steel and concrete, by way of indicating the principal material resource requirements of the project. These have taken into account the steel used for tracks, for tunnel reinforcement and for overhead wires, and the concrete used for permanent way, tunnels, viaducts and stations. The appraisal uses standard conversion factors for steel, but has used more specific conversion factors for concrete that accommodate the different characteristics of the scheme structures. The information was also the basis for embedded carbon figures that were used during sifting stages. Further details on the appraisal of material use are available in *Appendix E.11 Material Use*, which is available on-line at the [HS2 Phase Two document library](#).

5. Western leg: sustainability issues

5.1. Introduction

- 5.1.1. This section describes the main potential sustainability impacts, both beneficial and adverse, that would result along the western leg of the Phase Two proposals; they are generally described in a south to north direction. The section should be read in conjunction with Section 4, which provides the AoS scope for each topic and gives an overview of the appraisal method. Plans showing the features and locations referenced here are provided in Volume 2.
- 5.1.2. The potential impacts that are set out here are predicted to result from the proposed route in its current stage of design and on the basis of the current baseline environment. Some of these impacts could change in detail as further refinements are made, and as additional mitigation is introduced. Only the main impacts²⁷ are described here. Potentially lesser impacts are not recorded in this document, although they are listed in the technical appendices that are available separately.
- 5.1.3. Associated works, such as road re-alignments and utilities diversions (see Section 2.7), which have not been agreed at this stage, may also result in impacts. In addition, no construction planning has been undertaken at this stage. All of these additional works will be assessed by the EIA.

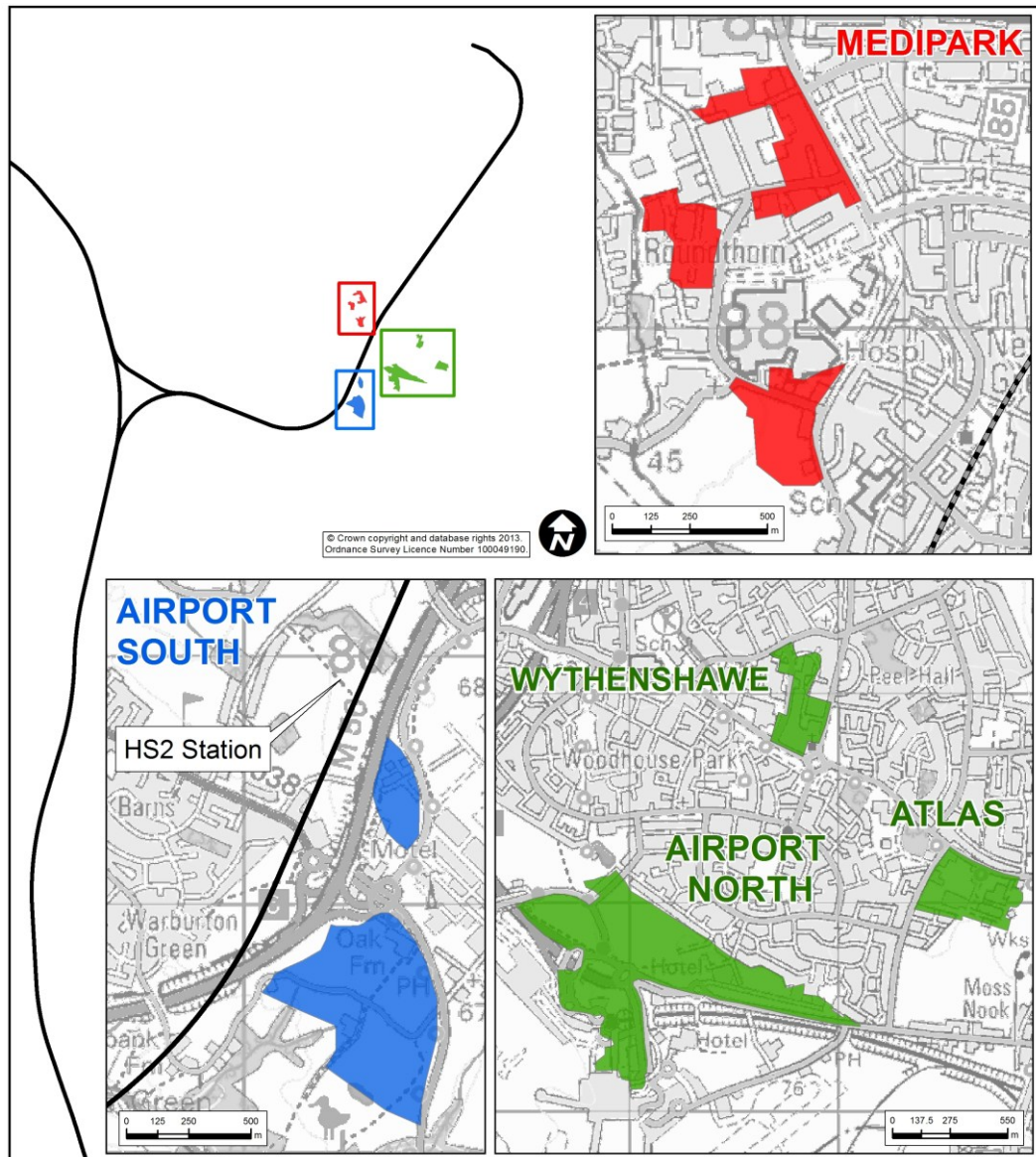
5.2. Planning and development

- 5.2.1. A review of major development proposals along the western leg identified a number of strategic sites that would potentially be affected by the proposed scheme.
- 5.2.2. The Highways Agency intends to improve the A556 trunk road between Junction 19 of the M6 near Knutsford and Junction 7 of the M56 near Bowdon. A Development Consent Order application was made in April 2013 and, at the time of writing, the proposals are open for consultation. The spur into Manchester would pass directly beneath these proposals at their northern end, where it turns to run alongside the M56.
- 5.2.3. There are a number of planning policy and development designations around the Manchester Airport High Speed Station. These include the “World Logistics Hub” and “Airport City” areas (blue and green zones; see figure overleaf) that are part of the Manchester Enterprise Zone.
- 5.2.4. On the west side of the M56 there is also an area policy within Trafford Council's Core Strategy that references the future potential development of the Davenport Green site; the HS2 proposals would be on the far eastern boundary of this area. The HS2 proposals would need to take account of any necessary highway modifications and future potential routes of the Manchester Metrolink.
- 5.2.5. At West Gorton, having emerged from tunnel, the route would pass along the western edge of a proposed mixed use development site which includes proposals for up to 565 dwellings and a community hub. Potential impacts would appear to be generally slight. An outline application was approved by Manchester City

²⁷ Main impacts are similar to the ‘significant’ effects that would be described within an Environmental Statement, in line with the EIA Regulations. The AoS has generally avoided defining ‘significance’, given the preliminary nature of the appraisal and the information upon which it relies.

Council in November 2012 and forms part of the wider regeneration proposals as set out within the West Gorton Masterplan.

Figure 5-1 - Manchester Enterprise Zones



5.2.6. The proposed HS2 terminus station in Manchester would support local policies in the Core Strategy (Public Consultation version, 2011), including the Mayfield development on the site of the former Mayfield Railway Station. It would also encourage the development of the eastern gateway to the city; and it could increase the density and quality of local development, thereby maximising the opportunities of Manchester Piccadilly Station in line with the Strategic Plan for Manchester City Centre (2009-2012). The implication for jobs and houses as a result of this strategic support is described below.

5.3. Employment and housing

Manchester Airport High Speed Station

5.3.1. The Manchester Airport High Speed Station would be located west of Manchester Airport at a site with a number of development designations (see Section 5.2).

- 5.3.2. HS2 is expected to enhance the development potential of the area, as it could support the delivery of additional warehousing as well as some office floorspace. With quite substantial development anticipated in any case, the relative impact of HS2 could be in the region of an additional 10,000m². This could be increased through further aspirational policy and changes in green belt policies.
- 5.3.3. The station would result in the demolition of around 3,000m² of existing business space. However, this could be more than offset by an increase in development area, to result in a net increase in commercial floorspace of between 12,000m² and 25,000m², which could support between 300 and 700 jobs. Residential floorspace could decrease by some 2,000m², due to the predicted residential demolitions (see Section 5.4). In this otherwise generally commercial/industrial area, no additional residential development is currently envisaged as a result of HS2.

Aerial view of Manchester Airport High Speed Station site looking north along the M56



Manchester Piccadilly

- 5.3.4. Piccadilly is a location that would support considerable additional development as a result of HS2, for a number of reasons. Built alongside the existing station at Manchester Piccadilly in the heart of the city, the HS2 Manchester terminus would allow better connections with regional rail services (which will increase as a result of the Northern Hub Scheme), as well as access to the wider Manchester public transport network (see Section 5.5). The central location is close to Piccadilly and the commercial core of the city, as well as the Oxford Road Corridor/First Street Regeneration Area, so forming part of a strategic economic growth and investment

location. There are few major constraints to development or access for key sites in the immediate vicinity of the proposed station: indeed the introduction of HS2 would provide an opportunity to improve connectivity and address underused development sites in this area. There are numerous strategic sites in the area around the station whose potential would be 'unlocked' and supported by HS2. There is also both a potential and precedent for high density building development within the city centre.

- 5.3.5. Bearing this in mind, it is estimated that HS2 could increase net commercial floorspace by between 605,000m² and 871,000m², which would support between 29,700 and 42,900 jobs. Residential floorspace could increase by at least 184,000m² and potentially up to 246,000m², equating to between 3,100 and 4,100 homes. The additional housing would be a particular local benefit given the above average levels of housing deprivation in the area. All the development, job and housing figures quoted in this report are net: that is they discount development that would have occurred without HS2 as well as deducting any demolitions and resultant displacement of jobs.
- 5.3.6. Due to the potential demolition of commercial properties, the terminus station could displace businesses currently providing an estimated 1,900 jobs. Although these displaced jobs are accommodated in the net figure for jobs supported, it is anticipated that in practice the majority of these displaced jobs would be accommodated in the city.

5.4. Property and community integrity

- 5.4.1. The western leg could result in the demolition of an estimated 139 dwellings. The majority of these would be associated with the spur into Manchester and the terminus station. An estimated 48 dwellings would be demolished at Manchester Piccadilly, north of the existing station. Where the tunnel under Manchester emerges in West Gorton, an estimated 22 dwellings would be demolished by the portal structure and tunnel approach, although a proposed housing development on this site (see Section 5.2.5) may affect the amount of demolitions required. This will only be determined when design details of the proposed housing scheme and Phase Two are developed. Three groups of properties, comprising an estimated 15 dwellings in total, would be demolished by the proposed Manchester Airport High Speed Station and its approach, to the south and east of Warburton Green.
- 5.4.2. Other demolitions would be limited to single properties or small groups (less than five) at various locations along the route. Lowton St Mary's is the only exception to this, where an estimated five dwellings would be demolished as the route passes through a narrow corridor between Lowton Common and Golborne.
- 5.4.3. The route could result in isolation of an estimated 57 residential properties at a number of locations, most notably at Wrinehill and just to its north; the northern edge of Crewe; and North Lowton and the east of Edge Green around the proposed depot at Golborne.
- 5.4.4. The proposed scheme would also require the demolition of one community facility at Manchester Piccadilly Station (a postal distribution centre). It would require the demolition of an estimated 99 commercial properties, almost all of which would be at Piccadilly, south of Culcheth and south of Lowton Common. An estimated two industrial properties would be demolished.
- 5.4.5. No appraisal of temporary construction impacts has been undertaken at this stage. However, as an indication of the number of people at greater risk from construction impacts (noise, dust and general disturbance), there would be approximately 1,100

dwellings within 100m of the surface route and the provisional station and depot construction boundaries.

5.5. Access issues

Manchester Airport High Speed Station

- 5.5.1. The HS2 station would have a direct link with Manchester Airport, the third busiest airport in the UK in 2012, with almost 20 million passengers flying annually to around 190 destinations. The airport is expected to grow, with plans to serve around 50 million passengers per year by 2030.
- 5.5.2. Frequent rail services link the airport with various cities including Leeds, Sheffield, Hull, York, Newcastle and Edinburgh, as well as with local stations. The Manchester Metrolink is currently being extended to the airport, and this is expected to be in operation in 2016.
- 5.5.3. The HS2 station would connect with the existing surface transport interchange, and its network of bus and coach services. The high speed station would have good road access, with links to the M56 and the A538 Wilmslow Road. A car park for up to 3,000 cars is proposed as part of the new station (exact number to be discussed with the local authority in light of their policies). Existing car parking at the airport provides some 22,000 spaces, although this is projected to increase to between 40,000 to 50,000 with the airport expansion.

Aerial view of existing Piccadilly Station looking west



Manchester Piccadilly Station

- 5.5.4. Manchester Piccadilly occupies a central location that forms a hub for both regional and local transport networks. The existing Piccadilly station offers good rail connections to various key destinations across the city and region including

Manchester Airport, Salford, Stockport and Bolton, as well as destinations further afield including South Wales, the south coast of England, Edinburgh and Glasgow. Passengers would be able to transfer directly between the existing rail and HS2 concourses.

- 5.5.5. A significant programme of improvements at Manchester Piccadilly will take place in connection with the Northern Hub programme of targeted upgrades to the railway in the North of England. Scheduled to complete in 2019, it will allow up to 700 more trains to run each day and provide space for 44 million more passengers a year. The programme includes the construction of a link between Manchester Victoria and Manchester Piccadilly, as well as two new platforms at Manchester Piccadilly Station that will enable better onward connections to the North. There will be new direct services to Manchester Airport and more fast trains to a variety of destinations.
- 5.5.6. The HS2 station would also be served by Manchester's Metrolink light rail system, which provides connections to Bury, Altrincham, Eccles, Salford Quays and other destinations. Metrolink is expanding from Chorlton to East Didsbury, from Droylsden to Ashton-under-Lyne town centre, through Oldham and Rochdale town centres, as well as to Manchester Airport.
- 5.5.7. Connections to local bus services are provided outside the Fairfield Street entrance of the existing station. The Manchester Central Coach Station, a short walk away on Chorlton Street, provides numerous regional coach services. Opportunity for better pedestrian connections from Piccadilly to the rest of the city would also be provided through the HS2 and Northern Hub station.
- 5.5.8. The Inner Ring Road in Manchester city centre would provide the main route connecting the HS2 station to radial and regional routes, specifically via the A635 and A635(M) (Mancunian Way).

Impacts on rights of way and country parks

- 5.5.9. The western leg of the proposed scheme would cross eight long-distance paths, including the Trans Pennine Trail; the Way for the Millennium; the Staffordshire Way; the Stone Circles Challenge (two intersections); the South Cheshire Way; the Crewe and Nantwich Circular Walk; the Cheshire Ring Canal Walk (two intersections); and the North Cheshire Way.
- 5.5.10. Three national cycle routes would be crossed by the proposed route.
- 5.5.11. It is assumed that permanent access along all public rights of way would be maintained through diversion or re-instatement (subject to agreement with the local authority), although there would be disruption to these routes temporarily during construction. A detailed appraisal of all access crossings will be undertaken as part of the EIA.
- 5.5.12. No country parks would be directly affected on the western leg, although Pennington Flash Country Park is within about 75m of Golborne Depot. Section 5.8 addresses any landscape and visual impacts on these designated areas.

5.6. Noise and vibration

Airborne noise

- 5.6.1. The airborne noise appraisal predicted levels of railway noise on groups of dwellings. The approach is described in more detail in Section 4.7, but in summary, three categories of impact have been used, namely:

- dwellings potentially exposed to 'high' HS2 noise levels, i.e. greater than or equal to 73 dB $L_{Aeq,18hr}$;
- locations where dwellings could qualify for noise insulation; and
- groups of dwellings that could have a noticeable (although not necessarily significant) increase in railway noise levels, a noise level of 50 dB $L_{Aeq,18hr}$ or more, and a change in existing rail noise levels of 3 dB $L_{Aeq,18hr}$ or more.

5.6.2. Since the publication of the Sustainability Summary (see Section 3.8), the noise specialists have worked closely with the scheme engineers to determine (at this stage of design) the feasibility of introducing noise barriers at the 'candidate areas for mitigation' (see Section 4.7). As expected, this has substantially reduced the number and extent of noise impacts reported at that earlier stage. The numbers of people predicted to have noise impacts is shown below, with a comparison between the impacts with and without additional mitigation.

Table 5-1– Estimated numbers of dwellings with noise impacts on the western leg

| Proposed scheme... | High noise levels | Noise Insulation Regulations | Noticeable noise increase |
|---|-------------------|------------------------------|---------------------------|
| .. without additional mitigation | <15 | 100 | 5,800 |
| .. with additional indicative mitigation | <5 | 30 | 1,100 |

5.6.3. The use of additional indicative mitigation would reduce noticeable noise by about 80%. It would reduce the number of dwellings potentially qualifying for noise insulation by around two thirds (70%); and the number of high noise level impacts by a similar amount.

5.6.4. The indicative locations of these impacts are illustrated on the noise maps contained in Volume 2 of the Sustainability Statement. The main residential areas where residual noise impacts are currently predicted include (by local authority):

- Great Haywood in Staffordshire;
- Chorlton in Cheshire East;
- Lostock Green and Lostock Gralam in Cheshire West and Chester; and
- Hollins Green in Warrington.

Other potential operational noise impacts

5.6.5. There is a potential for noise impacts from stations and depots due to trains, as well as to other sources such as fixed plant, PA systems or local traffic. It is likely that the majority of these impacts can be avoided or minimised through the use of effective planning and design, and through other noise mitigation measures. Nevertheless, the location of residential properties around the station locations and around the depots would present at least a moderate risk of noise impacts at these locations.

5.7. Air quality

5.7.1. Most of the area along the proposed route is in compliance with National Air Quality Objectives. According to Defra modelled background map data, background levels of NO_2 , PM_{10} and $PM_{2.5}$ currently meet these objectives along the length of the proposed route and are set to decrease in future years.

- 5.7.2. However, the Manchester Airport High Speed Station and Manchester Piccadilly Station, as well as the Golborne Depot site, are close to busy roads and overlap AQMAs where air quality objective levels are exceeded, particularly for NO₂. Any additional road traffic generated at these places, either during construction or operation, has the potential to exacerbate local pollution levels if no air quality improvements have been implemented by local authorities by that time. In developing scheme proposals, it would be necessary to comply with EU law on ambient air quality. This would be considered in more detail as part of the EIA.

5.8. Health, well-being and equality

Potential health impacts

- 5.8.1. Initial analysis indicates the potential for both positive and negative health impacts in and around the Manchester and Wigan areas, where existing levels of health-related deprivation are high. The main potential negative health impacts relate to displacement of jobs, noise and demolition of housing and community facilities. Potential positive health impacts relate to improved access to employment, new housing and access to transport, which in turn could increase access to education, services and facilities. People most vulnerable to health impacts (including people living in socio-economically deprived areas, older people and young people) would experience both positive and negative impacts.

Potential equality impacts

- 5.8.2. The equality analysis has identified where relevant groups of people with protected characteristics or PPCs (as defined by the Equalities Act 2010) are likely to occur in relatively high numbers along the route. The analysis identifies the potential for impacts of the proposed scheme to affect these PPC groups more than they would affect the local population generally.
- 5.8.3. Beneficial impacts are likely to occur around the Manchester Piccadilly Station catchment. This catchment area is home to relatively large proportions of PPC groups including Black, Asian and minority ethnic groups, faith groups and young people (16-24). These groups are likely to experience a greater benefit from net increases in local jobs and the increased availability of affordable housing that would be supported by the proposed scheme, provided they are able to access them (see Section 5.3).
- 5.8.4. In the immediate vicinity of this station, potential adverse impacts on PPCs may occur due to the demolition of housing and commercial, retail and industrial property. The immediate vicinity of the station is home to relatively high populations of people from Black, Asian and minority ethnic groups (many of whom are jobseekers), faith groups and young people (16-24). Access to affordable housing (including for larger families) and access to specialised retail outlets are likely to be some of the key concerns of PPC groups found in the immediate locality. The demolition of a group of approximately 50 dwellings on Chapeltown Street to facilitate station construction could lead to dispersion of this community and potentially bring particular adverse health and well-being impacts. HS2 Ltd would be committed to working closely and at an early stage with the local authority 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 the demolition of these dwellings, and to help to address wider impacts on the local community.
- 5.8.5. Access to jobs is also a key concern for Black, Asian and minority ethnic groups, and while some displaced jobs currently held by people in these groups are likely

to be replaced by the new employment opportunities, this may not be the case for all. The immediate area around the new station at Manchester Airport is also home to Black, Asian and ethnic minority groups and faith groups who may be subject to similar adverse effects from demolition of homes and businesses in that area.

- 5.8.6. Commercial demolitions on the Taylor Industrial Estate south of Culcheth have the potential to adversely and differentially affect the relatively high numbers of Muslim, mixed race and Black people, who live in the area, both as a result of job losses and through possible loss of specialist stores, although again, this is yet to be determined.

5.9. Landscape and visual impacts

Staffordshire

- 5.9.1. North-east of Handsacre, the route would run on a long viaduct over the River Trent, affecting the landscape character of the valley and causing visual impacts at Pipe Ridware and on the Way for the Millennium long distance path. Continuing north-west, embanked sections near Pipe Ridware and Moreton would have local impacts on landscape character. In particular, the embankment past Stockwell Heath and the associated loss of ancient hedgerows and trees would have a locally major landscape impact, as well as causing visual impacts on parts of Stockwell Heath and the Staffordshire Way. The detailed design of this section, and the proposed landscaping measures would seek to address these potential impacts as far as possible.

Aerial view west with Whitmore Heath in the foreground and Whitmore Wood beyond



- 5.9.2. At Great Haywood, a viaduct and embankments across the Trent Valley would introduce new elements in the landscape, affecting its character and resulting in visual impacts on the River Trent and Trent and Mersey Canal, and particularly at

the Great Haywood Marina. Further north and west, an embankment would pass through the hamlet of Marston affecting its character and setting and causing visual impacts. However, between Great Haywood and Marston, the route past Stafford and Hopton would be largely in cutting and impacts would be limited.

- 5.9.3. The route would pass in deep cutting through the flanks of Peasley Bank and Pire Hill south of Stone and north of Swynnerton, disrupting this section of countryside. The viaduct over the M6 and the impact on woodlands that edge the historic parkland at Swynnerton, would affect the wider landscape setting of the Conservation Area around 500m to the west of the route.
- 5.9.4. The route would continue through the undulating and wooded landscape between Swynnerton and Madeley. Potential impacts have generally been reduced through this section as a result of the various refinements that have taken place to the route. However, the scheme would still result in major impacts on the local area through fragmentation of the valley landscape, and direct impacts on Ancient Woodland, especially Whitmore Wood near Whitmore Heath. Visual impacts would affect parts of Shelton under Harley and Whitmore.
- 5.9.5. North of Madeley the route would pass across the floodplain of Checkley Brook, fragmenting and intruding into attractive landscapes west of the WCML.

Crewe and the Cheshire Plain

- 5.9.6. Approaching Crewe, new embankment and viaduct structures would have local impacts within this open farmland landscape, as well as causing visual impacts for dwellings near to the route. Changes to an earlier option, including routing it on the west side of the existing WCML, have helped to reduce potential impacts on Chorlton. The proposed Crewe Depot was located to a site adjacent to existing sidings in an area already affected by development. There would be some cumulative landscape and visual impact from the depot and the route south to Hough, but as the route would be closely aligned with the WCML, impacts would be generally slight.
- 5.9.7. Where HS2 would run alongside the WCML for several kilometres north of Crewe, impacts would be slight. Having diverged from the WCML, the route would introduce new landscape elements amidst the historic field patterns, fragment the narrow belt of open countryside between Winsford and Middlewich and directly impact Winnington Wood and Leonard's Wood, two ancient valley-side woodlands in the Lostock Gralam area. Visual impacts along this section would affect the Shropshire Union Canal, the Trent and Mersey Canal (also a Conservation Area) and the North Cheshire Way, as well as parts of the villages of Wimboldsley and Lostock Green.
- 5.9.8. The bridge over the M6 and the embankment further north would affect landscape character, as well as causing visual impacts at the Heyrose Golf Club, the village of Winterbottom and scattered dwellings close to the route. Extensive cutting would help limit impacts further north, although embanked sections at either end of this cutting would cause local impacts, including visual impacts on the western edge of Hoo Green, which would be exacerbated by impacts from the spur which diverges at this point (see below).

Mersey Valley and the Manchester Mosslands

- 5.9.9. Embanked sections around Agden Bridge and the viaduct across the River Bollin would give rise to landscape impacts, and to visual impacts on the Bridgewater Canal, the Cheshire Ring Canal Walk and the Trans Pennine Trail. However, between Agden Bridge and Warburton the route would be generally in cutting so helping to limit potential visual impacts.
- 5.9.10. The viaduct across the Manchester Ship Canal would be around 30m in height and located in a landscape with an open exposed character. The impact of the viaducts and embankments would therefore be major, affecting landscape character over a wide area. However, the structures would not represent wholly new landscape elements, as there are already several high road and rail crossings over the Manchester Ship Canal between Warrington and Irlam. The new crossing would be reasonably well separated from the closest existing crossing (the historic toll bridge at Warburton, around 800m to the south-west) and it is possible that an iconic new viaduct design could provide a feature of interest, although the impact of the approaches on this open landscape would remain. Visual impacts would affect residents at Hollins Green, Partington, Cadishead and Glazebrook, as well as canal users.

Aerial of the proposed Golborne Depot site looking north-westwards



- 5.9.11. Continuing north-west, the route would be carefully routed through the mossland landscape and would be largely in cutting, particularly past Culcheth, and towards Lowton, where impacts would be slight. North of Lowton it would pass through an old agricultural landscape, fragmenting the field patterns to some degree. Approaching the WCML, embankments would intrude on the low-lying landscape of the Leeds and Liverpool Canal corridor, potentially isolating the canal from open countryside north of Golborne and causing visual impacts for canal users. The proposed depot would additionally cause fragmentation of the countryside

between Golborne and Abram affecting views from Pennington Flash Country Park. The route and depot would cumulatively result in major impacts on the landscape and views across it.

Spur into Manchester

- 5.9.12. The impacts at Hoo Green where the spur into Manchester splits from the main route have been partly described above. The spur would pass under the distinctive winding country lanes north of Hulseheath, but would still affect the historic field patterns, hedgerows and hedgerow trees. Locally, north of Rostherne Mere, these impacts would affect the landscape setting of the mere, which is already influenced by the M6 to the north.
- 5.9.13. The proposed embankment east of Rostherne would enclose a strip of landscape with the M56, cause loss of some woodland and farm buildings and affect field patterns. These impacts would affect views from the southern edge of Ashley to Tatton Park, although views from Tatton Park parkland would be largely screened by the mixed plantings around the edge of the park.
- 5.9.14. Approaching the urban fringe of Manchester, the proposed route and high speed station would be closely associated with the motorway and existing airport structures. Impacts on greenfield land, woodland along Timperley Brook and buildings north of Hale Barns would result in local landscape impacts, as well as visual impacts on the northern edge of Hale Barns.
- 5.9.15. Impacts would generally be avoided as the route passes through tunnel under Wythenshawe, Northenden, Withington, Rusholme and Longsight. However, there could be visual impacts from the [four proposed ventilation shaft](#) site compounds and head house buildings, although locations for these are indicative only at this stage.
- 5.9.16. Piccadilly Station would have little adverse impact. It would create new connections through the site, and the inclusion of extra land within the operational site boundary north and south of the station approach could offer opportunities for high quality urban design, landscaping and public realm. Some views to the existing historic station structure would be adversely affected (see Section 5.10).

5.10. Cultural heritage

- 5.10.1. Overall the western leg has been selected and aligned so that it would have few impacts on known designated heritage assets. It would avoid physical impacts on all of the most significant designated features, including Scheduled Monuments, Registered Battlefields and Grade I and II* Listed structures, and only one Grade II* Listed building (Lightshaw Hall at Golborne, see below) would have anything more than a minor impact on its setting. In addition, the route has been aligned so that it avoids direct physical impacts on Registered Parks and Gardens, and impacts on their settings would also be largely avoided. The AoS has concluded that the majority of potential impacts would be negligible or minor at most. Unless stated otherwise, only those of potentially greater magnitude than this are described below.
- 5.10.2. The route would twice cross the Trent and Mersey Canal, once to the north of Great Haywood and again at Bostock Green, north-east of Winsford. The 19th century canal is designated a Conservation Area for its whole length, and the HS2 crossings would have a cumulative impact on its setting, as well as resulting in local adverse impacts at both of these locations.

- 5.10.3. The Registered Battlefield of Hopton Heath (1643) north-east of Stafford would be avoided and the route would be comprehensively screened from this important site; therefore no impacts would result.
- 5.10.4. North of Crewe, the route would pass some 200m east of the Scheduled medieval moated site at Minshull Vernon, separated from it by the WCML. This medieval double moat comprises a range of shallow earthworks preserved under pasture in a landscape of enclosed fields. The proposed route would be in shallow cutting and would be at least partly screened from the monument. However, within the generally open farmland, some impacts on its setting would be expected.
- 5.10.5. Passing west of Hoo Green, where the spur diverges eastwards, the setting of the Grade II Listed Ovenback Cottage near High Legh would be adversely affected. Further north, as the main route passes south of Culcheth, the Grade II Listed Newchurch Old Refectory (the Old Rectory) would be demolished. This is a red brick house dating from 1812 that is now isolated from the church and village of Culcheth (Newchurch).

Grade II* Listed Lightshaw Hall at Golborne



- 5.10.6. The Grade II* Listed Lightshaw Hall, a 16th century moated and timber framed farmhouse, much rebuilt in brick, would sit within the footprint of the Golborne Depot. The scheme has been designed to avoid direct impacts, but the building's setting would be greatly changed. The setting of the nearby Grade II Listed Byrom Hall of 1713 would be affected by the adjacent route.
- 5.10.7. The Manchester spur would result in few notable heritage impacts. There would be no impacts on the important Registered Parks and Gardens at Dunham Massey and Tatton Park, aside from possibly minor impacts on the setting of the latter on its northern edge. Approaching the proposed Manchester Airport High Speed Station, the route would require the demolition of the Grade II Listed Buckhall at Hale Barns. This is a mid-18th century brick farmhouse, although it now provides

office space for a modern hotel that has come to surround it, and its setting is greatly diminished.

- 5.10.8. At Manchester Piccadilly, the new HS2 station would result in internal alterations to the Grade II Listed Victorian train shed, with associated impacts on the character and setting of the station façade. The terminus would also affect the character of four Conservation Areas. However, only impacts on the Whitworth Street Conservation Area would be more than minor, with the proposed train crew building obscuring the views of the historic public façade of the existing station from the Conservation Area.

5.11. Biodiversity and wildlife

Internationally designated sites

- 5.11.1. Pasturefields Salt Marsh is a Special Area of Conservation (SAC) north-west of Rugeley, which forms the only significant remaining example in the UK of a natural salt spring with inland saltmarsh vegetation. HS2 Ltd has undertaken substantial work analysing the risks presented to this site, in conjunction with Natural England and the Environment Agency²⁸. As a result, the proposed scheme was selected on the basis of it having no adverse impact on the marsh's conservation status.
- 5.11.2. Much of the ecological interest of the area potentially affected by the western leg is associated with the meres and mosses of the Cheshire and Staffordshire plains. A number of water-bodies have been formed within depressions left by glaciation, resulting in a number of shallow meres and mosses.
- 5.11.3. One group of meres and mosses within the Cheshire Plain is collectively designated the Midland Meres and Mosses Ramsar site. The route would pass near two components of this – Betley Mere south of Crewe and the Mere, west of Knutsford, both of which are also SSSIs. Betley Mere would lie east of the route and would be too distant to experience impacts. The Mere, also east of the route, would be unaffected by the scheme, given the design measures agreed with the Environment Agency and Natural England to ensure groundwaters feeding the mere are maintained²⁹.
- 5.11.4. Rostherne Mere immediately north of the Mere is separately designated a Ramsar site, as well as a NNR and SSSI. The scheme would pass to the west of this site, and the spur to Manchester would pass to its north. Neither section would affect Rostherne Mere's international status, again given the design measures agreed with the Environment Agency and Natural England to ensure groundwaters feeding the mere are not affected³⁰.

²⁸ HS2 Phase 2: HRA Screening Report for Pasturefields Salt Marsh SAC

²⁹ HS2 Phase 2: HRA Screening Report for Midland Meres and Mosses Ramsar site

³⁰ HS2 Phase 2: HRA Screening Report for Rostherne Mere Ramsar site

Aerial view of Rostherne Mere looking northwards towards Manchester



Nationally designated sites

- 5.11.5. No nationally protected sites would be directly affected by landtake along the western leg. Between Hough and Pickmere, the route would be within 2km of Sandbach Flashes, Wimboldsley Wood, Plumley Lime Beds and Tabley Mere SSSIs. There is potential for the proposed scheme to affect surface water flows to all of these sites, although impacts are unlikely as the route affects only a small proportion of the catchment or is situated downstream of the sites. Any potential impacts are likely to be mitigated through scheme design.
- 5.11.6. The route would pass south of Abram Flashes SSSI and may give rise to impacts on surface water flows and quality, disturbance of birds (mainly during construction), and air borne pollution both during construction and operation of the Golborne Depot. It is likely that all potential impacts would be substantially mitigated through design and implementation of the CoCP, as well as through sensitive planting to buffer the SSSI.

Other important habitats

- 5.11.7. The scheme would have direct impacts on an estimated 19 Habitats of Principal Importance. It would affect eight woodland habitats, including five Ancient Woodlands, namely Whitmore Wood (near Whitmore), Leonards and Smokers Wood and Winnington Wood (near Lostock Gralam), Coroners Wood (near Partington) and Hancock Bank (north of Rostherne).
- 5.11.8. Seven areas of coastal floodplain and grazing marsh would be affected, mostly along the southern sections of the proposed scheme. Single areas of lowland meadow and purple moor grass habitat and rush pasture habitat would also be directly affected, as would two areas of traditional orchard.

- 5.11.9. Based on publicly available information, one county Wildlife Trust reserve – a small site called Sean Hawkins Meadow - could be directly affected by the route, although its exact location and extent is not known at present. No Local Nature Reserves would be affected by the route.

Natural areas and opportunities for biodiversity

- 5.11.10. The proposed route would cross four Natural Areas on the western leg, namely: Needwood and South Derbyshire Claylands; Meres and Mosses; Urban Mersey Basin; and a small part of the Midlands Plateau.
- 5.11.11. There would be a cumulative impact from the loss of woodland within the Meres and Mosses Natural Area, as these habitats are not well represented within the region. The loss of lowland meadow, purple moor grass rush pasture and fens in the Needwood and South Derbyshire Claylands would also be notable, as these habitats are of limited distribution but a key habitat within the Natural Area.
- 5.11.12. As stated in Section 4.13, a package of mitigation and enhancement measures will be considered as part of the EIA, which would seek to address both the direct impacts on designated sites, and to reflect the wider strategic ecological priorities of affected areas. They could be coupled with initiatives on ecosystem services, which could be introduced in the future.

5.12. Water resources and flood risk

Watercourse diversions

- 5.12.1. Close working between the scheme engineers and AoS water specialists has been successful in avoiding the need for permanent watercourse diversions along most of the route. However, the need for permanent diversions to one medium watercourse (Wincham Brook, discussed below) and 11 minor rivers are still envisaged at this stage³¹.
- 5.12.2. As the proposed route passes Northwich, in the area of Higher Wincham and Pickmere, the line would pass along the valley of the Wincham Brook, which the AoS determines to be a medium watercourse at this location, with a catchment of approximately 6km². The brook, which is a tributary of the River Weaver, would be crossed at three locations, two of which may require some realignment of the river channel.

Flood risk

- 5.12.3. The proposed route would cross floodplains at a number of locations. Generally, these crossings would be on viaduct or clear-span bridge to minimise the potential loss of flood storage and obstruction to flood flows. However, other solutions may be agreed in due course (see Section 4.14.7). The floodplains of various watercourses are crossed 21 times for more than 100m. A series of viaducts are currently proposed at these locations, as detailed in the table below.

³¹ The definition of major, medium and minor watercourses is given in Section 4.14

Table 5-2 – Western leg floodplain crossings over 100m

| Watercourse name | Viaduct name | Length (m) |
|-----------------------|-------------------------------|------------|
| Bourne Brook | Bourne Brook Viaduct | 730 |
| River Trent* | River Trent Viaduct | 1,900 |
| Luth Burn | | |
| River Trent* | Trent and Mersey Viaduct | 570 |
| Meece Brook | Meece Brook Viaduct | 270 |
| River Lea* | River Lea Viaduct | 440 |
| River Lea* | Checkley Brook Viaduct | 120 |
| Checkley Brook | | |
| River Dane* | River Dane Viaduct | 745 |
| Puddinglake Brook* | Puddinglake Brook Viaduct | 120 |
| Gad Brook | Gad Brook Viaduct | 150 |
| Wade Brook* | Wade Brook Viaduct | 188 |
| Peover Eye* | Peover Eye Viaduct | 250 |
| Wincham Brook* | Smoker Brook Viaduct South | |
| Wincham Brook | Smoker Brook Viaduct North | 440 |
| River Bollin* | River Bollin Viaduct West | 345 |
| Warburton Park Brook* | Warburton Viaduct | 180 |
| Manchester Ship Canal | Manchester Ship Canal Viaduct | 1,200 |
| Blackburn's Brook* | Blackburn's Brook Viaduct | 210 |
| Birkin Brook* | Birkin Brook Viaduct | |
| Corn Brook | West Gorton Cutting | 562 |

* Classified by the Environment Agency as a Main River

- 5.12.4. There is a risk of flooding at Manchester Piccadilly, where the station footprint would overlie the canalised River Medlock, and at Crewe Depot, where the operational site boundary would lie alongside the Gresty Brook and over a number of small watercourses. Golborne Depot would lie over three very small watercourses; other potential impacts may arise from road diversions, but these have not been appraised at this stage. In all cases, the detailed design would reflect the findings of later hydraulic modelling and make allowances for flood compensation.
- 5.12.5. HS2 Ltd will continue to work closely with the Environment Agency and other relevant parties to establish the most practical and effective solution for each crossing of the floodplain. Of the more significant crossings listed above, the crossing of the underground or 'lost' Corn Brook at West Gorton would require flood defences to protect the railway and other measures to ensure risk of flooding is not increased.
- 5.12.6. In total, the western leg would incorporate a total of 121 separate watercourse and canal crossings. Each of these will require more detailed study in due course where, for example, no flood mapping currently exists. Where appropriate, designs will be undertaken in close liaison with water specialists to identify satisfactory solutions that would meet the requirements of relevant bodies

including the Environment Agency, and that would comply with objectives of the Water Framework Directive (WFD). The EIA will also include WFD assessments of all surface water bodies that are crossed by the scheme.

- 5.12.7. The EIA will also assess the potential impacts from groundwater flooding, which have not been addressed at this stage.

Groundwater

- 5.12.8. There are four locations where the proposed route would pass through areas of sensitive groundwater, potentially affecting abstraction boreholes used to supplement public potable water supply. It is currently expected that impacts to all but one of these - Whitmore abstraction - would be avoided. These are described in more detail below.
- 5.12.9. The proposed route would cross SPZ2 associated with three Swynnerton abstraction boreholes in cutting and embankment. The cutting would be within the clay drift deposits and entirely above the water table. Consequently, notwithstanding any impacts during construction and the protrusion of any deep foundations, it is unlikely that the proposed route would adversely affect the groundwater abstraction at the boreholes.
- 5.12.10. South of Whitmore the proposed route would pass at or above ground level through both SPZ1 and SPZ2 (using a mixture of embankment, at grade and viaduct). As a result it would have no impact on the groundwater flow regime. However, the route would pass directly over the Whitmore abstraction point, possibly necessitating (subject to discussions with stakeholders) the provision of a new borehole at a suitable location nearby so as to maintain the currently supply.
- 5.12.11. At Lowton, east of Golborne, the route would pass in cutting through SPZ2. This is likely to be entirely within the clay drift deposits and above the water table. At this stage it therefore appears unlikely that the proposed route would adversely affect the nearby Pocket Nook 1 abstraction.
- 5.12.12. A little way north-west of this, the route would pass in shallow cutting through both SPZ1 and SPZ2. Again, the cutting is likely to be entirely within the clay drift deposits and above the water table, so no adverse impacts on the nearby Slag Lane abstraction are currently anticipated.
- 5.12.13. In addition to potable groundwater supplies, other notable licensed groundwater abstractions, generally for commercial or agricultural use, have been considered within a nominal 500m of the proposed route. There are three such abstractions falling into these categories, namely: two boreholes at Common Lane Farm, Kings Bromley (near Handsacre), and a borehole at Origin Development in Manchester city centre.
- 5.12.14. The AoS indicates that all three of these non-potable abstractions are unlikely to be significantly affected as a result of proposed scheme. This is based on the fact that the abstraction boreholes would not appear to be directly impacted by construction activities and that best-practice construction techniques would be employed to protect the groundwater resources from pollution.
- 5.12.15. For all of these abstraction locations, and for other groundwater bodies a requirement of the WFD will be to prove that there is no adverse impact particularly on the yields and quality of groundwater, which supports these abstractions and groundwater-dependent habitats; groundwater risk assessments will be required as a minimum supported by an appropriate ground investigation and consultation with the Environment Agency.

5.13. Land use resources

Agricultural landtake

- 5.13.1. The AoS process has sought to limit the loss of the highest quality agricultural land. High level agricultural land classification maps show that Grade 1 classified agricultural land is limited to the rich peat of Chat Moss between Manchester and Liverpool. Some 900m of land shown as Grade 1 classified would be crossed by the main route in the vicinity of Holcroft Moss. In addition, an estimated 19.8km of the route would be through land classified as Grade 2, notably along the Basford Brook south of Crewe and in the Mersey Valley around Lymm and Warrington. The depot south of Crewe is shown to occupy approximately 4.6ha of land shown classified as Grade 2, although much of the site comprises existing rail sidings.

Green belt

- 5.13.2. The main areas of green belt crossed by the route would occur west of Newcastle-under-Lyme and along much of the route north of Northwich, both along the main route and along the spur into Manchester. The Golborne Depot would occupy an estimated 25.8ha of green belt and Manchester Airport High Speed Station would occupy some 4.8ha of green belt.

Aerial view looking south towards the proposed Crewe Depot site alongside existing rail sidings



Landfill sites

- 5.13.3. The AoS identified two active (operational) landfill sites and 19 disused (non-operational) landfill sites within 250m of the proposed route. Higher risks were identified for both of the active sites and four of the disused sites, based on the type and length of crossing, the size of the landfill and its recorded contents.
- 5.13.4. The active sites are both permitted for hazardous/industrial waste. The Bostock landfill north-east of Winsford would be crossed in cutting for about 500m. The Risley IV landfill south of Culcheth would be crossed at grade and on embankment for about 140m.
- 5.13.5. The four disused landfills, each designated for non-hazardous waste, comprise:
- Stafford County Showground tip at Beacon Hill, north-east of Stafford, crossed by cutting for about 100m;
 - a former British Railways tip at Tommys Lane, Crewe, crossed by bored tunnel for about 120m;
 - Hollins Green tip east of Warrington, crossed by viaduct for about 230m; and
 - Lowton Sidings east of Golborne, crossed by cutting for about 365m.

Mineral sites

- 5.13.6. The AoS has identified two registered minerals sites that are reported as active and that would be crossed by the western leg. Hurstwood Pit is a small pit located to the east of Colton; its use is not known. However, aerial photos indicate that it is not currently used as it appears to be re-vegetated. Cash's Pit, north of Swynnerton would also be directly affected. Similarly, this small pit appears to be fairly mature woodland. At this stage, the AoS concludes that the western leg would not sterilise any designated mineral reserves.

5.14. Excavated materials and material resource

- 5.14.1. The current estimate for excavated material arising on the western leg is 16.65 million cubic metres, of which about 3.92 million cubic metres would be from tunnel excavation. However, these estimates do not take account of the materials likely to be incorporated within the scheme for the creation of landscaping and bunding as part of any mitigation proposals. As a result of the crossings of landfill sites (see above), it is possible that some of the waste material arising would be hazardous. The design of the route through these areas would need to ensure that potential impacts from possibly contaminated materials are fully mitigated, and that any wastes are handled in accordance with legal requirements and requirements of the CoCP.
- 5.14.2. The estimated quantities of bulk building material required for construction of the proposed scheme would comprise 323,100 tonnes of steel and 3,106,900 tonnes of concrete.

6. Eastern leg: sustainability issues

6.1. Introduction

- 6.1.1. This section describes the main potential sustainability impacts, both beneficial and adverse, that would result along the eastern leg of the Phase Two proposals; they are generally described in a south to north direction. The section should be read in conjunction with Section 4, which provides the AoS scope for each topic and gives an overview of the appraisal method. Plans showing the features and locations referenced here are provided in Volume 2.
- 6.1.2. The potential impacts that are set out here are predicted to result from the proposed route in its current stage of design and on the basis of the current baseline environment. Some of these impacts could change in detail as further refinements are made, and as additional mitigation is introduced. Only the main impacts³² are described here. Potentially lesser impacts are not recorded in this document, although they are listed in the technical appendices that are available separately.
- 6.1.3. Associated works, such as road re-alignments and utilities diversions (Section 2.7), which have not been agreed at this stage, may also result in impacts. In addition, no construction planning has been undertaken at this stage. All of these additional works will be assessed by the EIA.

6.2. Planning and development

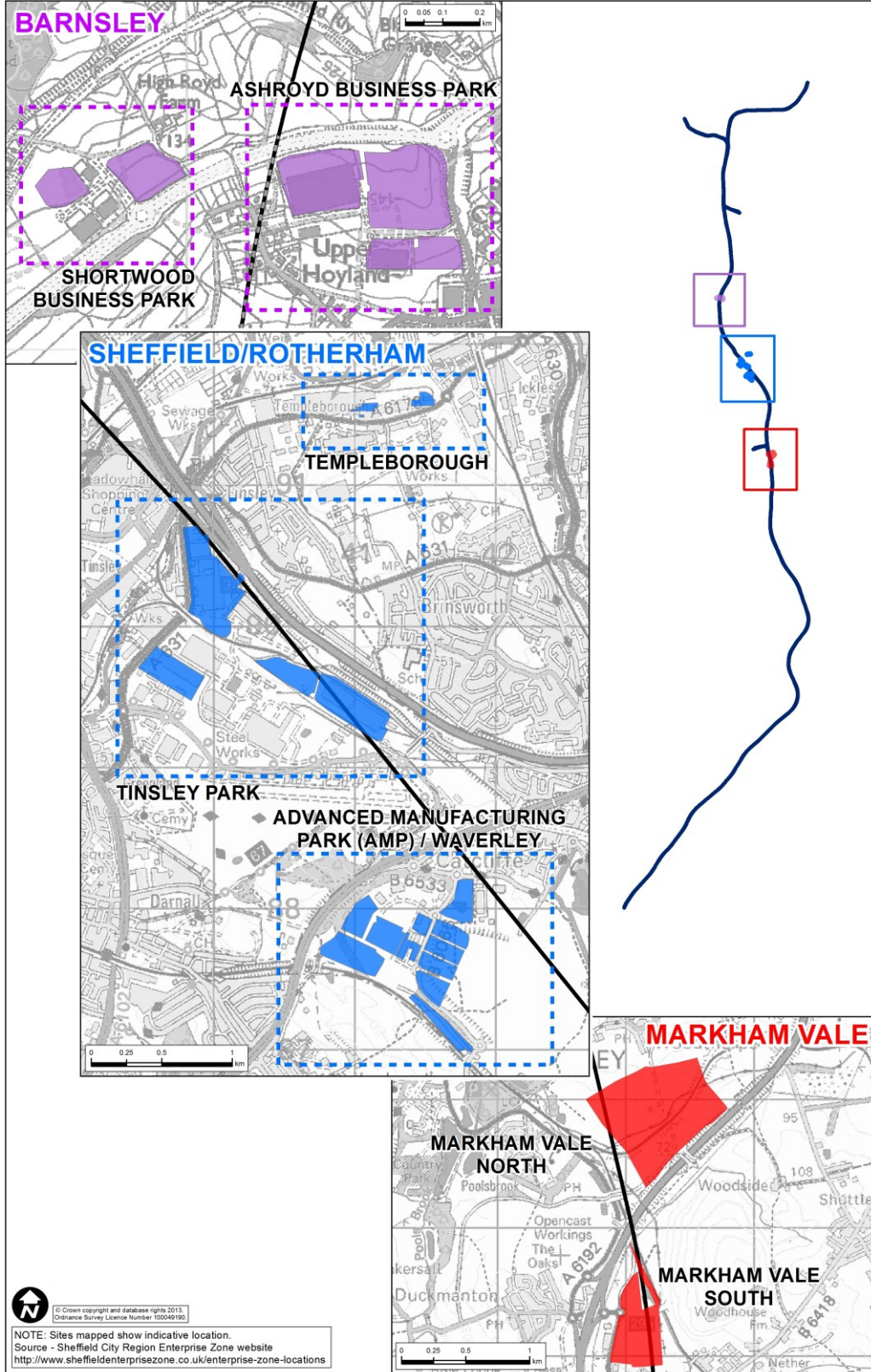
- 6.2.1. A review of major development proposals along the eastern leg identified a number of strategic sites that would potentially be affected by the proposed scheme.
- 6.2.2. The route would pass through the northern edge Measham Wharf Development, a site in Measham where an outline application for up to 450 residential dwellings on 19ha is currently being considered by North West Leicestershire District Council.
- 6.2.3. The initial preferred scheme (reported in January 2013) has been modified so that potential impacts on the [East Midlands Gateway](#), a proposed strategic rail freight interchange adjacent to East Midlands Airport, are avoided.
- 6.2.4. Immediately east of the East Midlands Hub Station, outline planning permission is sought for Lime Rise consisting of 775 dwellings on 42ha of land. The station would lie next to, but would not inhibit the development of this site. The application is being considered by Broxtowe Borough Council. The site is designated green belt, but following the announcement of the HS2 East Midlands Hub Station, there are plans to release it as a strategic location for growth³³.
- 6.2.5. Further north there are two proposed developments located just south of Junction 26 of the M1. East of the M1, outline consent is sought for a large site named Temple Park, which contains up to 555 dwellings, extra care retirement village and neighbourhood centre. The application was submitted in May 2013. The route would pass through the centre of this site.

³² Main impacts are similar to the 'significant' effects that would be described within an Environmental Statement, in line with the EIA Regulations. The AoS has avoided defining 'significance', given the preliminary nature of the appraisal and the information upon which it relies.

³³ Greater Nottingham Aligned Core Strategies Proposed Changes February 2013

6.2.6. Immediately west of Temple Park, outline consent is sought for a mixed use recreational facility. The route would not pass through this site, but located alongside Temple Park, it emphasises the growth that is planned in the area. This application is currently being considered by Broxtowe Borough Council.

Figure 6-1 - Sheffield Enterprise Zones



- 6.2.7. Heading north past Pinxton and towards the A38, the route would pass through the centre of a large site named Castlewood Grange, which has permission for the development of employment uses and local policy employment land allocations. Reserved matters have been granted for one part of this phased development, which is located around the existing East Midlands retail outlet centre.
- 6.2.8. The route would pass through and near a number of planned growth sites that form part of the Sheffield Enterprise Zone at Markham Vale, Sheffield/Rotherham and Barnsley (see plan on previous page).
- 6.2.9. The depot site north-west of Staveley is designated for industrial and business use; Chesterfield Borough Council is preparing the Staveley and Rother Valley Corridor Area Action Plan.
- 6.2.10. Waverley New Community, between Sheffield and Rotherham, is currently under construction: the eastern part would be crossed by the route. This site includes some 4,000 residential units, commercial development, finance and professional services, leisure and community uses. Work on these has now commenced. The masterplan for the site also includes the Waverley Advanced Manufacturing site which is already complete and would be avoided.
- 6.2.11. There are a number of policy allocations and planning consents on the approach to Sheffield Meadowhall Station: these include business and employment uses and the Meadowhall Quadrant masterplan. The HS2 station at Meadowhall would support the designation of the Sheffield Enterprise Zone, and the development of the area as a location for offices, with the potential to meet some longer term housing needs (Sheffield City Council Core Strategy 2009), the regeneration of the Lower Don Valley and growth of the wider city region (Sheffield Local Plan, City Policies and Sites, 2013). The potential implications for employment are described under Section 6.3.

Aerial view of the Meadowhall area looking south along the M1



- 6.2.12. The Welbeck landfill west of Normanton, which is currently the largest landfill facility within Wakefield District, would be crossed by the route. This site is currently identified under the waste development plan document for additional landfill capacity and for the development of new commercial and industrial waste recovery facilities and modernised household waste recycling facilities. In February 2013, planning permission was approved to allow waste disposal operations to continue for a period of three years.
- 6.2.13. Just north of this, the route would pass through the eastern edge of an approved mixed used development site, which includes Wakefield Trinity Wildcat Stadium and business units.
- 6.2.14. The route to the ECML connection would pass through North Newhold, a proposed employment park north of Garforth. Outline consent is sought for the development of approximately 95,000m² of non-residential floorspace and is currently under consideration by Leeds City Council.
- 6.2.15. The approach to the Leeds terminus would pass through Character Area 8 of the Aire Valley Action Plan known as the Stourton Corridor. The proposed alignment would follow an existing rail corridor but would require widening through an area with a number of policy allocations, including mixed employment, general industry and warehousing.
- 6.2.16. The Leeds terminus adjoins Holbeck Urban Village, Leeds South Bank area and the wider Aire Valley. It therefore has potential to aid regeneration and the delivery of jobs and housing. HS2 Ltd would work with the local authority and other stakeholders to realise opportunities that exist to the north and south of this site.

6.3. Employment and housing

East Midlands Hub

- 6.3.1. At the East Midlands Hub, HS2 could increase net commercial floorspace by up to 19,000m², which could support between 1,500 and 1,600 jobs. Residential floorspace is estimated to increase by at least 9,000m², and potentially up to 47,000m², equating to between 150 and 800 homes.
- 6.3.2. Potential demolitions of industrial and commercial properties could displace businesses currently providing an estimated 600 jobs³⁴. Although these displaced jobs are accommodated in the net figure for jobs supported, it is considered likely that they would be taken up in the local area.
- 6.3.3. The jobs and houses that would be supported by HS2 at the East Midlands Hub would be more limited than at the other more centrally located urban stations on the Phase Two network. There is an outline planning application for housing to the east of the station (see Section 6.2.4). Local public transport connections are currently relatively few, although they would be greatly enhanced in the future, both by the integration of classic services at the new station and by the planned extension of the Nottingham tram system (NET) for which funding has been approved (see Section 6.5).
- 6.3.4. Available development sites are limited on what is a large block of greenfield (and green belt land), within a generally residential area. The principal development site within a 2km catchment is between Toton and Stapleford, located in the green belt between the proposed HS2 station and the tram station. The site is

³⁴ Jobs were calculated using strategic level land classification suitable for this level of appraisal. This figure may be over-estimated at this location.

designated green belt and, as such, is currently unlikely to come forward. However, following the announcement of the HS2 East Midlands Hub Station, there are plans to release it as a strategic location for growth (see Section 6.2.4). If accepted, this would bring the site forward for strategic growth.

Sheffield Meadowhall

- 6.3.5. HS2 could increase net commercial floorspace by between 77,000m² and 106,000m², which could support between 4,000 and 5,400 jobs. Residential floorspace is estimated to increase by at least 15,000m², and potentially up to 20,000m², equating to between 250 and 300 homes.
- 6.3.6. The estimated employment figure takes account of the potential local job losses from the demolition of commercial properties, which could displace businesses providing an estimated 800 jobs. However, it is likely that the majority of these jobs would be accommodated in the region.
- 6.3.7. Meadowhall has excellent strategic access via motorways and highways, which provides an attractive feature for businesses. There are numerous available development sites associated with (amongst others) the Sheffield Enterprise Zone, whose occupation could be accelerated as a result of HS2. No sites around Meadowhall are currently zoned for development, although the Sheffield Enterprise Zone and area of Enhanced Capital Allowance have been allocated. Local planning policy seeks to promote various development uses including offices, residential and large-scale leisure (but not additional retail). However, many potential development sites are constrained by poor local accessibility, particularly by public transport, and by physical disconnection; together this would counteract the otherwise supportive influence of HS2.
- 6.3.8. As well as increasing available jobs, development supported by HS2 would help generate change in the types of jobs available, from predominantly industrial blue-collar jobs at a low employment density, to office-based white-collar jobs at a higher employment density, with less dependency on employment in the manufacturing and distribution sectors. This could benefit the local area, which exhibits a high level of unemployment and relatively high deprivation, although this would require some shift from the kind of employment that is characteristic of the area currently.

Leeds New Lane

- 6.3.9. The overall net additional commercial floorspace brought about by HS2 is estimated to be between 255,000m² and 385,000 m², which could support between 13,200 and 19,700 jobs. Residential floorspace is likely to increase by at least 100,000m² and potentially up to 141,000m², equating to between 1,700 and 2,400 homes.
- 6.3.10. The estimated employment figure takes account of the potential local job losses from the demolition of commercial properties, which could displace businesses currently providing an estimated 1,500 jobs. However, it is likely that the majority of these jobs would be accommodated in the region.
- 6.3.11. Leeds city centre is likely to support a large amount of additional development as a result of HS2. It has excellent local transport links including good rail connections throughout the region. There are also numerous sites of vacant and underused brownfield land within the station's catchment area that are available for development; for example, areas to the south of the river (the South Bank), to the east of Marsh Lane and along the Wellington Street and Whitehall Road corridors to the west. Local planning policy seeks to promote such areas for comprehensive

redevelopment and re-use as major retail, leisure, hotel, culture and office developments. The current mix of land use reflects the kind of development likely to be supported by HS2, with high rise buildings a key element.

- 6.3.12. The HS2 station would serve most of Leeds's central area, which is characterised by a high level of deprivation, but also high levels of qualification and professional occupations. Many workers in the city come from the local area, so the employment supported by HS2 would offer substantial benefits for the local population.

6.4. Property and community integrity

- 6.4.1. The eastern leg could result in the demolition of an estimated 139 dwellings. These would be largely limited to single properties or small groups (less than five) at various locations along the route. Demolitions at the station locations would include:
- East Midlands Hub, a total of seven residential demolitions of which six are located south-west of Toton.
 - Sheffield Meadowhall, an estimated 60 demolitions comprising a cluster of 49 at South Tinsley and eleven at Wincobank.
 - No residential demolitions would be required for the Leeds New Lane Station.
- 6.4.2. Other locations where groups of five or more residential demolitions are anticipated include: Whateley (six demolitions), Long Eaton (six demolitions), Nuthall (five demolitions), Langton Hall (seven demolitions) and Renishaw (nine demolitions).
- 6.4.3. The route could result in isolation of an estimated 234 residential properties number of locations, most notably: Whateley (also affected by severance), Worthington, Red Hill, West Killamarsh, Swaithe, Methley Lanes and Church Fenton.
- 6.4.4. The route would also require the demolition of three community facilities (including a bingo hall near Leeds New Lane Station). It would require the demolition of an estimated 128 commercial properties, largely at the station locations but also at Measham, Long Eaton and north of Strelley. An estimated nine industrial properties would be demolished.
- 6.4.5. No appraisal of temporary construction impacts has been undertaken at this stage. However, as an indication of the number of people at greater risk from construction impacts, there would be approximately 3,300 dwellings within 100m of the surface route and the provisional station and depot construction boundaries.

6.5. Access issues

East Midlands Hub

- 6.5.1. There are currently no rail stations in the immediate vicinity of the East Midlands Hub, but the new HS2 station would integrate platforms for classic services allowing direct connections with the existing rail network and potentially allowing direct shuttle services from Nottingham and Derby (with journey times of 12 minutes and 15 minutes respectively) and wider connections with Leicester and other stations in the East Midlands.
- 6.5.2. The Nottingham Express Transit (NET) tram network is likely to be extended with a new tram stop at Toton Lane, less than 1km from the proposed HS2 station;

completion of this is expected by 2014. With the introduction of the East Midlands Hub, there would be a further extension of the NET Line 3 across Toton Lane to the HS2 station, so linking it with Nottingham city centre, Beeston, Chilwell, the University of Nottingham and the Queens Medical Centre.

- 6.5.3. The area is currently well served by an extensive network of regular bus services, and road access is generally good with the A52 running east and west between Derby and Nottingham, and the M1 via Junction 25. A total of 1,300 car parking spaces are currently proposed at the HS2 station, although these numbers will be discussed with the local authority in light of their policies and assessed as part of on-going appraisal work.
- 6.5.4. In terms of airport access, East Midlands Airport is about 20 minutes' drive south along the M1.

Aerial view of the East Midland Hub Station site at Toton alongside existing rail sidings, looking south along the Erewash Valley



Sheffield Meadowhall

- 6.5.5. This proposed HS2 station would be integrated with the existing Meadowhall Station, which currently runs up to nine trains per hour each way between Sheffield city centre, with journey times of as little as five minutes. The station serves numerous local and regional destinations including Rotherham, Barnsley and beyond to Wakefield, Doncaster, Scunthorpe and further afield to Leeds and Manchester.
- 6.5.6. It is intended that interchange between HS2 and the existing Meadowhall Station would be provided for pedestrians between the upper concourse of the HS2 station and the existing station to allow access to the platforms on the Sheffield to Rotherham line and the platforms on the Sheffield to Barnsley line.

- 6.5.7. The existing station also links with the Sheffield Supertram network, providing a 15 minute connection with the city centre. Proposed future transport schemes include the 'tram-train project' which would allow trams to use the existing railway between Sheffield and Rotherham.
- 6.5.8. The existing station includes a large bus station with routes serving the local Sheffield and Rotherham area, as well as the wider South Yorkshire region.
- 6.5.9. Road access would make use of the M1 via Junction 34. East-west connections to Sheffield and Rotherham are provided by the A6109 Meadowhall Road and A6178 Sheffield Road. Proposed car parking at the HS2 station envisages provision of some 1,500 spaces, although these numbers will be discussed with the local authority in light of their policies and assessed as part of on-going appraisal work.

Leeds New Lane

- 6.5.10. The HS2 station in central Leeds would be next to the South Bank area of the city centre, about 300m south of the existing station, to which it would be connected via a pedestrian link; this would provide a walk time of some five minutes between the two. The existing Leeds station currently provides connections with a number of regional rail destinations including Bradford, Halifax and Castleford, as well as destinations further away; for example Newcastle upon Tyne and Edinburgh.
- 6.5.11. Pedestrian access to the station would be via Victoria Bridge and Neville Street, which would be remodelled for pedestrians and public transport use only. Taxi ranks would be located along the east side of the station and fed from Meadow Lane, with a second drop off point at the southern station entrance.
- 6.5.12. The existing Leeds station has a bus interchange providing connections to the city's extensive bus network. The station also includes facilities for cyclists.
- 6.5.13. Highway access to the Leeds New Lane Station would be from the M621 (Junction 3), which connects to the Inner Ring Road and also to regional motorways. Car parking for the HS2 station is currently proposed at the southern entrance and would provide up to 1,800 spaces, although these numbers will be discussed with the local authority in light of their policies and assessed as part of on-going work.
- 6.5.14. Leeds-Bradford International Airport is located to the north-west of the city, some 30 minutes drive away. There are also direct bus services (half-hourly in daytime) to the airport from Leeds and Bradford city centres.

Impacts on rights of way and country parks

- 6.5.15. The eastern leg of the proposed scheme would cross 14 named long distance paths, including the Trans Pennine Trail, which would be intersected in nine locations and would run parallel to the route for approximately 4.5km alongside the Aire and Calder Navigation Canal. The other crossings would affect the Heart of England Way; Ivanhoe Way (two intersections); Derwent Valley Heritage Way; Midshires Way; Trent Valley Way; Nutbrook Trail (two intersections); Robin Hood Way (two intersections); Cuckoo Way (three intersections); Sheffield Country Walk (three intersections); Barnsley Boundary Walk (three intersections); Dove Valley Trail; Dearne Way; and Leeds Country Way (three intersections).
- 6.5.16. Six national cycle routes would be crossed by the proposed route.
- 6.5.17. It is assumed that permanent access along all public rights of way would be maintained through diversion or re-instatement (subject to agreement with the local authority), although there would be disruption to these routes temporarily

during construction. A detailed appraisal of all access crossings will be undertaken as part of the EIA.

- 6.5.18. Four country parks would be crossed on the eastern leg, namely Kingsbury Water Park (for about 1,140m); Pooley Country Park (for about 570m); Rother Valley Country Park (for about 750m); and Rabbit Ings Country Park (for about 720m). The route would also pass alongside Rothwell Country Park for about 240m. Section 6.9 addresses any landscape and visual impacts on these designated areas.

6.6. Noise and vibration

Airborne noise

- 6.6.1. The airborne noise appraisal predicted levels of railway noise on groups of dwellings. The approach is described in more detail in Section 4.7, but in summary, three categories of impact have been used, namely:
- 'high average' noise levels, i.e. greater than or equal to 73dB_{L_{Aeq,18hr}};
 - locations where dwellings could qualify for noise insulation; and
 - noticeable (although not necessarily significant) increases in 'average' daytime railway noise levels (rail noise level of 50dB_{L_{Aeq,18hr}} or more and a change in existing noise levels of 3dB_{L_{Aeq,18hr}} or more).
- 6.6.2. Since the publication of the Sustainability Summary (see Section 3.8), the noise specialists have worked closely with the scheme engineers to determine (at this stage of design) the feasibility of introducing noise barriers at the 'candidate areas for mitigation' (see Section 4.7). As expected, this has substantially reduced the number and extent of noise impacts reported at that earlier stage. The numbers of dwellings predicted to have noise impacts is shown below, with a comparison between the impacts with and without additional mitigation.

Table 6-1– Estimated numbers of dwellings with noise impacts on the eastern leg

| Proposed scheme... | High noise levels | Noise Insulation Regulations | Noticeable noise increase |
|---|-------------------|------------------------------|---------------------------|
| .. without additional mitigation | <70 | 450 | 28,100 |
| .. with additional indicative mitigation | <15 | 200 | 7,800 |

- 6.6.3. The use of additional indicative mitigation would reduce noticeable noise by around three quarters (72%). It would reduce the number of dwellings potentially qualifying for noise insulation by a little over half (56%); and the number of high noise level impacts by about 80%.
- 6.6.4. The indicative locations of these impacts are illustrated on the noise maps contained in Volume 2 of the Sustainability Statement. The main residential areas where groups of dwellings with residual noise impacts are currently predicted include (by local authority):
- Kingsbury in North Warwickshire;
 - Measham in North West Leicestershire;
 - Long Eaton and Sandiacre in Erewash;
 - Stapleford and Nuthall in Broxtowe;

- Poolsbrook, Netherthorpe, Woodthorpe and Mastin Moor in Chesterfield;
- Renishaw and Killamarsh in North East Derbyshire;
- Swallownest, Woodhouse, Treeton and Blackburn in Rotherham;
- Beighton, Tinsley, Wincobank, and Shiregreen in Sheffield;
- Worsbrough, West Green, Cudworth and Royston in Barnsley;
- Crofton in Wakefield; and
- Woodlesford in Leeds.

Other potential operational noise impacts

- 6.6.5. There is a potential for noise impacts from stations and depots due to trains, as well as to other sources such as fixed plant, PA systems or local traffic. It is likely that the majority of these impacts can be avoided or minimised through the use of effective planning and design, and through other noise mitigation measures. Nevertheless, the location of residential properties around the station locations and around both depots would present at least a moderate risk of noise impacts at these locations.

6.7. Air quality

- 6.7.1. Most of the area along the proposed route is in compliance with National Air Quality Objectives. However, there are some areas (termed AQMAs), which are predominantly in the vicinity of busy roads, that currently exceed air quality objective levels, particularly for NO₂.
- 6.7.2. Of the proposed stations, the East Midlands Hub would be within 1km of an AQMA in Trowell on the northern outskirts of Stapleford. Sheffield Meadowhall would be located within the AQMA between Rotherham and Sheffield, and the Sheffield City AQMA is also adjacent to the site.
- 6.7.3. AQMAs within 1km of other parts of the proposed route include:
- the Metropolitan Borough of Birmingham near the route's divergence from the Phase One scheme;
 - a site parallel to the M1 in the vicinity of East Midlands Airport;
 - sites close to the M1 in Trowell including a site next to the M1 Junction 26;
 - a site near to the junction of the M1 and A38 at South Normanton; and
 - areas along the A655, A638 and M62 east and north-east of Wakefield.
- 6.7.4. Any additional road traffic generated at these places, either during construction or operation, has the potential to exacerbate local pollution levels if no air quality improvements have been implemented by local authorities by that time. This would be considered in more detail as part of the EIA.

6.8. Health, well-being and equality

Potential health impacts

- 6.8.1. Initial analysis indicates the potential for both positive and negative health impacts at certain locations where existing levels of health-related deprivation are high, namely Nottingham, Barnsley, Wakefield and Leeds. The main potential negative health impacts relate to displacement of jobs, noise and demolition of housing and

community facilities. Potential positive health impacts relate to improved access to employment, new housing and access to transport, which in turn could increase access to education, services and facilities. People most vulnerable to health impacts (including people living in socio-economically deprived areas, older people and young people) will experience both positive and negative impacts

Potential equality impacts

- 6.8.2. The equality analysis has identified where groups vulnerable to discrimination and social exclusion (referred to as people with protected characteristics or PPCs) are likely to occur in relatively high numbers along the route. The analysis also identifies the potential for impacts of the proposed scheme to affect them more than they would affect the local population generally.
- 6.8.3. The East Midlands Hub is not likely to give rise to any notable equality impacts, since PPC groups are not found in particularly high numbers in the immediate vicinity or catchment area of this new station.
- 6.8.4. There may be adverse effects on groups of PPCs at Nuthall. This area is home to relatively large proportions of Black, Asian and minority ethnic people as well as high numbers of faith groups and lone parent families. Job loss as a result of demolition of commercial property at Nottingham Business Park, north of Strelley, could have a disproportionate effect on all these groups.
- 6.8.5. The catchment around the new Sheffield Meadowhall Station is home to relatively high numbers of PPCs including children and young people (0-15), Black, Asian and minority ethnic people, faith groups and lone parent families. The catchment around Leeds New Lane Station is home to relatively high proportions of young people (16-24), Black, Asian and ethnic minority groups, and faith groups. These groups are likely to experience a greater benefit arising from net increases in local jobs and the increased availability of affordable housing that would be supported by HS2, provided they are able to access them (see Section 6.3).
- 6.8.6. In the immediate vicinities of these two stations, potential adverse impacts on PPCs may occur due to the demolition of housing and commercial, retail and industrial property. The immediate areas around the stations are also home to relatively high proportions of Black, Asian and minority ethnic groups (many of whom are jobseekers) and faith groups. Access to affordable housing (including for larger families) and access to specialised retail outlets are some of the key concerns amongst these groups. Access to jobs is a key concern for Black, Asian and minority ethnic groups and while displacement of some jobs in the area of these stations are likely to be replaced by the new employment opportunities, this may not be the case for all.
- 6.8.7. The demolition of a group of 49 dwellings at South Tinsley to facilitate Sheffield Meadowhall Station could lead to dispersion of this community and potentially bring particular adverse health and well-being impacts. HS2 Ltd would be committed to working closely and at an early stage with the local authority 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.
- 6.8.8. There is an area with particularly high proportions of children and young people (0-15) in the vicinity of Sheffield Meadowhall Station. Measures would be taken to mitigate any potential adverse noise impacts in this area.

- 6.8.9. Potential adverse impacts related to access to jobs and affordable housing may affect higher numbers of young people (aged 16-24) and a cluster of lone parent families in the vicinity of Leeds station.

6.9. Landscape and visual impacts

The M42/A42 corridor

- 6.9.1. The proposed route's initial close alignment with the M42, largely in cutting, would limit potential landscape and visual impacts over this long section between Water Orton and Tonge. Loss of woodland would give rise to local landscape and visual impacts at Kingsbury Water Park. Immediately north of the park, prominent viaducts and embankments would affect parts of the farmed landscape. The shallow cutting running past the village of Whateley would demolish a number of dwellings here (see section 6.4.2) affecting the character and setting of the village to some degree, as well as views from some properties. However, visual impacts further north, close to Tamworth, would generally be limited.
- 6.9.2. Direct impacts on Pooley Country Park would affect the landscape character near Polesworth and would have major impacts on views from the park. Embankments further north would cause localised visual impacts on parts of Austrey and Appleby Parva, although views would be in the context of the embanked motorway.
- 6.9.3. Further north, close alignment with the A42 and associated tree screening would tend to limit landscape and visual impacts although the scheme would directly impact on woodland and fragment and disrupt the landscape north-west of Rough Park. The deep cutting would affect landscape character near Worthington.
- 6.9.4. The viaduct over the A42 has been sensitively routed in relation to landform, but would affect landscape character, including the southern setting of the Conservation Area at Tonge from where visual impacts would also occur. Further impacts would affect the open undulating character west of Diseworth.

Soar and Trent valleys and Nottingham

- 6.9.5. East of the tunnel under the East Midland Airport and proposed East Midland Gateway site, the route would rise onto a viaduct over the Soar Valley. Within this open landscape, the viaduct would be widely visible, although the prevalence of power lines, roads and the existing power station would help to limit the landscape impact. Continuing over the Trent Valley, the route would cross woodland on the riverside bluffs at Thrumpton, as well as the western edge of the Conservation Area. Adding a further high level structure to the valley landscape and a distinctive skyline feature, the impact on the immediate character of the valley would be major.
- 6.9.6. Various visual impacts would arise from this long elevated section, including possibly major impacts for recreational users of the Trent and Mersey Canal and the Trent Valley Way, and for residents on the edge of Thrumpton. However, earlier changes in the horizontal alignment around Ratcliffe Cut, and in the vertical alignment through Long Eaton, have helped to reduce some potential visual impacts at these locations.

Aerial view across Red Hill and Thrumpton Park, looking south along the Soar Valley



- 6.9.7. In the vicinity of the East Midlands Hub, impacts on landscape and townscape character should be relatively low given the existing context of railway and brownfield land; visual impacts would affect residents in Toton. To the north, the proposed viaduct and embankment near Sandiacre would intrude into the characteristically flat and open floodplain causing major impacts on local landscape character; as well as visual impacts for users of the canal and local footpaths. Residential views from the north-east edge of Sandiacre would also be affected.
- 6.9.8. A small number of residents of Stanton Gate and on the northern edge of Stapleford would experience visual impacts, although this would be in the context of the existing embanked M1. Towards Strelley, careful routing and the proposed use of cut and cover tunnel would limit potential landscape and visual impacts. Further horizontal realignment of the scheme to the west, moving it closer to the M1 and changing its position around Nuthall and Bulwell Wood, has helped to reduce potential visual (as well as built heritage and ecological) impacts further north.

The M1 corridor (Nuthall to Staveley)

- 6.9.9. Continuing north, the route would generally align close to the M1, frequently in cutting, and pass through urban fringe and fragmented landscapes. Impacts would be generally limited over some 15km between Nuthall and Tibshelf. The landscape character would be locally affected as the route approaches Annesley Woodhouse, due to impacts on woodland and a section of deep cutting and high embankment. Having diverged temporarily from the motorway, the route would cut through a parkland landscape around Brookhill Hall, east of Pinxton.

- 6.9.10. The M1 remains a prominent feature through the landscape west of Hardwick Hall, and this would help to limit the potential impact of the proposed route, which realigns alongside the motorway for several kilometres. The route proposals through this area have been extensively designed to ensure close association with the landform and the motorway. However, the amalgamation of prominent historic features and landscapes makes the area sensitive to change, and some impacts would prevail. The setting of Stainsby would be affected at a local scale. Further north, views of the route would affect visual amenity from Bolsover Castle and its Conservation Area, although these should be attenuated by distance and partly screened by landform and tree cover; potential impacts on the setting of the castle are addressed at Section 6.10.10.

The Rother Valley and Sheffield

- 6.9.11. Approaching Sheffield, the proposed route would follow the Doe Lea and Rother rivers, which form a pathway for other linear infrastructure. The wooded landscape east of Staveley would help to contain impacts there. The proposed Staveley Depot would lie amidst brownfield and industrial land, and impacts would be slight as a result. The viaducts over the River Rother would affect the character of the valley and the historic townscape of Staveley, as well as views from the Canal Marina (currently under construction). However, the landscape is already influenced by the existing rail viaduct and the Staveley bypass.
- 6.9.12. However, approaching Renishaw, the impacts on the character of the Conservation Area would be major, as the viaduct would cross attractive flood meadows, treed river corridors and a number of valley-side bluffs and woodlands. Views would generally be contained, but visual impacts would affect recreational users of the Cuckoo Way and the Trans Pennine Trail, the latter affected intermittently over several kilometres.

Aerial view south along the Rother Valley, with the country park on the left and Beighton on the right



- 6.9.13. Continuing along the Rother Valley, the landscape has been affected by mining and now accommodates an existing railway and power lines. The landscape has been restored at Rother Valley Country Park, but as the route would pass at grade along an existing rail corridor, impacts on the park would be limited. In the Treeton and Catcliffe areas the proposed route would affect the character of the river corridor and separate the land at Orgreave from the river. Visual impacts would also be localised; affecting parts of the country park, local footpaths (including the Trans Pennine Way and Sheffield Country Walk); the western edge of Killamarsh and Swallownest; and the southern edge of Catcliffe.
- 6.9.14. At Meadowhall, the station would occupy an area already characterised by large scale development. However, the viaducts north and south of the station would affect the townscape setting of the Meadowhall Centre as well as views from the M1, the residential area of Wincobank, and the Trans Pennine Trail, which runs along the valley, although the M1 viaduct is already a strong influence on views. There would also be some potential loss of woodland and trees along the route in this area.

South and West Yorkshire

- 6.9.15. The proposed route would cross steeply rising ground north-east of Sheffield as it diverges from the M1. Cutting would dissect several blocks of woodland and open farmland. Despite the adverse impact on these important landscape features, the remaining woodland would help to contain views of the scheme. The route would continue through the undulating wooded terrain that frames the valleys of the Dove and Dearne rivers, potentially resulting in major landscape impacts due to woodland loss and disruption to the landform. Visual impacts would affect recreational receptors in the Dove Valley, including users of the Trans Pennine Trail, and residents of Worsbrough Dale and Lower Lewden.
- 6.9.16. North of Cudworth, the route would enter the small valley of Cudworth Dike, causing some fragmentation to the landscape, and visual impacts on the south-west of Shafton Two Gates village and at Rabbit Ings Country Park.
- 6.9.17. Potential impacts from the proposed depot at New Crofton would be within a landscape already affected by past mining and mineral railways. Impacts from the embankment of the spur connection would affect the setting of Walton Country Park and views from a few dwellings on the edge of Crofton, seen in the context of existing but lower railway embankments. There should be little or no impact on the setting of Nostell Priory to the north-east.
- 6.9.18. West of Normanton, deep cutting would affect the hillsides above the river, although the route has been otherwise sensitively located in landscape and visual terms. The high level crossing of the Calder would bisect a relatively undeveloped section of the valley, although key viewpoints, such as Bottom Boat and Lower Altofts, would be quite distant. The village of Methley Lanes would be directly impacted, resulting in major visual impacts for residents.

The River Aire and North Yorkshire

- 6.9.19. Between the Calder and Aire valleys, a wooded farmland landscape would be affected before the land falls away and the route crosses the River Aire and the Aire and Calder Navigation on a viaduct, giving rise to impacts on the diverse and relatively unspoilt river corridor. Visual impacts would affect users of local footpaths, although woodland would help to contain views. Local landscape impacts would affect the small valley west of Swillington and the wooded farmland landscape near Garforth, around Barrowby Hall. However, by closely following the

M1 between Swillington and Micklefield, potential impacts have been greatly reduced.

- 6.9.20. There would be some combined impacts of the route and spur into Leeds, although these would derive principally from the spur, which is described below.
- 6.9.21. The route would be largely in cutting east of Garforth, and landscape and visual impacts would be relatively limited within the flat farmed landscape already affected by motorways, a railway and a military airfield. East of Barkston Ash, the new viaduct structures would alter the character of the landscape west and north of Church Fenton and give rise to visual impacts to residents on the western and northern edge of the village.

The Leeds spur

- 6.9.22. The proposed spur into Leeds would pass along the Aire Valley. Initially the route would be well screened by woodland, although some of this would be lost as a result of the scheme. Further west, the more sensitive floodplain landscape on the northern edge of Woodlesford would be greatly affected by the introduction of the viaduct, including direct impacts on the Aire and Calder Navigation itself. The route would run immediately alongside or over the Navigation for some 1km, as well as over Woodlesford Lock. Continuing west, the route would return to grade around Rothwell, passing between Rothwell Country Park and Fishpond Lock and again potentially affecting the character and setting of the lock.
- 6.9.23. Within the open landscape of the valley, visibility would be extensive, resulting in major visual impacts for users of the Aire and Calder Navigation, residents on the north-eastern edges of Woodlesford and residents of more centrally located houses on higher ground. Recreational users of the waterway between the M1 and A642 would be similarly affected, including users of the Navigation, the Trans Pennine Trail and Rothwell Country Park. Further east impacts would be limited through the built up area into Hunslet.
- 6.9.24. The approach into Leeds would follow an existing railway line, which would greatly help reduce potential impacts. The station throat and platforms would directly affect a range of buildings and cause some loss of informal open space just west of Kidacre Street. The proposed scheme would have potentially major impacts on townscape character largely due to the sensitive historic setting of the area and the disruption to the street pattern, although there may be opportunities for townscape enhancement as part of future redevelopment.
- 6.9.25. The new station building would be broadly in keeping with the larger existing buildings in the area and visual impacts would be generally limited. However, the pedestrian link would cross the attractive open spaces at Granary Wharf, causing major visual intrusion on recreational users of this waterside area. The elevated platform and tracks would cause some visual intrusion at the southern end of the station.

6.10. Cultural heritage

- 6.10.1. The eastern leg has been selected and aligned so that it would have few impacts on known designated heritage assets. It would avoid physical impacts on most of the more significant designated features, including Registered Battlefields and Grade I and II* Listed structures. One Scheduled Monument (the Roman site at Ratcliffe on Soar) would be directly impacted, and the settings of three others would be affected; these are each described below. Five Grade II Listed structures may be demolished, although at least three are likely to be preserved subject to more detailed designs. The route has been aligned so that it avoids all

Registered Parks and Gardens, and impacts on the settings of those it passes would be generally low. The AoS has concluded that the majority of potential heritage impacts would be negligible or minor at most. Unless stated otherwise, only those of potentially greater magnitude are described below.

- 6.10.2. South of Measham, the route would pass on viaduct over the Grade II Listed Meer Bridge. It is likely that the viaduct can be designed so that physical impacts on this 19th century road bridge are avoided, although impacts on its setting would remain.
- 6.10.3. Having crossed the Soar Valley, the route would pass through Red Hill, directly affecting a Scheduled Roman site just north-west of Ratcliffe on Soar. The site is thought to have originated as an early Iron Age settlement that grew into an important Roman trade centre and river crossing. It also contains remains of the only known Roman temple in the county. Recorded fieldwork associated with other development proposals in the immediate area suggests that archaeological remains of potentially national importance extend beyond the designated area. With the proposed route on viaduct at this point, major impacts could affect below ground remains, and the final design (including location of viaduct piers) would need to be sensitive to the findings of any future archaeological survey.
- 6.10.4. On the north side of this hill is located the historic village of Thrumpton. The route would cross the western end of the Thrumpton Conservation Area affecting open land about 1km west of the main village.
- 6.10.5. Further north, having diverged east from the Erewash Valley and joined the alignment of the M1, the route would pass through Strelley. This historic village has numerous Listed Buildings, as well as a Scheduled medieval moat and fishpond at Strelley Church, which survive as above ground remains. Permanent impacts on these assets would be limited by incorporating a cut and cover tunnel through this area. The cutting leading into the tunnel would pass through part of the Strelley Conservation Area and would adversely affect the setting of the monument, but links between the monument and Strelley Hall and the church would be maintained.
- 6.10.6. South-west of Annesley Woodhouse, the route would pass by a Scheduled Monument comprising a series of fishponds. Thought to date from the medieval period when they were part of the Annesley Hall estate, the ponds are unusual for both their size and the water management system they exhibit. Although partly surrounded by trees in arable fields and east of a substantial industrial estate, the proposed embankment would be clearly visible from the designated area and would detract from its setting.
- 6.10.7. North of Tibshelf, the route would pass through a landscape with a complex mix of historic assets including the Hardwick Hall complex (comprising a Grade I House, Grade II* Registered Park and Garden and the Scheduled Old Hall), several Conservation Areas (with numerous Listed Buildings) and two further Scheduled Monuments. Given the sensitivity of this area, the route has been closely aligned with the M1, and this is instrumental in helping to limit the potential impacts of the railway. The setting of the Scheduled Hardwick Old Hall and the Grade I Listed Hardwick Hall, both situated some 1km east of the scheme, are already affected by views and noise from the M1 and the proposed route would not exacerbate this to any great degree, although with a more exposed aspect, the Old Hall would be moderately affected. Views of the scheme from higher ground within the New Hall's associated Grade II* Registered parkland, as well as noise from trains, could have local impacts on the character of the area.

The route would pass some 1km west of Grade I Listed Hardwick New Hall



- 6.10.8. Just north of this are the Scheduled earthwork remains from the manorial complex and chapel at Stainsby. These are not well preserved and there are no obvious assets contemporary with this medieval site to provide an historic setting. Views to Hardwick Hall are distant, and the link between these structures is not strong. However, there are few if any 'modern' visual intrusions in the landscape and views of the traffic on the M1 are limited, although background traffic noise is prevalent. The proposed cutting and embankment would impact the setting of those remains that are visible. Stainsby Conservation Area would also be crossed for about 400m by cutting and embankment along its eastern edge.
- 6.10.9. A little over 1km further north, the route would demolish the ruined remnants of the Grade II Listed Heath Old Church. There are a few standing remains of the medieval church at this isolated location surrounded by trees. The effect of demolishing this structure would be exacerbated by the impacts on the associated churchyard.
- 6.10.10. Immediately north, the route would pass by the Conservation Areas of Sutton Scarsdale and then Bolsover Castle, adversely affecting their character, although impacts on the Scheduled Sutton Scarsdale Hall, and on the Grade I Listed and Scheduled Bolsover Castle would be negligible.
- 6.10.11. The route would continue north from this historic area towards Sheffield. At Renishaw, the route would pass along the eastern edge of the Eckington and Renishaw Park Conservation Area for about 800m. The impact on the setting of the nearby Registered Park and Garden (known as Renishaw Hall) would be negligible, but impacts on the landscape of the eastern edge of the Conservation Area would be clear.

- 6.10.12. No further impacts on designated sites and features would arise until the route passes Cudworth, east of Barnsley. A Grade II Listed chimney of 1854 at Bleachcroft Farm is a freestanding structure that represents the only significant remains of the Midland Bleach Works industrial site. This would be demolished, although its setting has already been significantly degraded.
- 6.10.13. The Grade II* Registered Park and Garden of Nostell Priory would be some 650m north of the depot at New Crofton at its nearest point. However, review of the proposals here suggest that, given the intervening topography, existing quarrying and dense tree cover, potential impacts on its setting would be negligible.
- 6.10.14. The demolition of a Grade II Listed road bridge over the Aire and Calder Navigation at Swillington, east of Leeds may be necessary, although careful design of the proposed viaduct may allow it to pass over the canal bridge. A 19th century Grade II Listed stone and iron milepost north-east of Garforth would lie on the route, but it is assumed that it would be stored during construction and replaced over the cut and cover tunnel underneath the A642 Aberford Road.
- 6.10.15. The route further east has been aligned to avoid the Registered Towton Battlefield site (1461). No physical impacts would occur, although some minor impacts on the setting of this site may occur.
- 6.10.16. Entering Leeds, the proposed scheme would have a large impact on the Canal Wharf Conservation Area, where the new foot passenger walkway over the River Aire would greatly alter riverfront views and the character of this historic area. The new station would also affect the settings of the 18th century Grade II* Listed river lock and retaining walls and the former Leeds and Liverpool Canal and Company Warehouse. The setting of the Grade II Listed Victoria Bridge would be affected by the station concourse to its south east and the passenger walkway across the River Aire.

6.11. Biodiversity and wildlife

Internationally designated sites

- 6.11.1. South of Measham, the route would bridge the River Mease, which is designated a SAC principally due to its aquatic plant communities and the presence of two species of fish - spined loach and European bullhead. HS2 Ltd has undertaken substantial work analysing the risks to this site and its wildlife, including discussions with Natural England and the Environment Agency. As a result, the route was selected, and detailed elements of its design were conceived, on the basis of it having no adverse impact on the river's conservation status. This conclusion, together with the evidence upon which it is based is set out within the HRA Screening Report³⁵ and the associated draft Appropriate Assessment (AA) Report³⁶ that were prepared in support of option development. The draft AA report is based on the current pre-consultation design. It will be finalised in parallel with the preparation of the bill. However, it is most likely that the final AA Report will reflect the same conclusion of no likely significant effect.

³⁵ HS2 Phase 2: HRA Screening Report for River Mease SAC

³⁶ HS2 Phase 2: draft Appropriate Assessment Report for River Mease SAC

The River Mease



- 6.11.2. The proposed route would cross an area in Sherwood Forest that is potentially suitable for designation as part of the UK SPA network for two bird species (nightjar and woodlark), although does not yet qualify as a proposed SPA. Having consulted with Natural England, HS2 Ltd are currently investigating the possible effects to understand what the implications would be should the site be designated in the future.

Nationally designated sites

- 6.11.3. The proposed route largely avoids nationally designated nature conservation sites, and only two SSSIs - the River Mease and Bogs Farm Quarry - would be crossed by it. As discussed above, a detailed assessment of the River Mease has already been undertaken due to the river's European protection. The conclusion that adverse effects to the SAC would be avoided is equally valid for the SSSI.
- 6.11.4. Bogs Farm Quarry, east of the M1 at Selston, is designated a SSSI for wet, flushed grassland and unimproved species-rich grassland, as well as wet woodland along its northern edge. The narrowest central part of the site, which is largely wooded with secondary woodland, as well as smaller open areas possibly of wet grassland, would be crossed on viaduct. The largest area of species-rich grassland is in the eastern part of the site, away from the proposed viaduct. A potentially major impact would include habitat loss for construction and placement of viaduct piers, pollution during construction (although application of the CoCP should avoid this), shading, and changes in hydrology potentially arising from placement of viaduct piers in groundwater flows feeding flushed grassland. Design work will continue to seek effective mitigation through avoiding landtake and hydrological impacts. As discussed in Section 4.13, opportunities for enhancing habitats within the SSSI will be considered at the EIA stage.
- 6.11.5. The proposed scheme would also pass near to a number of other SSSIs. These will be reviewed again once a more detailed design has been developed. However, through consideration of the respective sensitivities of each site, as well as the possible impact pathway from the proposed route, the AoS has identified a risk of ecological impacts to seven of these SSSIs, generally due to potential impacts from HS2 on surface and ground waters that link with the sites. These SSSIs comprise:

- Alvecote Pools SSSI, east of Tamworth;
- Lount Meadows SSSI, north of Ashby-de-la-Zouch;
- Lockington Marshes SSSI, west of Ratcliffe on Soar;
- Sellers Wood SSSI, north of Nuthall;
- Bulwell Wood SSSI, also north of Nuthall;
- Annesley Woodhouse Quarries SSSI, south of Kirkby in Ashfield; and
- Kirkby Wharfe SSSI, north of Church Fenton.

6.11.6. In all cases, it is most probable that the application of the CoCP would effectively mitigate potential construction impacts. Equally, any risk of hydrological impacts, were further investigation to confirm these, would be addressed through careful design to ensure that surface or groundwater flows were maintained. Risks of other impacts will need to be addressed through detailed design and mitigation.

Other important habitats and designated sites

- 6.11.7. The scheme would have direct impacts on an estimated 43 Habitats of Principal Importance. It would affect 28 woodlands, some of which are also ancient woodlands. In total, nine ancient woodlands would be directly affected. The majority of these woods are clustered in areas around Hucknall in Nottinghamshire (such as New Farm Wood and Watnall Coppice) and near Chapletown and Worsborough, to the north-east of Sheffield (such as Smithy Wood, Hesley Wood and Wombwell Wood). Woodlands are a key feature of both the Southern Magnesian Limestone Natural Area and the Coal Measures Natural Areas within which these two groups respectively lie.
- 6.11.8. There would be crossings of five areas of coastal and floodplain grazing marsh habitat and three areas of fen habitat, which would generally be crossed on viaduct or only peripherally affected. Other Habitats of Principal Importance that would be directly affected by the proposed route are quite widely distributed and include lowland meadows (four) and wood pasture and parklands (three).
- 6.11.9. Three Local Nature Reserves would be affected by the route, namely:
- Nottingham Canal, designated for aquatic and associated habitats and crossed at Trowell west of Nottingham;
 - Norbriggs Flash, designated for its species-rich grassland and wetland habitats and crossed by the route east of Staveley; and
 - Carlton Marsh, designated for its wetland habitats and crossed along its eastern edge north-west of Cudworth.
- 6.11.10. Impacts to Nottingham Canal and Carlton Marsh would be minor given the potentially limited and peripheral habitat loss. However, the proposed route would cross the middle of Norbriggs Flash resulting in a more extensive impact.
- 6.11.11. Based on publicly available information, no county Wildlife Trust reserves would be directly affected by the proposed route.

Natural Areas and opportunities for biodiversity

- 6.11.12. The proposed route would cross four Natural Areas on the eastern leg, namely: Trent Valley and Rises; Midlands Plateau; Coal Measures; and Southern Magnesian Limestone.
- 6.11.13. There would be a cumulative impact from the loss of woodland and lowland meadows within the Coal Measures Natural Area, as these habitats are characteristic within the region. The loss of wood pasture and parkland and associated habitats would also have a cumulative impact in the Coal Measures as these are a key feature but of limited distribution.
- 6.11.14. There would also be a cumulative impact of the loss of woodland within the Southern Magnesian Limestone Natural Area as these are characteristic and the primary semi-natural habitat within this intensely farmed landscape.
- 6.11.15. As stated in Section 4.13, a package of mitigation and enhancement measures will be considered as part of the EIA, which would seek to address both the direct impacts on designated sites, and to reflect the wider strategic ecological priorities of affected areas. They could be coupled with initiatives on ecosystem services, which could be introduced in the future.

6.12. Water resources and flood risk

Watercourse diversions

- 6.12.1. Close working between the scheme engineers and AoS water specialists has been successful in avoiding the need for many potential permanent watercourse diversions along the eastern leg. However, the need for permanent diversions or realignments to five major watercourses, three medium watercourses and 19 minor rivers is still envisaged at this stage³⁷.
- 6.12.2. The major rivers that may need to be realigned are:
- The River Doe Lea. The more southern of two viaducts within the Doe Lea floodplain at Staveley may require small diversions of the river at two crossing points.
 - The River Rother. The proposed route would pass along the Rother Valley between Renishaw and Catcliffe, crossing the River Rother at a number of locations, particularly between Beighton and Treeton, where some degree of diversion or major channel works would be required at one location. In addition, the Beighton Mill Tail Goit at Beighton would be obstructed over some 500m, requiring the channel to be reinstated along this length.
 - The River Don. Sheffield Meadowhall station footprint may require in-channel works over several hundred metres.
 - The River Aire. The viaduct along the Aire Valley is likely to require diversion of the River Aire at two locations at Woodlesford.
 - Farnley Wood Beck. On the approach into Leeds, the proposed route would pass alongside a watercourse in the Stourton Freightliner Terminal, with earthworks directly over the channel for approximately 400m, requiring its diversion.

³⁷ The definition of major, medium and minor watercourses is given in Section 5.14.

View of the Aire and Calder Navigation looking east from the A642



6.12.3. The medium rivers that may need to be realigned are:

- Gilwiskaw Brook. The proposed viaduct over Gilwiskaw Brook at Packington may need to be extended southwards to avoid adversely affecting the watercourse. At the crossing point of the brook, works to the channel would be required to prevent the piers obstructing flows.
- Blackburn Brook. A viaduct would carry the route along the valley of the Blackburn Brook north of Sheffield Meadowhall Station. There would be a need for channel and bank works, and potential diversions of the brook in a few places.
- Cudworth Dyke. The proposed footprint of the scheme embankment would cross the Cudworth Dyke for around 200m at Carlton Marsh near Shafton Two Gates, although adoption of a viaduct through this section is likely to avoid the need for watercourse diversion.

6.12.4. All but Cudworth Dyke and Farnley Wood Beck are classified by the Environment Agency as 'Main Rivers'. Farnley Wood Beck is not under the control of the Environment Agency, and is presumed therefore to be under the control of Yorkshire Water.

6.12.5. A nine mile section of the Chesterfield Canal between Staveley and Kiveton is being restored to make it navigable. The restoration has been completed between Kiveton and Killamarsh and also up to the Staveley Basin. The remaining section of canal, once completed, would be crossed approximately four times by the proposed route. HS2 Ltd is in discussion with the Chesterfield Canal Trust to identify potential solutions for these crossings.

Flood risk

- 6.12.6. The proposed route would cross floodplains at a number of locations. Generally, these crossings would be on viaduct or clear-span bridge to minimise the potential loss of flood storage and obstruction to flood flows. However, other solutions may be agreed in due course (see Section 4.14.7). The floodplains of various watercourses are crossed 31 times for more than 100m. A series of viaducts are currently proposed at these locations, as detailed in the table below.

Table 6-2 – Eastern leg floodplain crossings over 100m

| Watercourse name | Viaduct name | Length (m) |
|---|---|------------|
| River Tame* | Kingsbury Viaduct | 1,276 |
| Thistlewood Brook | Kingsbury North Viaduct | 330 |
| River Anker* | Polesworth Viaduct | 640 |
| Bramcote Brook* | | |
| Bramcote Brook* | Austrey Viaduct | 310 |
| River Mease* | Measham Viaduct | 145 |
| Gilwiskaw Brook* | Packington Viaduct | 130 |
| River Soar* | Ratcliffe on Soar Viaduct | 3,420 |
| River Trent* | Long Eaton Viaduct | 1,715 |
| River Erewash* | Sandiacre Viaduct | 780 |
| River Erewash* | Stanton Gate Viaduct | 950 |
| River Doe Lea* | Poolsbrook Viaduct | 810 |
| Hawke Brook | | |
| River Doe Lea* | Staveley Viaduct South | 1,230 |
| River Doe Lea* | Staveley Viaduct North | 420 |
| River Rother* | Various | |
| River Don* | Meadowhall Viaduct South (for Meadowhall Station) | 3,300 |
| Blackburn Brook* | | |
| Blackburn Brook* | Meadowhall Viaduct North | 710 |
| River Dearne* | Lundwood Viaduct | 240 |
| Cudworth Dyke | Cudworth Viaduct | 240 |
| Haw Park Beck | Winterset Viaduct | 140 |
| River Calder | Woodhouse Viaduct | 210 |
| River Calder and the Aire and Calder Navigation | Normanton Viaduct | 1,030 |
| River Calder* | Bottom Boat Viaduct | 130 |
| Oulton Beck* | Oulton Viaduct East (upline) and Oulton Viaduct West (downline) | 230 |
| River Aire and Aire and Calder Navigation | Mickletown Viaduct | 505 |
| River Aire* | Swillington Viaduct | 555 |

| Watercourse name | Viaduct name | Length (m) |
|-----------------------------------|---|------------|
| Dorts Dike | Church Fenton Viaduct South and Church Fenton Viaduct North | 785 |
| River Aire* | Woodlesford Viaduct | 2,335 |
| Tributary of River Aire (Hunslet) | Hunslet Retaining Wall | 457 |

* Classified by the Environment Agency as a Main River

- 6.12.7. Issues of flood risk would arise at all three stations. The approach to the East Midlands Hub would lie partly within Flood Zone 3 and may require flood defences. Sheffield Meadowhall Station would largely occupy Flood Zone 3 (including some construction within the functional floodplain). At an elevated level, the line and platforms would be unaffected by flooding at Meadowhall; but ground-level vehicle access to the station would be impeded in an extreme flood event. Leeds New Lane Station would be largely in Flood Zone 2 and therefore only affected by flood events which exceed the 100-year return period. Staveley Depot would be largely within Flood Zone 2, although some of its approach lines would be at a low elevation and at risk of flooding. In all cases, the detailed design would reflect the findings of hydraulic modelling and make allowances for flood compensation.
- 6.12.8. HS2 Ltd will continue to work closely with the Environment Agency and other relevant parties to establish the most practical and effective solution for each crossing of the floodplain.
- 6.12.9. In total, the eastern leg would incorporate a total of 146 separate watercourse and canal crossings. Each of these will require more detailed study in due course where, for example, no flood mapping currently exists. Where appropriate, designs will be undertaken in close liaison with water specialists to identify satisfactory solutions that will meet the requirements of relevant bodies including the Environment Agency, and in particular that comply with objectives of the Water Framework Directive (WFD). The EIA will also include WFD assessments of all surface water bodies that are crossed by the scheme.
- 6.12.10. The EIA will also assess the potential impacts from groundwater flooding, which have not been addressed at this stage.

Groundwater

- 6.12.11. Aquifers of good yield and quality would be crossed in tunnel or cutting, notably in the area around Nottingham. However, no source protection zones or public water supplies would be directly affected by the eastern leg.
- 6.12.12. In addition to considering the potential impacts on potable water supplies (and therefore SPZs), other notable licensed groundwater abstractions have been considered within a nominal 500m of the proposed route; these are usually for commercial or agricultural use. There are four such abstractions which fall into these categories, namely: Acton Road works, Long Eaton; two sites north-east of Garforth; and one site at Stourton in the Aire Valley, near Leeds.
- 6.12.13. The AoS indicates that all four non-potable abstractions appear unlikely to be significantly affected as a result of proposed scheme. This is based on the fact that the abstraction boreholes would not appear to be directly impacted by the scheme and that best-practice construction techniques would be employed to protect the groundwater resources from pollution.

- 6.12.14. For all of these abstraction locations and for other groundwater bodies, a requirement of the WFD will be to prove that there is no adverse impact particularly on the yields and quality of groundwater that support these abstractions and groundwater dependent habitats, and a groundwater risk assessment will be required as a minimum supported by an appropriate ground investigation and consultation with the Environment Agency.

6.13. Land use resources

Agricultural landtake

- 6.13.1. The AoS process has sought to limit the loss of the highest quality agricultural land. High level agricultural land classification maps show that no Grade 1 classified agricultural land would be directly affected by the eastern leg. An estimated 30km of the route would be through Grade 2 classified agricultural land, notably in the Tame Valley, in the low hills between the Anker and the Mease valleys, in the hills between Strelley and Greasley, and in the undulating plateau between Garforth and Church Fenton. The East Midlands Hub would also occupy up to 0.5ha of Grade 2 classified land.

Aerial view of the New Crofton Depot site looking north-west with New Crofton in the background



Green belt

- 6.13.2. Green belt surrounds Nottingham and all of the main conurbations between Sheffield and Leeds, so the route would pass through it for much of its length. The East Midlands Hub would occupy an estimated 40ha of green belt. The New Crofton Depot would occupy an estimated 29ha of green belt.

Landfill sites

- 6.13.3. The AoS identified 13 active (operational) landfill sites and 69 disused (non-operational) landfill sites within 250m of the proposed route. Higher risks were identified for three of the active sites and 12 of the disused sites, based on the type and length of crossing, the size of the landfill and its recorded contents.
- 6.13.4. Of the active landfills:
- Erin landfill site, south-east of Staveley and designated for hazardous/industrial waste, would be crossed by embankment for some 150m;
 - Stairfoot landfill, south-east of Barnsley and used until recently for non-hazardous waste, would be crossed by tunnel for about 150m; and
 - Welbeck landfill east of Wakefield and designated for hazardous/industrial waste, would be crossed by embankment and cutting for some 25m.
- 6.13.5. The 10 disused landfills crossed by the scheme include two designated for hazardous/industrial waste, namely:
- Woodhouse Mill Tip at Treeton Dyke, Orgreave, crossed by viaduct for about 270m;
 - A British Steel Corporation sites at Sheffield, crossed by embankment for about 260m.
- 6.13.6. The recorded waste for other directly impacted disused landfills is non-hazardous waste. These sites comprise:
- Cocksparrow Farm at Marston, crossed in cutting;
 - Land west of railway, north of Kingsbury, crossed on viaduct for about 75m;
 - Old Chesterfield Canal at Killamarsh, crossed in cutting for about 850m, although this could be ameliorated through current canal restoration (see section 6.12.5);
 - Orgreave Road at Catcliffe, crossed on embankment for about 75m;
 - Swaithe Tip at Swaithe, Worsbrough, crossed by cutting, embankment and viaduct for about 100m;
 - C E Medlam also at Swaithe, Worsbrough, crossed on embankment for about 180m;
 - Cudworth North Junction at Royston, crossed on embankment for about 200m; and
 - Lemonroyd at Oulton, crossed on embankment and viaduct for about 560m.

Mineral sites

- 6.13.7. The AoS has identified four registered minerals sites that are reported as active and that would be crossed by the eastern leg.
- Cloud Hill Quarry, north-east of Worthington, which produces various types of road surfacing material, premixed concrete and agricultural lime and which would be passed along its northern edge;
 - Kirkby Park, north-east of Selston, although from aerial photos this appears to be inactive.

- At Staveley, the spur to the depot would run along the edge of a registered quarry east of Hall Lane, although impacts are likely to be very minor.
- As the route joins the existing railway near Church Fenton, it would pass through Copley Lane Quarry, a Magnesian Limestone quarry.

6.14. Excavated materials and material resource

- 6.14.1. The current estimate for excavated material arising on the eastern leg is 12.35 million cubic metres, of which about 1.35 million cubic metres would be from tunnel excavation. However, these estimates do not take account of the materials likely to be incorporated within the scheme for the creation of landscaping and bunding as part of any mitigation proposals.
- 6.14.2. As a result of the crossings of landfill sites, it is possible that some of the waste material arising would be hazardous. The design of the route through these areas would need to ensure that potential impacts from possibly contaminated materials are fully mitigated, and that any wastes are handled in accordance with legal requirements and requirements of the CoCP.
- 6.14.3. The estimated quantities of bulk building material required for the scheme would comprise a 409,400 tonnes of steel and 3,661,600 tonnes of concrete.

7. Scheme wide issues and combined impacts

7.1. Introduction

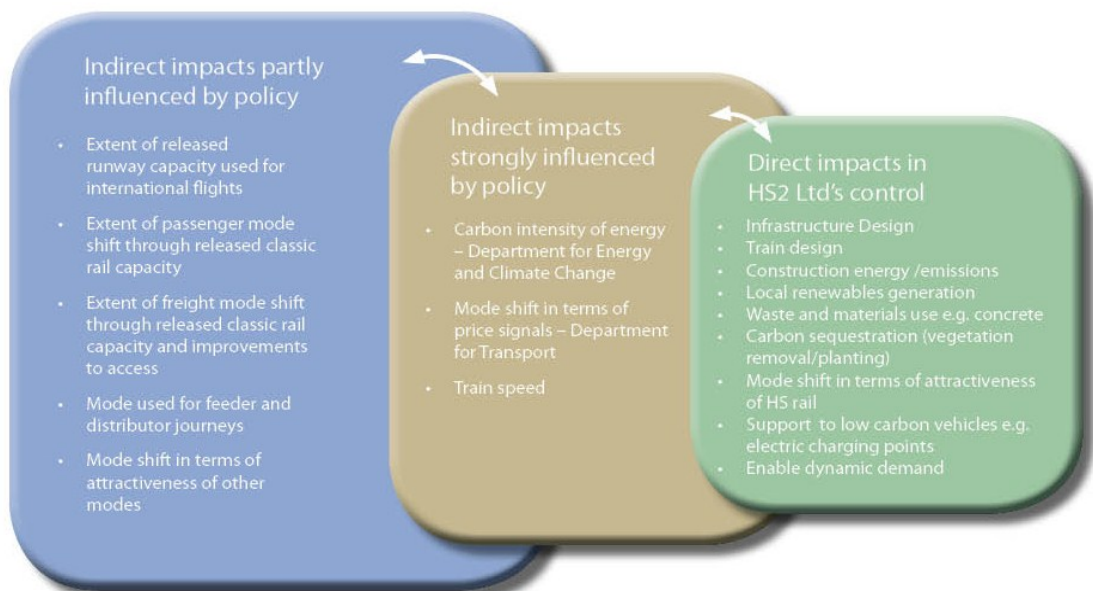
- 7.1.1. Although the main focus of the Sustainability Statement has been on highlighting the key sustainability issues that would occur along the route, some of the impacts of Phase Two can only be realised if Phase Two proposals are considered as a whole, or as part of a larger scheme still – combined with Phase One; for example, for carbon emissions, wider economic issues, and implications for the safety of passengers.
- 7.1.2. Other topics, though of key importance from a local perspective, should also be considered in a broader context. The scheme wide impacts of the other topics are recorded here, along with those of Phase One to provide a wider perspective of the scheme’s sustainability performance.

7.2. Carbon emissions

Overview

- 7.2.1. The AoS process includes an assessment of the carbon footprint for HS2 (both Phase One and Phase Two). This relies on data from the economic case, which is being revised at this time. Consequently, with this work in progress, the carbon report that encapsulates the findings of this workstream, will be published at a later time, alongside the economic case. However, the potential contribution that HS2 would make to the UK carbon agenda is quite well understood at this stage, and this is presented here.

There are a number of factors affecting HS2’s carbon footprint, many of which are outside its control



- 7.2.2. The carbon assessment involves calculating the difference between the carbon dioxide emissions resulting from HS2’s construction and operation over an assumed sixty year lifespan, compared with any potential reductions in carbon dioxide emissions over this lifespan as a result of people switching to high speed rail services in preference to other, more carbon polluting, transport modes.

Calculation of this net carbon footprint (CO₂ emissions minus potential CO₂ savings) relies on a host of factors and assumptions, a great number of which are outside the immediate influence of HS2.

Rail and carbon

- 7.2.3. In 2011 the transport sector contributed around 25% of the UK's greenhouse gas emissions³⁸. These emissions were predominantly from road vehicles (around 22%) with trains contributing around 0.8% of UK total emissions (4.4 Mtonnes CO₂e/year³⁹); HS2 would be a much smaller proportion still of this total rail contribution. National and international studies⁴⁰ confirm that rail transport is consistently amongst the most carbon efficient mass transport modes in terms of emissions per passenger-km; high-speed rail is particularly efficient in this respect.
- 7.2.4. For this reason, it is desirable to encourage greater usage of the rail network, and to seek to expand and upgrade the network to satisfy increasing future demand for transport, in line with Government policy⁴¹. This is exemplified in major new projects such as Crossrail, Thameslink and the programme of rail electrification for existing routes being developed by Network Rail⁴². HS2 is thus an important component of Government transport policy, helping to provide additional low-carbon transport capacity as envisaged within the DfT's HLOS document⁴³. The HLOS document states (Para 5) *'The strategic intent is to develop the network in a way that will enable it to shoulder demand until High Speed Two (HS2) becomes operational, but is then able quickly to adapt and integrate around the high capacity HS2 corridor'*.

HS2 carbon dioxide emissions

- 7.2.5. The construction and operation of HS2 will give rise - directly and indirectly - to carbon dioxide (CO₂) emissions. These emissions would arise from elements such as the fabrication of construction materials, the transport of construction and excavated materials to and from sites, and the generation of electricity used to power the electric trains. These elements are common to all major transport projects, whether they are rail, road or aviation schemes. Carbon emissions are thus an inevitable consequence of society's transport choices.

³⁸ 2011 final UK figures: data tables. <https://www.gov.uk/government/publications/final-uk-emissions-estimates>.

³⁹ There are a range of gases that contribute to climate change, each with a greater or lesser impact compared with CO₂. As a result, measures of emissions tend to be equalised to a CO₂ equivalent (or CO₂e).

⁴⁰ 'Carbon Footprint of High Speed Rail', Systra for the UIC (2011); 'Comparing environmental impact of conventional and high speed rail', Network Rail (2009); 'Relative carbon performance of rail compared to other modes', Department for Transport (2007); 'T618 – Traction Energy Metrics', Rail Safety and Standards Board (2007).

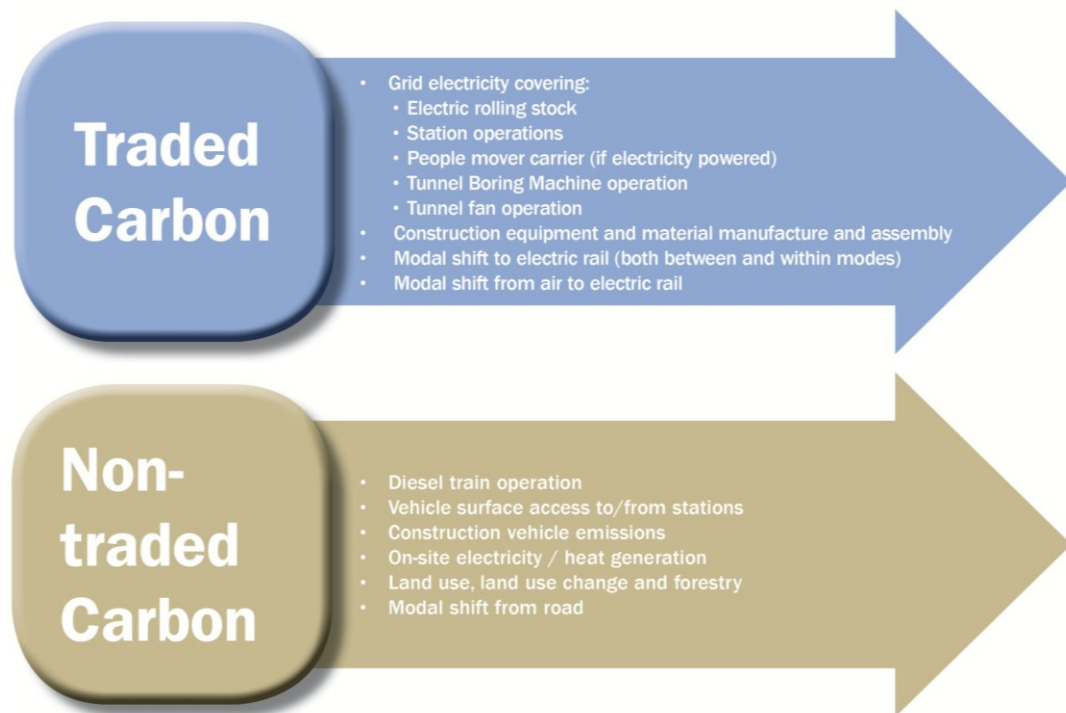
⁴¹ 'High Level Output Specification 2012', DfT <https://www.gov.uk/government/publications/high-level-output-specification-2012>

⁴² <http://www.networkrail.co.uk/asp/12273.aspx>

⁴³ 'High Level Output Specification 2012', DfT <https://www.gov.uk/government/publications/high-level-output-specification-2012Ref>

7.2.6. Most elements of carbon arising from HS2 fall within the EU's Emissions Trading System (EU ETS). This scheme sets a steadily decreasing cap on total carbon emissions and thereby ensures that carbon is reduced overall through measures such as efficiency improvements and adoption of new carbon-efficient technologies. Certainly, by bringing a greater number of emissions into the EU ETS, HS2 will be able to engender a greater influence on the UK's total carbon emissions.

Traded versus non-traded HS2 carbon



Potential carbon benefits from HS2

7.2.7. The presence of HS2 will induce 'modal shift' of passengers from road, conventional rail and aviation. These passenger shifts have the effect of reducing overall UK carbon emissions by displacing more carbon-intensive journeys on alternative transport modes.

7.2.8. Furthermore, there could be potentially significant secondary carbon benefits that arise from the construction of a wholly new rail transport scheme such as HS2. Because the new HS2 scheme would increase the total carrying capacity of the rail transport system, it would provide a means to free up capacity on existing rail networks (such as the WCML). If this 'released capacity' can then be used to transfer freight or passenger traffic from higher-carbon modes such as road or aviation to the existing rail network, a further carbon benefit arises. This benefit is unlikely to arise from alternative transport schemes that add no significant new strategic capacity.

7.2.9. Achieving these potential carbon savings relies partly on commitments that the HS2 project can itself make. But it also relies on a supportive and consistent wider

policy framework, in particular to deliver transport in line with long-term carbon goals as implied by the UK's commitment to decarbonisation of the economy⁴⁴.

Assessment of carbon futures

- 7.2.10. The analysis of future carbon outcomes from HS2 and other major, long-lived, transport schemes is a complex exercise, involving long-term projections of the UK's carbon future, its transport strategy, and travel demand context, much of which is very uncertain over the long term. Against this backdrop, estimates of HS2's carbon outcome depend as much upon the definition of these futures as they do on the innate carbon characteristics of the scheme itself. For example, alternative projections of the extent to which electric road passenger vehicles are taken up UK-wide over the next century may have an influence on the scale of relative carbon benefits from HS2's modal shift impacts.
- 7.2.11. The carbon report is expected to provide estimates of possible carbon outcomes of the scheme over a sixty year lifetime, using best judgement about alternative long term futures. Whatever this reveals, HS2 will undoubtedly provide a fundamental contribution to getting more people onto trains and thereby supporting a low carbon economy.

7.3. Climate resilience

- 7.3.1. Consideration of the resilience of the proposed scheme to the wider effects of climate change will be addressed in due course as part of the EIA. However, HS2 Ltd is committed to ensuring this resilience is considered within the design: one of the seven themes of its Sustainability Policy (see [Appendix B.4](#)) is to: "Build a network which is resilient for the long term and seek to minimise the combined effect of the project and climate change on the environment".

7.4. Safety and security

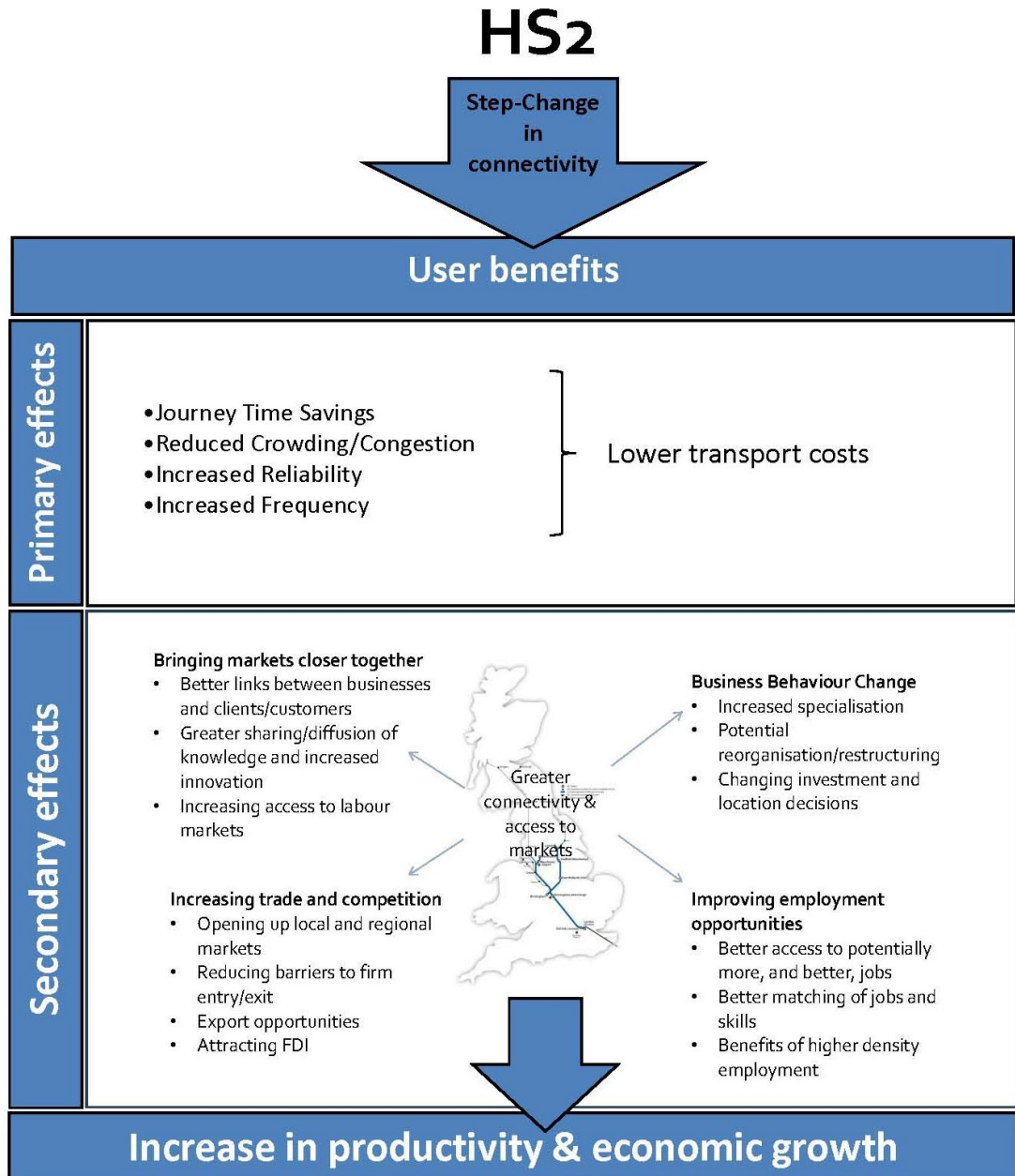
- 7.4.1. The introduction of HS2 would increase the choices that people make to travel between locations. Different modes of transport have varying degrees of risk levels associated with them due to the different hazards associated with each mode. Statistical evidence on injury and fatality rates shows that travel via rail or air is generally several times safer than travelling by road.
- 7.4.2. The AoS appraises the safety implications of HS2 (both Phase One and Phase Two). However, as this relies on data from the economic case, the more detailed safety technical appendix that would cover this topic has not been prepared at this stage.
- 7.4.3. The introduction of HS2 would offer an alternative mode of rail transport, which some people are expected to choose for certain journeys. If there are more people choosing to travel by rail than by air or by road, this would produce an overall shift in the risk levels to which these people are exposed and thus result in a change in overall safety.
- 7.4.4. HS2 could have a positive impact on safety, as relatively more dangerous journeys by car are replaced by much safer rail journeys on HS2 potentially resulting in a lowering of fatalities. Rail travel statistics also show significantly lower major injury rates compared to roads. The net change in injury levels would be a balance between any potential reduction in injury due to modal shift and potential increase

⁴⁴ *The Carbon Plan – Delivering our Low Carbon Future*, HM Government (December 2011).

in injury due to generated new demand for long distance high speed rail journeys by passengers who do not currently make that journey by road.

7.5. Wider economic issues

- 7.5.1. The more localised effects in terms of jobs and houses supported by new developments expected to come forwards around HS2 stations have been described in sections 5.3 and 6.3. This section considers the wider effects of HS2 on the economy, taking into account the full range of dynamic effects which may result from a transformational project such as HS2.
- 7.5.2. The proposed HS2 scheme represents a major transformation in the UK rail network and capacity and a significant public investment in national infrastructure. Such projects have the capacity to transform areas, driving longer-term shifts in economic performance and potentially altering the shape of economic geography.
- 7.5.3. The mechanisms through which HS2 could affect the productive capacity, economic performance, and economic geography of the UK are wide-ranging and complex. Analysis of the full potential economic impacts would need to consider the following ways in which the proposed scheme could increase productivity, and ultimately economic growth:
- **Improved market access.** Transforming journey times effectively shrinks distances between key cities and opens up markets. Businesses would have better access to a wider range of potential customers, suppliers, and labour. This would provide the opportunity for efficiency gains through improved sharing and diffusion of knowledge between businesses, which may also drive innovation, increased input-output linkages, and better access to labour with the best skills for the job.
 - **Increased trade and competition.** HS2 would open up opportunities for increased trade and competition between local and regional markets, and also promote wider export opportunities. By increasing access to markets it would reduce barriers to business entry/exit allowing for a more competitive marketplace, and potentially increased output and lower prices. Improved connectivity could also affect the ability of an area to attract foreign direct investment, particularly businesses that would have chosen to locate abroad without the opportunity provided by HS2.
 - **Change in business behaviour.** Wider market access and greater opportunities for trade and competition could also drive wider change in business behaviour, such as increased specialisation, potential re-organisation and re-structuring, and changes to investment and location decisions; all of which could lead to potential efficiency gains.
 - **Improved employment opportunities.** Opening up labour markets gives more people access to a wider range of jobs, and could improve the match between individuals' jobs and skills with resulting efficiencies. Potential changes in business behaviour could also lead to changes in the sectoral mix of employment opportunities, and higher density employment that could increase efficiency.



7.5.4. Given the difficulties in forecasting long term macroeconomic trends, and the complex interdependencies that determine the extent to which the potential economic benefits of a transport investment are realised, any estimate of the potential dynamic economic impacts (summarised above) would be subject to significant uncertainty. This type of analysis is outside the scope of the socio-economic appraisal for an AoS, and goes beyond the standard transport appraisal set out in the Economic Case for HS2. However, these types of impacts could be significant, and warrant further investigation. HS2 Ltd has set up a programme of work with the explicit aim of considering more widely how, as a transformational infrastructure project, HS2 could impact on the economy at the national and regional level. This work will:

- review the existing evidence on the links between transport, economic performance, and economic geography to understand the full range of mechanisms through which the proposed HS2 scheme could change economic outcomes;

- examine the economic impact of high speed rail in an international context, with a particular focus on the factors which affect the extent to which potential benefits are realised;
 - undertake new modelling to better understand potential impacts of changes in land-use as a result of the scheme;
 - consider the potential business behavioural responses to improved connections between cities in terms of trade, specialisation, industrial organisation and investment and location decisions; and
 - put evidence-based theory into a specific city/regional context to consider potential economic scenarios with and without HS2.
- 7.5.5. Early outputs of this work are expected to be available later this year. This is very much an emerging area, with a lack of any established methodology or consensus on approach. It is intended that early outputs provide the basis for a more informed debate on the approach in a way that can improve analysis of the full extent of potential economic impacts in future.
- 7.5.6. In reality, these mechanisms are closely linked and the ultimate impacts will depend to some extent on wider factors such as the prevailing economic climate, and integration with planning policy, local economic strategy and wider transport networks.

7.6. Direct employment

- 7.6.1. Estimates by HS2 Ltd of direct employment have been prepared for the Phase Two scheme as a whole. The operational scheme is expected to require an estimated 1,400 permanent jobs. Based on experience of previous large infrastructure projects, up to 10,000 jobs would be required at the peak of construction.

7.7. Phase One and Phase Two combined impacts

7.7.1. In order to provide an understanding of the sustainability performance of HS2 as a whole, this section summarises the potential combined impacts for Phase One and Phase Two, focusing on the appraisal categories that can be more easily quantified. The Phase Two data reflects the information reported in this document. Statistics for Phase One come from the draft ES for Phase One, where this provides equivalent information to the categories used in the table below (although these are based on a more detailed level of assessment and including potential landtake impacts from construction footprints). Where no equivalent category is available, the table reverts to data presented within the January 2012 [Updated AoS Report for Phase One](#)⁴⁵ to effect a meaningful comparison. This latter group comprises:

- Demolitions. The Phase One draft ES does not categorise properties in the same way as the Phase Two AoS and so does not allow for direct comparison.
- Jobs and houses supported. This was a category developed for the AoS and is not replicated by the Phase One draft ES.
- Materials figures. New figures are not yet available in the Phase One draft ES.

7.7.2. The information presented below is based on current designs for both phases, which have each been worked to different levels of detail and assessment. Some of the details will change as further design and assessment are undertaken and as further mitigation is introduced.

| | Phase One total | Phase Two Manchester | Phase Two Leeds | Phase Two total | Total |
|--|----------------------|----------------------|-----------------|-----------------|-------|
| Route characteristics (km) | | | | | |
| Total | 220.5 | 150.4 | 184.8 | 335.2 | 555.7 |
| At grade | 0.2 ⁽⁴⁶⁾ | 16.8 | 7.3 | 24.1 | 24.3 |
| Tunnel | 54.3 | 17.6 | 9.7 | 27.3 | 81.6 |
| Cutting | 73.5 | 55.8 | 75.1 | 130.9 | 204.4 |
| Viaduct | 20.0 ⁽⁴⁷⁾ | 14.3 | 32.7 | 47.0 | 67.0 |
| Embankment | 58.2 | 45.9 | 60.0 | 105.9 | 164.1 |
| Property and settlements | | | | | |
| Demolitions (residential) | 338 | 139 | 139 | 278 | 616 |
| Demolitions (community) | Not reported | 1 | 3 | 4 | - |
| Demolitions (commercial/retail) | Not reported | 99 | 128 | 227 | - |
| Demolitions (manufacturing/industrial) | Not reported | 2 | 9 | 11 | - |

⁴⁵ High Speed 2 London to West Midlands Appraisal of Sustainability - Post Consultation Route Refinements.

⁴⁶ Figure reflects detailed design incorporating landscaping and earth bunds.

⁴⁷ Another 14.2km is attributed to retaining walls and stations.

| | Phase One total | Phase Two Manchester | Phase Two Leeds | Phase Two total | Total |
|--|----------------------|----------------------|-----------------|----------------------|----------------|
| Total demolitions (including residential) | 528 | 241 | 279 | 520 | 1048 |
| Isolation and severance (number of dwellings) | 51 | 57 | 234 | 291 | 342 |
| Employment and housing | | | | | |
| Permanent jobs created | 1,500 | - | - | 1,400 | 2,900 |
| Construction jobs created | 9,000 | - | - | 10,000 | 19,000 |
| Jobs supported | 30,000 | 30,000-43,600 | 18,700-26,700 | 48,700-70,300 | 78,700-100,300 |
| Houses supported | Not reported | 3,100-4,100 | 2,100-3,500 | 5,200-7,600 | - |
| Jobs displaced ⁴⁸ | 800 | 1,900 | 2,900 | 4,800 | 5,600 |
| Noise | | | | | |
| People affected by noise (WebTAG annoyance) (mitigated scheme) | ~900 ⁽⁴⁹⁾ | ~250 | ~1,400 | ~1,600 ⁵⁰ | 2,500~ |
| People affected by noise (WebTAG annoyance) per km | ~4.1 | ~1.7 | ~7.6 | ~4.8 | ~4.5 |
| Landscape | | | | | |
| AONB crossed at surface (km) | 8.9 | 0 | 0 | 0 | 8.9 |
| Cultural heritage | | | | | |
| Scheduled Monuments directly affected | 1 | 0 | 1 | 1 | 2 |
| Registered Battlefields directly affected | 0 | 0 | 0 | 0 | 0 |
| Grade I & II* structures directly affected | 0 | 0 | 0 | 0 | 0 |
| Grade II structures directly affected | 19 | 3 | 5 | 8 | 27 |
| Registered Parks and Gardens directly affected | 2 | 0 | 0 | 0 | 2 |

⁴⁸ Figures accommodated in number for net jobs supported.

⁴⁹ Figure reflects baseline surveys and use of more accurate prediction method.

⁵⁰ Figure rounded according to Technical Report E6 – Noise and Vibration.

| | Phase One total | Phase Two Manchester | Phase Two Leeds | Phase Two total | Total |
|---|--------------------|----------------------|-----------------|-----------------|-------|
| Conservation Areas directly affected | 12 | 2 ⁽⁵¹⁾ | 6 | 8 | 20 |
| Biodiversity and wildlife | | | | | |
| Natura 2000 sites affected | 0 | 0 | 0 | 0 | 0 |
| SSSIs directly affected | 3 | 0 | 1 | 1 | 4 |
| Habitats of Principal Importance directly affected | 44 ⁽⁵²⁾ | 19 | 43 | 62 | 106 |
| Ancient Woodlands directly affected | 18 | 5 | 9 | 14 | 32 |
| Water resources and flood risk | | | | | |
| Major rivers diverted | 7 | 0 | 5 | 5 | 12 |
| Route through Flood Zone 3 (km) | 11.3 | 5.5 | 23.0 | 28.5 | 39.8 |
| Station/depot occupation of Flood Zone 3 (hectares) | 8.9 | 0.5 | 23.1 | 23.6 | 32.5 |
| Cutting or tunnel through SPZ 1 or 2 (km) | 14.4 | 1.7 | 0 | 1.7 | 16.1 |
| Land use resource | | | | | |
| Active landfills crossed | 0 | 2 | 3 | 5 | 5 |
| Grade 1 and 2 agricultural land (km) | 22.3 | 20.7 | 30.1 | 50.8 | 73.1 |
| Waste and material use | | | | | |
| Excavated material (M.m ³) | ~4 ⁽⁵³⁾ | 16.65 | 12.35 | 29.00 | 33.00 |
| Concrete (M.tonnes) | 6.56 | 3.11 | 3.66 | 6.77 | 13.33 |
| Steel (M.tonnes) | 0.67 | 0.32 | 0.41 | 0.73 | 1.40 |

⁵¹ One area (Trent and Mersey Canal) affected at two locations.

⁵² Numbers due for update based on new dataset.

⁵³ Phase One uses a net figure for surplus material assuming current re-use estimates within scheme design. Equivalent figures for Phase Two are prior to any mitigation considerations.

8. Continuing scheme design and EIA

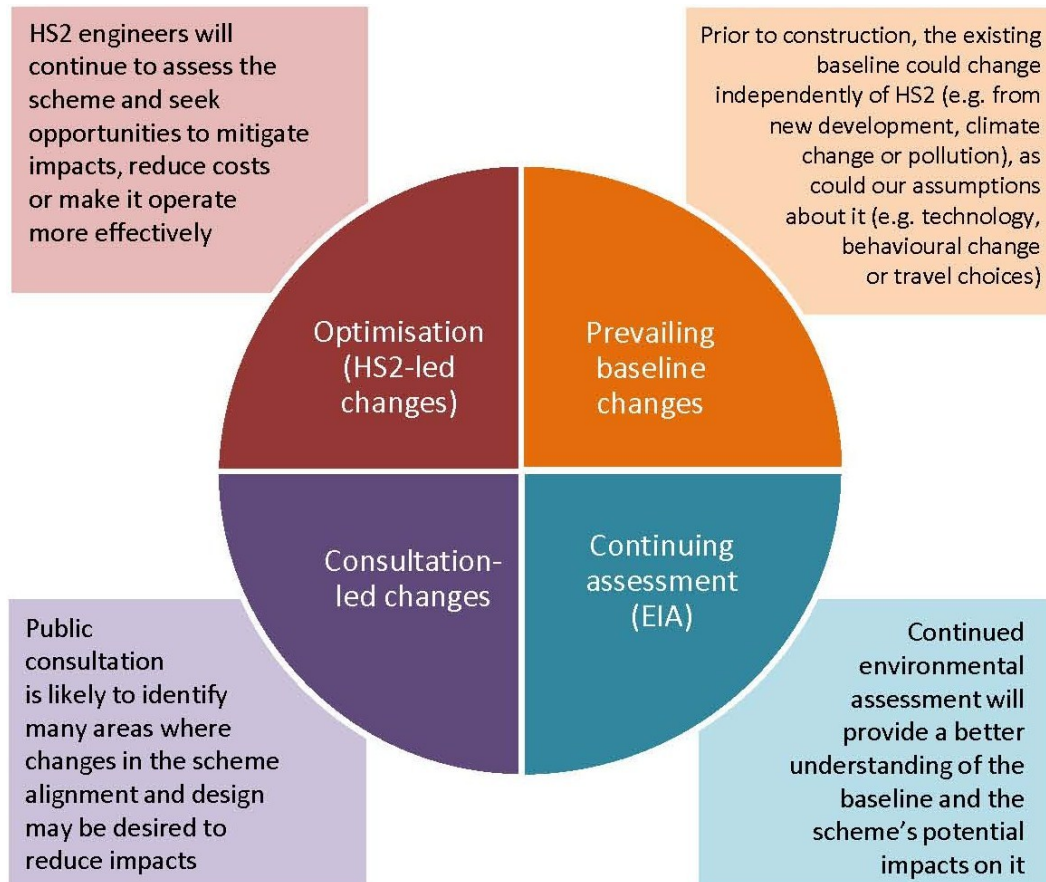
8.1. Next steps

- 8.1.1. This Sustainability Statement documents how sustainability has been integral to the development of the proposed scheme. It then describes the sustainability performance of the proposed scheme. This includes potential benefits; for example, from support for jobs (both directly and through the development that it brings forward), improved transport opportunities, safer travel and contribution to the low carbon economy. It also includes potentially adverse impacts; for example, through increased noise, changes to the landscape, loss of ecological habitats or production of waste. In this way, the Sustainability Statement benchmarks the sustainability performance of the proposed scheme for HS2 Phase Two based on a level appraisal appropriate up to this stage.
- 8.1.2. Over the coming months, the design will be developed further as a consequence of feedback from consultation and continued appraisal. Public consultation through to January 2014 will be a key part of this, and possible scheme refinements that emerge will be the subject of further AoS work. Once a preferred scheme is identified, it will be the subject of continued engagement that will take place in parallel with the EIA expected to take place during 2014 and 2015.
- 8.1.3. The sustainability performance of the scheme may therefore be improved as a result of the increased understanding of the scheme and its potential impacts. The way that these changes will be determined and implemented is set out below.

8.2. Benchmarking performance

- 8.2.1. The AoS has determined the sustainability performance of the proposed scheme, based largely on knowledge of the existing, baseline environment. However, up to and beyond the point that HS2 services on the full Y-network commence, the anticipated and actual sustainability performance of Phase Two may change. This might be because of changes to the scheme itself, such as refinements to the alignment or the adoption of specific measures to mitigate impacts or reflect best practice. It may be due to a better understanding of the environmental baseline developed during the EIA, which would determine the impacts of the scheme relative to a better understood baseline. Or it may be due to prevailing baseline changes, either in the environmental baseline or in factors such as behaviour, technology or transport choice. HS2 Ltd will put in place processes to monitor these and record any potential implications they might have for the scheme's anticipated sustainability performance, and as a result, to seek ways of improving the scheme's actual sustainability performance.

Expectations of the sustainability performance of the scheme may change over time driven by a number of factors



8.3. Monitoring change

- 8.3.1. Prior to construction, the EIA will be the mechanism used to identify and document the likely significant effects of the scheme, and therefore reflect any key changes in the anticipated sustainability performance of the scheme compared with those reported here. The EIA will involve a detailed assessment of impacts that relies both on in-depth research, detailed field assessments and consultation information. It will also assess a scheme that has numerous mitigation measures embedded within it, including detailed noise mitigation, proposed habitat creation and landscaping. The findings of the EIA will be reported in an Environmental Statement which will be publicly available and submitted with the hybrid bill.
- 8.3.2. Following the construction and operation of the scheme, HS2 Ltd would monitor the actual significant environmental effects in order to identify unforeseen impacts and, where necessary, to introduce appropriate remedial measures.
- 8.3.3. 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.

