High Speed Two Phase 2b
Crewe to Manchester
West Midlands to Leeds
Route refinements

HS2 Ltd's advice to Government

July 2017

www.gov.uk/hs2

Department for Transport

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1 Introduction

1.1.1 This advice lays out the recommendations of High Speed Two (HS2) Ltd for how the Phase 2b route should change from the preferred route presented at consultation in November 2016. The advice explains what changes are recommended, the rationale for these changes and how the impacts are expected to vary from the preferred route. Our aim is to ensure that the Secretary of State has a clear view of all of the proposed changes so he can make an informed decision about the Phase 2b route.

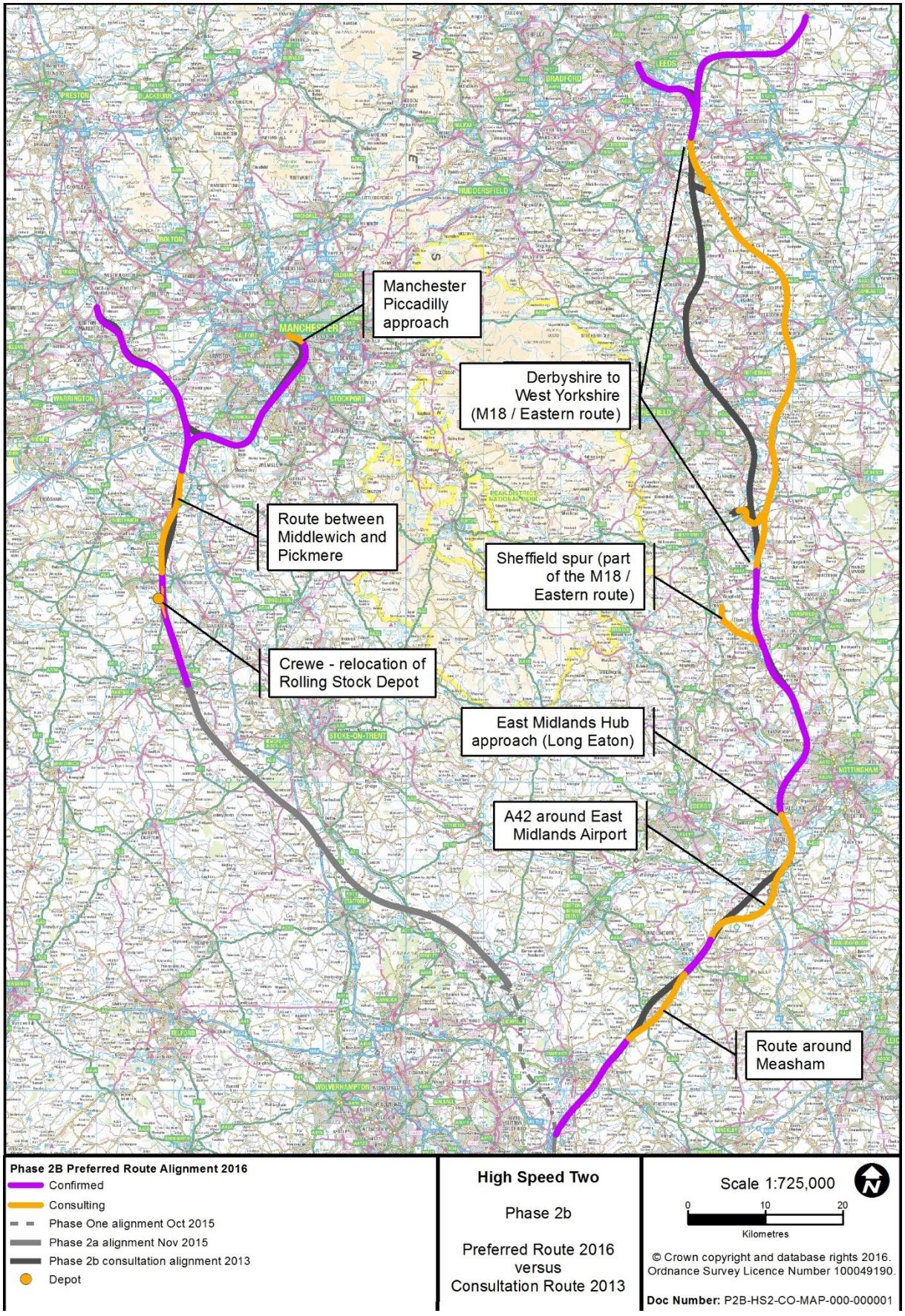
2 Scope of advice

2.1.1 The starting point for this advice is the preferred route presented for consultation in November 2016, as this is the last route which has been fully presented to Government and the public. Supporting material for this route has been previously published and is available at: www.gov.uk/government/collections/hs2-phase-two-from-the-west-midlands-to-leeds-and-manchester.

2.1.2 We provide advice on the seven proposed changes to the route that we consulted on between November 2016 and March 2017, following significant amendments to these parts of the route between 2013 and 2016. These seven proposed changes are (see also Figure 1):

- relocating the western leg rolling stock depot (RSD);
- the route between Middlewich and Pickmere;
- the Manchester Piccadilly station approach;
- the route around Measham, Leicestershire;
- the route along the A42 around East Midlands Airport;
- the East Midlands Hub approach (Long Eaton); and
- the route from Derbyshire to West Yorkshire (M18/Eastern Route).

Figure 1: Location of Phase 2b route refinements consulted on between November 2016 and March 2017



2.1.3 We also provide advice on the location of the eastern leg RSD. On the preferred route that the Secretary of State consulted on in November 2016, the proposed location of the eastern leg RSD is at New Crofton. However, it is recognised that the adoption of the M18/Eastern Route from Derbyshire to West Yorkshire, and the resulting approach into the depot, would result in greater impact on the local community than when we previously consulted on this in 2013. As a result, the Secretary of State requested HS2 Ltd undertake a study to consider alternative RSD sites on the eastern leg of Phase 2b. This advice document includes the outcomes of this optioneering work.

2.1.4 This advice does not cover Phase 2a, Crewe Hub or the work on the South Yorkshire Parkway and Connectivity Study, the outcomes of which need to be considered alongside this advice.

2.1.5 Subject to the agreement of the Secretary of State, changes recommended in this advice will be incorporated into hybrid Bill designs which will then be subject to further consultation as part of the hybrid Bill development process.

3 Phase 2b route development history

3.1 The 'Y strategy'

3.1.1 The concept and underlying strategy of the 'Y network' was advanced in the 2011 HS2 consultation, which also sought views on the route of Phase One between London and Birmingham. Following this consultation, the Government endorsed the phased 'Y model' and instructed HS2 Ltd to begin development of route options. The key requirements of this route were:

- to serve Manchester, Leeds, South Yorkshire and the East Midlands;
- to improve journey times to other destinations;
- to include connections to the classic network; and
- to consider connectivity to major airports.

3.2 Options Report 2012

3.2.1 Based on these requirements, HS2 Ltd undertook extensive optioneering work to develop route options in response to the Government's instruction. As we narrowed down the number of feasible routes, we examined the remaining options at progressive levels of detail to ensure that we focused our time on the most relevant and better performing options.

3.2.2 HS2 Ltd reported to Government in 2012 on options for a route for Phase Two[1]. This report described the challenges, assumptions and trade-offs adopted to deliver the work, and offered ministers a number of choices over route options, such as:

- serving the East Midlands through a station in Derby city centre or at Toton;
- serving South Yorkshire via a station at Sheffield Victoria or Meadowhall; and
- approaching Manchester either via the River Mersey or Manchester Airport.

3.2.3 Some of these options have since been revisited as part of our ongoing route refinement work.

3.3 Initial preferred route

3.3.1 Based on the options report, a number of site visits and discussions with potential station cities, ministers agreed an initial route for publication in early 2013. Route optioneering up to this point was confidential, to minimise the risk of unnecessary blight. This route is known as the initial preferred route.

3.4 2013 consultation route

3.4.1 The initial preferred route was subject to additional changes based on further discussion with ministers before consultation. The Phase Two consultation was opened in July 2013 and ran until January 2014.

3.4.2 The Phase Two 2013 consultation route was further refined and developed on the feedback and intelligence gathered through the Phase Two consultation, and through ongoing engagement with stakeholders and communities.

3.4.3 In October 2014, the report *Rebalancing Britain: From HS2 towards a national transport strategy*[2] outlined the challenges of poor connectivity and over-dependence on roads in the north of England, and suggested that this was leading to an imbalance in productivity and business opportunities compared to other parts of the UK. The report called for HS2 to:

- make cities and regions in the north more competitive by improving connectivity to global markets and to each other; and
- integrate with existing transport networks and improve connectivity within the Midlands and the north.

3.4.4 In March 2015, the Government and Transport for the North (TfN) published a joint Northern Transport Strategy. The strategy is to better connect the north of England's six major cities (Hull, Leeds, Liverpool, Manchester, Newcastle and Sheffield) and the

[1] *Options for Phase Two of the High Speed Rail Network*: https://www.gov.uk/government/publications/options-for-phase-two-of-the-high-speed-rail-network

[2] *Rebalancing Britain: From HS2 towards a national transport strategy*: https://www.gov.uk/government/publications/rebalancing-britain-from-hs2-towards-a-national-transport-strategy

North's biggest airport (Manchester Airport), with the right connections to the wider network. The Northern Powerhouse Rail (NPR) programme advanced by TfN is a key interface with the HS2 project, and, where appropriate, we note the potential linkages between the two in this advice.

3.4.5 In autumn 2015, the Government announced that delivery of the Phase Two route between the West Midlands and Crewe would be brought forward to 2027, to realise more of the benefits of Hs2 further north, sooner. This project is known as Phase 2a.

The Sheffield and South Yorkshire report

3.4.6 Since 2013, opinion among local stakeholders about the HS2 station location in South Yorkshire has remained divided and no consensus has been reached. This has made the decision about where best to locate an HS2 station in South Yorkshire very challenging. During this time, we reviewed options for South Yorkshire in light of these challenges and in the context of ambitions set by TfN for NPR, the results of which were detailed in the *Sheffield and South Yorkshire Report*[3] published by David Higgins in July 2016.

3.4.7 This report reviewed the options for a station in South Yorkshire, taking into account five key factors: demand (from South Yorkshire and markets further north); the needs of Sheffield and the wider region; connectivity with the existing rail network and the wider transport network; topography, urban density and the environment; and cost.

3.4.8 In particular, the report sought to ensure that any decisions balanced the need to serve South Yorkshire effectively with the need to avoid significant disbenefits to larger markets further north. The developing strategic context of the NPR project led us to reconsider how HS2 could improve connectivity between city centres in the north of England.

3.4.9 The Sheffield and South Yorkshire report laid out the options for serving South Yorkshire, making two key recommendations:

- That HS2 services should serve Sheffield Midland station in Sheffield city centre by running high speed 'classic compatible' trains into Sheffield via a dedicated link (spur) off the main high speed line. Under this proposition, the report stated it would be possible to provide up to two trains per hour into Sheffield city centre and a new high speed service to Chesterfield.

- That the high speed mainline be moved further east, initially running parallel to the M18. This alignment avoids the complexities and risks associated with the Meadowhall route and provides journey time savings for services heading to Leeds, York and Newcastle.

[3] *HS2: Sheffield and South Yorkshire Report 2016*: https://www.gov.uk/government/publications/hs2-sheffield-and-south-yorkshire-report-2016

3.4.10 The report also noted that using the existing Sheffield Midland station for HS2 services opened up the possibility of running high speed trains from Sheffield to Leeds by building a link back onto the main HS2 line north of Sheffield. This link could deliver TfN's ambition for a frequent 30-minute journey between Leeds and Sheffield, and might also be used by Birmingham–Leeds HS2 services, allowing them to route through Sheffield. TfN are considering the Sheffield–Leeds corridor alongside other NPR schemes.

3.4.11 The report also recommended that HS2 Ltd should undertake a study for a potential parkway station along the M18/Eastern Route, which could serve the South Yorkshire area as a whole. This study includes looking into the feasibility of extending HS2 services to locations beyond Sheffield Midland.

3.4.12 The Secretary of State asked HS2 to take forward the option set out in the Sheffield and South Yorkshire report, and this was the preferred Phase 2b route between Derbyshire and West Yorkshire that was presented for consultation in November 2016.

3.5 Phase 2b 2016 preferred route

3.5.1 The Phase 2b preferred route, announced in November 2016, is the route on which the 2016/17 consultation was based. It is the most recently published route and is therefore the starting point for this advice. A summary of this route is set out below.

3.5.2 The western leg of Phase 2b has a total length of 51 miles (82 km). At its southern end it connects to Phase 2a to the south of Crewe. Heading north, it passes under Crewe in a tunnel. At its northern end, the western leg joins the West Coast Main Line (WCML) at Golborne, south of Wigan. A spur from the HS2 mainline serves a new station at Manchester Airport before entering into an eight-mile (13km) tunnel to reach a new station at Manchester Piccadilly.

3.5.3 The western leg also includes a proposed rolling stock depot located to the north of Crewe, between the HS2 route and the WCML. This was part of the 2016/17 consultation and in this advice, we discuss our response to the feedback on this proposed location.

3.5.4 It should be noted that since the publication of the Phase 2b 2016 preferred route, consultation on the design refinements associated with the Phase 2a line of route (from the West Midlands to Crewe) has resulted in an extension and deepening of the tunnel under Crewe. The tunnel has increased in length by 2.55km (from 3.56km to 6.11km). This moves the interface between Phase 2a and Phase 2b further south, extending the length of the western leg of Phase 2b by approximately two miles to 53 miles (85km). It should be noted that this extension was not one of the seven proposed changes to the Phase 2b route that we consulted on between November 2016 and March 2017.

3.5.5 The eastern leg of Phase 2b has a total length of 123 miles (198 km). At its southern end, it connects to the Phase One route at Marston. At its northern end, the eastern leg joins the East Coast Main Line (ECML) by way of a connection at Church Fenton. The eastern leg includes a new station at Toton (East Midlands Hub), an infrastructure maintenance depot at Staveley and a new station at Leeds served by a spur from the HS2 mainline.

3.5.6 In November 2016, we proposed that South Yorkshire be served via a spur from the HS2 route, allowing services to join the Midland Main Line (MML) south of Chesterfield at Clay Cross, and travel on to Sheffield Midland. We also explained in November 2016 that we would be undertaking further work to consider alternatives to the location of the eastern leg rolling stock depot at New Crofton. We address the outcomes of this further work in this advice.

4 The 2016/17 consultation

4.1 Overview

4.1.1 The 2016/17 consultation document identified seven locations where we were proposing substantial changes to the route consulted on in 2013. The seven changes introduced new or different impacts on people, the environment or property. It is these seven changes that were consulted on. The seven proposed changes are described below, together with the questions we asked in the consultation.

4.2 Relocating the western leg rolling stock depot

4.2.1 Moving the proposed western leg rolling stock depot from a site near Golborne to a site north of Crewe between the A530 Nantwich Road and the WCML near Wimboldsley. This site would sit between the HS2 route and the WCML where the two lines diverge north of Crewe.

Question 1: *Do you support the proposal to locate the western leg rolling stock depot on the site north of Crewe? Please indicate whether or not you support the proposal, together with your reasons.*

4.3 Route between Middlewich and Pickmere

4.3.1 Changing the route over 26km in the Middlewich-Northwich area to avoid brining and gas storage infrastructure, and to minimise the risk of subsidence due to underlying geological conditions.

Question 2: *Do you support the proposal to change the alignment and raise the route through the Cheshire salt plains? Please indicate whether or not you support the proposal, together with your reasons.*

4.4 Manchester Piccadilly approach

4.4.1 Changing the alignment of the route on the approach to Manchester Piccadilly station to improve the operational efficiency of the station and avoid direct impacts on residential properties and a school at West Gorton.

Question 3: *Do you support the proposal to change the alignment of the approach to Manchester Piccadilly station? Please indicate whether or not you support the proposal, together with your reasons.*

4.5 Route around Measham, Leicestershire

4.5.1 Moving the route to the east of Measham in Leicestershire to avoid some of the significant impacts on the town, businesses and a major development site.

Question 4: *Do you support the proposal to realign the route to the east of Measham? Please indicate whether or not you support the proposal, together with your reasons.*

4.6 Route along the A42 around East Midlands Airport

4.6.1 Avoiding the need to tunnel under East Midlands Airport by instead passing to the east of the A42, east of the M1, east of the airport runway, under the access to the proposed East Midlands Gateway development and then past Kegworth in a cutting.

Question 5: *Do you support the proposal to realign the route in the area around East Midlands Airport? Please indicate whether or not you support the proposal, together with your reasons.*

4.7 East Midlands Hub approach (Long Eaton)

4.7.1 Amending the alignment of the route as it passes through Long Eaton to address local concerns about the creation of a physical barrier, impacts on the highway network and to reflect our improved understanding of flood risk in this area. The Secretary of State asked respondents to consider two options for the alignment in this area. Both options pass through Long Eaton directly to the east of the existing low level rail lines, either on a high level viaduct or on an embankment at a lower level.

Question 6: *Do you support one of the two options being considered by the Secretary of State for the alignment through Long Eaton? Please indicate which option you support, together with your reasons.*

4.8 Derbyshire to West Yorkshire (M18/Eastern Route)

4.8.1 Moving the alignment of the route from Derbyshire to West Yorkshire over 70km to reflect a change in the proposals for serving Sheffield, as proposed by Sir David Higgins in his Sheffield and South Yorkshire report, published on 7 July 2016.

4.8.2 Instead of travelling along the Rother Valley to a station at Meadowhall before heading north into West Yorkshire, the 2016 preferred route would follow the M1 and then the M18, passing between Conisbrough and Mexborough, and crossing more open country passing Thurnscoe, South Kirkby, Hemsworth and Crofton. This change in alignment would also require a change to the access to the proposed RSD at New Crofton.

4.8.3 To enable high speed services to serve Sheffield city centre and Chesterfield, a spur off the HS2 mainline was included between Huthwaite and South Normanton. This links into the existing Midland Main Line railway network south of Chesterfield by joining the Erewash Valley Line near Clay Cross.

Question 7: *Do you support the proposal to amend the route to serve South and West Yorkshire? Please indicate whether or not you support the proposal, together with your reasons.*

4.8.4 Changing the way Sheffield is served opens up the potential to meet TfN's aspirations for city-centre-to-city-centre connectivity if a junction was to be built onto the HS2 line north of Sheffield. The Secretary of State therefore sought views on the potential for an additional junction at Clayton to provide a northern connection to the high speed line.

Question 8: *Do you support the potential development of a northern junction to enable high speed services stopping at Sheffield to continue further north? Please indicate whether or not you support the proposal, and your reasons.*

Question 9: *Do you support the proposed location of the northern junction in the vicinity of Clayton? Please indicate whether or not you support the proposal, and your reasons.*

5 Drivers for refining the route

5.1.1 This advice describes the changes that HS2 Ltd recommends should be made to the Phase 2b route following the 2016/17 consultation. The drivers for these changes are presented below.

5.2 Post-2016/17 consultation route refinements

5.2.1 Following the 2016/17 consultation, HS2 Ltd considered whether it would be appropriate to refine the route in each of the seven areas in response to feedback received through the consultation.

5.2.2 In developing our refinements, we considered whether there were any new options that we had not previously considered, and whether the feedback from consultation had introduced any new considerations that had not been factored into our previous refinement activities. Where this has been the case, we have generated and assessed new options, and updated our appraisals as required.

5.2.3 Where consultation has not produced new options or issues, we have reviewed our previous recommendations to ensure that they remain valid.

5.2.4 This advice includes those areas where options were reviewed, but the recommendation is for no change. Where changes have been recommended, and if these are agreed by the Secretary of State, we will incorporate these changes into the hybrid Bill design.

5.2.5 Each route refinement area is discussed in Sections 8–14.

5.3 Relocation of the eastern leg rolling stock depot

5.3.1 Following engagement in the summer of 2016, a number of concerns were raised by the local communities about the location of the eastern leg rolling stock depot (RSD) at New Crofton.

5.3.2 As a result, and as reported in the Government's Command Paper on 15 November 2016, the Secretary of State requested that HS2 Ltd undertake a study to consider alternative RSD sites on the eastern leg of Phase 2b. The outcomes of this work are discussed in Section 15.

6 How we conducted the refinements

6.1.1 The HS2 Ltd route refinement process balances issues of engineering complexity, sustainability, cost, and business case performance to understand whether it may be possible to deliver alternative options that respond to the consultation. Possible changes were assessed against the route refinement baseline for that particular area (as described in the 2016 preferred route and 2016/17 consultation).

6.1.2 We have generated recommendations for how the route might be changed, for ministers to consider and respond to. It is for ministers to decide which changes they would like to see taken forward for development in the hybrid Bill process.

6.1.3 The drivers for each refinement are considered in the refinement summaries in Sections 8–14.

6.2 Summary of approach

6.2.1 Refinements were considered on a point-to-point basis, to ensure that options for refinement could be considered through pairwise comparisons, and that the key comparisons were clear.

6.3 Comparability of data

6.3.1 Sifting is a comparative exercise and so, in the interests of ensuring clarity and consistency across refinements, the same data sets were generally used throughout the process.

6.3.2 Although the options are consistent and comparable within each area, the information used to inform sifting comparisons cannot be applied directly to the route refinement baseline. This is because the refinements were not compared on the basis of the whole route, and because we have not updated the appraisals where our focus was on validating our previous advice against the 2016/17 consultation feedback.

6.4 Process overview

6.4.1 We sifted the refinement options to increasing levels of detail (described as initial, intermediate and full sift). This enabled us to prioritise the more promising refinement options. However, it is important to note that options which are 'parked' at these earlier stages of sifting, can be reviewed subsequently.

6.4.2 Reflecting the increasing level of detail, our recommendations for which refinements should be taken forward were also made subject to increasing levels of scrutiny:

Initial sift: Options at initial sift were considered by the relevant technical teams within the Phase 2b directorate.

Intermediate sift: Options at intermediate sift were considered by a panel drawn from the Phase 2b senior management team, including the head of route engineering, head of environment, head of stakeholder engagement, and policy manager.

Full sift: At full sift, a Change Forum with members drawn from across HS2 made recommendations on which refinements should be presented to ministers. The Department for Transport (DfT) is represented at this stage by their HS2 Programme Representative (P-Rep).

6.4.3 A number of criteria are used to consider the relative merits of different options. Broadly, these fall into the following categories: constructability; sustainability; journey time; cost; and demand/business case.

6.5 Exclusions

6.5.1 As with the approach we took during the same stage of Phase One of HS2, detailed feedback from stakeholders on the potential environmental impacts of each option – as opposed to the mitigation inherent in each alignment (e.g. avoidance of communities, businesses and environmental features, so far as possible) – was not used to differentiate options. Examples of this feedback include concerns about the detailed design of structures associated with an option, and concerns about potential localised noise and visual impacts.

6.5.2 Recommendations therefore reflect the expectation that it will be possible to address many of these concerns as we carry out further design, assessment and engagement activities.

6.5.3 At this stage of design, we have not generally considered other issues including the realignment of local highways and the impacts of construction, including phasing, management of construction traffic and location of work sites. We have also not considered in detail ancillary items, including ventilation shafts, at this stage.

6.5.4 Highway impacts were considered where they were a differentiator between options, and we have reviewed the preferred route and refinement route crossings of motorways and trunk roads with Highways England. At this stage, all highways realignments are indicative and would require further design, assessment and engagement.

6.5.5 There will be a number of opportunities to raise these detailed issues as part of further scheme development for local communities, stakeholders and members of the public. In addition to ongoing stakeholder and community engagement activities, the principal formal opportunities will be:

- public consultation on the working draft *Environmental Impact Assessment Report;*
- public consultation on the final *Environmental Impact Assessment Report; and*
- the Phase 2b hybrid Bill petitioning and Select Committee processes.

7 Route refinement recommendations

7.1 Overview

7.1.1 The process outlined above has produced a recommendation for each refinement area that was consulted on during the 2016/17 consultation. These recommendations are summarised below, before being discussed in greater detail in Sections 8–14.

7.1.2 Section 15 deals with the recommendations from the work to look into alternative locations for the eastern leg rolling stock depot (RSD).

7.2 Relocating the western leg rolling stock depot

7.2.1 **Recommendation:** The location of the western leg RSD should remain at the proposed site to the north of Crewe, near Wimboldsley. This site delivers a good fit with the requirements for an RSD. It has a straightforward connection to the West Coast Main Line (WCML) – enabling good access for HS2 services from the classic network – is centrally located on the western leg, and delivers reductions in impacts elsewhere on the route – notably sustainability impacts on listed buildings and Sites of Specific Scientific Interest (SSSIs) at Golborne. Moving the RSD from Golborne also means that significantly less infrastructure is required at the junction to Manchester, including the 4.5-mile (7km)-long northern chord that linked the Manchester spur and mainline, and associated grade separated junctions. The purpose of the chord was to enable empty trains to move between the RSD that was previously located at Golborne and Manchester Piccadilly station. The relocation of the RSD means that this section of the track will no longer be required, resulting in less land take and less noise and visual impacts in this area. It also significantly reduces the estimated cost of the route.

7.3 The route between Middlewich and Pickmere

7.3.1 **Recommendation:** The route between Middlewich and Pickmere should remain as set out in the 2016 preferred route. This alignment avoids direct interfaces with existing brining and gas storage infrastructure, such as caverns, wellheads and surface infrastructure, and would minimise the risk of subsidence from ground movements in the brinefield site. This reduces construction and operational risk, and addresses specific concerns over the long-term liability to HS2 Ltd as a result of passing over underground caverns. The route is raised in this area to allow for careful management of drainage and geological risk and provide more flexibility with regards to ground stability mitigation options.

7.4 Manchester Piccadilly approach

7.4.1 **Recommendation:** The tunnel alignment set out in the 2016 preferred route remains the optimal approach into Manchester Piccadilly. This alignment reduces the flood risk by moving the tunnel portal out of the Corn Brook floodplain, and reduces engineering complexity by moving away from existing railway viaducts. The changes also allow the approach to Manchester Piccadilly to be straightened, maximising operational capacity and reducing the impact on the existing structures at Manchester

Piccadilly. The relocated tunnel portal to the north of the TransPennine Express rail line reduces impacts on the existing railway during construction. Previous community impacts at West Gorton are also avoided, including a cluster of residential demolitions, a major development site and a local primary school.

7.4.2 Initial technical work has demonstrated that the existing Ardwick rail depot on the site of the northern tunnel portal can be reconfigured around HS2 to provide for both current and proposed future functionality. We will also consider any opportunities the site may provide for a future construction railhead to enable the construction of the tunnel. There will be further consideration of ventilation shaft locations for the Manchester tunnel, and the potential implications of the HS2 proposals for Northern Powerhouse Rail (NPR) during hybrid Bill development.

7.5 The route around Measham, Leicestershire

7.5.1 **Recommendation:** The route around Measham in Leicestershire should be amended to follow the A42 corridor. Major concerns were raised during the 2016/17 consultation regarding the 2016 preferred route to the east of Measham. These focus on the impact of 'islanding' a number of communities as a result of the line of route moving away from the A42 transport corridor, the increased noise and visual impacts on communities and the impact on local jobs. In response to the consultation, we have undertaken work to understand if the 2016 preferred route could be amended to avoid key impacts. This work confirmed that this was not possible at this stage of design.

7.5.2 We therefore recommend that the 2016 preferred route going to the east of Measham should be discounted in favour of a route in the A42 corridor, which is a refined version of the route presented for consultation in 2013. This route involves amending the 2013 consultation route by extending the River Mease viaduct and moving the route approximately 80 metres to the east as the route crosses the Westminster Industrial Estate. It avoids direct impacts on the main factory building belonging to Plastic Omnium Ltd, a key supplier to Jaguar Land Rover, which was a key concern about the 2013 consultation route. Our noise appraisal suggests that this route would result in lower overall noise impacts than the 2016 preferred route, reflecting less disturbance on local communities. It is important to note that this appraisal does not factor in the existing noise caused by the A42.

7.5.3 The other main concern about the 2013 consultation route related to the impact on a strategic development site at Measham Wharf, which has outline planning permission for 450 dwellings. While this impact will be slightly increased as a result of the proposed change, North West Leicestershire District Council has confirmed that alternative sites are available to deliver their strategic housing allocation targets for the area.

7.5.4 Further work and engagement will be required to manage outstanding concerns, including property impacts, and concerns from Plastic Omnium Ltd over vibration, access and disturbance. In addition, our new recommendation does reintroduce an impact on the A42.

7.5.5 The proposed change introduces a small upward cost pressure on the Phase 2b scheme.

7.6 The route along the A42 around East Midlands Airport

7.6.1 **Recommendation:** The 2016 preferred route remains the optimal solution for the route in this area, based on the significant cost saving and reduced engineering challenges that result from removing the need to tunnel under East Midlands Airport.

7.7 East Midlands Hub approach (Long Eaton)

7.7.1 **Recommendation:** Of the two options consulted on through Long Eaton, the high level viaduct option should be adopted. This option lengthens the viaduct through Long Eaton, with HS2 directly to the east of the existing low-level rail corridor. Compared to the 2013 consultation route and the lower level option consulted on in 2016/17, this option reduces the interactions between HS2 and the existing rail network. It requires less disruptive work on existing railway infrastructure and would help address concerns over the interaction between HS2 and the floodplain in the area. The higher level option also maintains east–west permeability through Long Eaton.

7.8 Derbyshire to West Yorkshire (M18/Eastern Route)

Strategic challenge – Meadowhall route (2013 consultation route)

7.8.1 **Recommendation:** Further analysis of the strategic criteria for the route through South Yorkshire does not support a move back to the Meadowhall route that formed the 2013 consultation route.

Northern loop and connection

7.8.2 **Recommendation:** If Hs2 were to serve Sheffield via Sheffield Midland station, there was general support in the 2016/17 consultation for the principle of a connection between HS2 and the existing network to the north of Sheffield, to enable services to 'loop' through South Yorkshire. This support was partly driven by an interest in facilitating improved Sheffield–Leeds connectivity as part of NPR aspirations.

7.8.3 Some feedback to the consultation raised suggestions for an alternative location for this connection. Network Rail is currently examining what work would be required to facilitate such a connection. At the moment, for the purpose of our business case, we continue to assume that this connection would be located at Clayton, and we will review this position in the light of Network Rail's work, and the wider feasibility work being undertaken as part of the NPR project.

Sheffield spur location

7.8.4 **Recommendation:** The location of the Sheffield spur to remain as set out in the 2016 preferred route. The HS2 spur to join the existing railway near Clay Cross is located near the A38 and Hilcote. Following suggestions made during the 2016/17 consultation, we looked at options for creating a spur further south, connecting HS2 to the Erewash Valley line to the north of Toton. However, these options significantly

increase journey time on the Phase 2b route from Long Eaton to Sheffield Midland, and also increase the cost associated with the route due to the additional electrification required on the classic network. We will undertake work as part of the hybrid Bill preparation to look at solutions that reduce impacts of the proposed spur, particularly on communities at Newton, Blackwell and Hilcote.

New corridors to the east of the M18

7.8.5 **Recommendation:** No change to the 2016 preferred route corridor in this area. We considered new corridors to the east of the existing M18/Eastern Route as part of efforts to avoid impacts at Wales, Aston, Bramley, Mexborough and Barnburgh. These new corridors would introduce impacts on new communities without delivering any improvement in the overall performance of the route.

Aston

7.8.6 **Recommendation:** No change to the 2016 preferred route alignment past Aston. We considered alternative vertical alignments, including a bored tunnel and a cut-and-cover tunnel as the route passes Aston. A bored tunnel introduced additional engineering and operational challenges, as well as additional cost. A cut-and-cover tunnel option could be considered in more detail during hybrid Bill development alongside further work to assess other potential mitigation options and highways realignments.

Mexborough

7.8.7 **Recommendation:** No change to the 2016 preferred route alignment past Mexborough. We considered refinements to reduce impacts at Mexborough, including moving the route to the east of Conisbrough (building on suggestions made in response to the consultation), moving the alignment locally to the east of the Shimmer housing estate to go through the Denaby Industrial Estate, and moving the route into a twin bored tunnel underneath Conisbrough.

7.8.8 Moving the route to the east of Conisbrough would introduce new community impacts elsewhere. This would also increase impacts on environmentally sensitive locations, including on a number of ancient woodlands and two SSSIs at Sprotbrough Gorge and New Edlington Brickpit. These impacts would result in the permanent loss of habitat and potential local amenity during both construction and operation. This route does, however, remove impacts on housing estates at Mexborough and reduce some of the landscape and visual impacts on the preferred route in this area. At the current stage of design, we do not consider that the case is sufficiently strong to change the preferred route to this new alignment. Given the different impacts, risks and opportunities associated with the preferred route and a route to the east of Conisbrough, we will keep this assessment under review as our design work progresses during the hybrid Bill process.

7.8.9 Moving the alignment locally to the east of the Shimmer housing estate would result in more commercial demolitions as a result of going through the Denaby Industrial Estate, and a slight increase in noise impacts. While tunnelling underneath Conisbrough would result in fewer demolitions and landscape and visual impacts,

tunnelling would involve a significant increase in cost and would introduce impacts in other areas.

Barnburgh

7.8.10 **Recommendation:** No change in the 2016 preferred route alignment past Barnburgh. As with the route at Aston, we considered alternative vertical alignments, including different lengths of bored tunnel, to try and reduce the size of the embankments past Barnburgh. A bored tunnel would involve significant additional cost. We will undertake further work during hybrid Bill development to assess potential solutions to reduce the impact on landscape as the route passes Barnburgh.

7.9 Relocation of the eastern leg RSD

7.9.1 **Recommendation:** The location of the eastern leg RSD should be moved from the site at New Crofton to a site located east of Leeds in the Aire Valley adjacent to the M1. The site forms part of the Temple Green development planned for the Leeds City Region Enterprise Zone at this location.

7.9.2 Following the instruction from the Secretary of State, we have looked at a range of options, both on the Leeds spur and on the HS2 mainline. We have ruled out a number of these for a variety of reasons, including cost, environmental, highway and community impacts.

7.9.3 Following the change in the M18/Eastern Route alignment announced in November 2016, further work demonstrated that there were significant concerns regarding the operational constraints imposed on the New Crofton site by the amended route alignment. The consultation exercise also endorsed community concerns regarding the impact of the site that were raised in the summer of 2016.

7.9.4 The depot layout at the proposed new site to the east of Leeds works better operationally than the layout of the site at New Crofton and there is scope to further improve the layout and operational arrangements of the site to the east of Leeds. Engagement with Leeds City Council on the proposed site indicates that there is the potential for joint working to identify opportunities to align aspirations for development plans in the area.

7.9.5 As the proposed new site is on the Leeds spur, this may create the need for additional stabling and maintenance loops elsewhere. We will develop proposals during the hybrid Bill process to identify the most appropriate way of addressing these challenges. We remain confident that a solution will be deliverable, and our initial costing of this additional infrastructure has been factored into our decision-making.

7.9.6 The proposed new site could potentially be utilised as a construction compound for the Leeds spur given the complexities of constructing the Leeds spur corridor (including the Woodlesford tunnel) and associated works alongside the existing Network Rail corridor up to Leeds station.

7.9.7 The newly proposed RSD facility east of Leeds is cheaper than the depot facility at New Crofton. Further investment may be required to provide the necessary operational flexibility, including additional stabling and maintenance loops (as

previously mentioned). This introduces a small upward cost pressure, but doesn't fundamentally change the case for the new site.

7.9.8 We expect that, in the event that the Secretary of State is minded to change the RSD location on the eastern leg, this will require further consultation.

7.9.9 Subject to the agreement of the Secretary of State, all recommendations arising from the route refinement process will feed into the hybrid Bill design.

8 Relocating the western leg rolling stock depot

8.1 Overview

8.1.1 The 2013 consultation route included a proposed rolling stock depot (RSD) located near Golborne, to the south of the HS2 junction with the WCML. During the 2013 consultation, concerns were raised about the sustainability and environmental impacts of the RSD, including the direct impacts on the Grade II* listed Lightshaw Hall, indirect impacts on the Grade II listed Byrom Hall, Abram Flashes SSSI and Pennington Flash Country Park. As a result, we received suggestions via the 2013 consultation that the RSD should be relocated.

8.1.2 The RSD is designed for the overnight stabling of trains, cleaning and maintenance. We expect that each HS2 RSD location will support around 125 new jobs in the local area when the railway is operational.

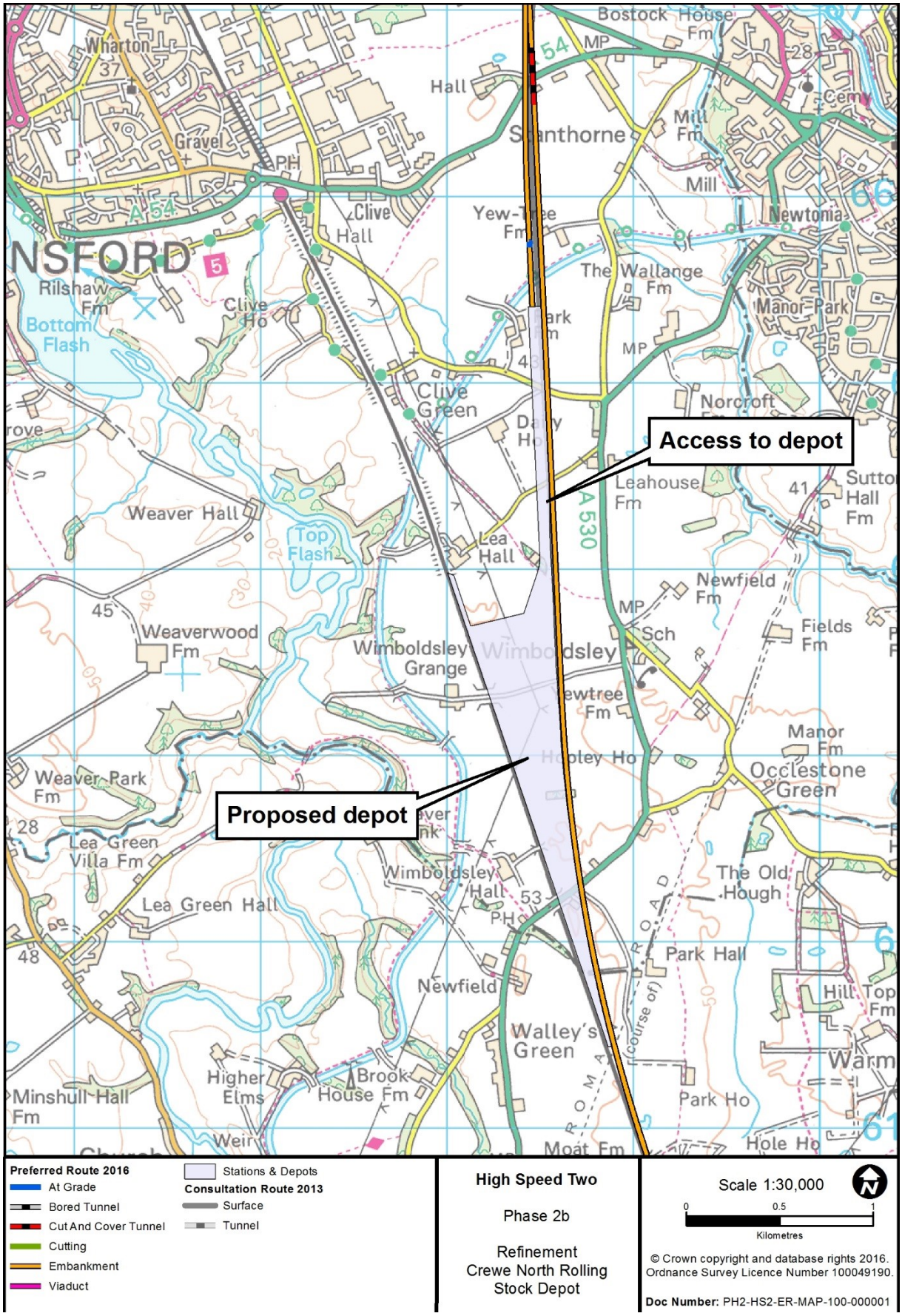
8.1.3 Following the consultation in 2013, we considered a range of alternative locations across the western leg that could meet the requirements for the RSD site. The requirements include: a large, flat site; a connection to the existing network; and a strategic location to facilitate access to the depot for HS2 trains serving destinations such as Liverpool, Manchester and Preston. Having done this work, the 2016 preferred route recommended moving the proposed RSD to a site to the north of Crewe between the A530 Nantwich Road and the WCML near Wimboldsley.

8.1.4 This site would sit between the HS2 route and the WCML where the two lines diverge north of Crewe. It provides a large, flat site, with opportunities for a connection to the existing network, and delivers reductions in impacts elsewhere on the route, including at Golborne. Moving the RSD from Golborne to the north of Crewe would also mean that significantly less infrastructure is required at the junction to Manchester.

8.1.5 In order to access the RSD north of Crewe, a grade separated junction is proposed in the area between Winsford and Middlewich. This junction would require a viaduct up to 16 metres high to allow one track to cross over the HS2 mainline to enable southbound trains to access the depot.

8.1.6 The RSD location proposed as part of the 2016 preferred route is shown in Figure 2.

Figure 2: Plan showing proposed location of Phase 2b western leg RSD to the north of Crewe



8.2 Consultation feedback on the 2016 proposed depot relocation

8.2.1 A range of views were expressed about the proposed move of the RSD to the site to the north of Crewe during the 2016 /17 consultation. There was support for the move on a number of grounds, including from respondents in both Golborne and Crewe. Some respondents expressed the view that, although the newly proposed site was not without environmental impacts, they were less significant than those associated with the site at Golborne.

8.2.2 Some respondents, such as the Environment Agency and local wildlife trusts, claim that the proposed new site would have a lower environmental impact than the Golborne site. For example, they highlight that the northern chord and crossing at Agden would no longer be necessary, reducing local environmental impacts. The Woodland Trust claims that the site proposed for the RSD would not impact on ancient woodland or old trees.

8.2.3 Other respondents cited their support for the proposed relocation based on the transfer of impacts from a residential area at Golborne to an agricultural area to the north of Crewe. The avoidance of previous impacts on Taylor Business Park and the village of Lowton were other cited examples of benefits of the proposed relocation.

8.2.4 Others stated that they supported the proposed relocation as it provided better connections to the existing transport network, with the proposed site adjacent to the existing WCML. A number of respondents supported the proposed relocation on the basis of the removal of the northern chord of the Manchester junction as a consequence of moving the RSD.

8.2.5 Some respondents expressed the view that moving the site of the RSD might bring employment to Crewe – a place with an historic association with the railway industry.

8.2.6 A larger number of respondents objected to the relocation. They expressed concerns over potential impacts around the new depot site, particularly the working hours of the depot and the associated noise and visual impacts on schools, residences and businesses nearby. In particular, concerns were raised regarding the visual impacts of the RSD due to the embankments and viaducts. Respondents believe that these impacts will be exacerbated by the flat nature of the surrounding landscape. They also raised concerns that the RSD will lead to increased rail traffic in the area and therefore cause an increase in noise, visual intrusion and environmental damage. The impact of air quality and noise during both construction and operation on Wimboldsley Primary School was raised as a particular concern.

8.2.7 A number of respondents emphasised the rural nature of the area, comparing this unfavourably to what some believe to be the choice of a brownfield site near Golborne. They also raised concerns about the proximity of the RSD to the Shropshire Union Canal, and the loss of agricultural land to the RSD and the potentially negative impact this could have on agricultural businesses in the area.

8.2.8 Other environmental issues raised by respondents included concerns that the construction and operation of the RSD will impact on the amenity of the local area,

such as access to the countryside, local footpaths and bridleways. Respondents expressed concerns about proposed watercourse diversions – for instance the River Dane and Wimboldsley Wood SSSI which are downstream of the RSD - and that the work could exacerbate flood risk and be affected by flooding itself. The Environment Agency also raised concerns about potential land contamination. Some respondents raised concerns that the RSD will separate heritage sites from nearby areas.

8.2.9 Concerns were raised about the impact of the construction phase on the existing transport network. In particular, respondents raised concerns about whether the local road network has the capacity to carry HS2 construction traffic and local traffic without a significant increase in congestion and disruption.

8.2.10 In contrast to those who supported moving the RSD because of the consequent removal of the northern chord of the Manchester junction, some respondents, including Manchester Airports Group, objected to this, as they believe it could hamper attempts to improve rail connections between Manchester and towns and cities to the west and north of it.

8.2.11 As with the route refinement further north, between Middlewich and Pickmere, stakeholders questioned whether the railway can be safely constructed in this area given the underlying ground conditions and history of salt mining and gas storage. Some respondents stated that construction could cause underground watercourses and salt streams to be redirected, which could affect the structural integrity of properties.

8.2.12 Consultees suggested a number of alternatives to this relocation. These were: moving the RSD back to Golborne; moving the RSD to Basford sidings; building the RSD in a tunnel or culvert; upgrading the WCML; and constructing parts of this section of the route in tunnel. Some respondents also suggested finding an alternative brownfield site for the location of the RSD.

8.3 Responding to the consultation feedback

8.3.1 We have previously considered a range of alternative sites for the location of the RSD, including brownfield sites. However, no brownfield sites were available that met the requirements of the RSD on the current line of route. It is worth noting that the previously located RSD at Golborne is not a brownfield site, as suggested in a number of consultation responses. While the RSD site to the north of Crewe is also not a brownfield site, the site would have become sterilised, situated as it is between the WCML and the HS2 mainline.

8.3.2 Basford was not considered as a location for the Phase 2b western leg RSD, as it would be located too far away for empty rolling stock movements from Manchester, Liverpool and Preston. The site was also considered as an unsuitable location for an infrastructure maintenance depot on Phase 2a, due to the impacts on a 370-plot housing development, 55-acre business park and existing rail infrastructure.

8.3.3 In responding to suggestions that the RSD should be built in a tunnel or culvert, the RSD location was driven by the requirements for a large, flat site with connections to

the classic network with the aim of providing a cost-effective solution. An underground depot site would be more costly and would be unlikely to meet the requirements of the depot.

8.3.4 In light of the consultation feedback, we have reviewed the decisions we have previously made regarding the location of the western leg RSD to ensure that the location to the north of Crewe remains the optimal solution. This work has been done particularly in the context of some suggestions for the depot location to return to Golborne.

8.3.5 As a result of this work, we recommend that the location of the western leg RSD should remain at the proposed site to the north of Crewe (as shown in Figure 2 above).

8.3.6 The site to the north of Crewe which, following the construction of HS2, would sit between the HS2 route and the WCML, would deliver a good fit with the requirements for an RSD. It has a straightforward connection to the WCML (enabling good access for HS2 services from the classic network), is centrally located on the Manchester leg, and delivers reductions in sustainability impacts elsewhere on the route – including at Golborne and other alternative sites. Moving the site away from Golborne removes direct impacts on Grade II listed buildings at Lightshaw Hall and Byrom Hall, and reduces proximity to Abram Flashes SSSI and Pennington Flash Country Park. It also reduces impacts on the Leeds and Liverpool canal users.

8.3.7 Moving the RSD from Golborne to the north of Crewe would also mean that significantly less infrastructure is required at the junction to Manchester. The purpose of the 4.5-mile (7km)-long northern chord that linked the Manchester spur and HS2 mainline via grade separated junctions at each end was to enable empty trains to move between the Golborne RSD and Manchester Piccadilly. The relocation of the RSD to Crewe North would mean that this section of the track would no longer be required, resulting in less land take, noise and visual impacts in this area, and would significantly reduce the estimated cost of the route.

8.3.8 We are aware that there are issues and concerns that remain with the proposed RSD location, although a number of these are also associated with the mainline alignment. There would be a moderate impact on the Grade II* listed Lea Hall and associated Grade II listed Gate Piers, and a moderate setting impact on the Grade II listed Park Farmhouse. There would also be minor impacts on the setting of the Grade II* listed Twelve Acres Farmhouse.

8.3.9 Other environmental impacts include visual and noise impacts for local residents of Wimboldsley – including the primary school and users of the Shropshire Union Canal – and landscape impacts arising primarily from the grade separated depot connections and the depot itself within largely open, flat rural landscape.

8.3.10 There are five demolitions at the southern end of the depot site, which were already isolated between the WCML and HS2 mainline. There would also be a wider crossing over the Shropshire Union Canal at this location.

8.3.11 We will work closely with local communities and stakeholders as part of further design development during hybrid Bill preparation to mitigate these issues and concerns – in

particular, to mitigate noise, visual and lighting impacts of the depot itself and the impacts of construction.

8.3.12 We will also engage with the Canal and River Trust to discuss their concerns regarding the wide four-track crossing over the Shropshire Union Canal, seeking to design the viaduct around the users of the canal.

CASE STUDY: Mitigating impacts through hybrid Bill development

During the HS2 Phase One hybrid Bill process it was possible to address concerns expressed by communities around the provision of large permanent railway facilities. We addressed these concerns largely through the design of the scheme and associated mitigation measures, and through reaching agreements with stakeholders.

The Phase One scheme, including the infrastructure maintenance depot (IMD) between the villages of Steeple Claydon and Calvert is a good example of this. Here, we included a wide range of measures in the scheme to address local concerns, which were primarily about the noise and visual effects of the scheme and construction traffic. Retained cuttings were included in the scheme to reduce noise and visual effects and to reduce land take from the Great Moor Sailing Club. Noise fence barriers were provided on top of the retaining walls to further reduce noise impacts on local residents. Landscape earthworks along the full length of the north side of the IMD, complemented by planting, were included in the hybrid Bill to reduce the visual impact on Steeple Claydon village. Green bridges were also included to maintain flight lines and habitat for a number of bat species as well as other wildlife. This has included creating significant areas of woodland habitat to strengthen flightlines and enhance roosting and foraging opportunities.

We introduced further mitigation measures around the IMD during the Select Committee process. Due to local concerns about light pollution from the facility changing the nature of the night sky in this rural area, a commitment was given to Aylesbury Vale District Council requiring their approval for the location and detailed design of artificial lighting used at the IMD. We also committed to running community engagement activities in the area around the IMD to provide the local people with the opportunity to inform the facility's detailed design. Finally, we committed to create a workforce travel plan, not just for the construction, but also for the operational phase of the scheme to reduce the number of vehicles using the rural roads around the IMD.

8.4 Wider network interfaces

8.4.1 We will continue to engage with stakeholders to ensure that the route in this area, and the operation of HS2, aligns with their needs and aspirations. Empty trains will access the RSD from both HS2 infrastructure and the existing network. Accordingly, we will continue to consider how the proposed RSD should integrate with existing and proposed infrastructure in the Crewe area, and we are actively engaging with Network Rail and DfT as they develop and consult on their vision for the future of Crewe.

8.4.2 Following the removal of the northern chord from our proposals, we will continue to work with partners, including TfN, to consider how the high speed line could facilitate east–west connectivity between destinations such as Liverpool, Manchester Airport and Manchester. For example, there is interest in using the high speed route and station in this area to form part of a wider network delivered as part of the NPR programme. It has been suggested that this could be delivered by a new connection between the existing network and the HS2 mainline to allow services from Liverpool to serve Manchester via the airport.

8.4.3 Any such proposals would connect to the route proposed in this advice but would require additional infrastructure in this area, beyond that set out in this advice. We will continue to review the impact of any such proposals as we develop the project, particularly in the light of the developing aspirations for the NPR project. Our work with TfN will help us understand the opportunities and implications of any proposals.

9 Route between Middlewich and Pickmere

9.1 Overview

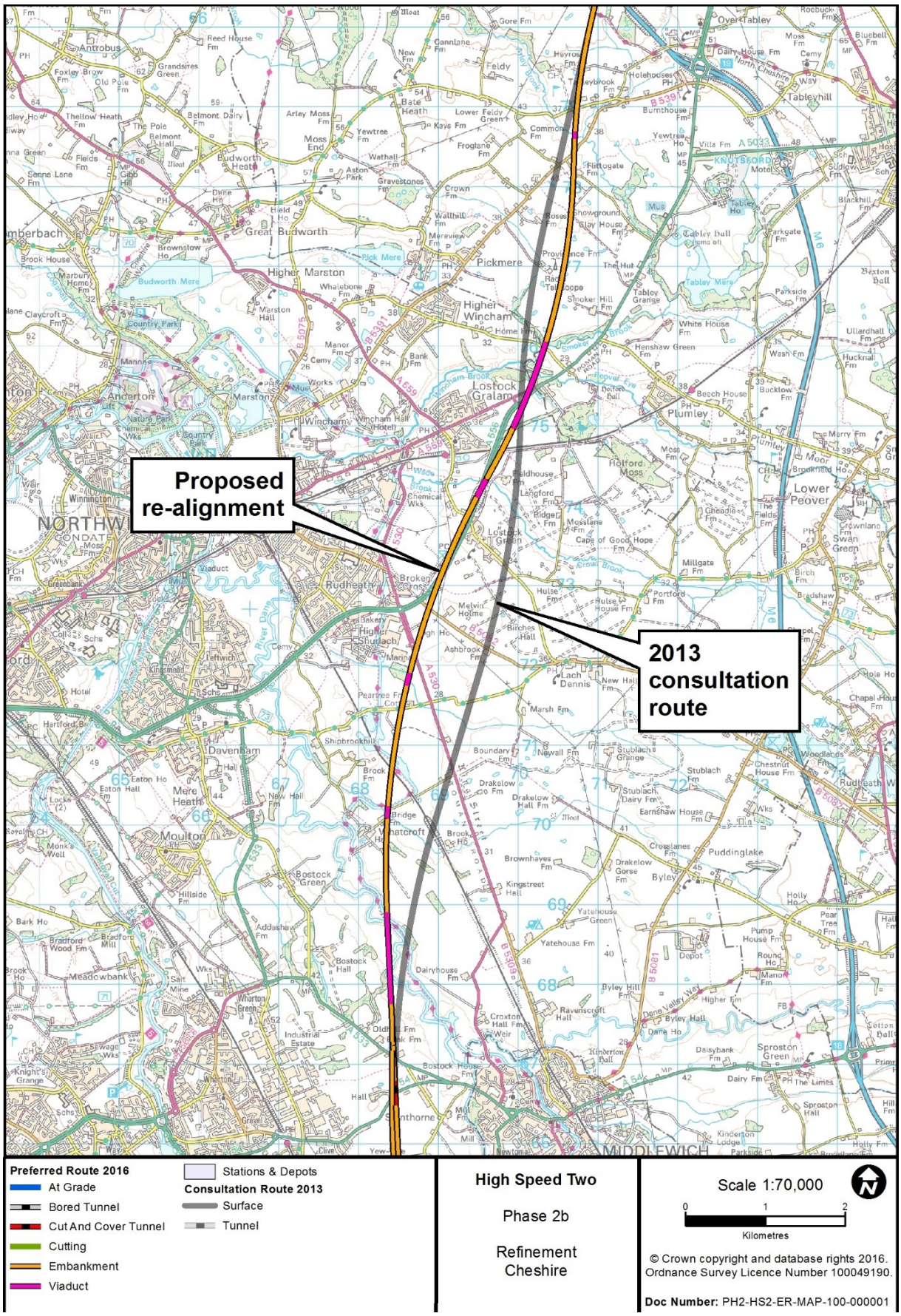
9.1.1 Respondents to the 2013 consultation raised a number of issues regarding the route between Middlewich and Pickmere, including the proximity of the route to Lostock Green, Lostock Gralam and Pickmere Telescope. Impacts on the Trent and Mersey Canal Conservation Area, the River Dane, Peover Eye, Leonard's and Smoker Wood and Winnington Wood ancient woodlands were also highlighted.

9.1.2 In addition, the 2013 consultation highlighted the potential for significant risk to HS2 as a result of the underlying geology of this area, and the associated industrial activity. There are a number of existing controlled brining and gas storage operations in the area and it was highlighted that the proposed route would have significant impacts on infrastructure related to these operations. Of particular concern was the crossing of sub-surface brine extraction and gas storage caverns, where long-term liability for the operation of these assets could become an issue. Respondents raised concerns over the potential risk of ground movement and subsidence.

9.1.3 Following the 2013 consultation, we considered a number of routes through this area with the aim of avoiding the areas with the highest risk due to brining and gas storage, including alternatives to the east and west of the 2013 consultation route. Our work included consideration of the impacts on communities and the environment, and the other engineering challenges that might be involved in alternative routes.

9.1.4 The outcome of this work led to the preferred route presented for consultation in 2016. This route was raised to be at least one metre above ground level to help manage the risk of subsidence and to allow for the management of drainage. It was also moved westwards to avoid the risk of passing over an area associated with active brine extraction and gas storage. The 2013 consultation route and the 2016 preferred route are shown in Figure 3.

Figure 3: Proposed 2016 preferred route realignment between Middlewich and Pickmere



9.1.5 For approximately three miles (5km) north of Crewe, the preferred route was raised onto an embankment. As the route heads north, between Winsford and Middlewich, and past the proposed rolling stock depot (RSD) location to the north of Crewe, the HS2 mainline was raised to run on a series of embankments and viaducts as it passes over the River Dane Floodplain and Trent and Mersey Canal. To the north of the River Dane valley, for approximately 7.5 miles (12km), the route has been raised up onto a series of embankments, interspersed with viaducts over floodplains, including over Peover Eye.

9.1.6 We also moved the route horizontally, to avoid constructing over existing cavities that would introduce significant additional risk to the route. Between Winsford and Northwich, the route moved westward by up to 800 metres. As a result, the viaduct over the River Dane was also lengthened and the route follows the existing A556 corridor for approximately 0.6 miles (1km). North of Lostock Gralam, the route has been moved eastwards by up to 400 metres. This is again driven by the need to avoid construction over existing cavities.

9.1.7 We recognised that these changes would result in increased visual impacts because the route is now higher through this area. The preferred route has moved further away from Lach Dennis and passes to the west rather than the east of Lostock Green, with some additional demolitions required in this area. The route also passes closer to Lostock Gralam, but further away from Pickmere and Higher Wincham.

9.2 Consultation feedback on the 2016 preferred route

9.2.1 During the 2016/17 consultation we received a number of comments about the proposed route refinement between Middlewich and Pickmere. Those in favour of the refinement mentioned a lower level of risk compared to the 2013 route as the revised route avoids the brining and gas storage caverns. Other respondents considered that the revised route represents better value for money.

9.2.2 However, a larger number of respondents raised concerns about the proposed change. Those who did not support the refinement cited ongoing concerns about HS2 Ltd's understanding of ground conditions and the ability to safely construct a high-speed railway in the area. Some stated that unstable ground conditions due to salt mining could cause subsidence and damage to the railway, and that there could be disturbance of underground gas storage caverns or gas pipes on the surface.

9.2.3 Some respondents were of the opinion that HS2 Ltd needed to do further ground investigation work to more accurately cost this section of route, or know whether the ground along the alignment can support a high speed railway.

9.2.4 There were views from respondents that the risk from salt has increased, rather than decreased, as a result of this refinement. Some respondents cite an area of subsidence at Billinge Green, near Lostock Gralam, as a particular concern. Some stakeholders, such as the Environment Agency and Mid Cheshire Against HS2 have highlighted to HS2 Ltd the risk of crossing gas storage, salt mines and underground facilities.

9.2.5 The elevated nature of the route through this area was also a source of concern, with many expressing the view that this will impede efforts to reduce the operational noise impacts of the railway. Concerns were also raised that the height of the alignment would make it a prominent feature in an otherwise low-lying landscape. The height, visual and noise impacts of the railway were particular concerns for the communities of Lostock Green and Lostock Gralam. Some concerns were also raised regarding how the elevated nature of the route in this area would affect overhead electricity lines.

9.2.6 The fact that the railway will form a long linear feature in the landscape caused concern among consultees about possible severance between communities and businesses on either side of the line, particularly between Lostock Green and Lostock Gralam. Concerns were also raised regarding the impact on the Trent and Mersey Canal, as there are now three crossings of the canal over a 1.2-mile (2km) section of route. A few respondents feel the environmental impact of the 2016 preferred route will be greater than the 2013 consultation route.

9.2.7 As with other route refinements, respondents were concerned about the impact of construction on the existing road network, particularly the A556, which is nearing completion of a major upgrade.

9.2.8 Several respondents, including some local property owners, suggested the 2016 preferred route would discourage investment in the area, with some specifying locations such as the Bostock Marina and Barons Quay. Individual respondents, including Cheshire West and Chester Council, cited commercial and residential developments that they state HS2 will prevent or impede, such as at Gadbrook Park, Lostock Triangle (Cheshire Business Park) and at the site of the Royal Cheshire County Show. The 2016 preferred route directly impacts on this site. Previously, the 2013 route intersected the edge of the site. Respondents also cited potential impacts on the Pickmere Radio Telescope, part of the Jodrell Bank Observatory.

9.2.9 Consultees suggested several alternatives to this refinement. These include: a return to the original 2013 alignment; a return to the original horizontal alignment, but with an increased height; the lowering of the route into tunnel; a horizontal alignment that follows the route of the M6; a route that runs through Knutsford and Sandbach; an alignment to the east of Middlewich; and a route that runs alongside the A556.

9.3 Responding to the consultation feedback

9.3.1 In responding to feedback from the 2016/17 consultation we have undertaken a strategic review of all previous route options in this area. This has included reassessing the 2016 preferred route against both the 2013 consultation route and a refined version of this with a higher vertical alignment. This strategic review has also included consideration of the suggested alternatives raised as part of the 2016/17 consultation.

9.3.2 The driver for this review has been to ensure that we are satisfied that the 2016 alignment remains the preferred route through the area based on the current level of information that we have, and particularly in the context of the risks associated with the construction, operation and long-term maintenance of the railway. Our work has also included consideration of the impacts on communities and the environment, and

the other engineering challenges that might be involved in constructing the railway in the area.

9.3.3 Our previous work indicates that routes following the M6 corridor would have similar issues associated with passing over an area of salt and would require a less favourable location for the junction of the Manchester spur and mainline connection to the WCML. These options would also have negative community and environmental impacts, including property demolitions, impacts on SSSIs and heritage assets.

9.3.4 We have assessed an alternative proposed during the 2016/17 consultation of extending the proposed HS2 tunnel below Crewe, taking it deeper into the bedrock below the salt strata, and returning to surface near the M6 crossing. Although this option would have environmental advantages over the 2016 preferred route (reduced noise and visual intrusion and reduced surface disruption to the general public during construction), the relatively long and potentially extremely deep tunnelling option would be significantly more expensive to construct than the current preferred route. Due to the depth and length of tunnel required, this option could also increase construction and safety risks. Extending the tunnel would also require us to find an alternative suitable site for the relocation of the western leg RSD.

9.3.5 Our previous work indicates that a route passing via Knutsford would present a range of issues, including a less favourable location for the Manchester junction. Therefore, options looking at this were discounted in previous sifting work. Other options that pass via Sandbach or to the east of Middlewich were discounted due to increased sustainability impacts on the local communities of Sandbach and Elsworth, poor ground conditions from known brine runs and similar impacts to the 2013 consultation route with regards to passing through controlled brining and gas storage sites.

9.3.6 We have also considered the scope for reducing the speed of the railway in this area to facilitate tighter curves and allow for a more flexible alignment that could reduce the height of the railway and also reduce some of the local environmental impacts. This part of the HS2 mainline would be used by direct HS2 services not only to Manchester, but also to the north-west and Scotland. Accordingly, our work suggests that relatively small reductions in speed could have substantial impacts on the overall benefits of the scheme.

9.3.7 A review of previous route options (including the alternatives proposed during the 2016/17 consultation) indicates that the 2016 preferred route (as indicated by the proposed realignment in Figure 3) carries the least risk regarding the construction, operation and long-term maintenance of the railway. If we are to successfully avoid existing brining and gas storage caverns in the area, this alignment remains the preferred route based on the information that we currently have available.

9.3.8 The risk of passing over the existing controlled brining and gas storage underground caverns and surface infrastructure is considered greater than other risks in this area. Given the issues raised during the 2016/17 consultation, we reconsidered the geological, commercial and community risks associated with both the 2016 preferred route and an amended version of the 2013 consultation route. The preferred route avoids direct interfaces with existing brining and gas storage infrastructure, such as

caverns, wellheads and surface infrastructure, and would minimise the risk of subsidence from ground movements in the brinefield site. This reduces construction and operational risk, and addresses specific concerns over the long-term liability to HS2 Ltd as a result of passing over underground caverns.

9.3.9 The preferred route is raised in this area to allow for careful management of drainage and geological risk and provide more flexibility with regards to ground stability mitigation options. A raised route is considered less likely to result in drainage path changes in the area and thus reduce risk. However, it may be possible to mitigate some of the drainage concerns by other means that would emerge during further design work undertaken as part of hybrid Bill preparation. We will therefore undertake more detailed consideration of the specific salt dissolution risks and the possible range of alternative risk mitigation measures, with a view to developing a design solution where the HS2 route can be lowered in the vicinity of local communities.

9.3.10 Our recommendation is based on the level of information that we currently have available at this design stage. We have undertaken significantly more work on this part of the route to understand the ground conditions and geotechnical risk, and have employed specialist consultants to assist in this task. We consider that the additional work has provided us with an appropriate level of intelligence to inform a decision regarding which route corridor carries the least risk in this area and provides us with the confidence that we can safely build and construct the railway within the risk tolerance permitted and the cost envelope provided.

9.3.11 We do, however, recognise that this is a sensitive and complex section of the route and that there is more work to be done before the hybrid Bill is deposited to further understand the geological risks and provide suitable mitigation solutions. We are looking into carrying out early geotechnical investigation work in the mid-Cheshire area and gathering more advanced survey information (for example, by using Interferometric Synthetic Aperture Radar (InSAR) technology and analysis tools).

9.3.12 We will also continue to liaise with local landowners, key stakeholders and commercial organisations, such as Inovyn (Ineos), to understand how HS2 can reduce any potential impacts on their future development and employment aspirations.

9.3.13 We recognise that the 2016 preferred route adopts a longer route through the salt areas (approximately a 0.6 mile/1km increase over the 2013 consultation route) and a slightly longer crossing of the Winsford Rock Salt Mine. However, we believe the associated risks can be managed through future mitigation design and continued engagement with stakeholders, such as Compass Minerals.

9.3.14 We also recognise existing concerns regarding impacts on the site of the Royal Cheshire County Show and the Trent and Mersey Canal, and are aware of the visual and noise impacts at Lostock Green and Lostock Gralam.

9.3.15 We expect that further opportunities for mitigation will emerge as we develop the design and this in turn could provide the opportunity to examine issues such as the height of the railway in more detail. As we carry out more detailed technical work, we will get a better understanding of whether the impacts of the railway could be

reduced in this area. We will undertake environmental surveys as part of the hybrid Bill process, which will provide us with a significantly greater level of understanding regarding our impact on the environment, including watercourses and the clearances required. Similarly, we will gain a better understanding of the design of earthworks and structures that could enable us to further mitigate the impact of the railway in this area.

10 Manchester Piccadilly approach

10.1 Overview

10.1.1 The preferred route presented in 2016 shifted the Manchester tunnel on the approach to Manchester Piccadilly station eastwards by up to 370 metres to the east of West Gorton and lengthened the tunnel by approximately 880 metres.

10.1.2 This removed engineering complexities associated with Corn Brook floodplain and existing railway viaducts, allowing improvements to the approach to Manchester Piccadilly. It also reflected concerns raised during the 2013 consultation about the direct impacts on residential properties, a school and a major development site at West Gorton.

10.1.3 The change also allowed the approach into Manchester Piccadilly to be straightened to maximise operational capacity and reduce impact on the structure of the existing station. The footprint of the station was shifted slightly further northwards and the platform configuration was amended to be one island and two side platforms. The combination of these changes reduced platform reoccupation times. The 2016 preferred route realignment of the tunnel is shown in Figure 4, below.

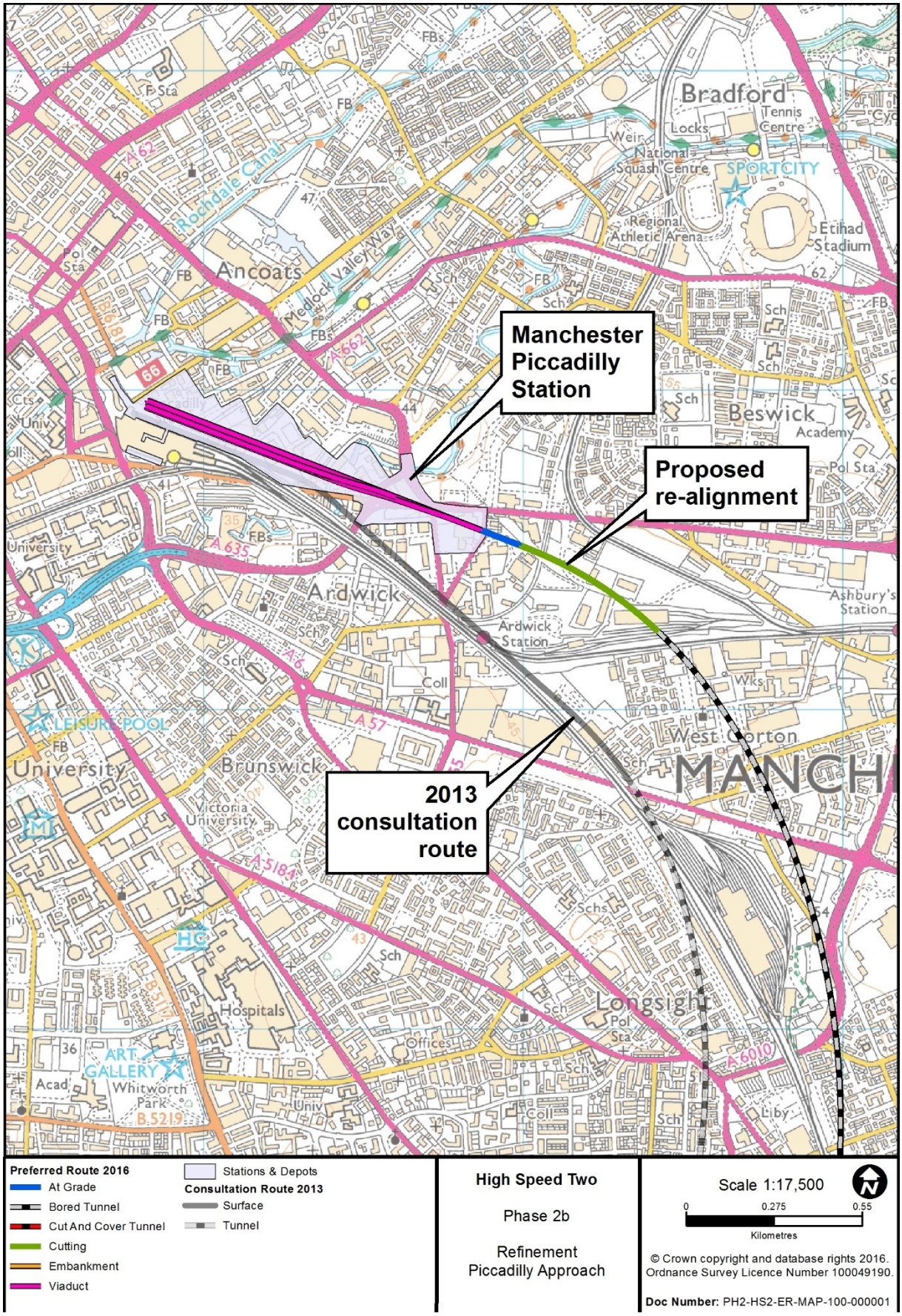
10.2 Consultation feedback on the 2016 preferred route

10.2.1 We received a range of feedback about the proposed route alignment of the tunnel during the 2016/17 consultation. Positive feedback included the significant community benefits in the West Gorton area. The approach to Manchester Piccadilly on the 2013 consultation route was expected to result in a number of demolitions in this area, and impact on a local primary school.

10.2.2 There was also feedback on the improvements to transport connectivity and capacity at Manchester Piccadilly, as well as on the improved performance for the HS2 service as a result of the straightened approach.

10.2.3 A number of key stakeholders have responded with positive feedback about the proposed change. However, some have caveated their support. Both Manchester City Council and Greater Manchester Combined Authority support the proposals around Manchester Piccadilly; however, they are seeking further information regarding the impact of the northern tunnel portal on the existing Ardwick rail depot and on potential development areas, as identified in the Piccadilly Strategic Regeneration Framework and other sites near the Ardwick depot.

Figure 4: 2016 preferred route realignment of the approach to Manchester Piccadilly station



10.2.4 Further reasons for supporting the proposed alignment that were cited by consultation respondents included the removal of a range of impacts, including those on the Holt Research Centre, a graveyard at St Paul's Church, a proposed development at a hall of residence, and a geothermal borehole proposed for Ardwick.

10.2.5 Network Rail responded positively to the proposed change, acknowledging the benefits of the new tunnel portal location and amended approach to Manchester Piccadilly given the reduction in disruption to WCML services. They did, however, raise concerns regarding the potential impact on the existing Ardwick rail depot.

10.2.6 Siemens currently manages the existing Ardwick rail depot for the TransPennine Express franchise. The 2016 preferred route moves the tunnel portal to the location of this depot. There are concerns about the impact this will have on the franchise, the loss of jobs in the local area, where the depot could be relocated to, as well as about the impact this could have on the aspirations for NPR services.

10.2.7 Further issues that have been raised regarding the preferred route include the impact on a Royal Mail operating centre. This centre is currently used for distribution and stabling of Royal Mail HGV fleet.

10.2.8 A number of concerns were raised during the consultation about each of the four indicative ventilation shaft locations shown along the Manchester tunnel. These have been identified as potentially impacting on sites such as the Withington Golf Club, the Christie NHS Foundation Trust's car park, a commercial development site and the site of a secondary school, now under construction. There are also concerns that the proposed ventilation shafts could have an impact on wildlife habitat at the Wrengate Wood SBI (site of biological importance). Further concerns were raised about the number of tunnel access points from a safety perspective.

10.2.9 There is also a range of concerns regarding environmental issues, including impacts on listed buildings, SSSIs and ancient woodland. Specific concerns raised include the impact on listed buildings, including Buckhall, the Four Seasons Hotel, and the Manchester Piccadilly train shed at Manchester Piccadilly. Other sites mentioned include the Bollin Valley and Sunbank Wood SBI. There was also concern raised about the loss of Green Belt land.

10.2.10 The Environment Agency has raised concerns about the potential risk of flooding during the construction of the tunnels, and the impact of contaminative fill materials on groundwater as a result of tunnel construction.

10.2.11 There is significant concern among those living above the proposed 2016 tunnel route about the impact HS2 could have on properties from both a structural and valuation perspective. Further comments related to the Manchester tunnel included concerns from Highways England about potential traffic impacts as a result of moving additional excavated materials from the now extended tunnel.

10.2.12 There are also general community concerns about the potential impacts on local amenities in the wider Manchester area, including to a golf course, the Trans Pennine

Trail and the River Mersey. Those living alongside the approach to Manchester Piccadilly are concerned about the noise and vibration impacts from the construction and operation of Hs2 and have requested limited train speeds and soundproofing for mitigation from these impacts.

10.2.13 A number of those responding to the consultation in this area made alternative suggestions for the route. These included an entirely underground HS2 station at Manchester Piccadilly to enable through services north; the use of a reintroduction of the line between Manchester Piccadilly and Manchester Victoria stations; and the need to consider NPR aspirations and plans as part of the station design and route alignment.

10.2.14 We also received a suggestion for an alternative tunnel alignment in order to relocate one of the ventilation shafts from its proposed indicative location.

10.3 Responding to the consultation feedback

10.3.1 As a result of the feedback received from the 2016/17 consultation, we have reviewed the previous decisions we have made regarding the alignment of the Manchester tunnel on the approach into Manchester Piccadilly.

10.3.2 We reviewed the consultation response suggesting an alternative tunnel alignment to change the location of the ventilation shafts and did not take it further as it would require slower geometry resulting in an increased journey time.

10.3.3 We did not consider an entirely underground HS2 station at Manchester Piccadilly to enable through services north as the proposed HS2 timetable requires Manchester Piccadilly to be a terminus station. An underground box and longer tunnel alignment would be more costly and provide significant engineering challenges.

10.3.4 Options that were similar to the 2013 consultation route that avoided Ardwick rail depot were previously considered. We did not take these options forward as they had similar impacts to the 2013 consultation route, particularly in terms of locating the tunnel portal in a floodplain and the impacts at West Gorton. Another option that avoided the depot was previously considered and discounted, as it would require a longer tunnel, longer journey time and increased costs.

10.3.5 Our recommendation is that the tunnel alignment for the 2016 preferred route (as shown in Figure 4) remains the optimal approach into Manchester Piccadilly. This alignment reduces the flood risk by moving the tunnel portal out of the Corn Brook floodplain, and reduces engineering complexity by moving away from existing railway viaducts. The changes also allow the approach to Manchester Piccadilly to be straightened, maximising operational capacity and reducing the impact on the existing structures at the station. The relocated tunnel portal to the north of the TransPennine Express rail line reduces impacts on the existing railway during construction. Previous community impacts at West Gorton are also avoided, including a cluster of residential demolitions, a major development site and a local primary school.

10.3.6 We are aware that a number of issues remain with the alignment of the tunnel and we continue to have discussions with all key stakeholders – including Network Rail – regarding the impact of the northern tunnel portal on the existing Ardwick rail depot.

10.3.7 We recognise the preference for the existing depot to remain in its current location, and have undertaken a study to examine whether the depot could be reconfigured around HS2 to provide for both current and proposed future functionality. To date, this work has revealed that there is sufficient space to do this. However, we recognise that there are challenges that will need to be addressed during the hybrid Bill design work.

10.3.8 The approach to Manchester Piccadilly in this location could offer the possibility of putting a temporary railhead at Ardwick. This would enable the removal of spoil and delivery of tunnel segments during construction, potentially removing a number of HGV movements from the road network which would otherwise be required to haul excavated soil and deliver segments. Again, our very early work indicates that there is sufficient space in the vicinity of the depot to enable this to happen, but further feasibility work in conjunction with partners, including Network Rail, will be required.

10.3.9 We are also working with Manchester City Council and the Greater Manchester Combined Authority to consider how the route alignment can minimise impacts on proposed development land, including sites identified in the Piccadilly Strategic Regeneration Framework and land around Ardwick.

10.3.10 We continue to work closely with TfN, DfT and Network Rail as options for the NPR network are developed, including synergies between HS2 and NPR for serving Manchester.

10.3.11 We are particularly aware of concerns from those living above the proposed tunnel route about the potential impact this will have on them, both during construction and operation of HS2. Allied to this, we recognise the issues that have been raised regarding indicative ventilation shaft locations, and their potential impacts, particularly on the Christie Hospital and Withington Golf Club. The ventilation shaft locations remain indicative and further work will be progressed to look at the locations in more detail. Assessing the feedback we have received during the 2016/17 consultation will form part of this work. We are prioritising this as we head into the next stage of design and hybrid Bill preparation.

CASE STUDY: Mitigating impacts through hybrid Bill development

During the hybrid Bill process for Phase One of HS2, it was possible to alter the proposed location of ventilation shafts to reduce the impact of the railway on residents and businesses. Additional Provision 4, following Select Committee requests to amend the Bill, saw the location of a ventilation shaft above the Euston tunnel move from a site at Salusbury Road to Canterbury Works. It was relocated due to its proximity to residences and the future development potential of that site. Similarly, Additional Provision 4 also saw the proposed ventilation shaft at Selco Builders' Warehouse near Hanger Lane gyratory moved northwards to an alternative site to avoid the need to displace the business. The design of the scheme around ventilation shaft headhouses was also altered to reduce their visual impact during the hybrid Bill process. Additional Provision 4 included revised landscape earthworks and mitigation planting at the Chalfont St Giles and Chesham Road ventilation shafts.

10.3.12 We will liaise with the Environment Agency and other key stakeholders as the design progresses to address concerns raised regarding impacts on watercourses, groundwater and other environmental issues. The Environmental Impact Assessment (EIA) that will be undertaken as part of the hybrid Bill development will assess the baseline and set out mitigation for impacts that arise.

11 Route around Measham, Leicestershire

11.1 Overview

11.1.1 The 2013 consultation route around Measham followed the eastern side of the A42 corridor, passing through the west of Measham. We received feedback during the 2013 consultation about the impacts on both local businesses (including Plastic Omnium Ltd, a key supplier for Jaguar Land Rover) and a significant local development site (Measham Wharf), as well as concerns about the impacts on the broader area. Highways England also raised concerns regarding the realignment of the A42 that would be required. An additional challenge in this area is the River Mease special area of conservation (SAC), which is subject to a European-level environmental designation.

11.1.2 As a result of this feedback, we reconsidered the line of route in this area and developed an alternative alignment to the east of Measham. This preferred route was presented for consultation in 2016, and diverges from the A42 to the south of Austrey, moving closer to this village. Continuing northwards, it passes Appleby Parva and Appleby Magna on their eastern side, before crossing the River Mease and the Forterra Brickworks site on a long viaduct approximately 11 metres high. The route then rises with the terrain in shallow cutting to the east of Measham. The route rejoins the corridor of the A42 to the south of Packington, running to the west of the village in a cutting before passing over Gilwiskaw Brook and its floodplain on a viaduct up to eight metres high.

11.1.3 The 2016 preferred route avoids some of the impacts to the west of Measham, including those on Plastic Omnium Ltd and the Measham Wharf development site, as well as a realignment of the A42. It would also lead to reduced noise impacts to the west of Measham. However, there would be new impacts to the east of the town, villages to the south and north of the town, as well as to a new crossing point over the River Mease. A copy of the 2013 consultation route and the 2016 preferred route is shown in Figure 5.

11.2 Consultation feedback on the 2016 preferred route

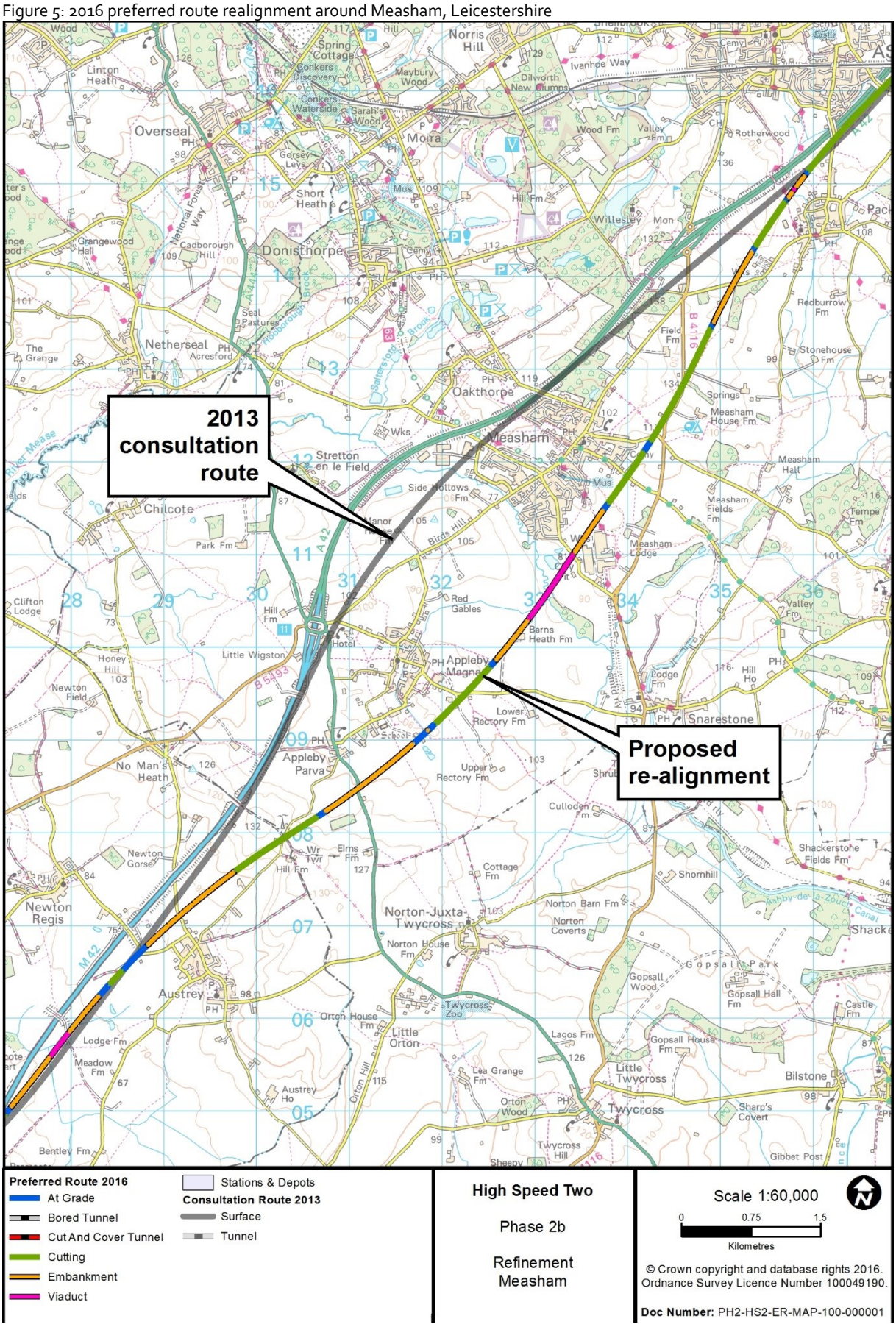
11.2.1 Respondents to the consultation on the 2016 preferred route to the east of Measham who supported the route refinement cited the reduction in noise impacts, removal of impacts on properties that were affected by the 2013 consultation route, reduced impact on the Ashby Canal, and a reduction in some impacts on SSSIs and woodland to the north-east of Measham. Further benefits that were cited, including by Highways England, focused on the reduced traffic impacts, particularly the removal of the need to realign the A42.

11.2.2 In contrast, the majority of respondents outlined opposition to the proposed change. Opposition focused on new impacts that have been introduced, particularly on the communities of Austrey, Appleby Parva, Appleby Magna, Measham and Packington. Concerns were raised about the impact of the 2016 preferred route 'islanding' three of these communities (Appleby Parva, Appleby Magna and Measham) between the A42 and the HS2 line of route, introducing significant severance from the surrounding area. Many referred to an HS2 Ltd policy of following existing transport corridors and questioned why this principle is not being followed in this area.

11.2.3 The route alignment change brings the HS2 line of route closer to a number of the communities within this area (including Austrey and Packington), which has led to significant concerns about noise and visual impacts. There were also suggestions from respondents that the 2016 preferred route would have an impact on more properties than the 2013 consultation route, thus requiring more compensation payments than would have been required previously. Respondents in a number of the affected communities expressed concerns about the height of the route, particularly the high embankments and viaducts that are in close proximity to the affected villages. Some respondents challenged the basis for the decision to move the route to the east of Measham, suggesting that the route had been moved to reduce impacts on a major local employer at the expense of the wider community.

11.2.4 Another key area of concern was the impact on local schools, in particular the Grade I listed St John Moore Church of England Primary School in Appleby Magna. Respondents are concerned about the impact that construction and operation of HS2 will have on the school, particularly the health and wellbeing of pupils. Other community impacts cited by respondents included the Measham Cemetery and the Packington burial ground, playing fields in Austrey, Ashby Canal, Pooley Country Park, Normandy Wood, and various footpaths, churches and community allotments.

Figure 5: 2016 preferred route realignment around Measham, Leicestershire



11.2.5 A number of respondents outlined concerns about the impact the 2016 preferred route alignment would have on employment locally. The general view was that, while the route has been moved to remove the impact on a key local employer, the 2016 preferred route may impact more jobs than the 2013consultation route, and that the jobs would be at businesses which would find it more challenging to relocate. Businesses that have been cited as being directly impacted by the route change include the Forterra Brickworks in Measham, Packington Sewage Treatment Works and local farms, including Red Hill Farm and Barns Heath Farm, which contain a large number of small businesses on business parks. Other respondents cited impacts on a local hotel and spa. In addition, there were concerns about the direct impact on farming activities in the area, particularly as the preferred route goes through Agricultural Grade 2 farmland, which, it is believed, will be rendered unusable for farming.

11.2.6 Respondents cited that, while a key justification for the route change to the 2016 preferred route was to remove an impact on the proposed Measham Wharf development site, it is widely believed that the 2016 preferred route introduces impacts onto other housing development sites in the area, including the Nursery Fields site at Measham where construction has commenced.

11.2.7 North West Leicestershire District Council stated within their response to the consultation that they are confident alternative housing sites are available to meet their strategic housing allocation targets should the development at Measham Wharf be impacted.

11.2.8 In addition to concerns about the noise, visual, and air quality impacts from construction and operation of HS2 in this area, the most significant area of concern regarding environmental impacts relates to the River Mease SAC. A number of respondents were concerned about the impact of the 2016 preferred route on the SAC, citing a longer river crossing, and an alignment that moves the crossing further from the existing A42 crossing of the River Mease. Natural England also stated concerns about the proximity of the route to two landfill sites, which they state could result in contamination of the River Mease SAC.

11.2.9 Concerns have also been raised about the ground conditions in the area, including the prevalence of subsidence in some areas, the curvature of the route impacting on speeds, the realignment and crossing of the A444 to the south of Appleby Parva, the impact on local roads and bus services, and the risk of flooding – including as a result of the impact on the sewage works.

11.2.10 A number of respondents suggested alternative alignments to the 2016 preferred route. Several suggested moving the alignment further east, removing the impacts on the communities and the River Mease and addressing subsidence problems. Respondents also suggested moving the route to the west of the A42, or following the M1 corridor. It was also suggested that the route should be in bored tunnel from Kingsbury to the north of Measham. Other suggestions included returning to the previous 2013 consultation route – but avoiding the key employers – and amending the 2016 preferred route to avoid key employers.

11.2.11 Suggestions were also made on how to improve the current alignment, by using more tunnels and cuttings to reduce noise and visual impacts. A respondent referred to using embankments instead of viaducts, as these could be mitigated more easily.

11.3 Responding to the consultation feedback

11.3.1 As a result of the feedback received from the 2016/17 consultation, we have reviewed the alternative suggestions made and previous decisions on the HS2 line of route in this area.

11.3.2 We have previously considered a number of options in this area of the route, including routes to the west and further east, and tunnels beneath Measham. The tunnelled options were discounted due to the significant cost implications, and sustainability impacts associated with the generation of excavated materials. There would also be potential sustainability impacts from the location of ventilation shafts, and the provision of emergency access.

11.3.3 A route to the west of Measham and the M42/A42 corridor was previously discounted due to the additional length of the A42 realignment (and associated cost), and additional demolitions required on the west side of the A42. A high speed route alignment following the M42/A42 corridor on its western side is not practicable due to the curvature of the highway corridor and the requirement for additional crossings of the corridor.

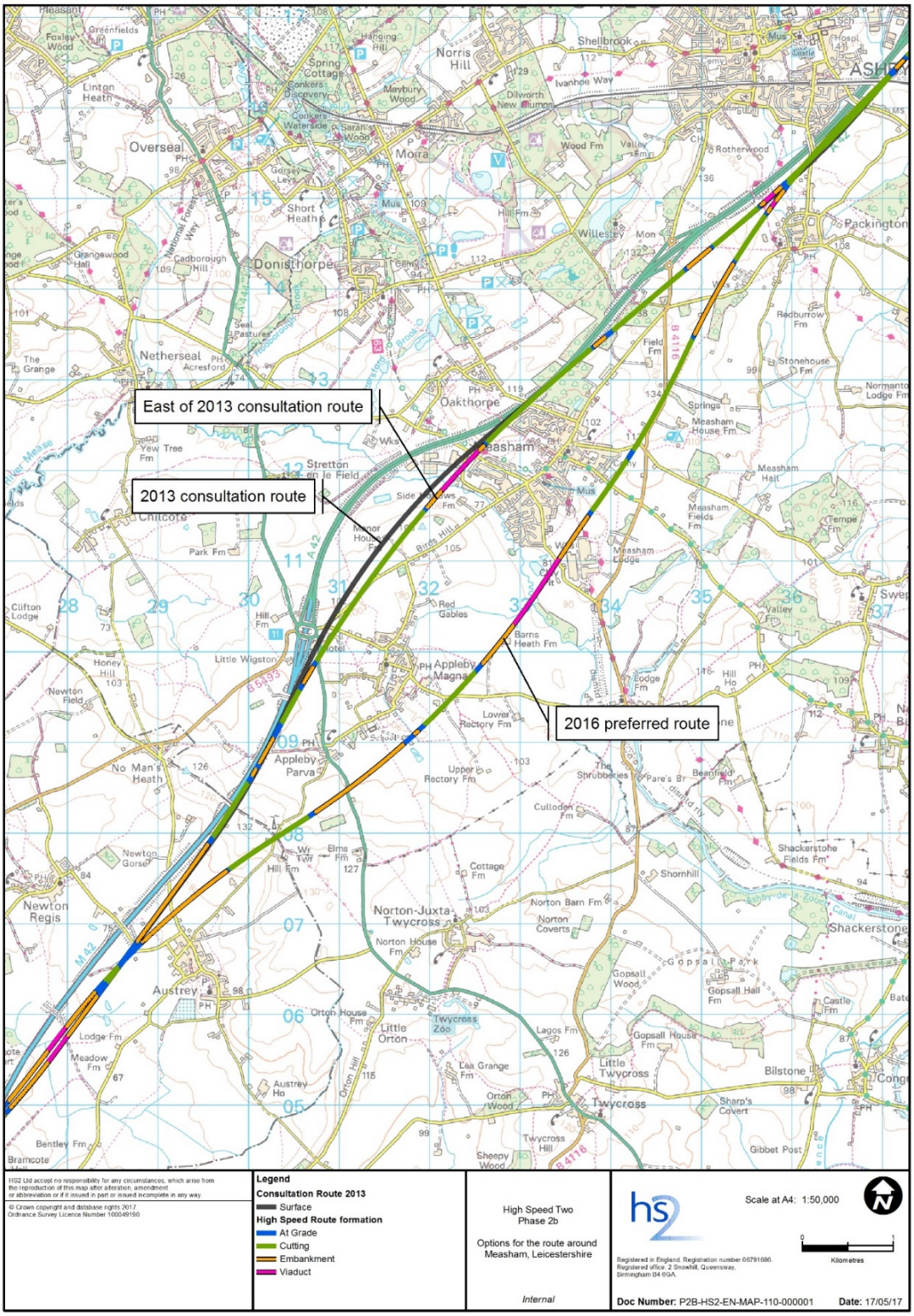
11.3.4 A route further to the east of Measham (and further to the east of the 2016 preferred route) would avoid a crossing of the River Mease SAC and reduce the impacts on Measham, but it was discounted due to the increased sustainability impacts, including on the Ashby Canal SSSI, two ancient woodlands, a biodiversity action plan (BAP) habitat, fragmentation of the landscape and a major river diversion. This route was also longer, increasing both journey time and cost.

11.3.5 Use of the M1 corridor through the East Midlands was previously discounted given the higher ground, increased journey time and higher cost.

11.3.6 In response to the 2016/17 consultation, we have undertaken work to understand if the 2016 preferred route could be amended to avoid a number of the key impacts cited during the consultation. This work confirmed that this was not possible without prioritisation of impacts or through slowing the design speed significantly.

11.3.7 Following this, we have reassessed the impacts of the 2016 preferred route against routes that follow the A42 transport corridor. These include a route broadly similar to the 2013 consultation route (this had a minor refinement in 2015 to reflect new standards), and a route 80 metres to the east of the 2013 consultation route. These three routes are shown in Figure 6.

Figure 6: A42 corridor routes and the 2016 preferred route to the east of Measham[4].



[4] Note that the 2013 consultation route had a minor refinement in 2015 to reflect new standards.

Comparing routes in the A42 corridor and the 2016 preferred route

11.3.8 A comparison of routes in the A42 corridor and the 2016 preferred route indicates that these are comparable with regards to journey time and their impacts on the River Mease. A habitat regulations assessment (HRA) screening report completed for the 2013 consultation route and subsequently updated for the 2016 preferred route identified potentially significant effects on the integrity of the River Mease SAC.

11.3.9 Further assessment undertaken as part of the appropriate assessment (AA) for the HRA concluded that effects on the SAC would be negligible and did not identify a preferred option based on the design details available at the time. Further design and mitigation will need to be developed in discussion with Natural England and the Environment Agency to ensure that there is no adverse effect on the SAC. However, based on our current understanding, the condition of the River Mease to the west – in the area of the routes in the A42 transport corridor – is generally more degraded than the habitat to the east of Measham in the vicinity of the 2016 preferred route crossing of the Mease, which has habitat with the potential to sustain otter, is a longer crossing and would involve a complex landfill interface north of the river.

11.3.10 Following the existing A42 transport corridor removes the issue of 'islanding' the communities of Appleby Parva, Appleby Magna and Measham between HS2 and the A42 that is caused by the 2016 preferred route going to the east of the town. It also avoids the demolitions, noise and visual impacts associated with the 2016 preferred route and avoids the impact on jobs that has been cited as part of the 2016 preferred route consultation, including those at the Forterra Brickworks, Packington Sewage Treatment Works and Red Hill Farm and Barns Heath Farm.

11.3.11 Our noise appraisal suggests that a route in the A42 transport corridor would result in lower overall noise impacts than the 2016 preferred route, reflecting less disturbance on local communities. It is important to note that this appraisal does not factor in the existing noise caused by the A42.

11.3.12 Routes in the A42 transport corridor take the route further away from the villages of Austrey to the south and Packington to the north, reducing the noise and visual impacts on these communities.

11.3.13 We therefore recommend that the preferred route presented in November 2016 going to the east of Measham should be discounted in favour of a route in the A42 corridor.

11.3.14 Of the two routes that we have looked at in this corridor, our recommendation is for the adoption of a refined version of the 2013 consultation route that moves the alignment approximately 80 metres to the east and places it on a longer viaduct over the River Mease. This is shown as the 'east of 2013 consultation route' in Figure 6 above. This route reduces the number of commercial demolitions compared to the original 2013 consultation route, and avoids the direct impact on the Plastic Omnium Ltd main factory building. While this route slightly increases the impact on the Measham Wharf development site, as mentioned above, the 2016/17 consultation response from North West Leicestershire District Council indicated that they have

alternative locations that will enable them to meet the strategic housing allocation targets for the area.

11.3.15 The proposed change introduces a small upward cost pressure on the Phase 2b scheme.

11.3.16 We note that issues remain with this route. Whilst there is a reduced number of demolitions associated with this route, we recognise there are some property impacts. In addition, our new recommendation requires the realignment of the A42 and we will continue to liaise with Highways England regarding this. We will also continue to engage with the Environment Agency to assess concerns associated with the crossing of the River Mease SAC.

11.3.17 We are also aware that Plastic Omnium Ltd and Jaguar Land Rover will have concerns regarding the impact on the 'just-in-time' nature of their business during construction. However, we are of the view that these impacts can be managed with careful planning, but note that further work and engagement will be required to manage outstanding concerns over vibration and access impacts, as well as disturbance. We will continue to engage with Plastic Omnium Ltd regarding these issues. Through avoiding Plastic Omnium Ltd we also acknowledge there is a greater impact on units in the Westminster Industrial Estate.

CASE STUDY: Mitigating impacts through hybrid Bill development

During the HS2 Phase One hybrid Bill process, agreements were reached with a number of organisations that rely on 'just-in-time' production methods to satisfy their concerns about potential construction and operational phase impacts. These included organisations such as BMW and Jaguar Land Rover. Commitments were given to BMW, for instance, that vehicular access will be maintained at Hams Hall 24 hours a day, seven days a week, during the construction phase. This agreement included building a temporary road prior to the closure of Faraday Avenue to ensure that access could be maintained at all times. Commitments were also given to Jaguar Land Rover to engage with their 'just-in-time' suppliers to keep them informed of detailed construction plans to allow them to coordinate deliveries to their Castle Bromwich site from Castle Bromwich Business Park, and thus minimise disruption to their operations.

Several organisations near the Phase One railway also had vibration sensitive equipment. Agreement was reached with these organisations on how to manage and avoid vibration arising from the construction and operational phases impacting on their operations. For example, University College London was given a commitment that they would be provided with a risk assessment and vibration management protocol in advance of construction starting to monitor vibration on their property and prompt effective mitigation, if required.

12 Route along A42, around East Midlands Airport

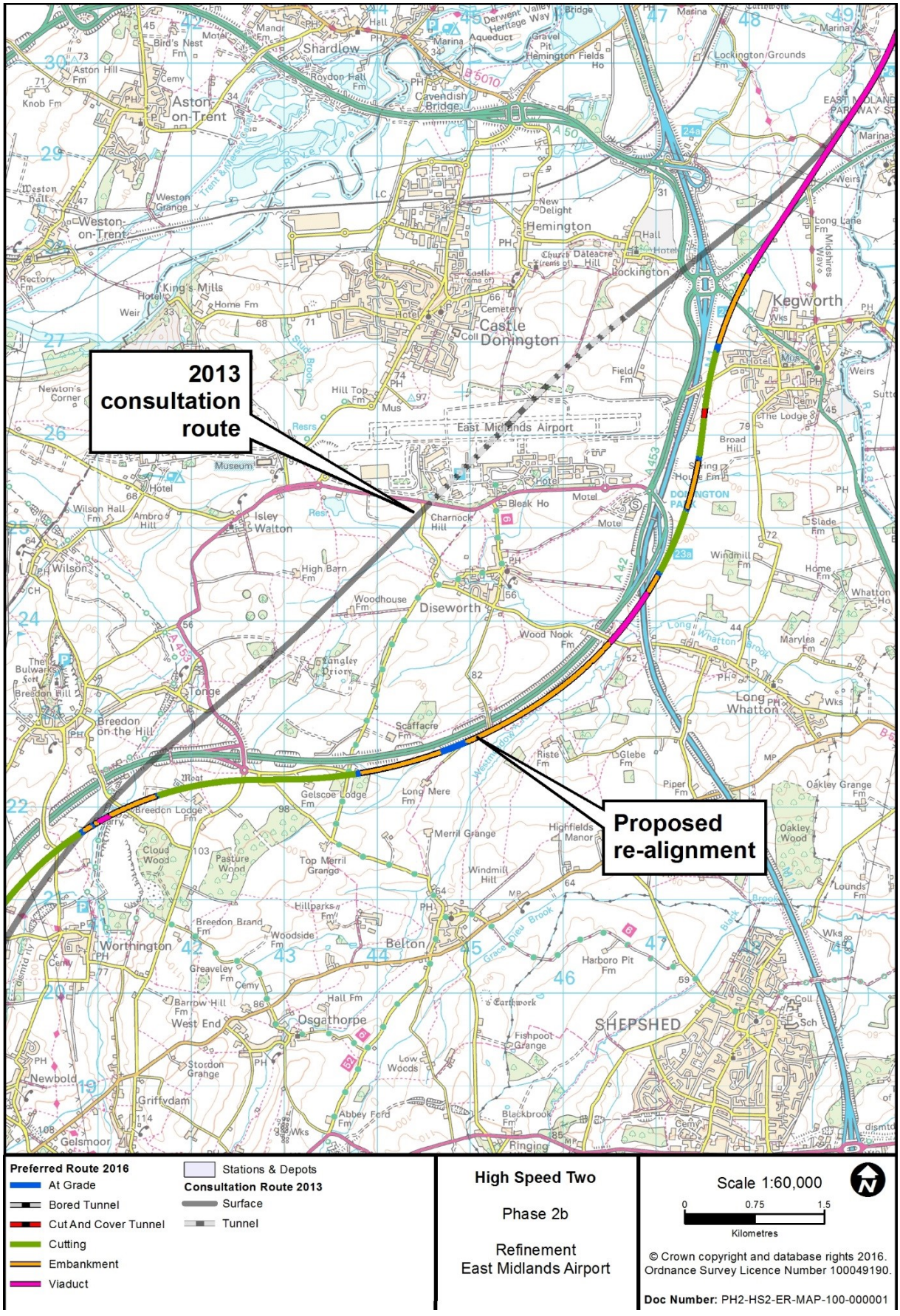
12.1 Overview

12.1.1 The 2013 consultation route followed the A42, past Ashby-de-la-Zouch before crossing the A42 on a 16-metre viaduct and leaving the A42 corridor east of Breedon-on-the-Hill. It then passed under East Midlands Airport and the majority of the proposed East Midlands Gateway development (East Midlands Gateway Strategic Rail Freight Interchange) in a tunnel, which required a ventilation shaft. North of the tunnel, the route passed over the M1, north of Junction 24 near Lockington, and crossed the floodplains of the River Soar and the River Trent on 2.1 mile (3.4km) and 1.0 mile (1.7km) viaducts respectively.

12.1.2 Issues raised following the 2013 consultation included the engineering and construction complexities associated with tunnelling underneath the airport. Concerns were also raised regarding the proximity of the route to a number of communities, including those at Tonge and Breedon-on-the-Hill. Key impacts that were cited included the noise and visual impacts, as well as visual impacts on the Trent Valley. A number of respondents also raised concerns about the impacts on the proposed East Midlands Gateway Strategic Rail Freight Interchange.

12.1.3 The refinements made in this area for the 2016 preferred route focused on developing an alternative route that would avoid the need for a tunnel underneath the airport, resulting in a reduction in engineering complexity and a cost-saving opportunity. The route would instead follow the A42 and M1 transport corridor on its eastern side, east of the airport runway, and under the proposed Kegworth Bypass associated with the proposed East Midlands Gateway Strategic Rail Freight Interchange. It would then continue northwards, passing Kegworth on its western side in a cutting before rejoining the 2013 consultation route to the north of Kegworth. The 2016 preferred route, as well as the 2013 consultation route, are shown in Figure 7.

Figure 7: 2016 preferred route realignment along the A42 around East Midlands Airport.



12.1.4 In detail, the 2016 preferred route would more closely follow the A42 largely on a mix of cutting and embankment, remaining on its eastern side. This would avoid the need for the 16-metre high crossing of the A42 near Tonge proposed in 2013 and enable the route to sit lower in the landscape as it passes through this area. The route would cross the Boden Brook on a viaduct up to 10 metres high, followed by a viaduct up to 16 metres in height to cross the Diseworth Brook floodplain and the M1 to the east of its junction with the A42.

12.1.5 The route would pass through the public safety zone of East Midlands Airport on the east side of the M1, below ground level and in a short cut-and-cover tunnel, to minimise operational impacts during construction. The route would then pass under the proposed Kegworth Bypass associated with the East Midlands Gateway Strategic Rail Freight Interchange.

12.1.6 The route then passes Kegworth in a cutting as it crosses Ashby Road. It would rise on to an embankment before crossing the River Soar floodplain on a viaduct, where it would rejoin the alignment of the 2013 consultation route.

12.2 Consultation feedback on the 2016 preferred route

12.2.1 We received a range of feedback during the consultation on the 2016 preferred route in this area. There was support for the proposed realignment given the reduced impacts on East Midlands Airport (including from the airport), as a result both of removing the need to tunnel underneath the airport, and by avoiding risks and complications associated with engineering works in the vicinity of the airport. There was also support from the communities of Breedon-on-the-Hill and Tonge following the removal of the A42 crossing. Positive feedback was also received about the reduced cost of the route in this area, and the move to ensure the route more closely followed the existing A42 transport corridor.

12.2.2 More respondents expressed opposition to the proposed change. A number of concerns were raised regarding the impact of the 2016 preferred route on the communities of Belton, Long Whatton, Diseworth and Kegworth, particularly the potential noise, visual, pollution and lighting impacts.

12.2.3 Many respondents expressed general concerns about the perceived impacts of the 2016 preferred route on residential properties, with some stating the proposed compensation for affected residents is not enough.

12.2.4 Respondents were also concerned about the impact on proposed housing developments to the west of Kegworth, the height of the viaduct as it crosses the M1 and Long Whatton Brook, and the height of the embankments and viaducts north of the A6 as the route heads north of Kegworth.

12.2.5 Concerns were also raised regarding the ongoing proximity of the route to the airport, the interface with the Strategic Road Network – namely the A42 and M1 – and the impact on HS2 journey times as the route speed has been reduced to follow a more curved alignment.

12.2.6 Issues were raised regarding the impact on local conservation areas, including the Long Whatton SSSI and woodlands such as those at Pasture Wood and Cloud Wood.

12.2.7 A number of respondents expressed a preference for the 2013 consultation route, saying that the 2016 preferred route would impact a greater number of people than the 2013 proposal. Some respondents also stated that the 2013 consultation route would deliver a better connection to East Midlands Airport, emphasising the importance of an integrated transport system. While it is acknowledged that the 2013 route would be more expensive, some respondents felt that this was worthwhile to mitigate disruption through having the route in a tunnel.

12.2.8 Other than the 2013 consultation route, the most popular alternative raised by respondents was for HS2 to link with East Midlands Airport. Some respondents suggested realigning the route to run through East Midlands Parkway station, feeling that this would be a better location for the East Midlands high speed station given the large amount of infrastructure already in place, good connectivity, and the lack of residential properties in the nearby area. Other respondents suggested using the Midland Main Line to run directly to Nottingham and Derby.

12.3 Responding to the consultation feedback

12.3.1 As a result of the feedback received, we have reviewed the alternative suggestions made and previous decisions taken on the route in this area. The majority of alternative suggestions focused on the location of the East Midlands high speed station. This was not part of the route refinement consultation conducted in 2016, but HS2 Ltd has previously considered a wide range of station options for serving the East Midlands, including stations at Derby, Nottingham, East Midlands Parkway and East Midlands Airport. This work considered a range of issues, including accessibility and demand across the region, engineering and sustainability issues, and the preferences of local stakeholders. In January 2015, the East Midland's local authorities reached a consensus on Toton as their preferred Hs2 station location.

12.3.2 Given a number of comments stating a preference for the 2013 consultation route, we have also reassessed this route against the 2016 preferred route. This work has concluded that the preferred route (as shown via the proposed realignment in Figure 7 above) remains the optimal solution for the route in this area, based on the significant cost saving and reduced engineering challenges.

12.3.3 Although the 2016 preferred route is 0.8 miles (1.3km) longer and the route speed is slower (170.8mph/275kph), resulting in an increased journey time of 55 seconds, this route avoids the two-mile (3km)-long tunnel under the East Midlands Airport, the associated ventilation shaft and also avoids engineering complexities, associated with the 2013 route impacts on the East Midlands Gateway Strategic Rail Freight Interchange and the M1/A50 crossing. The viaduct over the River Soar floodplain is also reduced in length by 460 metres.

12.3.4 In terms of sustainability impacts, at this stage, the two options broadly perform equally, although some impacts are either removed or transferred to new receptors. In addition, impacts on the East Midlands Gateway Strategic Rail Freight Interchange are reduced.

12.3.5 The 2016 preferred route would avoid heritage impacts past the Langley Priory Grade II* listed building and reduce impacts on the communities at Tonge and Breedon-on-the-Hill, as well as on the Tonge Conservation Area. The 2016 preferred route also has significantly reduced noise impacts compared to the 2013 consultation route. However, the preferred route would introduce heritage impacts to the Breedon Lodge Grade II listed building, severing the lodge from an associated moat.

12.3.6 We recognise that there are ongoing concerns with the 2016 preferred route alignment in this area. In particular, we will work closely with stakeholders and local communities as part of design development for the Phase 2b hybrid Bill to consider options to mitigate the impacts of the route on the communities of Belton, Long Whatton, Diseworth and Kegworth, including any impact on the proposed housing developments to the west of Kegworth.

12.3.7 Impacts on the East Midlands Gateway Strategic Rail Freight Interchange are reduced, but we will continue to work closely with the developer to understand how this interface can best be managed, focusing on how access to the SRFI site can be maintained and how we can mitigate impacts on the Kegworth bypass which is being brought forward as part of this development.

12.3.8 The 2016 preferred route passes through the public safety zone (PSZ) for East Midlands Airport, which contains the airport runway lights, and Instrument Landing System. This will need to be considered during hybrid Bill design, and prior to construction. HS2 Ltd will be legally required to assess the impact of passing through the PSZ and demonstrate how safety will be managed. We will continue to liaise closely with East Midlands Airport to mitigate the impacts on airport assets and access. Based on precedents at other airports and the result of our engagement to date, we believe that this impact can be managed effectively. We also note that an access road for the Strategic Rail Freight Interchange is currently proposed to pass through the PSZ.

12.3.9 We will also continue to work closely with Highways England during hybrid Bill preparation to mitigate impacts on the Strategic Road Network, including the A42, M1 and the A453. We will also engage with Uniper UK Limited to mitigate potential impacts on Ratcliffe-on-Soar Power Station.

CASE STUDY: Mitigating impacts through hybrid Bill development

During the development of the HS2 Phase One hybrid Bill, we found opportunities to address similar concerns to those raised by consultees in this area.

For instance, we included measures in the scheme to alleviate concerns over local construction traffic with several lengths of haul road included that were dedicated to taking HS2 construction traffic off the existing road network. Additional Provision 4, following Select Committee requests to amend the Bill, included a haul road in the scheme at Ickenham to reduce the volume of construction traffic on public highways; a commitment was given to Northamptonshire County Council regarding the creation of a bypass at Chipping Warden during the Select Committee process; and the Environmental Statement included temporary slip roads off the M25 between Junctions 16 and 17 so HS2 construction traffic could avoid using smaller local roads near West Hyde before accessing the arterial road network.

In line with HS2 Ltd's general design commitment to keep the railway as low in the landscape as possible, we made several changes to the route's vertical alignment during the hybrid Bill process. Additional Provision 2, for example, lowered the vertical alignment of the route to the west of Hints village in Staffordshire, placing the line in deep cutting and reducing the visual and noise impacts of the route, as well as allowing less land to be taken from Rookery Wood.

Where the line was on viaduct or embankment, we included additional lengths of noise barrier and visual screening through the hybrid Bill process to reduce the scheme's impact. Commitments were given during the hybrid Bill process to remove 44 of 48 minor noise effects reported in the Environmental Statement at residential properties at South Harefield through the implementation of a three-metre noise barrier on the Colne Valley viaduct, or through noise mitigation measures which delivered equivalent performance. Additional Provision 4 included extra noise barriers on the northern side of the Lower Thorpe viaduct.

13 East Midlands Hub approach (Long Eaton)

13.1 Overview

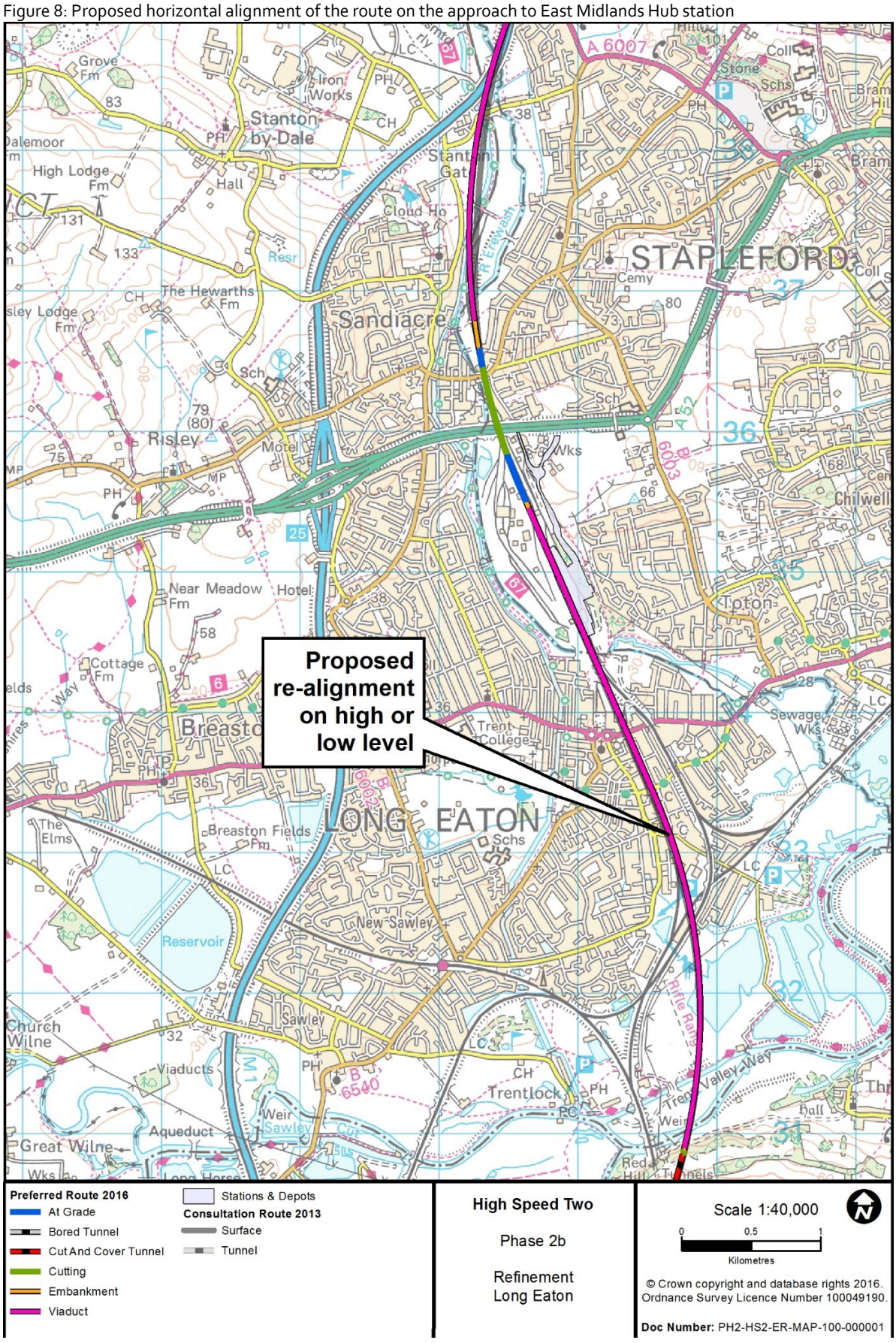
13.1.1 There are a number of significant challenges and constraints as the HS2 route approaches the East Midlands Hub station at Toton. These include interfaces with the existing rail network, and interactions with highways and the floodplain. The HS2 route needs to reflect these constraints while considering the impacts on local communities, particularly the need to avoid creating a physical barrier across the communities of Long Eaton and Toton. Our design must also reflect the technical requirements for HS2 so that we can be confident it will be deliverable and operable.

13.1.2 The 2013 consultation highlighted concerns over local connectivity in this area, particularly because of the possible impact on local highways of the construction and operation of the railway. Following the 2013 consultation, we undertook further work to understand the wider rail network through this area. This highlighted that the 2013 consultation route would involve major work on the two existing rail corridors through Long Eaton, which could involve construction impacts being spread more widely in this area than in the HS2 corridor alone. As a result, we considered options that would minimise construction impacts on the existing rail corridor.

13.1.3 The 2016/17 consultation presented two options for consideration in this area. The first would lengthen the viaduct over the River Trent floodplain to approximately 4,700 metres, so that the route would pass through Long Eaton on a viaduct, with HS2 directly to the east of the existing low-level corridor (Option 1). The viaduct would cross Main Street at a height of approximately 17 metres, Station Road at a height of approximately 16 metres, and the A6005 Nottingham Road at approximately eight metres. The current level crossings on the existing network are assumed to remain as existing.

13.1.4 The second option lengthened the viaduct over the River Trent floodplain to approximately 2,470m, before moving onto a retained embankment through Long Eaton (Option 2). This has a lower vertical alignment than Option 1 with HS2 crossing Station Road at a height of four metres and then travelling through the rest of Long Eaton on a retained embankment, following the same general horizontal alignment as Option 1. Figure 8 shows the proposed horizontal alignment through Long Eaton.

Figure 8: Proposed horizontal alignment of the route on the approach to East Midlands Hub station



13.2 Consultation feedback on the 2016 preferred route

13.2.1 We received a range of feedback on the proposals put forward for the route through Long Eaton during the 2016/ 17 consultation. Support for the overall proposals was based on the route following the existing rail corridor, and the potential regeneration opportunities for Long Eaton.

13.2.2 However, a significant number of respondents objected to the proposals. Those who did, raised issues and concerns regarding the impact of both options on the local community, particularly in terms of impacts on the local road network, traffic access across the rail corridor and severance of the community of Long Eaton. Many respondents expressed concerns that the local roads in the area are inadequate to support the necessary volume of traffic to construct the railway, and that the increase in traffic as a result of construction and operation will contribute to higher levels of pollution.

13.2.3 A number of issues were raised regarding the potential noise and visual impacts on the community of either option, particularly in areas such as New Tythe Street and Bonsall Street, given their proximity to the proposed line of route. Concerns were also raised about the potential cumulative impact of noise from the HS2 line, the existing railway and the M1.

13.2.4 Many respondents expressed concerns about the negative impact of proposals on property prices, with some saying that the proposals will make Long Eaton a 'dormitory town' with house prices unaffordable for local people. Some respondents also expressed the view that the proposals will drive local businesses away from the town and will have a negative impact on tourism.

13.2.5 Highways England raised concerns regarding access to the planned East Midlands Hub station from the A52, as well as construction traffic impacts on the M1 Junctions 24 and 25 and the A453 and A52 corridors. Network Rail raised concerns regarding the construction and operational impact on their operations in the Long Eaton area, particularly in relation to level crossings.

13.2.6 A number of concerns were raised regarding the environmental impact of the proposals, particularly in relation to local flooding issues and their impact on the route and on Green Belt land around Long Eaton and the Erewash and Nottingham Canals. The proximity of the route to Bulwell Wood SSSI, Seller's Wood SSSI and the Attenborough Gravel Pits SSSI was also raised.

13.2.7 Of the two options presented during the consultation, there was more support for Option 1 (the high level viaduct) than Option 2 (the lower level option). The most commonly cited benefits of Option 1 were that this option would reduce impacts of the route on traffic and the local community, and allow continued use of the two rail crossings, minimising impacts on Nottingham Road and Station Road and minimising the physical segregation of Long Eaton. The view was also expressed that the high level viaduct would benefit local businesses and the local economy by reducing the impact on local roads. It was also felt that the high level option would have less impact on floodplains.

13.2.8 The most commonly cited impact of Option 1 was the increased visual impact of the raised viaduct, with many feeling this would be out of proportion with the existing built-up environment. Concerns were also raised about the noise impacts, the safety of the viaduct option and the disruption to the local community during construction.

13.2.9 In terms of Option 2, the most commonly cited benefits were the potential reduction in visual impact compared with the high level viaduct, and the potential reduction in noise impacts due to the lower alignment. Some respondents felt that the lower level retained embankment would have fewer environmental impacts than the proposed higher level viaduct.

13.2.10 The most commonly cited impacts of Option 2 were the impacts on local roads and property, exacerbating existing traffic concerns on Station Road and Nottingham Road. Concerns were raised about this option splitting Long Eaton in two, acting as a physical barrier within the community, and the fact that this alignment could place tracks in the line of sight of first-floor bedrooms. Some concerns were also expressed regarding the potential flood risk associated with Option 2.

13.2.11 Alternative suggestions for the route in this area were to place the route in tunnel under Long Eaton. A number of suggestions were made for potential alternative HS2 station locations to Toton, including East Midlands Airport, East Midlands Parkway, Derby and Nottingham. The prime benefit of these suggestions was felt to be the realignment of the route away from Long Eaton.

13.2.12 Other alternative alignment suggestions included taking the HS2 route via Spondon or Derby; closing the existing low level railway in Long Eaton and raising both the new and the existing lines; and using an alternative alignment that takes the railway through the Erewash Valley.

13.3 Responding to the consultation feedback

13.3.1 As a result of the feedback received, we have reviewed the alternative suggestions made and previous decisions taken on the route in this area. The reasons for not progressing with alternative station locations are set out in Section 12 above.

13.3.2 Tunnelling under Long Eaton was not progressed due to the significant length and cost of tunnel that would be required as a result of the Trent and Soar floodplains.

13.3.3 We are confident that the horizontal alignment of the route as it passes through Long Eaton is the most appropriate, given the challenges and constraints as the route approaches the East Midlands Hub station at Toton, as set out in paragraph 13.1.1.

13.3.4 Based on the feedback we have received, our recommendation is that the route should use the high level option, lengthening the viaduct over the River Trent floodplain to pass through Long Eaton on a viaduct, with HS2 directly to the east of the existing low-level corridor.

13.3.5 Placing the route on a viaduct would reduce interactions between HS2 and the existing rail network, requiring less disruptive work on existing railway infrastructure. It would also help address concerns over the interaction between HS2 and the

floodplain in the area (requiring fewer flood defences). The high level option also maintains east–west permeability through Long Eaton. Lengthening the viaduct would, however, potentially increase noise and visual impacts.

13.3.6 The lower option would introduce a physical barrier through Long Eaton, potentially increasing severance of the community. This would also introduce a number of conflicts with the existing highways network that would need to be resolved, including Station Road and the A6005 Nottingham Road.

13.3.7 We recognise that there are ongoing concerns and issues associated with the route as it goes through Long Eaton – in particular, the potential noise and visual impacts, and the proximity of the route to properties on New Tythe Street and Bonsall Street. We will work closely with stakeholders and local communities as part of design development for the Phase 2b hybrid Bill to assess the impacts of the Trent Valley viaduct and consider potential solutions to reduce noise and visual impacts, particularly in Long Eaton.

13.3.8 We will continue to work closely with local authorities and key stakeholders to support local regeneration opportunities associated with the location of the East Midlands Hub station at Toton. We will also work to ensure the design of the station allows for effective road and pedestrian access, and will discuss local transport authority aspirations for improved transport connectivity to and from the station.

13.3.9 Network Rail highlighted a number of operational implications that would arise from our route through Long Eaton, including their long-term aspirations to close level crossings on their network and the possible impact of freight services using the existing sidings at Toton Yard. We will liaise with Network Rail to further understand the impact of the preferred route on their operational and maintenance requirements, including the future use of the freight yard and their aspirations to close level crossings.

13.3.10 Highways England also highlighted the interfaces with the M1, A52 and A453. We will engage with Highways England throughout the hybrid Bill development process to identify mutually acceptable solutions for our interfaces with the Strategic Road Network.

13.3.11 Further north, we are aware of issues and concerns associated with the route as it crosses the M1 at Trowell and as it passes Sandiacre. We will work with local communities and stakeholders to address these concerns and mitigate these impacts as part of further design development.

14 Derbyshire to West Yorkshire (M18/Eastern Route)

14.1 Overview

14.1.1 The 2013 consultation route travelled to a station at Meadowhall along the line of the Rother Valley, before heading north into West Yorkshire.

14.1.2 As described in Section 3, since 2013 opinion among local stakeholders about the HS2 station location in South Yorkshire has remained divided and no consensus has been reached. This has made the decision about where best to locate an HS2 station in South Yorkshire very challenging. During this time, HS2 reviewed options for South Yorkshire in light of these challenges and in the context of ambitions set by TfN for NPR, the results of which were detailed in the Sheffield and South Yorkshire report published by David Higgins in July 2016.

14.1.3 As a result of this work, we recommended an alternative approach to serving South Yorkshire. This involves a spur from the HS2 route that connects to the existing network south of Sheffield, to enable HS2 services to travel on to Sheffield Midland station.

14.1.4 This approach also means the HS2 mainline can take a different route through South Yorkshire, travelling to the east of Rotherham along the line of the M1 and M18, and then heading north–west to rejoin the 2013 consultation route south of Altofts.

14.1.5 The Secretary of State asked us to take forward this option, and this was the preferred route presented for consultation in 2016.

14.1.6 Much of the 2016/17 consultation feedback relating to the M18/Eastern Route through South Yorkshire challenged the decision to move away from the previous 2013 consultation route serving a station at Meadowhall. We have therefore given consideration to the wider strategic context in which this decision was made to ensure that this decision properly reflected the issues raised in consultation responses. This is dealt with in Section 14.2.

14.1.7 In light of the 2016/17 consultation feedback, we also considered whether any improvements could be made to the alignment of the M18/Eastern Route through the route refinements process that we have undertaken on the other refinement areas. This is dealt with in Section 14.3.

14.2 Reviewing the strategic context for serving South Yorkshire

The 'refined Meadowhall route'

14.2.1 Following the 2013 line of route consultation, we reviewed a wide range of refinements for the Phase Two route, including a number that would form part of the Meadowhall route. As we explained in summer 2016, when we compared the Meadowhall and M18/Eastern routes, we based this comparison on the 'refined Meadowhall route' which incorporated these changes. This was because the 'refined

Meadowhall route' was better in terms of costs and overall sustainability performance than the Meadowhall route that we presented in the 2013 consultation.

14.2.2 We have not previously published the 'refined Meadowhall route' due to the risk of introducing further blight across South Yorkshire. As the Secretary of State is now taking a decision on those elements of the Phase 2b route which have been subject to consultation, this risk is substantially reduced and we are accordingly publishing this alignment. The 'refined Meadowhall route' and the 2013 Meadowhall consultation route are shown in Figure 9.

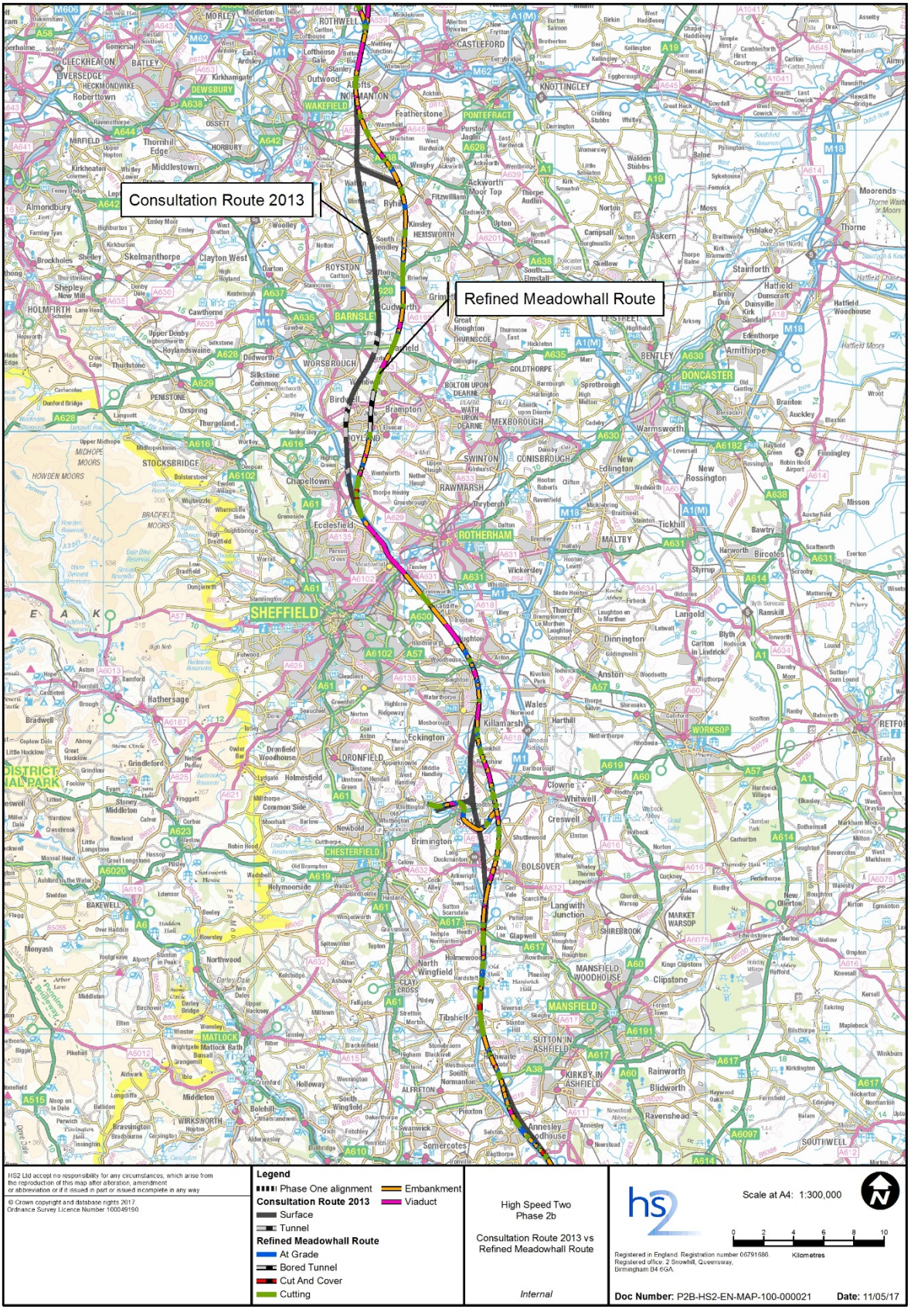
14.2.3 The main changes in the 'refined Meadowhall route' were to:

- Move the route further to the east past Bolsover and Markham Vale to avoid the significant risks involved in crossing the landfill sites at Markham Vale. While this would bring the route closer to Bolsover Castle, it would enable the route to avoid the Chesterfield Canal restoration.
- Move the route further to the east as it travels north of Sheffield. This would enable us to avoid a number of tunnels that were proposed in the 2013 consultation route, contributing to significant reductions in the cost estimate and offering some sustainability improvements.

14.2.4 We have previously published a range of comparisons to demonstrate the relative performance of the route options from a sustainability perspective. These are presented below in the 'topography, urban density and environment' section, and demonstrate that, while the 'refined Meadowhall route' offers improvements on the route presented in the 2013 consultation, the M18/Eastern Route performs significantly better than either of these options on this basis.[5]

[5] Our formal reporting on the sustainability impacts, as set out in the Appraisal of Sustainability Reports published in 2013 and 2016, is undertaken on a route-wide basis. This comparison of the routes through South Yorkshire is provided here for additional context.

Figure 9: Meadowhall 2013 consultation route and 'refined Meadowhall route'



Regional consensus and other alternative options

14.2.5 Following on from the 2013 consultation on the Phase Two route, and during wider engagement with key regional stakeholders, it was demonstrably clear that the distributed demand across South Yorkshire made it difficult for local authorities to agree on the most appropriate approach to serving South Yorkshire. This remains the case. For example, while a number of respondents to the 2016 /17 consultation argued that the Meadowhall route could support further development in the M1 corridor at locations such as Waverley and the Advanced Manufacturing Innovation District (Sheffield Airport), a number of respondents directly involved in these developments welcomed the M18/Eastern Route as it would remove the impacts on these development sites.

14.2.6 A number of responses to the 2016/17 consultation called for the HS2 route to serve Sheffield city centre directly, rather than via the existing network. We have previously considered options that would serve a high speed station in Sheffield either alongside the existing Sheffield Midland Station, or on the site of the decommissioned Sheffield Victoria Station. Our consideration of these options, including our rationale for not taking these options forward, is set out in the advice materials published in July 2016. In addition, a direct line into Sheffield would limit the opportunity to serve the wider region through the kinds of parkway station options we are currently considering following instruction from the DfT.

14.2.7 Given that these issues still stand, and that we have not received any new intelligence as a result of the recent consultation, we have not undertaken further work to look again at new high speed alignments into Sheffield city centre.

Serving South Yorkshire – key strategic tests

14.2.8 The Sheffield and South Yorkshire report published in July 2016 set out five key strategic tests when considering the basis on which HS2 should serve South Yorkshire. These were:

- Demand: the degree to which a solution would reflect the wider demand picture across the UK.
- The needs of Sheffield and the wider region: the ability of any particular route and station to serve the specific demand in South Yorkshire.
- Connectivity with the existing rail and wider transport network: the scope for a particular option to integrate into the existing and proposed transport network in the region.
- Topography, urban density and environment: the impacts of a particular route, which is influenced by factors such as the landscape and population density, and includes consideration of community and environment issues.
- Consideration of cost: the relative estimated costs of different route options.

14.2.9 We have revisited these tests based on the feedback provided in the 2016/17 consultation to consider what influence this feedback would have on our previous

advice. Although we separate out the individual factors below, any decision-making should be based on the combination of these factors. This means that, although some factors may be less clear-cut than others, it is the overall picture that must be considered. A brief summary of our consideration against each of these issues is set out below.

Demand

14.2.10 Our view on demand is informed by the standard UK government transport modelling methodology. This demonstrated that the demand for long-distance travel emanating from South Yorkshire is lower than the demand from other markets further north. This in turn suggests that the benefits generated by stopping services in South Yorkshire may be offset by the reduction in benefits to other, larger markets as a result of longer journey times.

14.2.11 The original conception for the route via Meadowhall involved stopping five trains an hour on their way to destinations further north (and similarly for southbound services). This provided a very high level of service for South Yorkshire and was feasible because all services passed through the station.

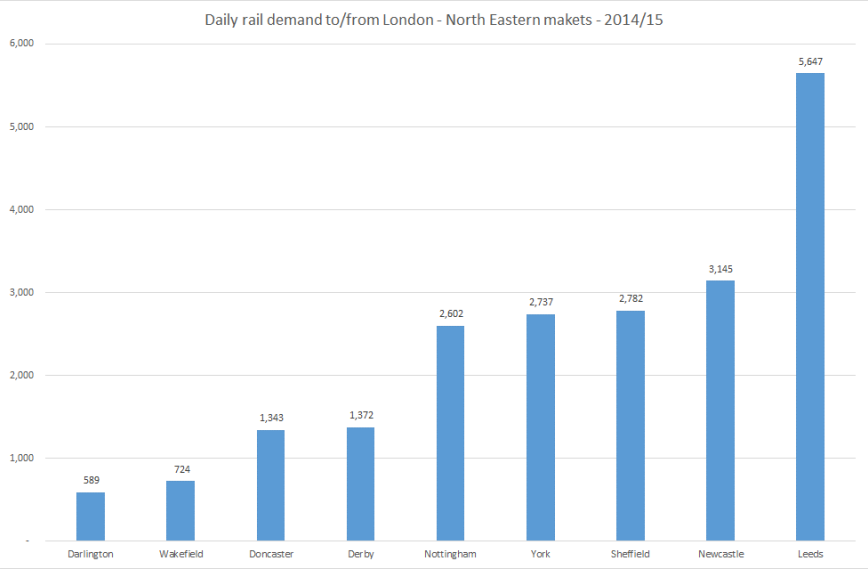
14.2.12 The demand modelling that was undertaken in support of the announcement in November 2016 demonstrated that the M18/Eastern Route delivered an overall improvement in the case for the full scheme. This was driven in part by the faster services to and from destinations further north, thanks both to a faster overall alignment and by not stopping a majority of services in South Yorkshire. Our analysis was based on train service specifications that were specific to each option; these are set out in the back of the Economic Case published in support of the announcement in November 2016[6].

14.2.13 We have revisited our analysis and understanding of demand and our work continues to suggest that this analysis holds good. Therefore, we do not recommend changing the route based on the overall demand picture for the full network.

14.2.14 Figure 10 shows current estimated daily rail boardings to/from London for major destinations on the eastern leg. Leeds is by far the largest market, with other large markets from Newcastle, Sheffield, York and Nottingham. This continues to suggest that, as discussed previously, consideration of how to serve South Yorkshire needs to reflect on the potential impacts on larger markets served by HS2.

[6] HS2 Phase 2b Crewe to Manchester and West Midlands to Leeds: Economic Case https://www.gov.uk/government/publications/hs2-phase-2b-crewe-to-manchester-west-midlands-to-leeds-economic-case

Figure 10: Daily rail trips (boardings) to/from London.



Source: HS2 Ltd

The needs of Sheffield and the wider region

14.2.15 Some of the strongest feedback that we received in the 2016/17 consultation related to the pattern of demand in the region, and how the Meadowhall route offered better services to the South Yorkshire region as a whole.

14.2.16 We observed above that there is no single view across the city region about the right way to serve South Yorkshire. Many of the stakeholders who objected to the M18/Eastern Route did so on the basis that it would serve the wider South Yorkshire region less effectively than the previous Meadowhall option.

14.2.17 Our work does demonstrate that, for potential passengers in towns such as Rotherham, it would take longer to travel to Sheffield Midland than Meadowhall, whether by car or train (we further consider transport accessibility in the relevant section below). Our own work similarly demonstrates that, for much of the wider South Yorkshire region, it would take longer to travel to Sheffield Midland rather than the station previously proposed at Meadowhall. However, it does not consider the opportunity to shape services in South Yorkshire so that they integrate with HS2 services at Sheffield Midland; we consider this further below.

14.2.18 The argument for serving South Yorkshire with a station at Sheffield Midland is also based on the fact that this is where demand in the region is centred. This is based on where passengers board. Reviewing the proposals for development by Sheffield City Region highlights the fact that the largest level of regional housing development and employment growth in a single area in the region is also proposed to be delivered in Sheffield. We would expect, therefore, that this would continue to be the largest regional centre of demand. This is reflected in the results of our modelling.

14.2.19 Similarly, although some respondents to the 2016/17 consultation argued that a station at Meadowhall would be better for regional development, this view was not universal. The HS2 Ltd Design Panel, a body of independent experts convened to advise HS2 Ltd on design issues, noted that a city centre site could do more to drive

regeneration and development. Similarly, a number of organisations responsible for regionally important developments such as the Advanced Manufacturing and Innovation District also welcomed the move to the M18/Eastern Route as a way of securing the future of these developments by avoiding concentrations of proposed developments.

Analysis of regional rail demand

14.2.20 Rail travel within the South Yorkshire region comprises local, regional and long distance services. All major cities in the region have their own local rail station.

14.2.21 One of the challenges that was raised by a number of respondents to the 2016/17 consultation related to our interpretation of regional demand and its limitations. Respondents argued that, because existing services to much of the region are relatively poor, this supresses regional demand for long-distance services in the model. To consider this, we have built on our work undertaken for the Sheffield and South Yorkshire report by undertaking comparative analysis of the propensity in the region for long-distance travel. Our assessment of demand in the South Yorkshire region is based on the same model as that described in the demand section above.

14.2.22 At present, the majority of long-distance rail services in South Yorkshire are from Sheffield Midland and Doncaster railway stations. These stations offer the most frequent, direct and fastest services to long-distance destinations such as London, the Midlands and the north east.

14.2.23 In many cases these two stations (together with Wakefield) are the only stations in the region to offer direct services to London and Birmingham, as well as the fastest journey times at present to these destinations and Leeds (see Table 1).

Table 1: Current rail services - summary of selected rail destinations available from South Yorkshire.

	Direct services (trains per hour)			Current fastest journey time (mins)		
	London	Birmingham	Leeds	London	Birmingham	Leeds
Urban areas within Sheffield City Region						
Sheffield city centre	2-3	2	5	121	63	40
Meadowhall	×	×	4	124*	86*	48
Rotherham	×	×	1	136*	92*	56
Barnsley	×	×	3	156*	107*	32
Doncaster	4 – 5	1	3	94	88	29
Worksop	×	×	×^	112*	108*	88*
Urban areas outside Sheffield City Region						
Wakefield	2 – 3	1	8–9	114	99	11
Pontefract	×	×	1	167*	127*	30
Scunthorpe	×	×	×	134*	139*	77*

Source: National Rail Enquiries (April 2017). ×= no direct services. * = interchange required. ^There are two (slow) direct services per day from Worksop to Leeds, which run via Sheffield Midland.

14.2.24 This means that people living outside these areas must choose between:

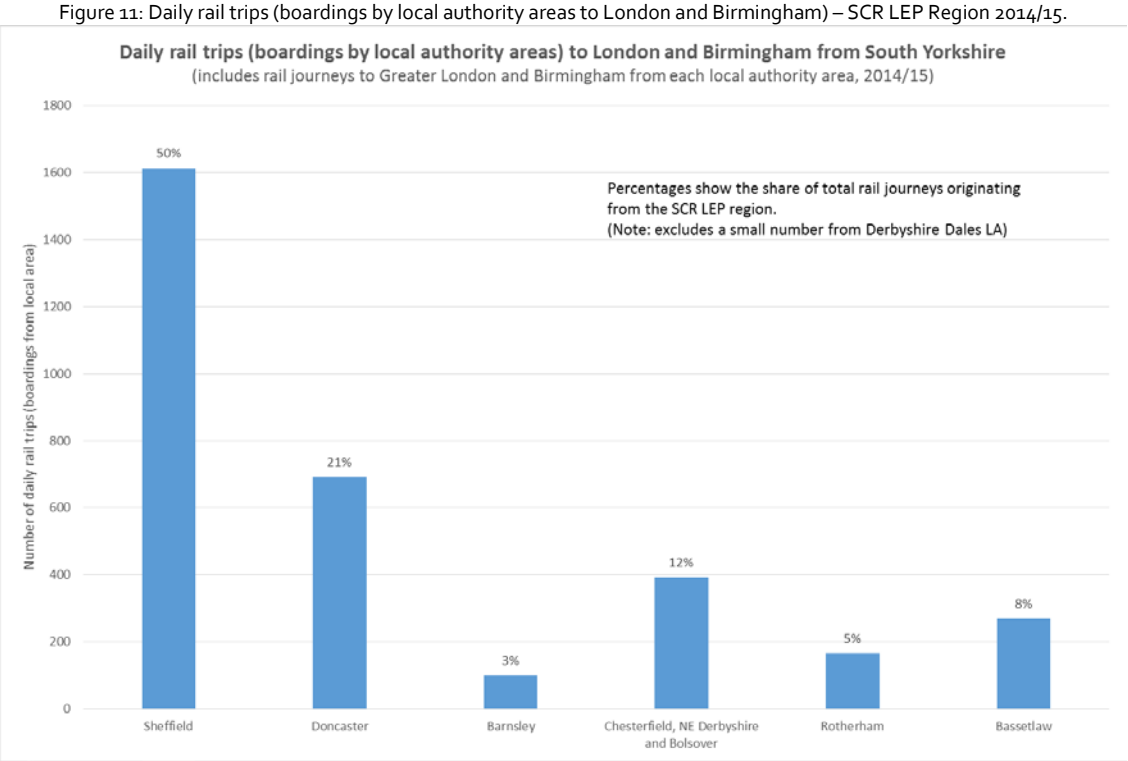
- travelling (by road or public transport) directly to a larger station, such as Sheffield, Doncaster or Wakefield;
- travelling (most likely by road) to their own local station to take a regional service and interchanging at Sheffield, Doncaster or Wakefield; and
- avoiding rail travel and using road only.

14.2.25 In making such decisions, people are likely to consider such factors as total door-to-door journey time, waiting and interchange time, convenience, road congestion and parking. For example, a faster rail journey from Sheffield may be weighed up against driving into the centre of the city and finding parking.

14.2.26 As such, it is unsurprising that the Sheffield and Doncaster areas currently make up the largest proportion of long-distance rail journeys. At present, more than 70 per cent of daily boardings to London and Birmingham are from these two areas (see Figure 11)[7]. In comparison, these areas make up 47 per cent of total population within the Sheffield City Region (SCR) Local Enterprise Partnership (LEP) area.

14.2.27 In contrast, there are much fewer rail journeys to London and Birmingham commencing from the other areas (e.g. Barnsley and Rotherham make up only eight per cent, despite comprising 27 per cent of the population).

Figure 11: Daily rail trips (boardings by local authority areas to London and Birmingham) – SCR LEP Region 2014/15.



Source: HS2 Ltd

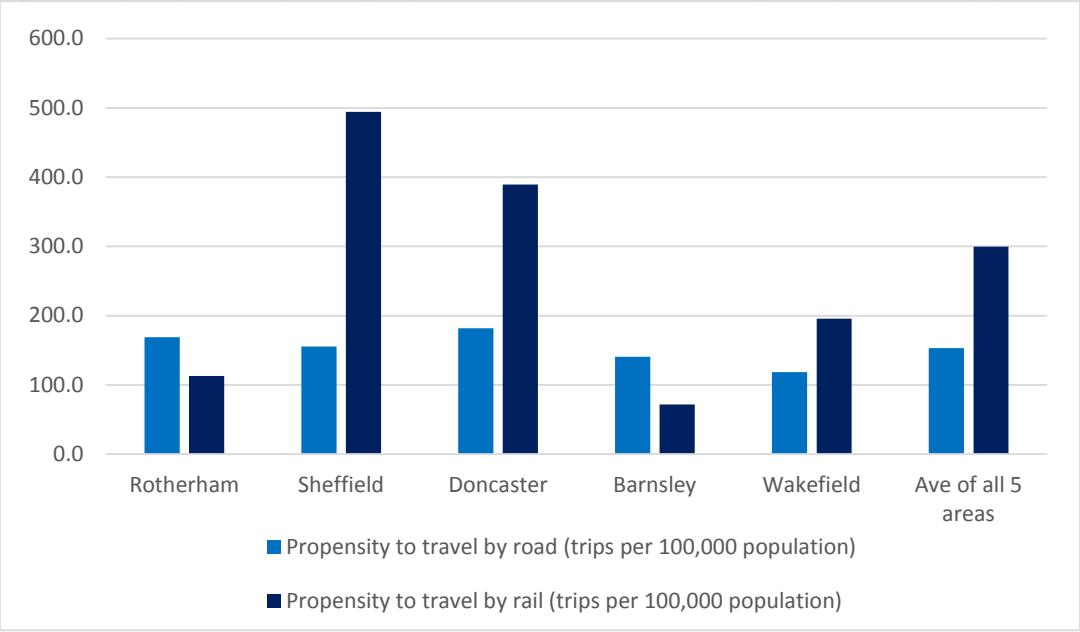
[7] London and Birmingham have been used as a proxy for overall long-distance rail travel.

14.2.28 A comparison of the share of rail and road demand to London/Birmingham suggests that road demand is fairly consistent across South Yorkshire, and varies largely in line with population (see Figure 12).

14.2.29 This does suggest that demand for travel by rail is lower than would otherwise be expected in some areas, when compared with centres such as Doncaster and Sheffield, which already have good rail connectivity.

14.2.30 However, it does not consider other relevant factors that govern propensity for long-distance travel, including, for example, employment in knowledge industries that are focused around Sheffield.

Figure 12: Propensity to travel by road (highway) and rail to (inner) London and Birmingham (trips per 100,000 population).



Source: HS2 Ltd

14.2.31 In order to consider the demand pattern across the HS2 network in a fair and consistent way, we cannot adopt different approaches to modelling demand in specific locations. It is reasonable to argue that the demand picture is more nuanced than our current data suggests; however, it is not possible to assert what this alternative picture might look like with any greater certainty.

14.2.32 The critical question remains whether a more nuanced picture would fundamentally alter the conclusions that HS2 Ltd previously advanced. While accepting the limitations of our current data, we do not consider that, given the wider context of current and proposed population and employment growth, this fundamentally changes our conclusion.

14.2.33 Although our current proposal is to serve South Yorkshire via Sheffield Midland, opportunities remain to expand this service in the future, through the delivery of a parkway station on the HS2 mainline or existing network, the extension of HS2 services to run beyond Sheffield Midland, or a combination of both – as well as

consideration of how the existing transport network might better support connectivity to new HS2 services.

Connectivity with the existing rail and wider transport network

14.2.34 Our consideration in this area covers three main topics: the road network, the existing rail network, and the proposals currently under development by TfN.

14.2.35 One of the concerns raised about Meadowhall station was the impact on the road network, and particularly the M1. Respondents to the 2013 consultation raised concerns that introducing a station at Meadowhall would significantly worsen traffic on the M1 and air quality in the area. These comments reflected the views of the HS2 Ltd Design Panel that raised concerns about the constraints at Meadowhall, including the highways infrastructure and air quality. Respondents to the more recent 2016/17 consultation raised similar concerns about the impact of our proposals to serve Sheffield Midland on the local road network in Sheffield.

14.2.36 It is clear that it will be necessary for the appropriate roads infrastructure to be in place in order to support the development of Sheffield Midland as a hub for HS2. This will need to be considered as part of wider strategic planning in the region.

14.2.37 There are, therefore, transport concerns in connection with both locations. At Meadowhall, the main issue was about the capacity on the Strategic Road Network. For Sheffield Midland, the greater concern was about local roads and parking. Nonetheless, the fundamental concern over the ability to absorb demand growth on the local network is similar.

14.2.38 Another aspect of transport integration is the existing rail network. The main challenge in terms of integration with the rail network focuses on whether there is scope to accommodate additional HS2 trains on the existing network.

14.2.39 When originally considering the option to serve Sheffield Midland via the Midland Main Line, HS2 Ltd agreed with Network Rail a series of assumptions relating to the rail network in 2033 and we continue to work on this basis. Part of these is the assumption that, by 2033, the Midland Main Line will be electrified in line with current investment plans, and that further investment in signalling will have been delivered.

14.2.40 We have already noted the possibility of running HS2 services beyond Sheffield Midland to serve other stations in the region, further enhancing the connectivity delivered by HS2. As well as the benefits in terms of serving additional markets, this could also help to address capacity concerns at Sheffield Midland and we will consider this opportunity further as the scheme develops.

14.2.41 Queries were also raised through the 2016/17 consultation about the implications on the existing network of HS2 services running north of Sheffield to rejoin the HS2 line, as envisaged in the Government Command Paper published in November 2016. Our assumptions about funding for this work are discussed further below. We understand that the DfT has instructed Network Rail to begin consideration of how such services could be facilitated and we will continue to work with Network Rail and the DfT on this issue.

14.2.42 In general terms, such a large enhancement to the UK rail network can be expected to have complex interactions with the existing network. In the case of Meadowhall, this complexity related primarily to the delivery of effective passenger interchange. In the case of Sheffield Midland, our work demonstrates that, although joining the existing rail network to serve Sheffield introduces additional operational complexity on the network, it also unlocks new opportunities for connectivity. For example, we are undertaking work to consider whether services could be extended so that they run beyond Sheffield Midland to other destinations, rather than terminating in Sheffield.

14.2.43 These opportunities could also be further enhanced by service planning to support the development of Sheffield Midland as a hub for HS2, as envisaged at other stations on the existing network served by HS2.

14.2.44 As we have noted, it is important that an investment on the scale of HS2 reflects both the existing UK transport network, and also the aspirations for future development. The most significant of these is the ongoing NPR project, led by TfN. This changing context was central to revisiting previous recommendations about the route in South Yorkshire.

14.2.45 One of our key reasons for proposing a move away from Meadowhall was to facilitate the delivery of services between Sheffield and Leeds city centres. A number of respondents to the 2016/17 consultation argued that TfN's aspirations could be better delivered by services from Meadowhall, rather than Sheffield city centre. However, this is counter to TfN's stated aspiration of services from city centres, an approach also advocated by stakeholders from the wider north of England. We therefore consider that serving Sheffield Midland would better align with TfN's wider plans for improved rail connectivity across the north of England.

Topography, urban density and environment

14.2.46 The Sheffield and South Yorkshire report stated that the presence of the shopping centre and associated businesses meant that there is a substantial price to pay in terms of demolition of properties with the Meadowhall route and station. Major local employers such as British Land (who own the Meadowhall shopping centre), Outukumpu and Alcoa would be affected.

14.2.47 It also stated that, while the existing M1 viaduct does establish a context against which any impacts should be measured, the sheer scale, height and length of the proposed station does pose design challenges that appear daunting.

14.2.48 When assessing the M18/Eastern Route, the Sheffield and South Yorkshire Report stated that this would avoid the complexities associated with the Meadowhall viaduct, the problems of air quality and congestion – and therefore access – at the shopping centre, as well as the substantial compensation risk associated with demolition of businesses in the area. The report also stated that the M18/Eastern Route would carry much less risk from the legacy of mining in the area, involve fewer potential watercourse diversions, and result in less overall expected noise impacts. It did, however, recognise that there would be impacts on a new housing development between Mexborough and Conisbrough, some existing communities and also on the

landscape in parts of the Rother and Dearne valleys. Overall, though, the Sheffield and South Yorkshire Report concluded that it expected that fewer properties would need to be demolished with the M18/Eastern Route.

14.2.49 These conclusions are further endorsed by our detailed work to look into the impacts of routes through South Yorkshire. At the start of this section, we touched on some of the differences between these routes. These differences in impact result from the different nature of the routes via Meadowhall – which pass for some of their length through built-up areas – and the M18/Eastern Route, which passes through much more rural environments.

14.2.50 Accordingly, although the M18/Eastern Route has more impacts on the landscape, it has significantly fewer impacts on people and communities.

Table 2: An appraisal of potential demolitions associated with the routes through South Yorkshire [8]

Potential demolitions	2013consultation route - Meadowhall	'Refined Meadowhall route'	M18/Eastern Route
Residential	84	80	35
Commercial and industrial	57	47	16
Overall	**141**	**127**	**51**

14.2.51 As shown in Table 2, direct property impacts along the 'refined Meadowhall route' would be around 127, compared to around 51 along the M18/Eastern Route.

14.2.52 At this very early stage of the design, there is a reduction in potential residential demolitions when the M18/Eastern Route (35) is compared against the 'refined Meadowhall route' (80). The figure of 35 includes approximately 16 direct residential property demolitions based on the operational footprint of the railway at the Shimmer estate, Mexborough. It should be noted that when considering the options that we published in July 2016, in the Sheffield and South Yorkshire report, we assumed (in the absence of more detailed information) around 55 residential demolitions at Mexborough, i.e. a conservative estimate.

14.2.53 It is also worth noting that the 80 residential demolitions on the 'refined Meadowhall route' do not include potential demolitions at the Waverley new community site south of Sheffield. Including this development site, which is avoided as a result of moving to the M18/Eastern Route, would further increase the difference between the two impacts of the two routes.

14.2.54 Overall, there are also fewer clusters of residential demolitions (defined as five or more) on the M18/Eastern Route in comparison with the 'refined Meadowhall route', including the avoidance of 49 demolitions at South Tinsley and 11 demolitions at Wincobank.

[8] The potential for demolitions is based on the known earthworks of the alignment at this early stage of the process. Following a route decision, this is likely to change with ongoing design development, construction planning and environmental assessment. For example, demolitions resulting from ancillary works, mitigation and realignment of existing infrastructure (such as roads and railways) are not included at this stage.

14.2.55 Around 70 per cent fewer commercial properties are directly impacted by the M18/Eastern Route than the 'refined Meadowhall route'.

14.2.56 Our analysis demonstrates that, even after refining the Meadowhall route, there are far fewer people living in close proximity to the M18/Eastern Route. Based on indicative appraisal, the number of dwellings within 100 metres of the surface route for the 'refined Meadowhall route' is 1,000, compared with 600 on the M18/Eastern Route.

14.2.57 At this early stage of design, the M18/Eastern Route also performs better from a noise perspective (see Table 3).[9]

Table 3: An appraisal of households experiencing noticeable noise impacts on the routes through South Yorkshire.

	2013 consultation route – Meadowhall	'Refined Meadowhall route'	M18/Eastern Route
Households experiencing noticeable noise impacts	17,500	29,000	9,700

14.2.58 Moving the eastern leg rolling stock depot (RSD) from New Crofton to a site located east of Leeds in the Aire Valley adjacent to the M1 would reduce the landscape and visual impact on residents of New Crofton and users of Anglers Country Park. A direct impact on the North Crofton Co-operative Colliery development site would also be avoided, and habitat loss north of Anglers Country Park would be reduced.

14.2.59 A number of respondents to the 2016/17 consultation put forward the challenge that the impacts along the M18/Eastern Route were more egregious than on a more urban route, as there would be fewer benefits for those living in rural, as opposed to urban, areas. This is a similar concern to that raised on parts of the Phase One route. The Home Owner Payments schemes developed for Phase One and now proposed by the Government for Phase 2b are designed to address this issue by providing a cash payment to those most immediately affected in rural areas. The scope and purpose of this scheme is discussed further in relation to the property consultation, which ran alongside the 2016/17 route refinement consultation. As we have mentioned previously, the possible development of a parkway station, subject to demand, would also place more people across South Yorkshire within easy reach of an HS2 station.

14.2.60 We are fully aware that such concerns relate not only to the impact of the operational railway, but also to the construction phase. We also note that, while the overall impacts may be fewer, there remain significant impacts on some more rural communities. As part of the development of the hybrid Bill we will need to understand the most appropriate approaches to mitigating the impacts of constructing and operating HS2. However, based on our overall consideration of the relative

[9] Our formal reporting on the sustainability impacts, as set out in the Appraisal of Sustainability Reports published in 2013 and 2016, is undertaken on a route-wide basis. The comparison here is based on the route through South Yorkshire only and is provided for additional context.

sustainability performance of these options, we continue to advocate the M18/Eastern Route.

14.2.61 A number of concerns were also raised in connection with the geological risks presented by the landscape and historical mining activity – these are discussed further below.

Cost

14.2.62 Our estimates currently suggest that the M18/Eastern Route could be delivered at a substantially lower cost than an equivalent route through Meadowhall. This is partly a reflection of the fact that the Meadowhall route required a long viaduct alongside the M1 and across the Don Valley, with a station along part of its length.

14.2.63 There were two main challenges to this view of costs in the 2016/17 consultation. First was the contention that we had underestimated the level of risk inherent in this new route, particularly due to geological issues. It is true that, thanks to the previous 2013 consultation, we have a greater understanding of the geological risks involved in the Meadowhall route, and that some of these risks were significant. Our work to date has indicated that there is a lower level of risk from geological issues arising from the legacy of industrial activity than on the Meadowhall alignment. Nonetheless, the intelligence that respondents provided to us on these issues will be critical to the development of the design for a hybrid Bill.

14.2.64 Our overall estimate for the M18/Eastern Route includes contingency provision in the form of optimism bias at 40 per cent. This approach, which has been validated against Treasury guidance and subject to detailed assurance, was adopted elsewhere on the Phase Two route. We have applied this level of optimism bias throughout route development, and we do not consider that the risk inherent in the M18/Eastern Route is so considerably higher as to warrant a different approach to risk management in this area.

14.2.65 The other specific challenge to our appraisal of costs was that our estimate specifically excluded a number of critical costs that would be necessary to make the proposals work in practice. For ease, we have broken these down into three sections below.

14.2.66 For the route from the HS2 connection to Sheffield Midland, we agreed a number of assumptions with Network Rail about what would be required and what we could reasonably expect to be in place before 2033. As part of this, we have agreed the assumption that the Midland Main Line (MML) will be electrified before 2033. This means that HS2 Ltd will need only to electrify those elements of the Erewash Valley Line that connect to the MML, and this has been accounted for in the estimate.

14.2.67 In terms of Sheffield Midland, further consideration will be required as to the appropriate operational assumptions as well as the actual infrastructure requirements. For example, the infrastructure requirements will be influenced by how many HS2 services can be expected to terminate at Sheffield Midland, rather than running through. They will also be influenced by how services will run on the existing network after 2033, when HS2 is delivering enhanced connectivity to destinations including the East Midlands, West Midlands, and London. These discussions will further inform

consideration of what investment is required by both HS2 Ltd and Network Rail, and we will continue to work with DfT and Network Rail to understand the issues around this.

14.2.68 North of Sheffield Midland, it is proposed that services could run on a loop and rejoin the HS2 network to provide direct connections between Sheffield and Leeds city centres. We have included within our estimate a figure to deliver a junction between the existing and HS2 networks. We have agreed with DfT that further investment to deliver the necessary capacity, such as electrification, would not be delivered by the HS2 project, as its strategic scope would be wider than HS2 alone. As noted above, Network Rail is currently considering what work is necessary to facilitate such services.

14.2.69 HS2 Ltd is currently assuming that a number of services will travel on this 'loop' through South Yorkshire, and this is an important element of the strategic argument for the M18/Eastern Route. However, as demonstrated in the economic analysis published in November 2016[10], the economic argument for the M18/Eastern Route does not depend on the delivery of this loop. While, therefore, we will continue to keep the position under review in respect of this element of the infrastructure, we do not consider at the moment that the need to agree the scope and funding of any future improvements is a sufficient risk to invalidate the case for the M18/Eastern Route.

14.2.70 Our base case does not currently assume that we would deliver a parkway station as part of the scheme, although there may in future be a case for this to be included. Therefore, while the cost of such a parkway is not included in our estimate, we have similarly excluded any benefits that may emerge as a result. Similarly, as discussed above, extension of services north of Sheffield Midland are likely to deliver costs, benefits, and potential savings elsewhere and these are not currently part of our case.

14.2.71 While we therefore acknowledge that there are a number of risks and uncertainties in the estimate, we do not currently consider these sufficient to alter our view that the M18/Eastern Route will deliver savings against a route via Meadowhall. In particular, the scale of the estimated savings are such that, even if the gap narrows following further work, the M18/Eastern Route can still be expected to perform better from a cost perspective.

Conclusion

14.2.72 As we stated at the start of this section, we agree that the case for adopting the M18/Eastern Route is based on a range of factors. Similarly, we acknowledge that, in a number of areas, respondents to the 2016/17 consultation have provided valuable challenges to our previous analysis. Nevertheless, based on our review of the consultation feedback against these five criteria, we continue to recommend that the

[10] HS2 Phase 2b Crewe to Manchester and West Midlands to Leeds: Economic Case https://www.gov.uk/government/publications/hs2-phase-2b-crewe-to-manchester-west-midlands-to-leeds-economic-case

Phase 2b route between Derbyshire and West Yorkshire should be advanced on the basis of the M18/Eastern Route.

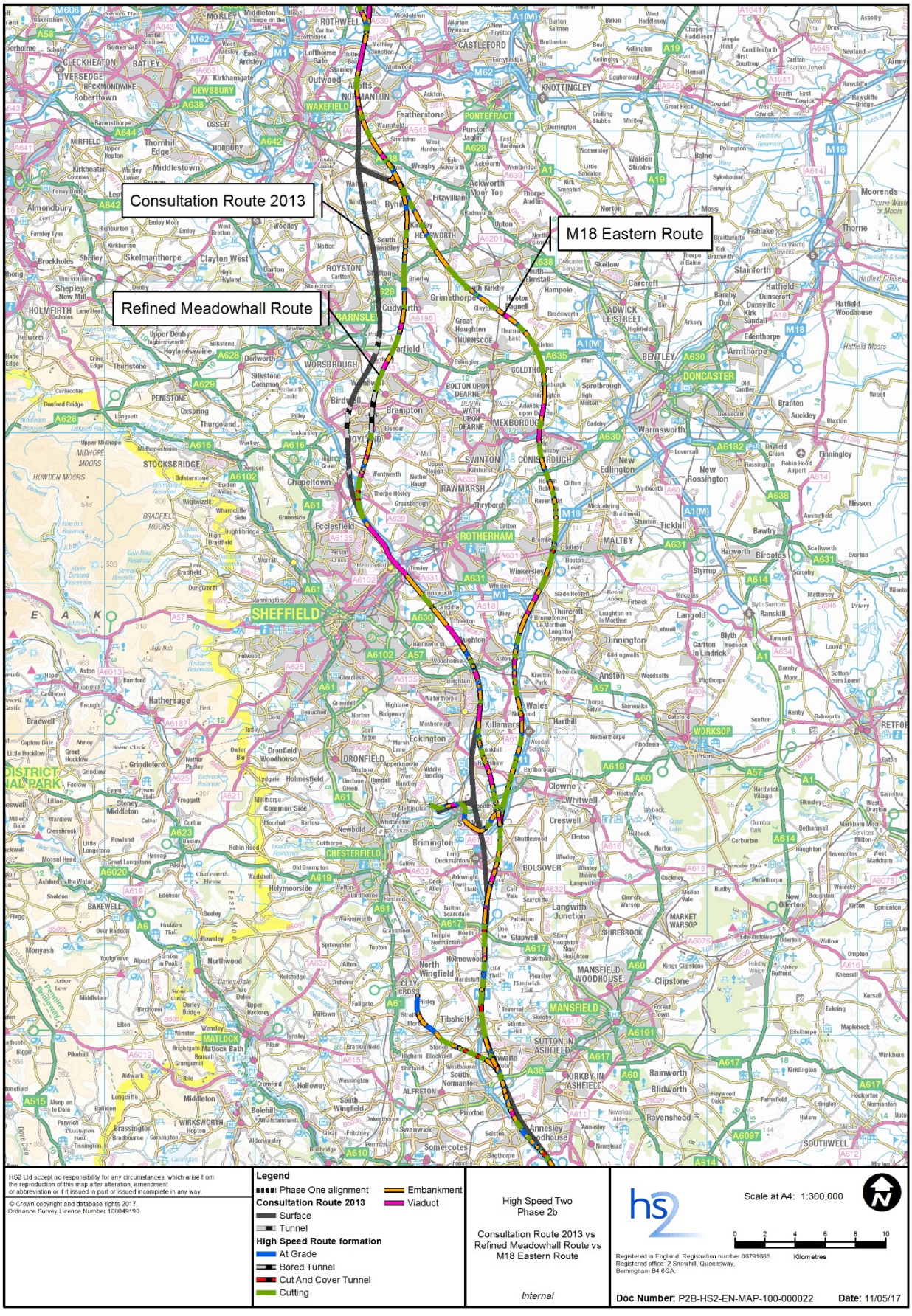
14.2.73 In the following section, we consider whether there are refinements that could improve the performance of the M18/Eastern Route further.

14.3 Refining the M18/Eastern Route

Overview

14.3.1 The preferred M18/Eastern Route set out during the 2016/17 consultation is shown in Figure 13. This is shown along with the 2013 consultation route and the 'refined Meadowhall route' referred to in Section 14.2.

Figure 13: M18/Eastern Route



14.3.2 The 2016 preferred route emerges from a tunnel to the north-east of the conservation area, at Nottingham Business Park, and bears northwards to run alongside the M1 to the A38 where the South Yorkshire spur is located. North of the spur to Sheffield, the mainline would run in a cutting before passing under the M1 at Tibshelf; it would be positioned on the west of the M1 as it passed Hardwick Hall.

14.3.3 The spur to join the existing railway near Clay Cross is located near the A38 and Hilcote. The spur will pass under the M1 and Alfreton Road, south of Newton, before joining the existing Erewash Valley railway east of Stonebroom. The spur will enable HS2 services to connect to the Midland Main Line to serve existing stations at Chesterfield and Sheffield city centre.

14.3.4 The preferred route for the M18/Eastern Route alignment starts north of Tibshelf and broadly follows the M1 and M18 corridor between Tibshelf and Wales. Between Tibshelf and Heath, the route runs to the west of the M1 motorway. North of Heath, the route crosses to the east of the M1 and passes Bolsover on a mixture of embankment and viaduct, before passing east of a series of spoil tips and landfills at Markham Vale. The route crosses back over to the west of the M1 near Mastin Moor. The approach to the infrastructure maintenance depot at Staveley links the HS2 mainline near Mastin Moor via a former mineral railway. The HS2 mainline continues northwards towards Wales, following the west side of the motorway as closely as possible.

14.3.5 The route passes Wales in a retained cutting on the west of the M1 before continuing north and crossing the existing railway and Pigeon Bridge Brook on a viaduct, passing to the east of Aston. The route at this point is away from the motorway (given the relative speed differences and impact on curvature) as it continues north, before returning to the line of the motorway and crossing the M1/M18 junction near Thurcroft on two viaducts.

14.3.6 Travelling north from Wales, the route initially follows the M1 and M18 corridors on the western side, passing between Bramley and the M18 in retained cutting before diverging towards Conisbrough Parks and the Dearne Valley. The route then passes between Mexborough and Conisbrough on a viaduct, continuing north and crossing the River Dearne floodplain, also on a viaduct. The route then climbs steeply towards Goldthorpe.

14.3.7 The route passes to the east of Barnburgh on embankment and Hickleton in deep cutting, before heading north-west to pass north of Thurnscoe and Clayton on a viaduct over the existing railway. This location has been identified as a potential connection point between HS2 and the existing railway, where trains travelling north from Sheffield could continue north on the HS2 mainline.

14.3.8 Continuing north-west, the route passes to the west of South Kirkby, Hemsworth and Fitzwilliam on a number of cuttings and embankments. The route passes over the A638 on a viaduct between Crofton and Sharlston Common, before passing over the existing railway at Kirkthorpe and then continuing west of Normanton and Altofts, where it rejoins the alignment of the 2013 consultation route. The route then

continues to Leeds via a spur off the mainline, and to Church Fenton where it connects to the existing rail infrastructure before continuing on to the East Coast Main Line.

14.3.9 Based on the M18/Eastern Route presented for consultation in 2016, the New Crofton RSD would be located to the east of Wakefield, south of Crofton, on former industrial land adjacent to the existing railway line. As described earlier, in response to concerns raised by the local community during engagement activities, we are considering a number of alternative locations for the depot. The outcomes of this work are set out in Section 15.

Consultation feedback on the 2016 preferred route

Route alignment

14.3.10 We received a large number of consultation responses regarding the 2016 preferred route proposal for the M18/Eastern Route, focusing particularly on environmental concerns, community impacts, engineering considerations and alternative suggestions. There were also comments detailing benefits that the M18/Eastern Route delivers in comparison to the previous Meadowhall route alignment, consulted on in 2013.

14.3.11 The benefits that were outlined in the consultation feedback largely related to improvements in connectivity for Sheffield and Chesterfield, reduced impacts on residential areas and commercial developments affected by the 2013 consultation route alignment, and reduced environmental impacts.

14.3.12 Specific environmental improvements that were identified by respondents included the reduced impact on the Rother Valley and its Country Park, reduced impact on the Chesterfield Canal, and the reduced environmental impacts on towns and villages such as Renishaw, Killamarsh and Treeton. There were also comments regarding the fewer areas of mining legacy on the M18/Eastern Route as opposed to the Meadowhall route, which respondents believed could make it cheaper to build, and easier to mitigate.

14.3.13 There were also general comments about the benefits of HS2 to this region and the north of England. A number of respondents directly involved with regional development proposals in the M1 corridor at locations such as Waverley and the Advanced Manufacturing Innovation District (Sheffield Airport), welcomed the M18/Eastern Route as it would remove the impacts on these development sites. A number of respondents also cited the potential for the M18/Eastern Route to complement the delivery of TfN's wider plans for improved rail connectivity across the north of England (this is discussed more fully in Section 14.2).

14.3.14 Conversely, there were substantially more comments from respondents outlining concerns with, and opposition to, the 2016 preferred route alignment. The most prevalent of these concerns was the impacts on a number of communities along the route, in particular Newton, Blackwell, Aston, Bramley, Mexborough, Conisbrough, Barnburgh and Crofton. The main concerns voiced by respondents in these communities relate to property demolitions. At Bramley, one respondent to the consultation states that over 70 properties on the Broadlands Estate will be affected

by the M18/Eastern route proposals[11]. Significant concerns were also expressed regarding the impact of the route on new housing developments, either completed or still under construction, in particular the Shimmer housing estate in Mexborough.

14.3.15 A number of concerns were also raised by members of these communities regarding noise and visual impacts, air quality impacts, disturbance from construction operations, loss of tourism and impact on the local economies, potential road closures or realignments, Public Rights of Way (PRoW) closures, and impacts on community amenities.

14.3.16 These concerns reflected a number of issues raised at engagement and information events during the consultation period regarding the retained cuts at Wales and Bramley and the construction and operational impacts on these communities, the required highway realignments at Aston and the impact of high embankments in the vicinity of Barnburgh. There is a wider view that, as well as being impacted by the M18/Eastern route proposals, these communities will not see any benefits from HS2.

14.3.17 Highways England also requested ongoing and further discussions regarding specific interfaces with the Strategic Road Network on the M18/Eastern Route, including the mainline and spur between the M18 Junctions 28 and 29, the constructability of crossings (particularly the M1/M18 junction), and the preservation of passive provisions for future motorway widening. As requested, we will continue to engage with Highways England as part of hybrid Bill development.

14.3.18 Furthermore, there was also a wide range of comments and concerns relating to environmental impacts of the route. Respondents raised concerns about the impacts on SSSIs, ancient woodland, SACs, nature reserves and other key sites, in particular the Carr Vale, Peter Fidler and Denaby Ings nature reserves. In addition, there were concerns raised about impacts on Hardwick Hall and Bolsover Castle, heritage assets, conservation areas and key landmarks, including the South Kirkby Iron Age Hillfort, Stainsby Monument, Frickley Church and Nostell Priory. There were also concerns raised about the impacts on habitats including Nostell lakes, Manvers lake, the Doe Lea watercourse and other rivers. The Environment Agency also identified sites along the line of route where contaminated land exists, and where there is a risk from contamination.

14.3.19 In addition to a significant number of calls to revert to the previous Meadowhall route (see Section 14.2), a number of respondents suggested other alternatives to the proposed alignment of the M18/Eastern Route. These ranged from suggestions to use brownfield sites or existing railways to taking the mainline route through Sheffield city

[11] Based on the current stage of design, it should be noted that HS2 Ltd do not expect to have to demolish any property on this estate. We will be undertaking further work during the EIA process to establish the impacts of construction and operation of HS2 on those living in this and other areas. The potential for demolitions is based on the known earthworks for the proposed alignment at this early stage of the process. Following a route decision, this is likely to change with ongoing design development, construction planning and environmental assessment. For example, demolitions resulting from ancillary works, mitigation and realignment of existing infrastructure (such as roads and railways) are not included at this stage.

centre. Other suggestions included moving the route further to the east and using more tunnels, in particular between Altofts and Hemsworth and at the East Midlands Designer Outlet. Further suggestions included connecting to Doncaster Sheffield Airport, and moving the route further east at Hickleton and to the other side of the motorway near Aston. Others requested viaducts over the Chesterfield Canal and at Conisbrough, an alternative alignment along Doe Lea Valley to avoid nature reserves, and re-routing HS2 services to serve Barnsley.

14.3.20 Comments were also received stating that the M18 / Eastern route was one that HS2 Ltd had assessed and previously dismissed in 2012. Respondents stated that this route was rated as having the highest level of environmental impact, which could not be mitigated[12].

Sheffield spur

14.3.21 There were also a number of comments on the proposed spur to Sheffield Midland. These focused particularly on the deliverability of the spur and its impacts.

14.3.22 Communities along the spur, such as those at Hilcote, Newton, Blackwell and Tibshelf, raised concerns about property demolitions, operational noise, pollution and construction phase impacts. There is also a concern that the spur will result in severance for the communities of Newton and Blackwell.

14.3.23 There were a number of concerns about the environmental impacts of the spur, including impacts on ancient woodlands, wildlife habitats, hedgerows, heritage and conservation areas, and general impacts on the countryside. Particular concern was raised regarding the impact on 'natural' rural areas, such as Doe Hill Country Park.

14.3.24 Comments regarding the deliverability of the spur included questions about who will cover the cost of electrifying the existing line, as well as the cost of undertaking improvement works to stations to allow for HS2 services. Other concerns included the impact on the classic network as a result of incorporating HS2 services, the reliability issues for HS2 with existing services travelling on the classic network, and engineering challenges arising from ground conditions.

14.3.25 The two main alternatives to the Sheffield spur that were suggested were: to re-route the mainline route through Sheffield; and to use the Erewash Valley Line from Toton to Sheffield.

14.3.26 Some respondents commented on the benefits of the spur option, including the benefits it brings to Chesterfield, the benefits to Sheffield city centre, and benefits from city centre connectivity improvements. There were also comments on the

[12] HS2 Ltd has found no record of this classification from the appraisal of sustainability at this time. It should be noted that route options looked at prior to the 2013 consultation may have followed a similar corridor to that of the M18 / Eastern route, however, the route alignments encompassed a number of differences, meaning that a direct comparison between the two is not possible. Section 14.2 includes an assessment of the impact of the M18/Eastern route based on a number of factors, including topography, urban density and environment.

positive economic impacts from the proposals, and the ability for the city centre station to accommodate demand.

The northern loop and Clayton Junction

14.3.27 Where the 2016 preferred M18/Eastern Route crosses the existing rail network at Clayton, there is scope to construct a junction between HS2 and the existing network that would allow northbound HS2 services to rejoin the HS2 mainline. This would enable services to run directly between Sheffield Midland and the proposed HS2 station in Leeds; it could also help to meet TfN's aspiration for fast, frequent journeys between these city centres. Although only indicative design work has been done on this connection, the 2016/17 consultation asked for views on this proposal.

14.3.28 A range of responses were received to this question, with a significant number broadly related to the change away from the 2013 consultation route serving Meadowhall to the M18/Eastern Route. There were a variety of comments specifically on the northern loop and junction proposals, including the suitability of the site in Clayton. Alternative junction and loop locations were also suggested. We also received comments on the benefits that this proposal would deliver.

14.3.29 Several respondents commented on the importance of delivering connections between Sheffield and Leeds, some stating that catering for this was more important than catering for Sheffield to London demand. Furthermore, other respondents believed that the delivery of the junction and loop would improve transport links in the region, and improve connectivity both between the north and south and within the north. Some respondents expressed the view that this proposal can deliver economic benefits to Sheffield and Leeds, and bring their economies closer together. Stakeholders who are opposed to the wider M18/Eastern proposals, such as Doncaster Metropolitan Borough Council, stated that if these wider proposals are pursued, then it is vital that the junction and loop are delivered.

14.3.30 Further respondents argued that delivering improved services between Sheffield and Leeds should be an urgent Government priority, with others arguing that this could lead to additional investment and infrastructure projects in the region. Comments were made that there are also benefits from this proposal for Chesterfield, which will see dramatically improved links to Leeds and the north. Network Rail outlined their support in principle for the junction as it removes the need for HS2 services to terminate at Sheffield Midland, offsetting any potential capacity problems in the station, and it also opens up journey possibilities between Sheffield and Leeds. Finally, some respondents supported the location in Clayton, as it is seen as the most logical choice for a junction.

14.3.31 Conversely, there were a substantial number of comments by consultation respondents outlining opposition to the proposals. These focused on the unsuitability of both the section of network proposed for the loop, and Clayton as the location for the junction.

14.3.32 A significant number of responses questioned the decision to include the northern loop and connection in the HS2 proposals if the funding for any classic network

improvement works has not been agreed. Further comments relating to this point regard the significant amount of work that this section of classic network would require for HS2 services to operate on it, particularly regarding electrification. There were also criticisms that, while there has been no commitment from TfN to fund these improvements, the costs have also not been included in HS2 cost calculations when comparing the M18/Eastern Route against the Meadowhall route consulted on in 2013. Furthermore, respondents pointed out that, in their view, there are already Sheffield–Leeds services that have a similar journey time to those set out in the M18 loop proposals, which often run below full capacity, thus calling in to question the need for this proposal, and whether the demand justifies the cost.

14.3.33 Further concerns that were raised related to the impacts from running additional services on the existing network, and any works that would need to be undertaken to improve the line. Respondents expressed the view that there will be an increase in noise, air quality and light pollution impacts for those living next to the existing line, as a result of improvement works and the operation of additional services on this section of track. There were also concerns about the impact on the existing local services on this line, which some felt may be lost to allow HS2 services to keep to schedule.

14.3.34 Similar concerns exist in relation to the construction of the junction at Clayton, particularly where it will impact on the local countryside. Several specific concerns relate to the ground conditions as a result of historic mining in the area, the impact on the highway infrastructure around the village of Clayton and how this will accommodate all the construction activity, and on the conservation area in the village. Further concerns were raised about the visual impact of the junction, the effect on property prices, impacts on local businesses and farmers, potential flooding issues, the use of a greenfield site for the junction, and the impact on listed buildings.

14.3.35 There were also a significant number of responses to this question that mentioned proposals for a parkway station. It should be noted that this was not the subject of this consultation. As discussed earlier, a separate feasibility study is being undertaken by HS2 Ltd to consider the scope and feasibility of locating a parkway station in the South Yorkshire area. This work is ongoing and includes a look into the feasibility of extending HS2 services beyond Sheffield Midland on the existing railway network.

14.3.36 Alternative suggestions that were made in relation to the Clayton junction included suggestions to revert to the Meadowhall route consulted on in 2013, to continue the loop to Wakefield to serve this station, and to combine the junction proposals with any South Yorkshire parkway proposals. Further comments included constructing the junction on brownfield land, using an existing station for the junction, and constructing a through route through Sheffield. Finally, there were suggestions about moving the junction nearer to Conisbrough.

Responding to the consultation feedback

14.3.37 In responding to the consultation, and the concerns and suggestions that have been raised, we have considered a range of potential refinements to the M18/Eastern Route. These have included new routes and alignments to the east of the M18 and separate, more local refinements at Aston, Mexborough and Barnburgh.

Routes to the east of the M18

14.3.38 These refinements have included a new alignment directly to the east of the M1 and M18 and a new transport corridor further to the east of the M1/M18 transport corridor (see Figure 14). These routes have been looked at as part of efforts to try and avoid the impacts of the route as it passes Wales, Aston, Bramley, Mexborough and Barnburgh.

14.3.39 The new alignment directly to the east of the M1 and M18 exacerbates Highways England concerns by introducing skewed crossings of the M1 at Wales and the M18 at Bramley. Both of these would have significant constructability issues and would transfer impacts from one side of the community to the other in these locations.

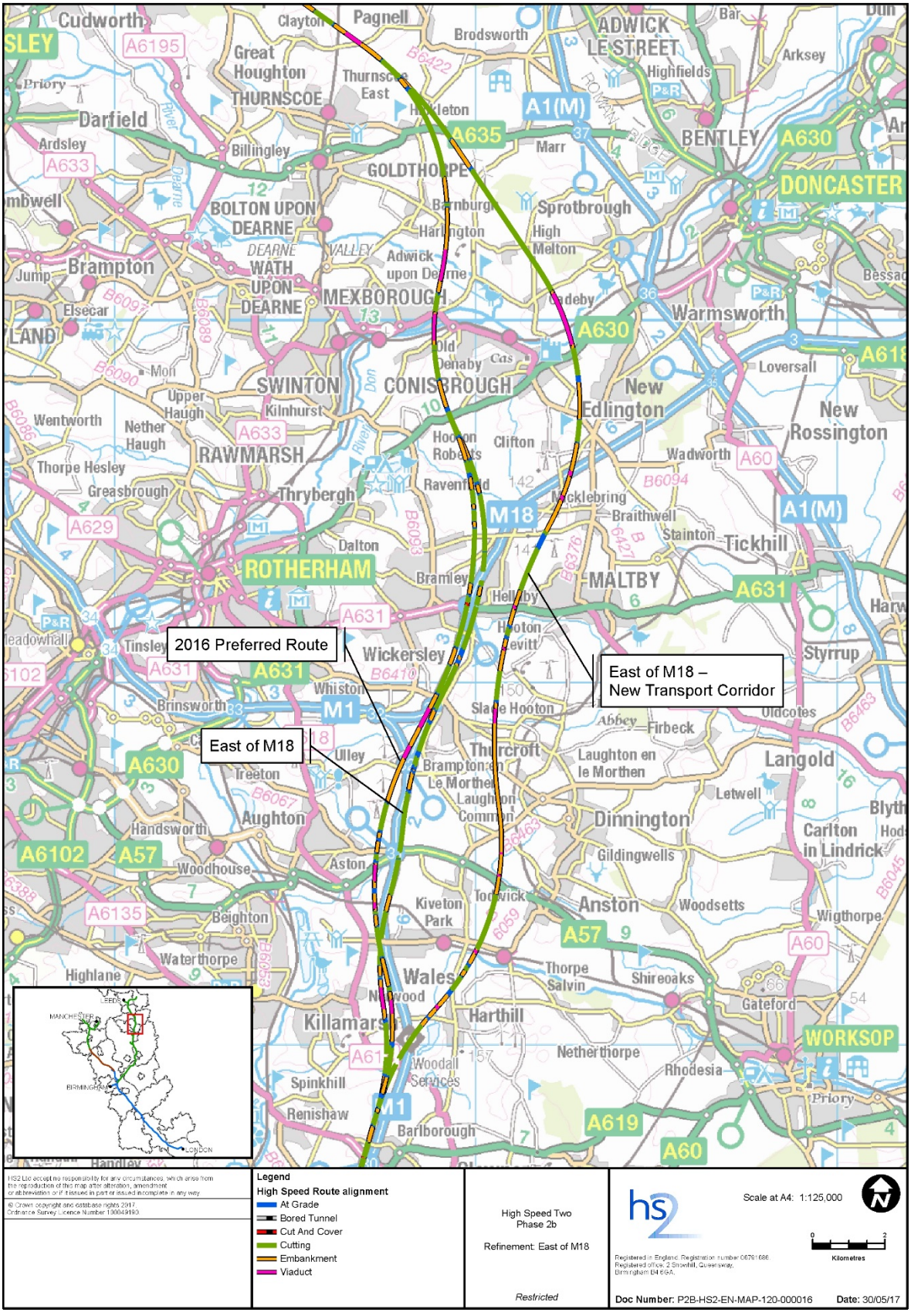
14.3.40 While this new route would avoid major landscape and visual impacts at Aston, the M18 junction and Thurcroft, there would also be a number of additional demolitions associated with this route, with no significant change to noise impacts. The route would introduce impacts on new communities without delivering any improvement in overall performance.

14.3.41 The route further to the east of the M1 / M18 (as shown in Figure 14 below) would involve a new transport corridor, from north of Barlborough to Hickleton, on a mix of cutting, embankment and viaducts. The new route would be longer in length, adding journey time to the route. It would also introduce new community impacts, 'islanding' a number of communities between the M1 and the HS2 corridor, and increase overall noise impacts.

14.3.42 The new route would also involve significant engineering challenges, including a skewed cut and cover crossing of the M1 south of Woodall, with associated community and environmental impacts, and a high viaduct at Sprotbrough. Two additional SSSI's, at New Edlington and Sprotbrough, and a number of ancient woodlands would also be intersected.

14.3.43 As described above, we also looked at a number of more local refinements, including at Aston, Mexborough and Barnburgh to avoid impacts on these communities.

Figure 14: East of M18 route refinements looked at following the 2016/17 consultation.



Aston

14.3.44 At Aston, we looked into whether we could minimise the complex highway realignments required to the A57 and B6067, and reduce construction impacts on the wider community, by maintaining the same horizontal alignment but putting the route into a bored tunnel. Placing the route in a tunnel avoids the need for any highways realignments and would reduce overall noise impacts.

14.3.45 However, this is a significantly more expensive option. The need for a tunnel portal would also increase impacts elsewhere, including on the Nicker Wood Ancient Woodland and ensure the route is higher at Brampton-en-le-Morthen to cross the M1/M18 junction, increasing visual impacts here. The refinement would also result in two watercourse crossings of a floodplain to the north.

14.3.46 We looked into whether we could lower the route at Aston into a cut-and-cover tunnel (again maintaining the same horizontal alignment). This would reduce the impact of the highways realignment required for the M18/Eastern Route, allowing the B6067 to remain in its current alignment. However, the A57 would require a longer permanent realignment to cross over the cut-and-cover tunnel, bringing the A57 closer to residential properties in Aston. It should be noted that the environmental and sustainability impacts of this road realignment haven't been fully appraised at this stage of the design.

14.3.47 The environmental benefits and impacts of this change would be similar to those associated with the introduction of the twin bored tunnel, but would also result in a minor setting impact on Aston Conservation Area remaining due to cutting and tunnel.

14.3.48 At this stage of the design, we recommend that no changes be made to the 2016 preferred route alignment as it passes Aston. However, we expect that more opportunities for mitigation will emerge as we take forward design development; this could provide the opportunity to further examine issues such as the height of the railway and the interfaces with the local highways network at Aston. We will engage with local communities during the hybrid Bill stage to do this.

CASE STUDY: Mitigating impacts through hybrid Bill development

During the hybrid Bill process for Phase One of HS2, opportunities were taken to mitigate similar impacts by including additional lengths of cut-and-cover tunnel in the scheme. For example, the hybrid Bill included cut-and-cover tunnels at Wendover in Buckinghamshire, where the alignment runs to the west of the main part of the town. During Select Committee, the length of this tunnel was increased to the north and south, the height of noise fence barriers was increased at the northern end and additional noise barriers were provided on the viaduct and embankment that cross the Chiltern Line and the A413 to the south of the town. Similarly, the 2012 review of refinements to the proposed scheme lengthened the Burton Green cut-and-cover tunnel and made the cuttings shallower, thereby reducing the noise and visual impacts of the scheme and reducing the number of HGV movements in the area during the construction phase. This tunnel was lengthened again as part of Additional Provision 2 (an amendment made to the hybrid Bill after its deposit at the request of the Select Committee) and the height of the alignment was lowered through the area.

Mexborough

14.3.49 We have looked at a number of refinements to reduce the impact of the M18/Eastern Route at Mexborough, including options that remove the direct impact on the Shimmer major development site. Options looked at included realigning the route to the east of Conisbrough (building on suggestions made in response to the consultation), moving the alignment locally to the east of the Shimmer estate through the Denaby Industrial Estate, and moving the route into a three-mile (4.9km) twin bored tunnel underneath Conisbrough.

14.3.50 A realignment of the route past Mexborough to the east of Conisbrough would introduce new community impacts elsewhere. This would also increase impacts on environmentally sensitive locations, including on a number of ancient woodlands and two SSSIs at Sprotbrough Gorge and New Edlington Brickpit. These impacts would result in the permanent loss of habitat and potential local amenity both during construction and operation. This would also represent a significant increase in the number of SSSIs intersected on the Phase 2b route.

14.3.51 This route does, however, remove impacts on housing estates at Mexborough and reduce some of the landscape and visual impacts on the preferred route in this area. At the current stage of design, we do not consider that the case is sufficiently strong to change the route to this new alignment. Given the different impacts, risks and opportunities associated with the preferred route and a route to the east of Conisbrough, we will keep this assessment under review as our design work progresses during the hybrid Bill process.

14.3.52 Moving the alignment locally to the east of the Shimmer estate to go through the Denaby Industrial Estate would result in a long viaduct over existing infrastructure and the River Don floodplain, introducing new major impacts elsewhere, particularly on the industrial estate and other residential areas. This option would slightly increase

overall noise impacts and would result in more commercial demolitions, and is therefore not being taken forward.

14.3.53 We have looked into options that involve a bored tunnel underneath Conisbrough, including different lengths of tunnel. While tunnelling underneath Conisbrough would result in fewer demolitions and landscape and visual impacts, it would involve a significant increase in cost and would introduce impacts in other areas. Our initial work looked at a shorter length tunnel (approximately three miles or 4.9km in length). This tunnel would require a ventilation shaft, resulting in community impacts where this is located. The track gradients required for this tunnel were at exceptional levels and could affect maintenance and passenger comfort.

14.3.54 In order to provide track gradients which are below exceptional levels, the tunnel would need to be extended by a minimum of 1.46 miles (2.35km) resulting in a tunnel length of 5.5 miles (7.25km). This would place the northern tunnel portal in the vicinity of Hickleton, increasing landscape and community impacts in this area. To avoid a tunnel portal in the Hickleton area, a potential solution would be to extend the tunnel by a further 1.4 miles (2.25km) resulting in a tunnel length of 5.9 miles (9.5km). A longer tunnel would also require two ventilation shafts. We are therefore proposing that this option is not progressed.

Barnburgh

14.3.55 Further north, we have looked into options that address issues that have been raised through the consultation regarding the impacts at Barnburgh and Hickleton.

14.3.56 These include reducing the height of the embankments to the east of Barnburgh. Doing so would see the route maintain its currently proposed horizontal alignment, but move into a 990 metre bored tunnel due to topographical constraints north-east of Barnburgh. This would reduce major landscape and visual impacts at Barnburgh, but the major landscape impacts at Hickleton would remain, due to the required tunnel portal.

14.3.57 We also looked at lowering the alignment of the route as it passes Hickleton into a bored tunnel to reduce impacts in this area. This would also enable a reduction of the embankment height at Barnburgh. However, this option would result in a significant increase in cost, and result in additional demolitions. Major landscape and visual impacts would be avoided at Hickleton, but the deep cutting and tunnel portal would result in major landscape impacts east of Barnburgh.

14.3.58 At this stage of design, we do not recommend changes to the alignment as the route passes Barnburgh. However, further work will be undertaken during hybrid Bill development to examine issues such as the height of the railway, and assess potential solutions to reduce the impact on the landscape as the route passes Barnburgh. We will engage with local communities during the hybrid Bill stage to do this.

CASE STUDY: Mitigating impacts through hybrid Bill development

On Phase One of HS2 there are several examples where the alignment of the route was lowered during the hybrid Bill development process to reduce the noise and visual impacts of the scheme on communities. For example, the 2012 'Review of Possible Refinements to the Proposed London to West Midland route' lowered the alignment and introduced a green tunnel to the east of Greatworth village. The Phase One Environmental Statement included landscape earthworks and planting along the line of route in this area to screen the tunnel portal and blend the tunnel into the surrounding landscape. The Phase One Review of Possible Refinements also lowered the alignment of the route as it passed between the western edge of Aylesbury and Lower Hartwell. Through the development of the hybrid Bill, landscape earthworks along the eastern side of the alignment, noise fence barriers on both sides of the track, and screening planting were included in the scheme.

Sheffield spur

14.3.59 As noted above, the 2016 preferred route currently has a spur near the A38 and Hilcote to enable HS2 trains to join the existing railway to the south of Clay Cross and travel to Sheffield Midland. The spur passes under the M1 and Alfreton Road, south of Newton, before joining the existing Erewash Valley railway east of Stonebroom. The spur will enable HS2 services to serve Chesterfield and Sheffield Midland.

14.3.60 Spur connections at Wales and to the south of Killamarsh were considered at a previous stage of route development. These were parked as trains would have to enter Sheffield Midland from the north, providing additional capacity issues. Accessing Sheffield Midland from the north would introduce the requirement for services to turn-back to access areas to the north of Sheffield. There would also be implications of this from an operational point of view at Sheffield Midland, with likely requirements for extra platforms due to additional services approaching from the north and longer platform occupation times.

14.3.61 Suggestions made during consultation included the creation of a spur that connects HS2 to the Erewash Valley Line to the north of Toton. The options considered included a connection at East Midlands Hub (EMH) through modified switches and crossings and additional track (1.5 miles/2.5km) to the north of EMH, and an option that created a new grade-separated viaduct to the north of EMH.

14.3.62 Connecting via additional switches and crossing at EMH and additional track to the north of the station would require widening on the Network Rail corridor (to accommodate two additional connecting tracks). It would also restrict HS2 Sheffield services to outside platforms, which would limit operational flexibility. This option would also increase landscape and visual impacts along the River Erewash, close to Sandiacre. The inclusion of a new embankment within the floodplain would also result in increased flood risk impacts with increased land take of Habitats of Principal Importance (HPI) alongside the River Erewash.

14.3.63 Connection via a new grade separated junction to the north of EMH would involve a significant highway realignment at Stanton Gate and would increase the length of the M1 realignment. Bridges on the A52 and Derby Road would also need to be widened. As above, this option would also increase landscape and visual impacts along the River Erewash, close to Sandiacre. It would also have a direct impact on the Stanton Gate Local Nature Reserve.

14.3.64 Both of these options would remove the sustainability and environmental impacts with the current spur. However, both significantly increase journey time on the Phase 2b route from Long Eaton to Sheffield Midland (by more than seven minutes), and increase the cost associated with the route through the length of electrification (greater than 20.5 miles/33km) that would be required on the existing Erewash Valley Line.

Northern loop and Clayton Junction

14.3.65 As set out in Section 14.2, we are currently assuming that a number of services will travel on the northern loop through South Yorkshire. This is an important element of the strategic argument for the M18/Eastern Route. However, as demonstrated in the economic analysis published in November 2016, the economic argument for the M18/Eastern Route does not depend on the delivery of this loop.

14.3.66 We are aware that many respondents advocated that such a connection should be delivered if HS2 were to serve Sheffield via Sheffield Midland. This support was partly driven by an interest in facilitating improved Sheffield–Leeds connectivity as part of NPR aspirations. However, some respondents to the 2016/17 consultation advanced alternative propositions for the location of this connection. Network Rail is currently examining what work would be required to facilitate such a connection. At the moment, for the purpose of our business case, we continue to assume that this connection would be located at Clayton. We will review this position in the light of Network Rail's work and the wider feasibility work being undertaken as part of the NPR project.

15 Eastern leg rolling stock depot

15.1 Overview

15.1.1 The 2013 consultation route proposed a rolling stock depot (RSD) on the eastern leg of Phase 2b at New Crofton. The 2013 route alignment resulted in the main high speed line passing to the west of the proposed RSD site. This site was initially identified as it represented a good fit with the engineering, operation and design requirements of a RSD.

15.1.2 However, the M18/Eastern Route refinement announced in November 2016 results in the HS2 mainline route passing to the east of the New Crofton depot site, altering the access to the RSD. Changing the access to the RSD made the site less efficient from an operational perspective and was likely to result in greater impact on the local community.

15.1.3 As a result of these issues, in November 2016 the Secretary of State requested a study to consider alternative RSD sites on the eastern leg of Phase 2b.

15.1.4 Following the November 2016 route announcement, further work revealed the centre-fed depot layout resulting from the eastern approach to be sub-optimal. As a result, it is recognised that the adoption of the M18/Eastern Route and the resulting approach into the depot would cause a greater impact on the local community than when we previously consulted in 2013.

15.1.5 During ongoing engagement with local stakeholders and the local community, and in the response to the Phase 2b formal route refinement consultation between November 2016 and March 2017, the suitability of the proposed site at New Crofton was questioned for a number of reasons. These included:

- the site has been rehabilitated following former industrial use and is currently rural in appearance;
- the impact on the local community caused by the reconfiguration of the depot and change in access required due to the proposed realignment of the main high speed line;
- the noise, lighting and visual impacts of the depot on the local community; and
- the perception that the depot will cause a barrier between Crofton and villages to the south and west, and the likely impact on access into and out of the village.

15.2 Optioneering work

15.2.1 The RSD is designed for the overnight stabling of trains, cleaning and maintenance. We expect that each RSD location will support around 125 new jobs in the local area when the railway is operational.

15.2.2 The specifications for the RSD site are for a large, flat site, and a strategic location to facilitate access to the depot for HS2 trains serving the eastern leg of Phase 2b. The

site needs to be as close as feasible to Leeds, and should preferably be brownfield rather than greenfield. The site should be suitable for 24-hour operation, and accessible to the workforce and to/from the local transport network.

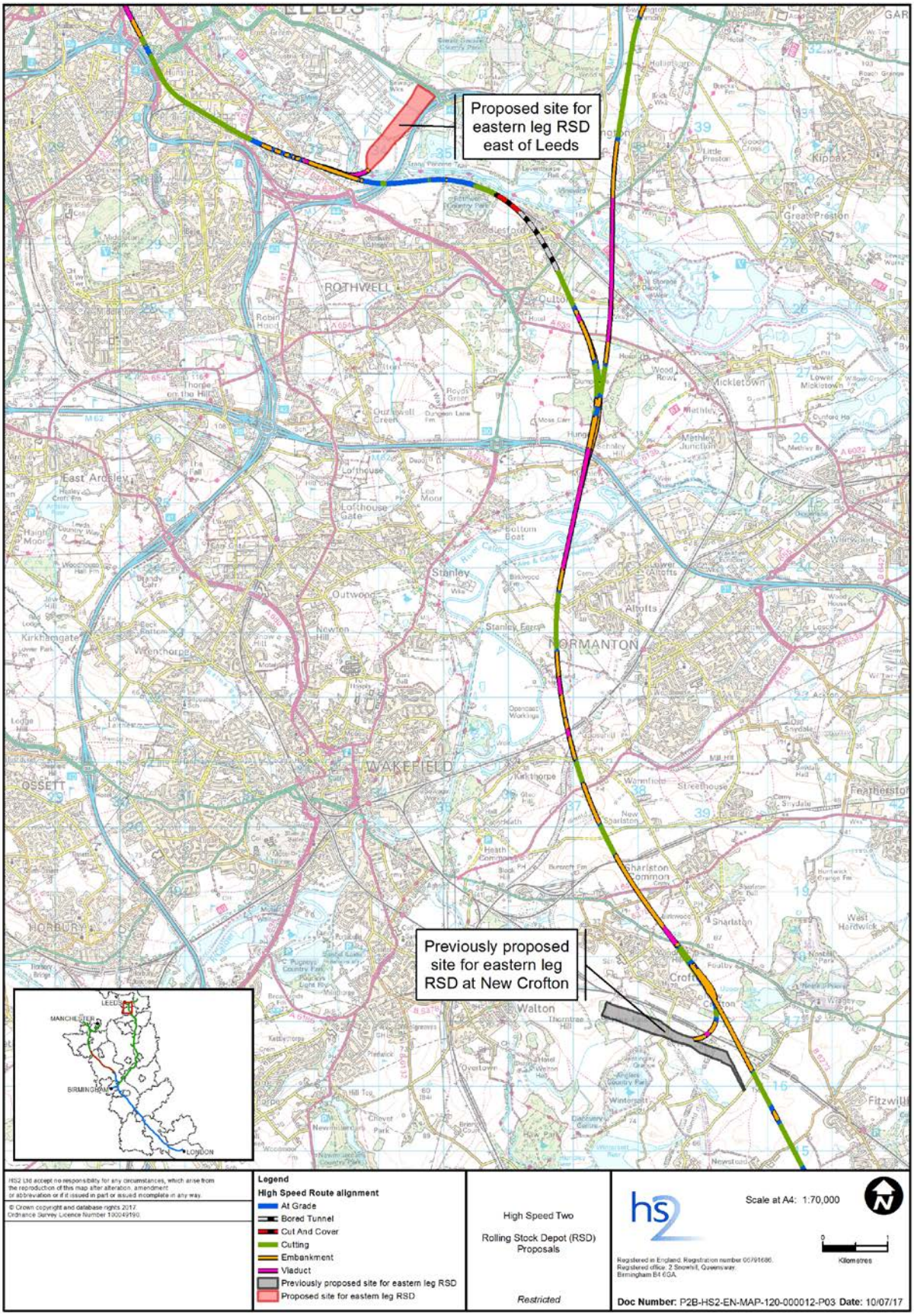
15.2.3 Following the instruction from the Secretary of State, a number of potentially suitable RSD site locations were identified at the northern end of the Phase 2b eastern leg. These included potential sites on both the Leeds spur and on the mainline.

15.2.4 Following an initial assessment, a number of these have been identified as less suitable for a variety of reasons, including cost, environmental, highway and community impacts.

15.2.5 Three sites were shortlisted for more detailed assessment, alongside the initially proposed site at New Crofton. In assessing these locations, we considered the suitability of each against the balance between a range of factors including operational suitability, impact on the environment and local community, engineering complexity and cost

15.2.6 Taking into account the concerns raised regarding the originally proposed site at New Crofton, and the operational issues that have resulted from the change in the M18/Eastern Route alignment, we recommend that the proposed eastern leg RSD is relocated to a site east of Leeds in the Aire Valley, adjacent to the M1. The site forms part of the Temple Green development planned for the Leeds City Council Enterprise Zone at this location. The new site location, as well as the previous location at New Crofton, is shown in Figure 15.

Figure 15: Location of previously proposed eastern leg RSD at New Crofton; and the newly proposed location to the east of Leeds.



15.2.7 The proposed new site is located on industrial land adjacent to the M1 up to Junction 45 and the A63 corridor. This site would be connected to the Leeds spur corridor using a flat junction and two approach tracks. The site is a brownfield site, used previously for industrial purposes, with good highway connections and is part of the Temple Green major development site, which has planning consent for a large area of commercial development.

15.2.8 The proposed new site provides operational benefits when compared to the site at New Crofton and has the potential for modification and improvement without increasing costs or impacts. The site also has the potential to provide a significant operational cost saving due to the reduced distance for running empty coaching stock.

15.2.9 Being a former industrial site, located in an urban area, the new site has reduced environmental impacts compared to the New Crofton site. The previous landscape and visual impacts on residents of New Crofton and users of Anglers Country Park are reduced. Direct impacts on the New Crofton Mine Major Development Site are also avoided, and habitat loss north of Anglers Country Park is reduced.

15.2.10 Engagement with Leeds City Council on the proposed new site east of Leeds indicates that there is the potential for joint working to identify opportunities to align aspirations for development plans in the area.

15.2.11 It should be noted that, as this site is on the Leeds spur, this may create the need for additional stabling and maintenance loops elsewhere. We will develop proposals during the hybrid Bill process to identify the most appropriate way of addressing these challenges. We remain confident that a solution will be deliverable, and our initial costing of this additional infrastructure has been factored into our decision-making.

15.2.12 The RSD site east of Leeds could potentially be utilised as a construction compound for the Leeds spur, given the complexities of constructing the Leeds spur corridor (including the Woodlesford tunnel) and associated works alongside the existing Network Rail corridor up to Leeds station. A range of further options for the railhead are under investigation as part of hybrid Bill development work.

15.2.13 The proposed RSD facility to the east of Leeds is cheaper than the depot facility at New Crofton. Further investment may be required to provide the necessary operational flexibility, including the provision of additional stabling and maintenance loops. This introduces a small upward cost pressure, but doesn't fundamentally change the case for the new site.

15.2.14 We expect that, in the event that the Secretary of State is minded to change the RSD location on the eastern leg, this will require further consultation.

16 Next steps

16.1.1 As outlined above, we expect that, should the Secretary of State be minded to change the location of the eastern leg rolling stock depot, this will require further consultation.

16.1.2 Subject to the agreement of the Secretary of State, other changes recommended in this report will be incorporated into hybrid Bill designs and included in the design which will then be subject to further consultation as part of the hybrid Bill development process.

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