HS2 Phase Two
West Midlands to Crewe
Summary of route refinements

November 2015
CS392B

Department for Transport

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Executive summary

In July 2013 the Secretary of State for Transport published proposals for Phase Two of High Speed Two (HS2) and initiated a seven-month period of public consultation to gather views on the route and stations proposed in the consultation. Following the consultation, we undertook a review of the route and proposed a number of refinements to the route.

In March 2014, following the close of consultation, the report *HS2 Plus* was prepared by our incoming chairman, Sir David Higgins. This set out a number of recommendations to the Government, including a proposal to accelerate the delivery of the route between the West Midlands and Crewe to realise some of the benefits of Phase Two more quickly.

We remain of the view that the route between the West Midlands and Manchester should run via Crewe, and this report deals specifically with the route between the West Midlands and Crewe. We are continuing to review the rest of the Phase Two consulted route in the light of feedback received from the consultation.

This report sets out the route that HS2 Ltd recommends taking forward between the West Midlands and Crewe, and explains the issues that HS2 Ltd and the Government have considered in the route development process.

This route would start at the connection to the Phase One route near Fradley Wood, about 2.5 miles (4km) north of Lichfield. It would join the West Coast Main Line (WCML) approximately 700m south of Crewe Station. The design also includes passive provision for the Phase Two route to continue to Manchester and the North West.

The route presented in this report is largely similar to that presented at consultation. Changes to the consultation route include:

- a relocation of the start point of the route to reflect changes to the Phase One route proposed to the HS2 Hybrid Bill Select Committee, which shifts the route up to 30m eastwards in the southern 1.2 miles (2km);[1]
- the design and inclusion of maintenance loops, in the location indicated at consultation;
- amendment to the design of the route as it passes Hopton to address a number of technical issues;
- extension of the tunnel at Whitmore Heath and the introduction of a section of retained cutting through Whitmore Wood Ancient Woodland; and
- changes to the West Coast Main Line (WCML) junction south of Crewe to reduce

[1] The Phase 2a route has been amended on the assumption that the proposed change will be reflected in the Phase One route.

the overall height of the structures.

This report includes a full discussion of the changes made to this route. It includes changes driven by lessons learned from Phase One, as well as those driven by findings from consultation.

This document:

- provides background to the development of proposals to accelerate part of Phase Two (known as 'Phase 2a');
- sets out the refinements that we have considered to the preferred route; and
- explains the process that we have adopted to reach our recommendations.

It should be read alongside other supporting technical documentation from HS2 Ltd and our consultants, and the Government's response to our advice.

Although the report addresses route refinement undertaken to date, further design development will continue throughout the development of a hybrid Bill. For example, we will consider further opportunities for mitigating the impacts of this route as part of the development of an Environmental Statement in support of the Bill.

Following an announcement of the Secretary of State's decision on the route from Fradley to Crewe, this section of the route is now referred to as "Phase 2a".

1 Introduction

1.1 Developing the project

1.1.1 The report *HS2 Plus*, published in March 2014, recommended accelerating the delivery of the Phase Two route from the West Midlands to Crewe. The report also recommended that consideration be given to a new hub station at Crewe, which is discussed in more detail later in this report. These recommendations were reiterated in the report *Rebalancing Britain*, which was published in October 2014.

1.1.2 Our work on HS2 continues to demonstrate that the project will deliver a range of benefits for the UK. For example, by improving local connectivity HS2 will help to drive regional growth. We are working with Network Rail on projects such as Capacity Plus to ensure that the HS2 project joins up with plans for the classic network.

1.1.3 Our current plans would see services running on the full Phase Two route by the end of 2033. Bringing forward the delivery of part of the route will spread the expected benefits further north, sooner.

1.1.4 Based on the work undertaken to date (including that described below), we consider that the best route for a high speed railway between the West Midlands and Manchester is via Crewe. Building on this recommendation, we have brought forward proposals for refinements to the route between West Midlands and Crewe, based on the feedback we received through consultation, and the application of lessons learned from the developing Phase One design.

1.1.5 This report sets out our recommended refinements, and explains the approach we adopted to reach these proposals.

1.2 Bringing forward delivery

1.2.1 The aim of bringing forward the delivery of the route between the West Midlands and Crewe is to bring more of the benefits of HS2 further north, sooner. In order to provide assurance that this is the most appropriate way to deliver this objective, HS2 Ltd and DfT have jointly considered the business case for the project from a number of perspectives, including:

- Does the proposed project deliver the Government's strategic priorities?
- Does it offer good value for money?
- Is it affordable?
- Will the supply chain be able to support the delivery of the project?
- How will delivery be managed?

1.3 Project context

Phase Two

1.3.1 This report addresses the route between Fradley and Crewe specifically, as an acceleration of the full Phase Two project. However, these proposals should be seen in the context of the full project. The report *Rebalancing Britain* concluded that "the strategic proposal for Phase Two is right", and we are continuing with detailed work on the remainder of the Phase Two consulted route. Our expectation remains that Phase Two as a whole will open by the end of 2033, and this assumption informs our modelling in support of the decision on this route.

1.3.2 On a wider scale, we are also working with the Department for Transport, Network Rail and partners in Transport for the North to consider how the HS2 scheme can link most effectively with the Government's Northern Powerhouse strategy.

1.3.3 The Government is providing more information on its plans for the full Phase Two route alongside the decision on the route between the West Midlands and Crewe.

Phase One

1.3.4 Phase One of HS2 will, subject to Parliamentary approval, provide a high speed rail route between London and the West Midlands. It includes a connection to the WCML at Handsacre, near Lichfield, so that HS2 trains can serve destinations north of Birmingham before the delivery of Phase Two.

1.3.5 The experience of developing the Phase One scheme has helped to inform our approach to Phase Two. This report discusses some of the lessons learned from Phase One that we have applied to the development of this project.

1.3.6 The Phase One hybrid Bill is currently being considered by Parliament. It would provide powers for the construction of Phase One of HS2, including the delivery of new platforms at Euston station. With Network Rail, we are continuing to develop the proposal for Euston Station; an Additional Provision to the hybrid Bill has been deposited in Parliament to seek the powers to deliver this updated project.

1.3.7 Services are expected to start running on the Phase One route from 2026, serving London and Birmingham, as well as destinations further north such as Liverpool, Manchester and Preston, via the Handsacre junction. Our current assumption is that this service pattern would continue until the opening of the full Phase Two route, but would benefit from faster journey times to Crewe. Work will continue through the hybrid Bill development process to consider and optimise these interactions, including further service opportunities.

1.3.8 We continue to consider opportunities for aligning the delivery of Phase One and the route between the West Midlands and Crewe. Making the most of potential synergies between the two projects could deliver a range of benefits, including managing construction impacts and making the most of commercial opportunities.

2 Refining the route

2.1 Consultation and engagement

2.1.1 The consultation on the Phase Two route and stations was launched on 17 July 2013 with a closing date for responses of 31 January 2014.

2.1.2 During this time, public events were held at locations along the Phase Two route, including locations between Fradley and Crewe at Handsacre, Stafford, Stone, Whitmore, Madeley and Crewe. These events were designed to help people learn more about the proposed Phase Two route, and raise questions or concerns with technical specialists and representatives of HS2 Ltd and DfT. Members of the public were able to respond to the consultation in writing or online.

2.1.3 This consultation built on an ongoing process of engagement with stakeholders across the Phase Two route. We have met a wide range of stakeholders including local authorities, MPs, communities, and statutory bodies. This engagement helped to give us a deeper understanding of the areas through which the route would run, and the concerns of those people and organisations affected by the route.

2.2 What did the consultation ask?

2.2.1 The consultation sought respondents' views on the following questions:

1) *Do you agree or disagree with the Government's proposed route between the West Midlands and Manchester? This includes the proposed route alignment, the location of tunnels, ventilation shafts, cuttings, viaducts and depots as well as how the high speed line will connect to the West Coast Main Line.*

2) *Do you agree or disagree with the Government's proposals for:*

    a. A Manchester station at Manchester Piccadilly?

    b. An additional station near Manchester Airport?

3) *Do you think that there should be any additional stations on the western leg between the West Midlands and Manchester?*

4) *Do you agree or disagree with the Government's proposed route between West Midlands and Leeds? This includes the proposed route alignment, the location of tunnels, ventilation shafts, cuttings, viaducts and depots as well as how the high speed line will connect to the East Coast Main Line.*

5) *Do you agree or disagree with the Government's proposals for:*

    a. A Leeds station at Leeds New Lane?

    b. A South Yorkshire station to be located at Sheffield Meadowhall?

    c. An East Midlands station to be located at Toton?

6) *Do you think that there should be any additional stations on the eastern leg between the West Midlands and Leeds?*

7) *Please let us know your comments on the Appraisal of Sustainability (as reported in the Sustainability Statement) of the Government's proposed Phase Two route, including the alternatives to the proposed route?*

8) *Please let us know your comments on how the capacity that would be freed up on the existing rail network by the introduction of the proposed Phase Two route could be used?*

9) *Please let us know your comments on the introduction of other utilities along the proposed Phase Two line of route?*

2.2.2 An independent report of the consultation process and a summary of issues raised have been published alongside the Government's decision on this route. This is available at gov.uk/hs2.

2.2.3 We considered the issues raised in the consultation, and developed options to enable us to answer the concerns that were advanced. These options were appraised at progressively greater levels of detail to understand where it might be appropriate to refine the route. See below for more information on this process.

2.3 Responding to consultation

2.3.1 In order to respond to concerns raised through the consultation, we followed a process of route refinement similar to that adopted for Phase One.

2.3.2 The route refinement process balances issues of engineering complexity, sustainability, cost and business case performance to understand whether it would be appropriate to amend the route presented in consultation in response to the feedback to the consultation. This process is referred to as 'sifting'.

2.3.3 In some cases this included examining specific options that were put forward by respondents through consultation. In addition, we generated and considered a range of alternatives for different sections of the route, to ensure that we could respond comprehensively to consultation feedback. This report summarises this work and sets out our resultant recommendations.

2.3.4 Options for each refinement area are developed on a 'point-to-point' basis to ensure that the options can be compared with each other.

2.3.5 The criteria used to consider the options can be broadly categorised as:

- constructability, including possible risks, such as landfill or geological conditions;
- sustainability, including impacts on communities and the environment;
- journey time;

- comparative cost; and
- demand/business case.

2.3.6 The relevance of each criterion is partly determined by the refinement in question. For example, issues of demand and business case may be particularly pertinent in sifting options for stations.

2.3.7 Refinement options were sifted to increasing levels of detail which enabled us to prioritise the more promising refinement options, whilst retaining a clear evidence trail to explain how we reached our recommendations.

2.3.8 The result was a series of recommendations to the Government for possible refinements to the route, which are set out in the following chapter. The development of a hybrid Bill will lead to more detailed consideration of impacts and possible associated mitigation, as set out below, and may also lead to further design refinements, where appropriate.

2.3.9 At the current stage of route development, we have focused mainly on refining the alignment of the route itself. We have not, for example, considered opportunities for further mitigation of impacts. We explain about next steps in route refinement at the end of this report.

2.3.10 Highway impacts were considered where they were a differentiator between options, and we have reviewed the consultation route crossings of motorways and trunk roads with Highways England. At this stage, all highway realignments are indicative and would require further design, assessment and engagement. These issues were not included within the Appraisal of Sustainability, given the current level of design. However, they will be assessed during the Environmental Impact Assessment process.

2.4 Lessons learned from Phase One

2.4.1 In addition to the findings from consultation, other changes arose from design development as a result of applying lessons learned from Phase One. The deposit of the hybrid Bill in November 2013 meant that we could apply the lessons learned from this process to the Phase Two route. This work also included the application of some value engineering measures, which aim to deliver cost efficiencies reflecting those applied to Phase One.

2.4.2 This has resulted in modifications at certain locations, particularly to vertical alignments and gradient profiles. For example, we have assessed every watercourse crossing (major and minor) along the route and, where possible, have provided sufficient clearance to culvert the watercourse underneath the railway, as required. We have also reflected the route updated design standards related to track alignment, which aim to deliver a better standard of ride comfort.

2.4.3 The advantage of undertaking this work at this stage is to offer increased confidence in the footprint, design and deliverability of the railway, at a comparatively earlier stage of the design than in Phase One.

2.4.4 Design changes that were introduced into the route as a result of design development included:

- Reducing the width of the railway (the 'trace'), which reduces the overall land required by the railway and also reduces the cost.
- Reducing the diameter of tunnels, meaning that tunnelling would produce less excavated material, and could help to reduce costs.
- Reviewing locations where the route crosses watercourses. This helps to reduce flood risks to the railway and the surrounding area, as well as reducing detrimental impacts on watercourses.
- Adjusting the track alignment to improve drainage, offering improved operational performance.

2.4.5 Some small changes were also necessary where an individual refinement was inserted into the overall route to form a single coherent design.

2.4.6 We explain in Chapter 4 why we have recommended each refinement to the consulted route. Lessons learned from Phase One have also informed our approach to planning for hybrid Bill development, which is discussed in Chapter 5.

3 Station and route options

3.1 Introduction

3.1.1 As part of our early route development work between 2010 and 2012, we generated a range of options for routes between the West Midlands and Manchester. The findings of this work are detailed in the report *Options for Phase Two of the High Speed Rail Network*, delivered to the Government in March 2012 a wide range of possible route options between the West Midlands and Manchester. This report is available at gov.uk/hs2.

3.1.2 The sifting process identified a number of routes, including options via Stoke-on-Trent. A route via Crewe was taken forward to consultation, based on considerations including environmental impacts, engineering feasibility, and connectivity.

3.1.3 The rationale was the opportunity for classic rail connectivity at Crewe, as opposed to a parkway station. Joining the WCML at Crewe would allow HS2 to serve wider markets in North Wales, Cheshire and Liverpool. A more detailed explanation of these options and their relative advantages is set out in our 2012 report.

3.1.4 Throughout our route development work, we have sought to reduce sustainability impacts - for example, by avoiding communities or major sustainability features. The route presented at consultation was the result of more than two years of optioneering and development – the aim being to deliver the best balance between reducing sustainability impacts, meeting demand, and delivering benefits. As our strategic view of HS2 develops, we continue to keep these conclusions under review to ensure that they reflect the wider context presented by work such as the Crewe Hub project below.

3.1.5 It underpins the route presented at consultation and these findings have informed further route refinement. Where appropriate, we have interrogated our findings to ensure that they remain robust in the light of evidence presented at consultation.

3.1.6 Some options for alternative stations that we received in the consultation would have wider implications for the western leg. These are addressed below. The consultation did not reveal strong support for alternative station options, including alternatives that we had previously considered.

3.2 Crewe hub station

3.2.1 The proposals set out in this report would allow for HS2 services to run at high speed to Crewe. The route includes a junction to allow services to join the West Coast Main Line and serve the existing Crewe station and wider destinations. It also includes provision for a tunnel under Crewe, as proposed in the consultation.

3.2.2 The Government has asked Network Rail to consider options for an integrated transport hub at Crewe. Similar proposals were advanced in consultation responses and were included in the report HS2 Plus. We continue to support Network Rail in

this work, and we expect that the Government will take further decisions on a Crewe hub in the coming years.

3.2.3 Some of the choices in connection with a Crewe Hub station may require adjustment to the way in which the HS2 route joins the WCML and continues north. We will therefore continue to work with Network Rail to ensure that we understand the interactions between these developing projects. The location of the WCML junction and any provision for the full Phase Two route will be finalised as part of the decision making on a hub station, and will be reflected as required in the development of the design for the hybrid Bill.

3.3 Stoke-on-Trent

3.3.1 As part of the route development process described above, we considered a number of routes that passed near Stoke-on-Trent. These were not taken forward for reasons including geophysical challenges and higher sustainability impacts. This is discussed further in Chapter 4 of the options report published in 2012.

3.3.2 In their consultation response, Stoke-on-Trent City Council proposed connecting to the classic network near Stoke-on-Trent to allow classic compatible services to serve Manchester via Stoke. Serving Manchester by classic-compatible services would not offer the high speed proposition for services to Manchester that was specified in our instructions from the Government. In addition, assessment of the routes which were proposed highlighted significant concerns over the operational feasibility of operating new classic-compatible services on mixed traffic lines, with a potential impact on the reliability of HS2.

3.3.3 In order to ensure that we were able to give full and fair consideration of Stoke-on-Trent City Council's proposition, we also reviewed a further response to the consultation from the council which proposed a high speed alignment through Stoke-on-Trent. Following the approach to route optioneering that we have used throughout the route development process, we developed this into a route that met our technical requirements and could be compared against the consultation alignment through Crewe using our sifting methodology. This is referred to below as the 'Stoke route'.

3.4 Stoke route

3.4.1 The Stoke route follows the consultation route through Staffordshire until north of the A34, near Stone. At this point, it bears east towards Stoke-on-Trent, following the existing railway corridor through Stoke-on-Trent, before re-joining the consultation route north of Crewe, and connecting to the WCML in order to serve Liverpool. The route includes a new station in Stoke-on-Trent serving both high speed and classic routes. The baseline route via Crewe includes the connection to the WCML south of Crewe, and assumes that services via the WCML will use the existing Crewe station.

3.4.2 Our analysis suggests that a route via Crewe would offer shorter journey times to the key markets of Manchester and the North, and better connectivity to regional markets in Staffordshire, Cheshire and North Wales.

3.4.3 Based on these route options, we carried out some comparative economic modelling of a number of scenarios for services via Crewe or Stoke-on-Trent to compare their performance. This modelling considered a range of stopping patterns and considered both accelerated routes and a full western leg via Crewe or Stoke.

3.4.4 This modelling shows a significant reduction in the benefits and revenues generated by a Stoke route in comparison with the baseline route via Crewe. This is driven by a number of factors, including the additional journey time resulting from the slower route through Stoke-on-Trent, and the wider regional connectivity delivered by the proposed connection at Crewe.

3.4.5 The wider results of our work indicate that the Stoke route also performs less well in sustainability terms than the route via Crewe, as well as entailing some significant engineering challenges.

3.4.6 These findings reaffirm our previous analysis that the wider markets in this area are best served by a connection to HS2 at Crewe. We would not therefore recommend the suggested route alignment via Stoke-on-Trent.

3.5 Options for serving wider markets

3.5.1 Wider work is being undertaken to understand how the benefits of a high speed network can be spread as widely as possible. For example, HS2 also serves markets such as Stafford, Liverpool and Preston via connections to the classic network.

3.5.2 For the purpose of modelling in support of a route decision, we have adopted the Phase One Train Service Specification without modifications. However, we will continue to consider what opportunities may exist to serve wider markets as part of the development of the Phase Two project. This could include options for serving Stoke-on-Trent.

3.5.3 More information about our assumptions in connection with Train Service Specifications can be found in the accompanying Economic Case.

4 Review of refinements

4.1 Introduction

4.1.1 The route refinements presented in this section cover the route from the West Midlands to Crewe, from south to north. The route has been broken down into the following geographic sections:

- Fradley to Great Haywood (Route Section HSM03);
- Great Haywood to Swynnerton (Route Section HSM03);
- Swynnerton to Madeley (Route Section HSM06);
- Madeley to Chorlton (Route Section HSM08); and
- Chorlton to Crewe (Route Section HSM09/10).

4.1.2 These refinements are our recommendations, which have been agreed by the Secretary of State for Transport in taking a route decision.

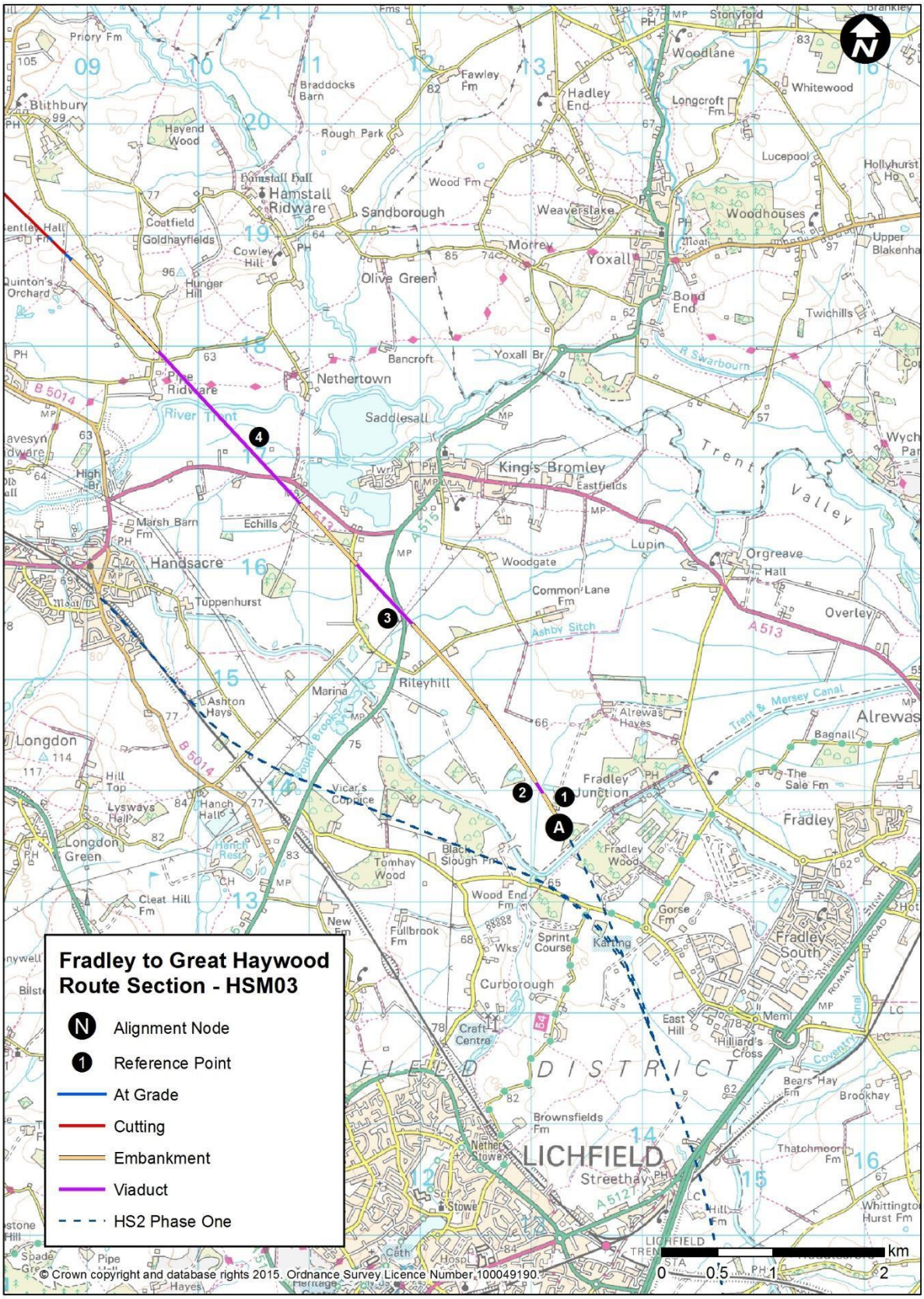
4.1.3 In addition to the changes listed in this chapter, we have undertaken a number of route-wide changes. This has included reducing the trace (the width required by the railway) and the diameter of tunnels. More information on these issues is available in the accompanying reports available at gov.uk\hs2.

4.2 Fradley to Great Haywood

4.2.1 The route commences near Fradley Wood, just north of the Phase One connection with the WCML and approximately 1.6 miles (2.5km) north of Lichfield.

4.2.2 We have proposed moving the Phase One route in this area, in response to the Select Committee considering the hybrid Bill for Phase One. We have now submitted an Additional Provision to the hybrid Bill to implement this change to the hybrid Bill design. In order to align with this updated Phase One design, the southernmost 1.2 miles (2km) of the Phase Two consultation route has shifted eastward by up to 30m (see point 1 on the Fradley to Great Haywood map) and the Curborough (Pyford) Brook Viaduct (2) has been lowered by up to 3m to a maximum height of 9m.

4.2.3 We have reviewed the height of the Bourne Brook viaduct (3) and raised it by up to 4m to a maximum height of 13m. Likewise, the height of the River Trent viaduct (4) has been raised by up to 7m, to a maximum height of 14m. These increases have been driven by a number of factors, including track and clearance requirements, as explained in section 2.4. In addition we have amended the design to incorporate maintenance loops (as discussed below), as well as to avoid the creation of very deep cuttings as the landscape rises to the south of Blithbury.


Fradley to Great Haywood
Route Section - HSM03
Alignment Node
Reference Point
At Grade
Cutting
Embankment
Viaduct
HS2 Phase One
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km
0
0.5
1
2
Fradley Junction
Fradley
Fradley South
Alrewas
Kings Bromley
Handsacre
Riley Hill
Curborough
LICHFIELD
Streethay
Hamstall Ridware
Sandborough
Yoxall
Nethertown
Saddlesall
Longdon
Longdon Green
Trent Valley
River Trent
Ashby Sitch
Trent & Mersey Canal
A513
B5014
A5127

Maintenance loops near Pipe Ridware and Blithbury

4.2.4 Maintenance loops are sidings used to provide stabling for maintenance trains. Having previously been shown at an indicative location for the consultation route, maintenance loops (5) have now been incorporated into the proposed route. This provides greater certainty over the footprint and operability of the railway. More information about the design and purpose of maintenance loops can be found in the accompanying Route Engineering Report at gov.uk\hs2.

4.2.5 The maintenance loops would be on embankment up to 13m high at the southern end, descending into shallow cutting at the northern end. In order to accommodate the four tracks required, the railway corridor has been widened to up to 30m and would require additional space for road access and parking (although the detail of this would be developed at a later stage).

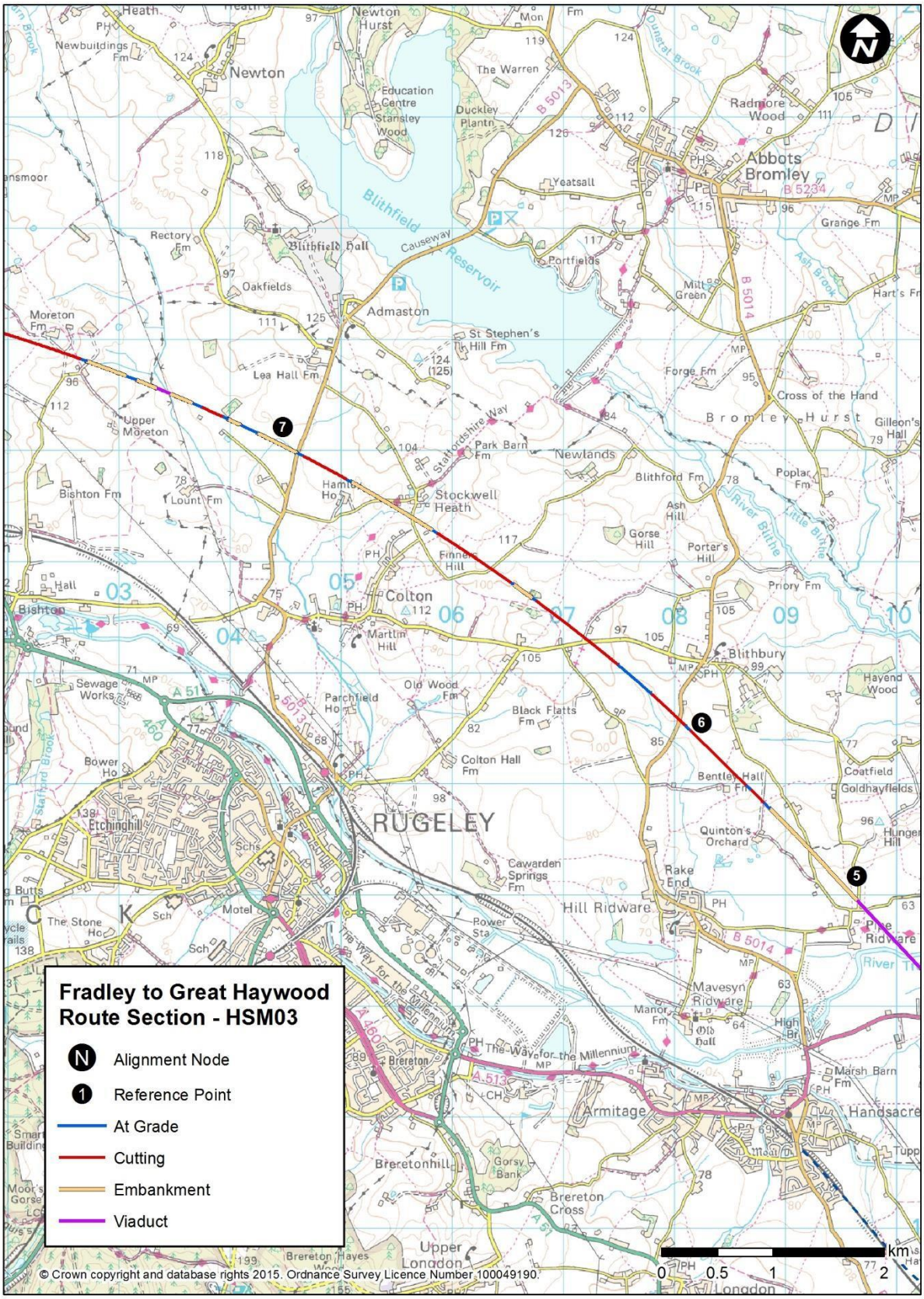
4.2.6 Inclusion of the loops has required that the consultation route be straightened slightly; it has been moved 22m south-west in the area south of Blithbury (6).

Stockwell Heath

4.2.7 Concerns were expressed during consultation about the route past the village of Stockwell Heath. There were limited options to move the route horizontally away from local villages in this area, due to the scattered nature of the surrounding settlements – shifting the route away from one settlement would move it closer to others without offering overall improvements.

4.2.8 We reviewed options that would lower the alignment past Stockwell Heath. Lowering the route would result in significantly deeper cuttings, particularly to the south of Stockwell Heath. This would generate significantly wider cuttings, cause additional impacts on the landscape, and incur extra cost. Lowering the route would also require the diversion of local roads over the top of the railway which could have additional impacts. Therefore, these options have not been recommended.

4.2.9 To the north of Stockwell Heath and to the south of Moreton (7), the route has been raised by up to 3m, from approximately 1m above ground level to a maximum height of 4m, in order to improve clearance over watercourses, as explained previously.


Fradley to Great Haywood
Route Section - HSM03
N Alignment Node
1 Reference Point
At Grade
Cutting
Embankment
Viaduct
RUGELEY
Abbots Bromley
Colton
Blithbury
Hill Ridware
Armitage
Handsacre
Admaston
Newton
Stockwell Heath
Bromley Hurst
Newlands
Upper Longdon
Brereton Cross
Blithfield Reservoir
Trent & Mersey Canal
Staffordshire Way
The Way for the Millennium
River Blithe
0 0.5 1 2 km
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4.3 Great Haywood to Swynnerton

Wider route options between Ingestre and Yarlet

4.3.1 Previous work on route alternatives in this area had examined options that would run further north than the consultation route, following the existing railway corridor and the River Trent before bearing west towards the WCML.

4.3.2 The consultation route in this area performs favourably, compared to alternatives, in terms of direct community impacts (potential noise and demolition impacts). It would avoid conflict with Hopton Heath Registered Battlefield, the existing rail network remodelling at Norton Bridge Junction and the Ministry of Defence Stafford development site.

4.3.3 A further driver for recommending the consultation route is that it would avoid Pasturefields Special Area of Conservation. This is a protected European site of particular importance: it is the UK's only significant remaining example of a natural salt spring with inland saltmarsh vegetation.

4.3.4 As a result of this earlier work, we do not recommend any substantial changes to the line of route through this area.

4.3.5 Concerns were expressed during consultation about the route from Ingestre to Yarlet, including whether the route could be tunnelled to reduce impacts. We do not consider that tunnelling would be appropriate in this area; the local topography necessitates a long section of tunnel with substantial quantities of excavated material to be managed, with significant cost implications.

4.3.6 As a result of concerns raised during consultation, we have also reviewed route options that would shift the route up to 60m further south-west of Staffordshire Showground and north-east of Marston. None of the options was able to offer substantial benefits over the consultation route, and they would have resulted in increased impacts at Hopton. Therefore, these route options have not been recommended.

4.3.7 As the design detail of the route progresses, we will better understand the construction and operational impacts of the railway. This will allow us to identify opportunities for more effective mitigation of potential impacts, working with local communities in this area.

Viaduct over Trent and Mersey Canal and River Trent flood plain

4.3.8 Concerns were raised during consultation about the impacts on the Trent and Mersey Canal near Great Haywood. Although, as explained above, we are not proposing to change the alignment in this area, we have reviewed the length of the viaduct (8) and extended it by approximately 100m as part of the design development process, so that it now starts to the east of the existing railway and replaces the embankment proposed in the consultation route. This results in a

reduction in the footprint of the railway adjacent to Great Haywood Marina and improves access to the east side of the canal. We recommend including this change in the proposed route.

Ingestre Park and Staffordshire Showground

4.3.9 We have reviewed the vertical alignment to the south of Ingestre Park and lowered it in order to comply with updated track design standards (as noted in section 2.4), thereby increasing the depth of cutting from a maximum of 12m to 17m (9).

4.3.10 In response to issues raised during consultation, an option to put the route in green tunnel past Staffordshire County Showground was considered. This option was not taken forward due to the high cost of the green tunnel, given the relatively limited environmental benefits, and the scope to undertake further mitigation at a more detailed design stage.

Hopton

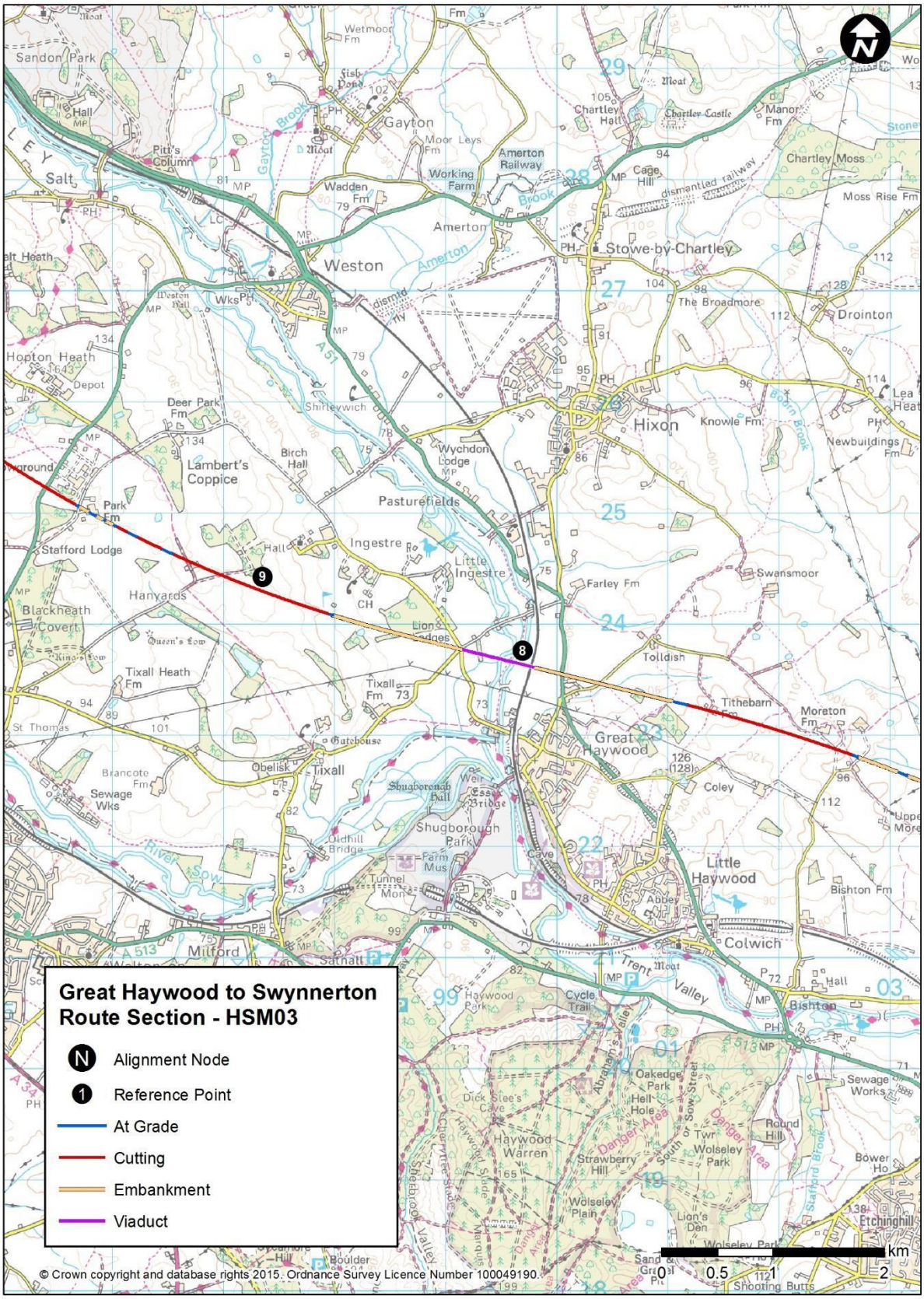
4.3.11 We have increased the height of the route past Hopton (10) by approximately 4m to increase clearance over the Kingston Brook. As noted in section 2.4, this would reduce both detrimental impacts on the watercourse, and the risk of blockages.

4.3.12 As a result of this raise, the cutting (11) immediately west of Hopton would be approximately 4m shallower than at consultation, at a maximum depth of 16m, and the cutting to the north of B5066 Sandon Road (12) would be approximately 5m shallower than at consultation, at up to 15m deep.

4.3.13 We also undertook further consideration of the proposed green tunnel at Hopton, taking into account the increased height of the route. Introducing a green tunnel in this area on this revised alignment would have a larger visual impact on the landscape and would require a greater footprint for landscaping. In addition, delivering a green tunnel would require the provision of associated tunnel infrastructure, including portals and provision for parking and access. We also considered that there are likely to be significant construction impacts associated with a green tunnel.

4.3.14 We therefore considered whether, given the increase in the height of the route at this location, there could be alternative options which would mitigate noise and visual impacts in this area.

4.3.15 Based on this work, we recommend that the green tunnel on the consultation route south of Hopton be replaced with a 'false cutting'. This false cutting would effectively be a retaining wall on the north side of the route and would subsequently be designed to integrate with the landscape, so helping to mitigate visual impacts as well as noise impacts for Hopton. When compared to the green tunnel, the proposed false cutting would bring a substantial reduction in the footprint required to construct and operate HS2, as well as a reduction in the height of the associated structure.


Great Haywood to Swynnerton
Route Section - HSM03
N Alignment Node
1 Reference Point
At Grade
Cutting
Embankment
Viaduct
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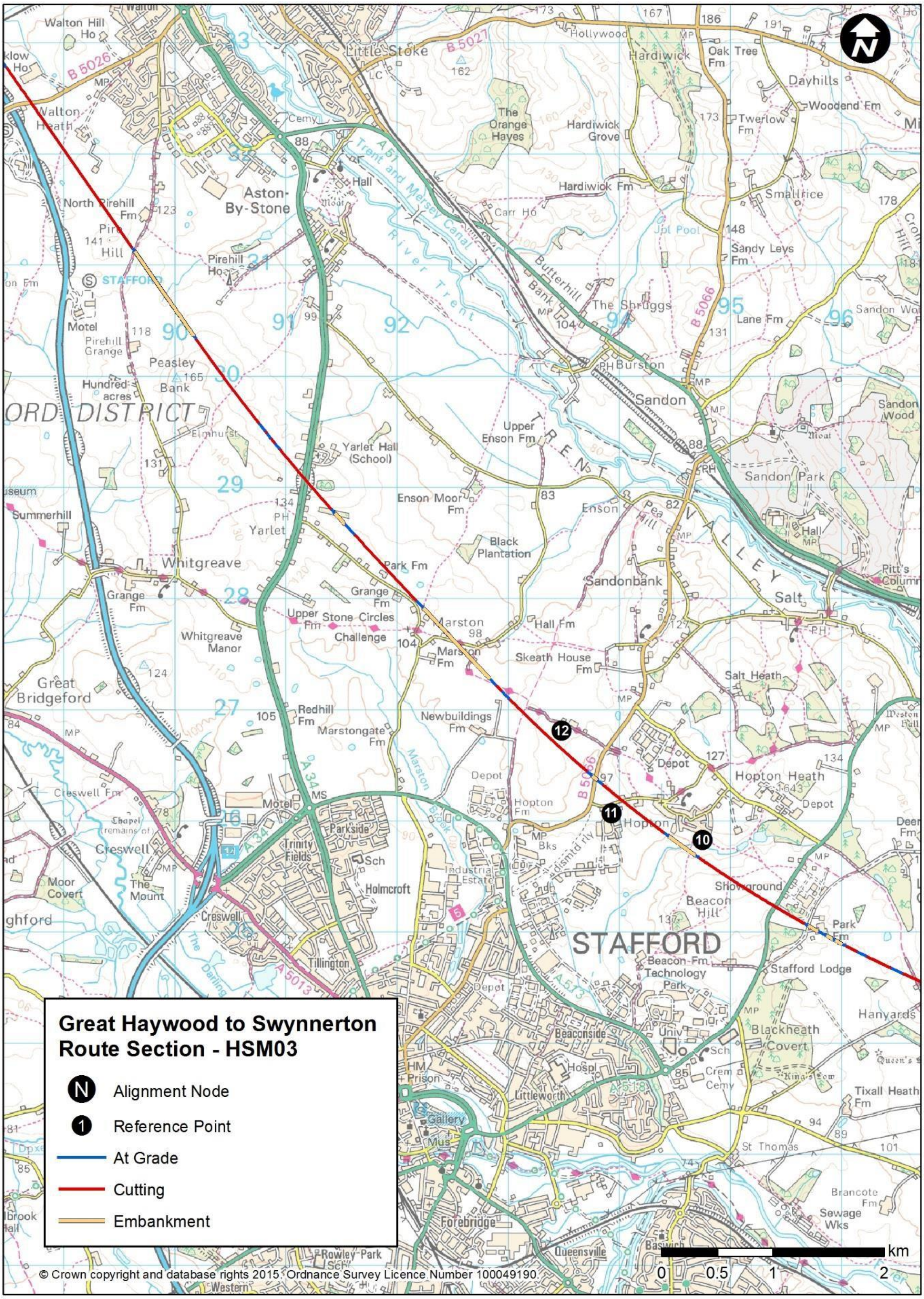
km
0
0.5
1
2


Great Haywood to Swynnerton
Route Section - HSM03
Alignment Node
Reference Point
At Grade
Cutting
Embankment
STAFFORD
0
0.5
1
2
km
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M6 crossing near Swynnerton

4.3.16 During the consultation, concerns were raised about the landscape and visual impacts of the alignment over the M6 and heading north towards Crewe. It was requested that the alignment be lowered by approximately 5m past Swynnerton. It was also suggested that the alignment could be lowered under the M6.

4.3.17 Concerns were also raised during consultation with regards to the proximity and depth of the route past Swynnerton abstraction boreholes.

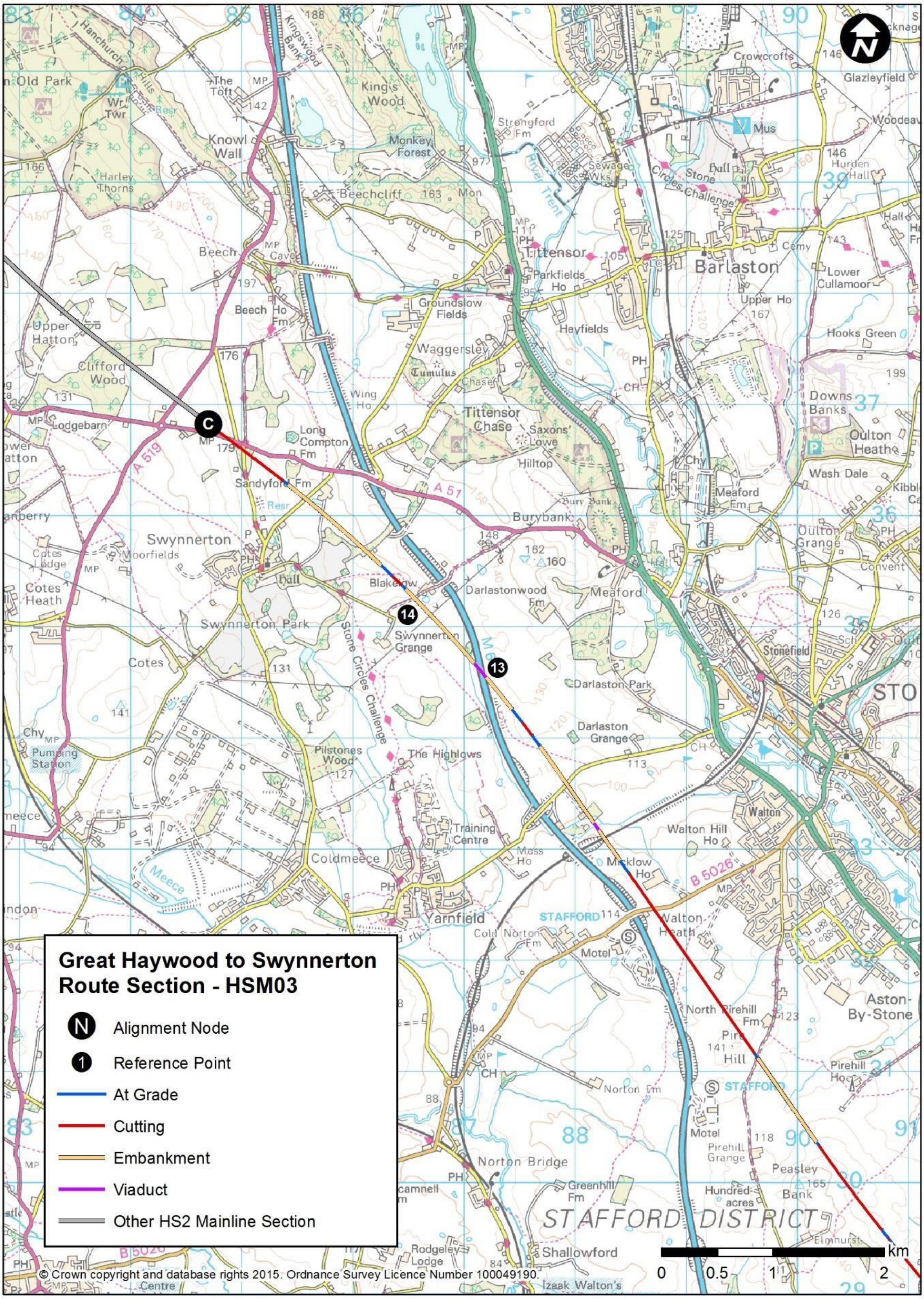
4.3.18 We have reviewed the alignment alternatives in this area. Consideration was given to tunnelling under the floodplain and railway in order for HS2 to pass under the M6. This deeper option increased the cost substantially, creating additional amounts of excavated material, without providing any significant reductions to sustainability impacts.

4.3.19 A route passing under the M6 and through a deeper cutting past Swynnerton would raise significant concerns over the impact on the Swynnerton Borehole Source Protection Zone 2 and on the surrounding landscape due to the increased earthworks associated with the deep cutting.

4.3.20 A further option of crossing over the M6 and running at grade past Swynnerton, then into cutting under the A51, would require local roads to be raised to cross the line of route, which would produce additional visual impact in the area. This would not affect the crossing of the M6 and might lead to additional visual intrusions as a result of raising local highways to cross the railway. In addition, it would increase the size of the cutting through the Swynnerton Borehole Source Protection Zone.

4.3.21 The alternatives considered would increase impacts on the local environment and incur additional cost, without resolving concerns highlighted following consultation. Therefore, we do not recommend further changes to the route in this location.

4.3.22 We have reviewed the vertical alignment over the M6 near Swynnerton (13) and raised it by up to 4m, to a maximum height of 15m, in order to comply with updated design standards. This would achieve better clearance of the motorway, resulting in an embankment some 3m higher (up to an overall height of 17m) to the south-east of Swynnerton (14).



Great Haywood to Swynnerton
Route Section - HSM03
Alignment Node
Reference Point
At Grade
Cutting
Embankment
Viaduct
Other HS2 Mainline Section
C
14
13
Swynnerton
Yarnfield
Barlaston
Tittensor
Meaford
Coldmeece
Walton Heath
Norton Bridge
Shallowford
STAFFORD DISTRICT
0 0.5 1 2 km
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Marston and Yarlet

4.3.23 Concerns were raised during consultation about the route past Marston and Yarlet and options to lower the route in this area have been reviewed. These options deepened the cuttings past Yarlet Lane by up to 7m, but have not been recommended as they would widen the footprint of the railway and significantly increase cost without demonstrably reducing impacts on the local environment and community.

4.4 Swynnerton to Madeley

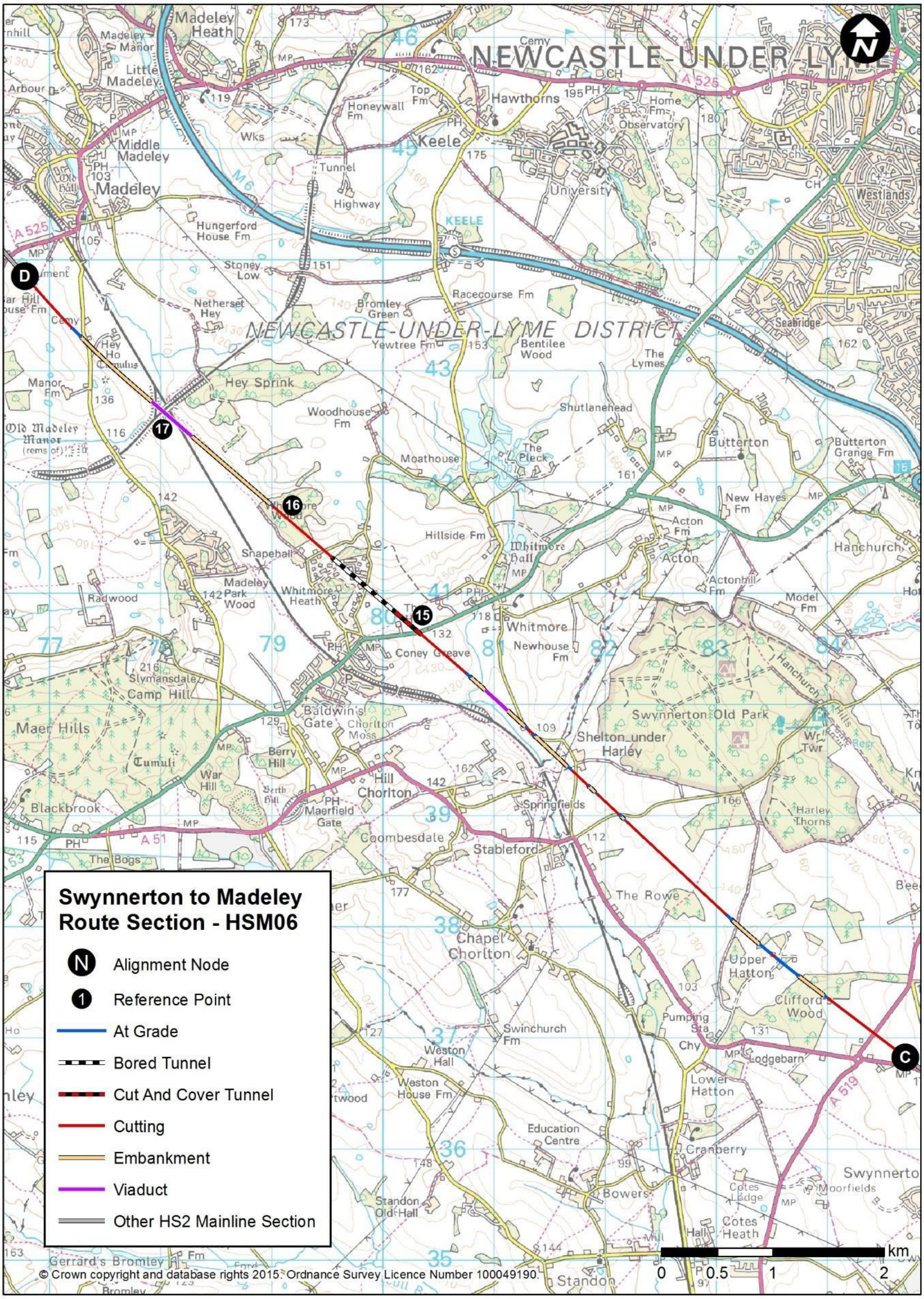
Whitmore Heath tunnel and Whitmore Wood

4.4.1 The route crosses the Meece Brook Valley before cutting through the hills west of Whitmore. Concerns were raised during consultation on the impacts of the route near Whitmore Heath, and the viaduct over the Meece Brook floodplain. There was also concern over the impact of the route on Whitmore Wood Ancient Woodland. Some respondents suggested straightening the route in this area or extending the tunnel at Whitmore Heath. Concerns were also raised about the route's proximity to Whitmore abstraction borehole; this will be addressed at the next stage of design.

4.4.2 We have reviewed several options for refining the consulted route in this area. Although a deeper, longer, bored tunnel would avoid construction through Whitmore Wood Ancient Woodland, it would have significant additional cost implications. Therefore, this option is not recommended.

4.4.3 Instead, we have amended our plans to include a revised alignment that extends the tunnel to the south of the A53 by means of a cut-and-cover tunnel (15), achieving some environmental improvements.

4.4.4 It is also proposed to design the route through Whitmore Wood Ancient Woodland (16) with a retaining wall on the north-east side of the cutting. This would reduce the footprint of the railway through the ancient woodland, particularly due to the steep topography in this area. As the design of the route progresses, there may be opportunities to consider how to further reduce the impact of the route on the ancient woodland, particularly with regard to our approach to construction, and we will keep this under consideration.


Swynnerton to Madeley
Route Section - HSM06
Alignment Node
Reference Point
At Grade
Bored Tunnel
Cut And Cover Tunnel
Cutting
Embankment
Viaduct
Other HS2 Mainline Section
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0 0.5 1 2 km

Crossing over WCML

4.4.5 We have reviewed the vertical alignment over the WCML and River Lea to the south of Madeley (17), and have raised it by approximately 5m, from a maximum height of 11m to 16m, in order to achieve increased clearance over the WCML and comply with updated structural and track design standards. This has enabled us to optimise the WCML crossing at the current level of design.

4.4.6 The adjustments mean an increased landscape and visual impact over the River Lea due to the higher viaducts.

4.5 Madeley to Chorlton

Madeley tunnel and Bar Hill

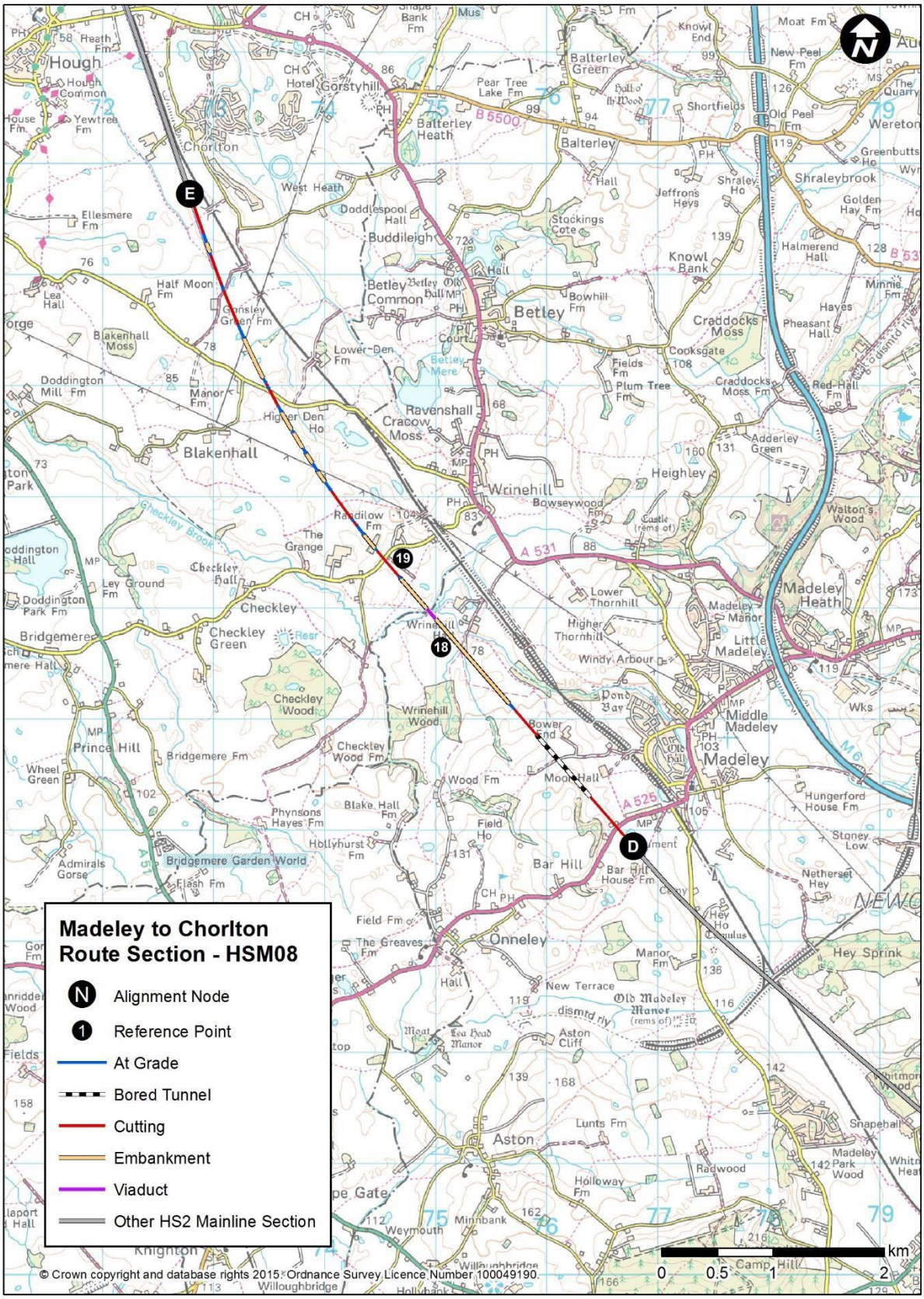
4.5.1 Concerns were raised during consultation with regards to the twin bore tunnels at Madeley and the impact of the railway on the community at Bar Hill, Barhill Ancient Woodland, Madeley Cemetery (war memorial), Hey House (Grade II listed building), the River Lea floodplain, and severance of the land between HS2 and the WCML.

4.5.2 As with the tunnels at Whitmore Heath, we have reviewed options that would extend Madeley tunnel southwards, and options that follow the WCML more closely to the north of Madeley in order to reduce the amount of land isolated between railways. However, we do not consider that extending the twin bore tunnels would be appropriate in this area and the cost of a cut-and-cover tunnel would be high given the relatively limited environmental benefits. Therefore, we do not recommend an extension of Madeley tunnel. Also, following the WCML more closely is not recommended, as the route could not be improved without speed reductions and significant lengthening of crossings over floodplains.

River Lea and Checkley Brook to Den Lane

4.5.3 We recommend lowering the embankment to the north of Madeley tunnel (18) by up to 3m, to a maximum height of 11m. This would improve track drainage through Madeley tunnel and clearance over watercourses to the north.

4.5.4 Further to this, the cutting (19) between the River Lea and Den Lane has been reduced from a maximum depth of 13m to a maximum depth of 9m to better meet updated design requirements for track gradient and watercourse clearance and also to allow for the proposed changes associated with the Crewe junction described below. Due to the undulating topography, sections of the route in this area are on embankment up to 5m high.


Madeley to Chorlton
Route Section - HSM08
N Alignment Node
1 Reference Point
At Grade
Bored Tunnel
Cutting
Embankment
Viaduct
Other HS2 Mainline Section
E
19
18
D
N
© Crown copyright and database rights 2015 Ordnance Survey Licence Number 100049190.
0 0.5 1 2 km

4.6 Chorlton to Crewe

4.6.1 To the north of Madeley, the proposed consultation route would run on the west side of the WCML, gradually drawing parallel around Chorlton. Here, the route would become elevated to form a junction for HS2 services to connect with the WCML. Numerous concerns were raised during consultation with regards to the height of the viaducts south of Crewe, which allow HS2 to connect to the classic network via the WCML. Several junction configuration options have been examined, including the southward extension of the Crewe tunnel.

4.6.2 The recommended option would be to alter the configuration of the junction (20) to the south of Crewe by moving one of the viaducts further north (21), thereby staggering the connections to the WCML. This means that the junction is reduced from three levels of railway to two and the maximum viaduct height would be reduced from 16m on the consultation route to a maximum of 10m in the current design.

4.6.3 The recommended option would provide the best solution in terms of reducing the height of HS2 viaducts and potential highway crossings while maintaining operability for HS2 and Network Rail. This option is strongly recommended as the reduction in height of railway viaducts and potential associated highway crossings would have lower overall impacts.

4.6.4 In parallel with the connections to the WCML, the HS2 mainline would rise onto a viaduct to pass over an existing railway connection with Basford Hall sidings, before dropping down into cutting and terminating approximately 1 mile (1.6km) north of the A500. Until the rest of the route from the West Midlands to Manchester is operational, all services would connect into the existing rail network via the WCML. Provision would be made for the HS2 mainline tracks to later continue towards Manchester and the North using a tunnel under Crewe.

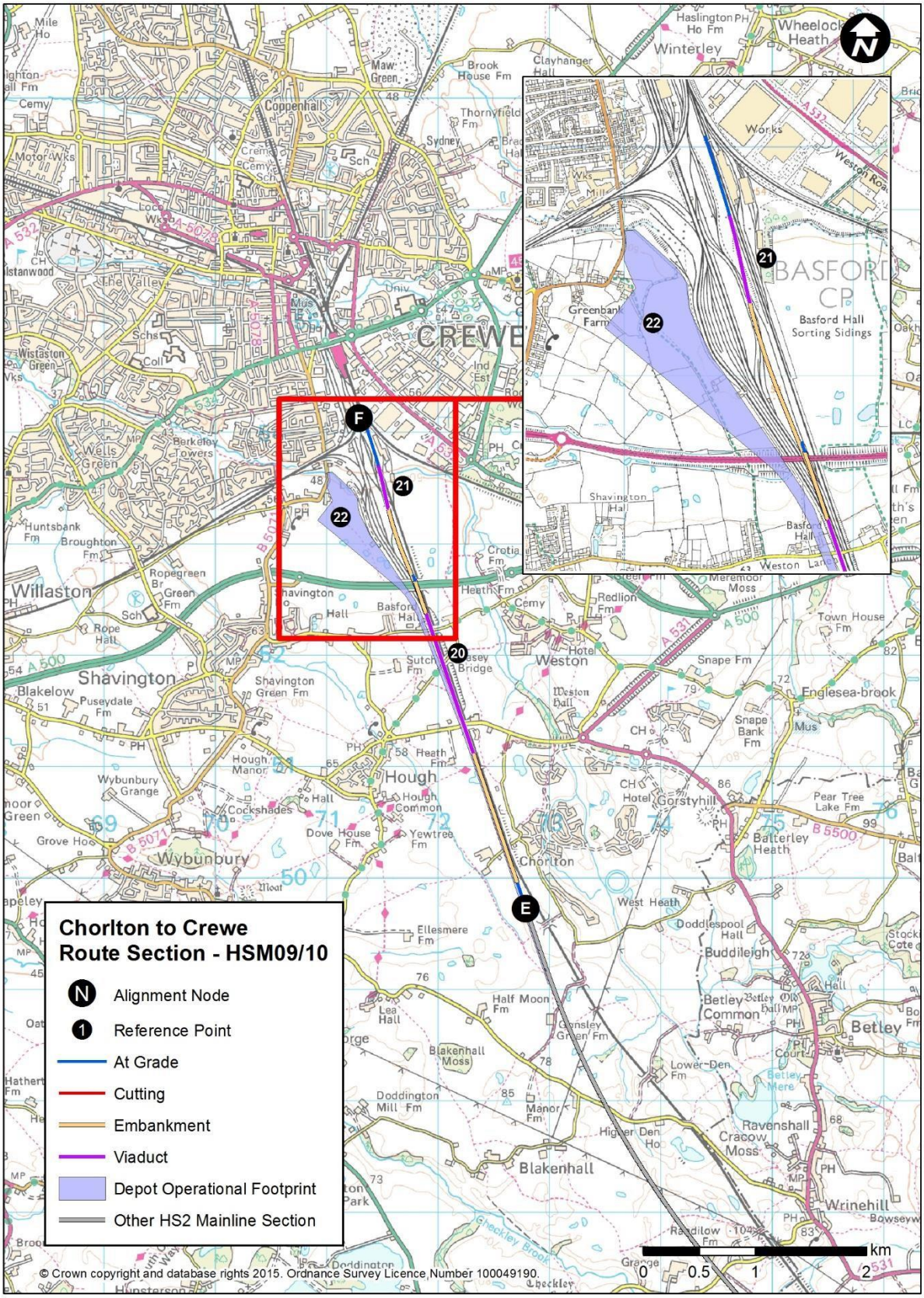
4.6.5 This junction would run to a point approximately 700m to the south of Crewe station.

Infrastructure maintenance depot

4.6.6 An infrastructure maintenance depot is proposed approximately 0.9 miles (1.5km) to the south-west of Crewe, and west of existing railway sidings at Basford Hall (22).

4.6.7 As well as providing a facility for the route between the West Midlands and Crewe, the depot would ultimately be required to support the full western leg of Phase Two. Based on the lessons learned from the Phase One design, the infrastructure maintenance depot for the full western leg could be up to 37ha in size.

4.6.8 For the purpose of appraisal, we have assumed the presence of the larger 37ha site rather than the proposal set out at consultation. Further work will be necessary to understand the detailed design of the depot, and how it would be delivered, including any staging strategy.


Chorlton to Crewe
Route Section - HSM09/10
Alignment Node
Reference Point
At Grade
Cutting
Embankment
Viaduct
Depot Operational Footprint
Other HS2 Mainline Section
F
E
20
21
22
CREWE
BASFORD CP
Basford Hall Sorting Sidings
Shavington
Willaston
Hough
Wybunbury
Blakenhall
Chorlton
Weston
Betley
Wrinehill
km
0
0.5
1
2
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4.6.10 As explained in this report, further developments in the project to develop a Crewe hub station may require us to review the alignment proposed above. We continue to collaborate with Network Rail to ensure that we understand the interactions between these projects, and are working to a common set of assumptions.

5 Next steps

5.1.1 Following the route decision, Hs2 Ltd and DfT will begin the development of a hybrid Bill to secure powers from Parliament for the construction of the preferred route between the West Midlands and Crewe. Our approach will build on the lessons that we have learned from the development of the Phase One hybrid Bill.

5.1.2 As part of developing a hybrid Bill, we need to undertake an environmental impact assessment to inform our Environmental Statement. This involves surveying, modelling exercises, analysis and engagement with relevant stakeholders to further understand the likely significant effects of the preferred route and to consider the most appropriate environmental mitigation along the route.

5.1.3 Other issues that will be considered at this stage include the realignment of local highways and the impacts of construction. In addition, we will undertake further work to consider ancillary items, including power supply locations, signalling systems, drainage and railway access.

5.1.4 Our current schedule would see us depositing a hybrid Bill by the end of 2017, with construction work starting by 2022, leading to the first services using the route in late 2027.

5.1.5 Detailed construction planning, including phasing, management of construction traffic, and location of work sites, will also take place as part of the development of the hybrid Bill.