

High Speed Rail: Preferred Route to Crewe

Sustainability Report

Phase Two Post-Consultation Update:

West Midlands to Crewe

A report by Temple-RSK for HS2 Ltd



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LEADERS IN ENVIRONMENT,
PLANNING & SUSTAINABILITY.

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A Report for HS2 Ltd

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

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Executive summary

In July 2013 the Secretary of State for Transport published proposals for HS2 Phase Two and initiated a seven-month period of public consultation. Since that time certain refinements and modifications to these proposals have been made, which have been recommended by HS2 Ltd. These have come about in response to the feedback received during consultation; due to changes prompted by scheme wide design requirements that have been developed for the more advanced HS2 Phase One proposals; or due to other minor design improvements.

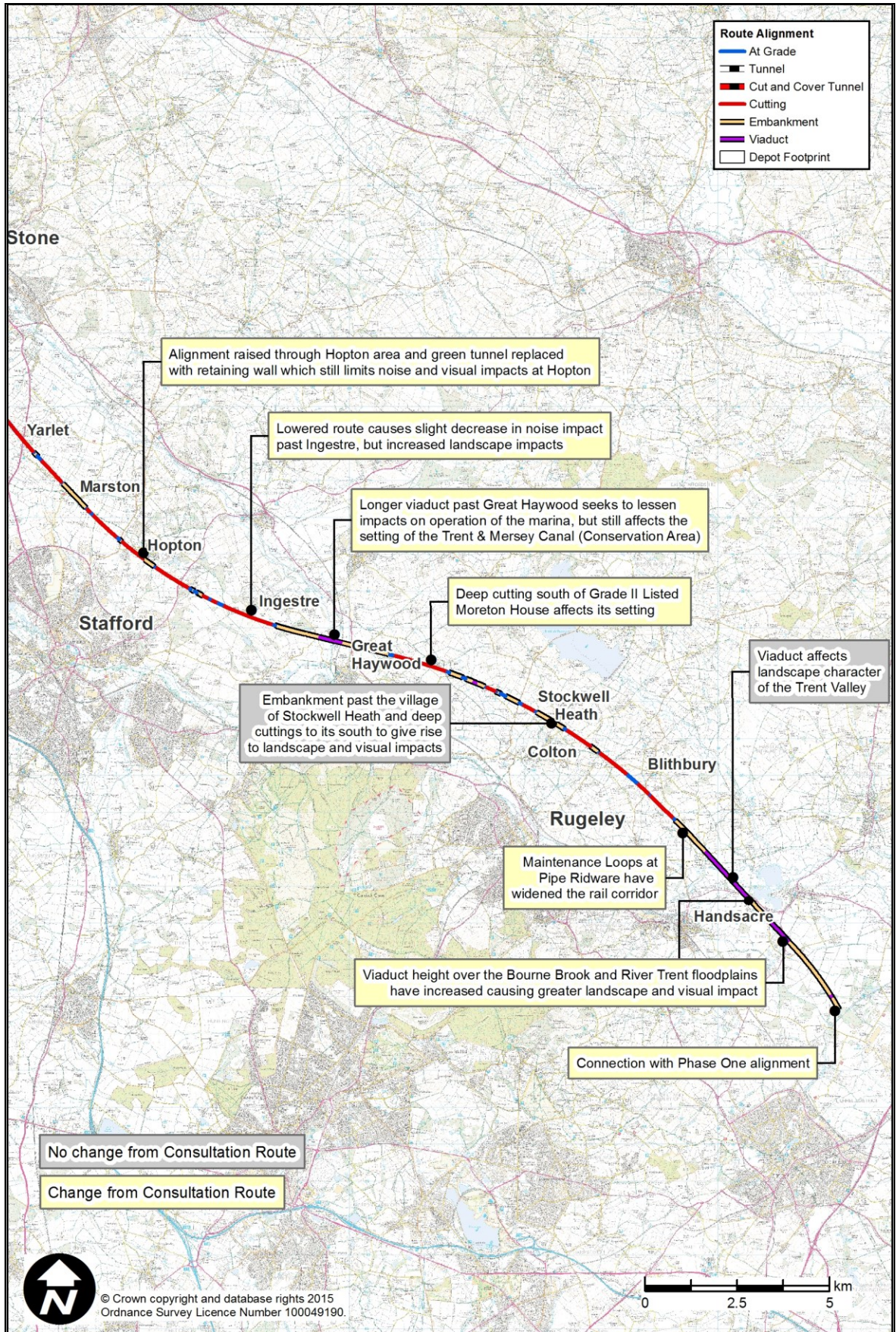
The document *HS2 Plus* (March 2014) recommended bringing forward the Phase Two route to Crewe. This sustainability report has been prepared to outline the potential environmental and community impacts of the preferred scheme to Crewe. In particular, it describes how the potential impacts for this section of the route compare with the scheme that was presented at consultation.

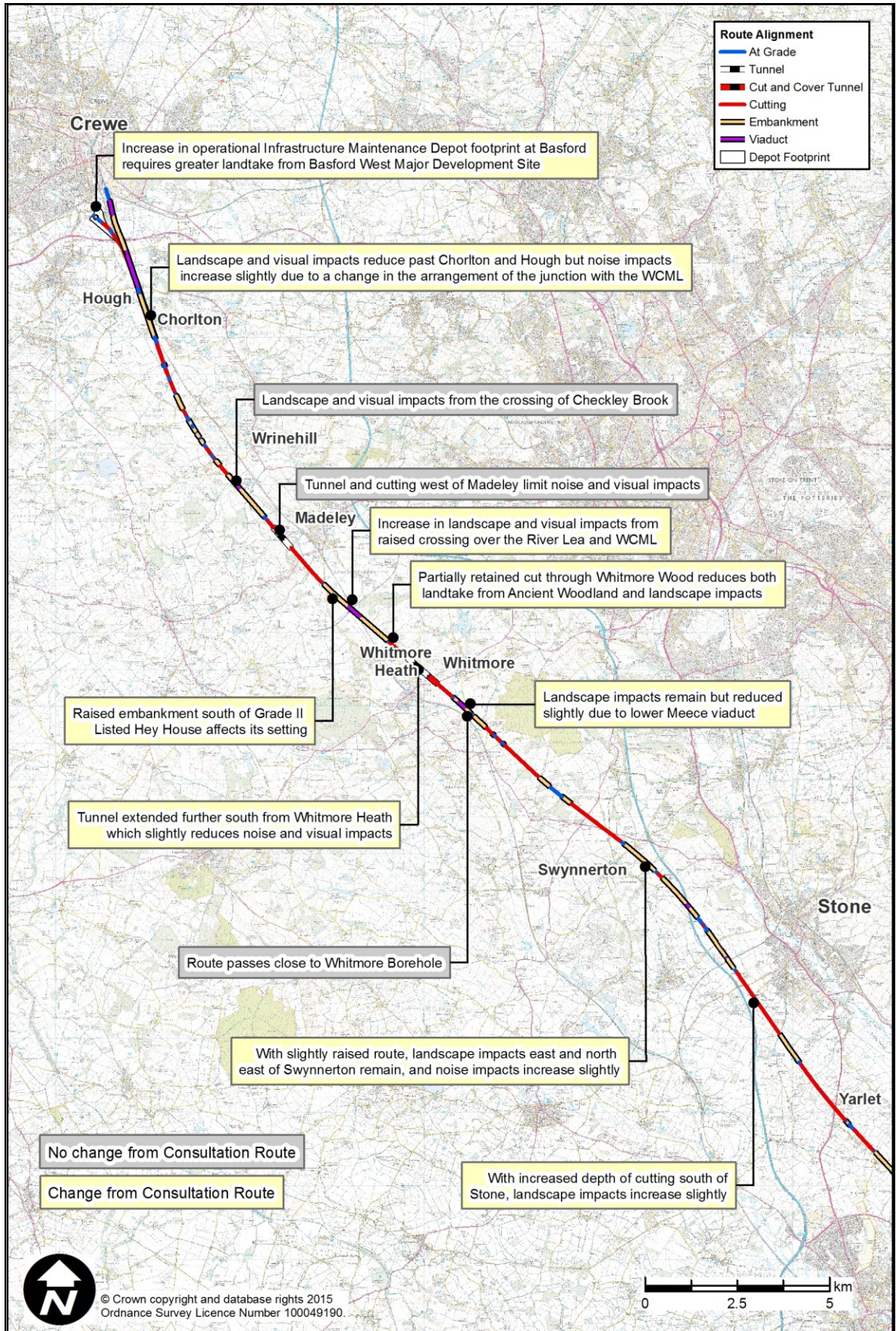
The preferred scheme between Fradley, where it connects with Phase One, and Crewe follows largely the same route that was presented at consultation and its effects remain broadly as they were described within the 2013 Sustainability Statement. However, the details of some of the potential environmental and community impacts have changed as a result of the post-consultation refinements.

Most of the refinements have involved changes to the height of the route over or under roads, railways and watercourses. At certain locations viaducts have been extended. The revised Phase One alignment has required a 30m eastward shift of the connection point with Phase Two, and at Pipe Ridware the design of the maintenance loops has been developed further and these are now included in the proposals. At Hopton the alignment has been raised to alleviate the potential water impacts of the consultation scheme and as a result the green tunnel has been replaced with a landscaped retaining wall to mitigate impacts for residents. The tunnel at Whitmore Heath has been lengthened and a retained cut introduced at Whitmore Wood has reduced landtake from this Ancient Woodland. In addition, south of Crewe the design of the proposed junction with the West Coast Main Line has been simplified.

The main impacts of this preferred scheme are highlighted on the following maps, with emphasis placed on any changes from the consultation scheme.

The next step is to develop the design and mitigation supported by more detailed environmental analysis (in the form of an Environmental Impact Assessment (EIA)). HS2 Ltd will work and engage with stakeholders both during and after the EIA.





Introduction

- 1.1.1. In March 2014, Sir David Higgins, the Chairman of HS2 Ltd, recommended bringing forward development of the Phase Two route from the West Midlands up to and including a new regional transport hub at Crewe by 2027¹.
- 1.1.2. Building on this recommendation, HS2 Ltd has brought forward proposals for refinements to the route between the West Midlands and Crewe.
- 1.1.3. This sustainability report describes the potential impacts of the preferred route between Fradley and Crewe on communities and the environment. In particular, it describes how the impacts for this section of route compare with the scheme that was presented at public consultation. Impacts of the consultation scheme as a whole were described in the 2013 *Sustainability Statement*².
- 1.1.4. Further information on the key issues that HS2 Ltd has considered and the recommended changes since public consultation in 2013 are contained in the HS2 Summary Report³.
- 1.1.5. Technical requirements for the line of route and depot design are provided in the HS2 Route Engineering Report³.

Refinements to the consultation scheme

2.1. Overview

- 2.1.1. In July 2013 the Secretary of State published proposals for HS2 Phase Two and initiated a seven-month period of public consultation. At the same time, HS2 Ltd reviewed the consultation scheme in light of experience gained from the development of the Phase One route for the hybrid Bill.
- 2.1.2. In response to the feedback received during consultation and as a result of the experience gained from Phase One, HS2 Ltd along with its engineering and environment consultants investigated a number of areas for possible modifications to the scheme. Further scheme revisions were driven by an initiative to improve the technical performance of the design or deliver cost efficiencies.
- 2.1.3. Environment consultants Temple-RSK and the HS2 Ltd Environment Team have been fully involved in this process, appraising the environmental implications of these proposed scheme changes. Using the independent Appraisal of Sustainability (AoS) process has ensured that sustainability has continued to be taken into account within option development and decision making. Figure 2-1 provides an overview of the AoS process and key milestones to date.

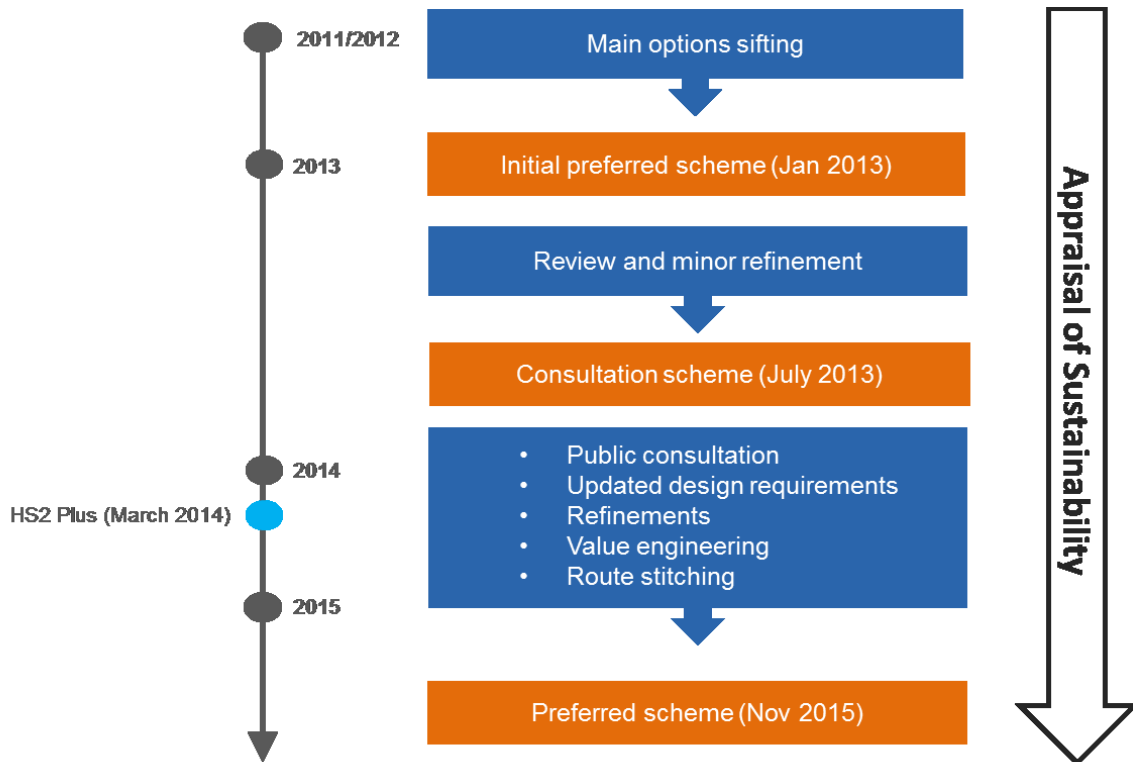
¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374695/HS2_Plus_-_A_report_by_David_Higgins.pdf

² <https://www.gov.uk/government/publications/hs2-phase-two-consultation-sustainability-statement>

³ <https://www.gov.uk/government/organisations/high-speed-two-limited>

2.1.4. The scheme will now be subject to further design development, supported by an Environmental Impact Assessment (EIA). The EIA will be underpinned by a series of detailed environmental studies informed by various surveys, modelling exercises, analysis and engagement with a range of specialist organisations and interested parties.

Figure 2-1 – Evolution of the preferred scheme



2.2. Design requirements

2.2.1. In support of the emerging Phase One scheme proposals, HS2 Ltd prepared a series of updated standards that the HS2 design (both Phase One and Two) had to meet. The requirements, which reflect industry best practice, aim to ensure HS2 is designed and built for optimal passenger comfort, as well as long-term operational considerations such as maintainability, safety and durability. The requirements are principally concerned with the camber and gradient of the track alignment, as well as the structural clearance over or under roads, other railways, watercourses and floodplains.

2.2.2. Based on Phase One experience, the design requirements have evolved and, where appropriate, have been applied to Phase Two, allowing for the more formative stage of development of these proposals. This has resulted in modifications at certain locations, particularly to vertical alignments and gradient profiles. Further refinements were then made, driven by responses to the public consultation.

2.3. Consultation changes

2.3.1. Public consultation took place between July 2013 and the end of January 2014. During this time public events were held at locations along the route, including locations between Fradley and Crewe: at Handsacre, Stafford, Stone, Whitmore, Madeley and Crewe. At these events people interested in the scheme and its potential benefits and impacts could come to learn more, ask questions, raise

concerns and share local insight. Written response was facilitated through consultation forms, which could be submitted by post or on-line.

- 2.3.2. In addition, a series of meetings were held with local authorities, parish councils, interest groups, local MPs, owners of major assets, and certain key environmental stakeholders. As well as enabling people and organisations to learn more about the scheme, these meetings and events allowed HS2 Ltd to better understand local and strategic issues and concerns, and glean local knowledge.
- 2.3.3. An independent report of the consultation process and a summary of the issues raised have been published alongside the decision document⁴. Options were developed to address the issues that were raised during consultation. These were then reappraised and those that were feasible when considered alongside other scheme requirements were progressed.

2.4. Other changes

- 2.4.1. In addition to these two key drivers of change, other minor scheme revisions arose from:
- route 'stitching': with changes from consultation and design requirements focused on different geographical areas, other small changes were necessary where the designs for these areas needed to be re-joined to form the whole scheme.
 - value engineering and updated design: a further series of small design updates reflected ongoing initiatives to improve the technical performance of the design (learning from Phase One) or deliver cost efficiencies.

2.5. Refinement process

- 2.5.1. Since the close of consultation in January 2014 the scheme has evolved through a refinement process resulting in the development of the preferred scheme. This process is referred to as sifting. The appraisal of the scheme post consultation has used the same sequence of three sifting stages used during the earlier AoS work (described in the 2013 Sustainability Statement), where design and appraisal detail has increased as the number of options has reduced.
- 2.5.2. In general, this three stage sifting process started with consideration of major environmental features (essentially national and European designations) at the initial sift (sift 1), through to more detailed geographical analysis at the intermediate sift (sift 2), and specialist review at the most detailed appraisal during the full sift (sift 3). At this last stage, the alignment options were designed to include earthworks, as well as horizontal and vertical profiles showing approximate rail heights in comparison to ground level. In some cases, where differences between refinement options were minor, a greater level of detail was considered at a comparatively earlier stage in the sifting process to help differentiate between options.
- 2.5.3. Where refinement options were designed to an increased level of detail to support the full sift, the Temple-RSK specialist AoS team appraised the options. The findings were consolidated and presented for each option at a series of review workshops to allow relative merits and disadvantages to be discussed and compared.

⁴ 'High Speed Rail: Investing In Britain's Future – Consultation on the route from the West Midlands to Manchester, Leeds and beyond'. A report produced by Ipsos Mori for the Department for Transport and HS2 Ltd: <https://www.gov.uk/government/organisations/high-speed-two-limited>

- 2.5.4. The findings of the AoS work contributed, amongst other considerations, to the progression of options which led to the recommendation of refinements to the route.

3. Scheme description and refinements

- 3.1.1. The preferred route between Fradley and Crewe comprises an estimated 38.6 miles (62.1 km) of new high speed railway, which includes 37.6 miles (60.1km) of running track and 1.3 miles (2km) of passive provision to allow construction of the next part of the Phase Two route (on which decisions have not been taken). This is made up of the following mix of alignment characteristics.

Table 3-1 – Route characteristics

Alignment	Preferred Route (km)	Change from Consultation Route (km)
At grade	5.4 (9%)	+0.4
Tunnel	1.8 (3%)	-0.2
Cutting	24.7 (40%)	-2.1
Embankment	23.7 (38%)	+2.2
Viaduct	6.5 (10%)	-0.5

- 3.1.2. Of this, an estimated 8.8 miles (14km) (just over 20% of the surface route) is within 150 metres of an existing major transport route (A-road, motorway or railway).
- 3.1.3. The route commences at Fradley about 1.6 miles (2.5km) to the north-east of Lichfield, continuing north-west from the refined Phase One alignment at the proposed Streethay junction. There has been a 30m eastward shift and a 3m lowering over the Curborough (Pyford) Brook (to a maximum height of 9m) in order to align with the refined Phase One alignment design, submitted as an amendment (additional provision) to the Phase One hybrid Bill. To comply with updated track requirements and make provision for the maintenance loops further north, the consultation route has been raised by up to 4m over the Bourne Brook north of Rileyhill, requiring a viaduct up to 13m high. The route then enters the Trent Valley as it passes to the north-east of Handsacre on a 1.2 mile (1.9km) long viaduct which has been raised by some 7m to a maximum height of 14m. This increase has been driven by a number of factors including updated track requirements, the incorporation of the maintenance loops (discussed below) and avoidance of very deep cuttings as the landscape rises to the south of Blithbury.
- 3.1.4. Having previously been considered at an indicative location for the consultation scheme near Pipe Ridware, maintenance loop proposals have now been developed further and included within the preferred scheme design. The maintenance loops comprise two additional sections of track, one on either side of the mainline, each about 0.9 miles (1.4km) long. The footprint has been widened by about 40m to accommodate the four tracks, and would require additional space for road access and parking (although the detail of this would be developed at a later stage). As a result of the raised alignment to the south, the maintenance loops are on embankment up to 13m high at the southern end, descending into shallow cutting at their northern end. Inclusion of the loops has required the consultation route to be straightened slightly, moving it some 22m south-west in the area south of Blithbury.

- 3.1.5. Passing north-west through the hills east of Colton that separate the Trent and Blithe valleys, the route passes Stockwell Heath. It then bears westwards across the Trent Valley a second time, to the north of Great Haywood. In response to both updated design requirements and a desire to reduce disruption to the operation of the existing marina at Great Haywood, the viaduct presented at consultation has been lengthened by about 100m (to about 670m) to form a single structure over the West Coast Main Line (WCML) and Trent and Mersey Canal.
- 3.1.6. Continuing north past Stafford, the consultation alignment has been lowered slightly in order to meet updated design requirements related to track curvature: the embankment south of Ingestre has been lowered by up to 3m to a height of about 11m, and the cutting immediately to its north has been deepened by up to 8m, to a maximum of 17m.
- 3.1.7. The route continues past the northern edge of Stafford where an increase in height of approximately 4m was required approaching Hopton to provide requisite clearance over the Kingston Brook. As a result of this, and following further analysis of the engineering requirements of the design in this area, the green tunnel on the consultation scheme south of Hopton has been replaced with a retaining wall on the north side of the route, which would act as a 'false cutting'. At the next stage of scheme development and assessment, this structure will be designed to integrate with the surrounding landscape, so helping to mitigate visual impacts as well as the majority of noise impacts for Hopton. Immediately north and north west of Hopton the cutting is now up to 5m shallower than at consultation, at up to 16m deep.
- 3.1.8. Turning north-west, the route then runs alongside the M6 for about 3.2 miles (5km). The route passes over the M6 to the north of Yarnfield and continues past the eastern side of Swynnerton. The viaduct over the M6 presented at consultation has been raised by up to 4m to an overall maximum height of 15m. Consequently, this would raise the consultation scheme to the south-east of Swynnerton to a maximum height of 17m, continuing on an embankment up to 9m high to the east of Swynnerton, some 6m higher than the consultation scheme. These changes would achieve improved clearance of the motorway.
- 3.1.9. The route crosses the Meece Brook Valley before cutting through the hills west of Whitmore. In response to consultation the proposed tunnel beneath Whitmore Heath is now continued southwards by some 350m through the introduction of a cut-and-cover section. This achieves some environmental improvements and, reduces the considerable amount of excavated material from the deep cutting of the earlier design. This revision also results in a 2m lower viaduct across the Meece Brook (now up to about 10m high). North of the bored tunnel, the cutting through Whitmore Wood was over 100m wide on the consultation scheme. In response to consultation, this cutting has now been reduced to a width of about 60m through use of retained cut on the north-east side.
- 3.1.10. The route then enters the valley of the River Lea. The viaduct over the WCML and the Lea has been increased in height by just over 5m (up to 16m) to provide improved clearance over these features. The route then continues west of Madeley in bored tunnel, before aligning with the WCML and then remaining along its west side for several kilometres. The embankment north of Madeley has been lowered by up to 3m, to a maximum height of 11m.
- 3.1.11. The cutting west of Wrinehill has been reduced from 13m to 9m maximum depth to allow for the other changes associated with the Crewe junction described below, and to better meet updated design requirements for track gradient and watercourse clearance. As the route approaches Crewe, a new junction with the WCML would allow HS2 trains access to Crewe station and onward connections on the existing network to serve Liverpool and stations en route, as well as

Warrington and North Wales. In response to consultation and in order to help simplify the configuration of the junction, the scheme in this location has been refined: whilst the mainline has risen on viaduct by up to 3m, one of the viaducts has now been moved further north so reducing the junction from three levels to two, and consequently reducing the overall maximum height from 16m to 10m.

- 3.1.12. A depot for use in maintaining the HS2 railway infrastructure is proposed west of the route, on the southern edge of Crewe alongside the Basford Hall sidings. This infrastructure maintenance depot would provide a central store and supply point for engineering materials, as well as facilities for rail plant maintenance and rescue and recovery locomotives. In accordance with the re-configuration of the junction with Crewe and increased understanding of the operational requirements, the footprint of the depot has increased by approximately 15ha.
- 3.1.13. The mainline rises onto a viaduct to pass over a connection with the Basford Hall sidings, before dropping down into cutting and terminating approximately 0.9 miles (1.5km) north of the A500. Until the rest of the route is operational, all services would connect into the existing rail network via the WCML. Provision is made in the design for the HS2 mainline tracks to later continue north towards Manchester using a tunnel under Crewe (as proposed at consultation).

4. Sustainability impacts

4.1. Introduction

- 4.1.1. The following sections describe the potential impacts for the preferred scheme between Fradley and Crewe. The conclusions reflect closely those of the 2013 Sustainability Statement, but any changes from the consultation scheme have been stated and are reiterated in a summary box for each relevant topic. The impacts reported here are largely those deemed to be of more than minor consequence, although this does not reflect the more detailed assessment methodology applied (nor mitigation to be added) during the EIA. The reference numbers used within the text relate to those on the maps in Section 5, which help the reader to pinpoint the named features and locations.
- 4.1.2. Certain sustainability topics, which were addressed in the 2013 Sustainability Statement, are not covered in this report. These include:
- Equality, health and well-being: no specific health or equality impacts were identified along the consultation route to Crewe, and this continues to be the case for the preferred route. In addition, a review of the equality appraisal conclusions from the 2013 Sustainability Statement found no changes as a result of refinements made to the alignment post consultation.
 - Employment and housing: employment and housing impacts reported in the 2013 Sustainability Statement are largely associated with stations, which are absent from the preferred route to Crewe. Wider economic issues are conveyed only in the context of the whole scheme and are addressed in Section 7 of the 2013 Sustainability Statement. Consequently these issues have not been re-appraised for the preferred route to Crewe.
 - Access issues: for the AoS, appraisal of access focused largely on impacts associated with connectivity and transport integration at stations. In terms of impacts on rights of way, the preferred route to Crewe would cross the same five long-distance paths affected by the consultation scheme, access along all of which would sought to be maintained (where appropriate).

- Air quality: no specific air quality concerns were identified along the consultation route to Crewe, and this continues to be the case for the preferred route. Potential impacts from construction are not considered at this stage, but would be addressed through rigorously applied control practices.
- Carbon: the carbon impact of HS2 is conveyed in the context of the whole scheme, which is fully reported in Appendix F to the 2013 Sustainability Statement, *HS2 and Carbon*.

4.1.3. Full consideration of these issues will be given through the EIA, based on the legal requirements of that process.

4.2. Planning and development

4.2.1. The proposed Crewe Infrastructure Maintenance Depot is located on a site (Basford West) where outline planning consent was granted in July 2014 for general industry, storage and distribution across approximately 40ha of land ^①. Development of this site is currently in progress. Basford West forms part of a wider regeneration plan within the area south of Crewe.

4.2.2. In accordance with updated operational requirements of the depot for the wider HS2 network, the proposed depot footprint within the Basford West site has increased, requiring up to 20ha of the land identified for development.

4.2.3. An area east of the WCML has also been identified for development (Basford East) although at this stage of design there are no potential impacts from the preferred scheme on this proposed site.

Key changes from the consultation scheme

- Newly consented major development site at Basford West affected by the maintenance depot
- Proposed footprint for the maintenance depot approximately 15ha greater than the consultation scheme.

4.3. Property and community integrity

4.3.1. The preferred route between Fradley and Crewe could result in the demolition of an estimated 18 dwellings. These are all limited to single properties or small groups (fewer than five) at various locations along the route.

4.3.2. The route could result in isolation of an estimated 15 residential properties, most notably at Wrinehill and north of Wrinehill ^②.

4.3.3. The route could also require the demolition of one commercial property. No potential community or industrial demolitions have been identified at this stage.

4.3.4. No appraisal of temporary construction impacts has been undertaken at this stage. However, as an indication of the number of people at greater risk from construction impacts (noise, dust and general disturbance), there would be approximately 100 dwellings within 100m of the surface line.

Key changes from the consultation scheme

- One less commercial demolition due to change in database information rather than as a result of scheme refinement.



4.4. Noise

Airborne noise

- 4.4.1. The airborne noise appraisal predicted levels of railway noise on groups of dwellings. The approach is described in more detail in the 2013 Sustainability Statement, but in summary, three categories of impact have been used:
- dwellings potentially exposed to 'high' HS2 Ltd noise levels, i.e. greater than or equal to 73 dB $L_{Aeq,18hr}$;
 - locations where dwellings could qualify for noise insulation; and
 - groups of dwellings that could have a noticeable (although not necessarily significant) increase in railway noise levels: a noise level of 50 dB $L_{Aeq,18hr}$ or more, and a change in existing rail noise levels of 3 dB $L_{Aeq,18hr}$ or more.
- 4.4.2. The Temple-RSK specialists have worked closely with HS2 Ltd to determine (at this stage of design) the feasibility of introducing noise barriers at the 'preliminary candidate areas for mitigation'. This should substantially reduce the number and extent of noise impacts expected at this early stage. Table 4-1 shows the number of people predicted to experience noise impacts and compares the impacts with and without additional mitigation. Noise maps showing affected groups of properties are included in the Volume 2 Sustainability Mapping.

Table 4-1– Estimated numbers of dwellings with noise impacts between Fradley and Crewe

Preferred route	High noise levels	Potentially qualifying for noise insulation	Noticeable noise increase
Without additional mitigation	<10	<40	3300
With indicative additional mitigation	<5	<20	650

- 4.4.3. The use of additional mitigation could reduce noticeable noise impacts by about 80%. It could reduce the number of dwellings potentially qualifying for noise insulation by around half and the number of high noise level impacts by a similar amount.
- 4.4.4. The main residential areas where residual noise impacts are currently predicted include:
- Great Haywood ; and
 - Chorlton .

Key changes from the consultation scheme

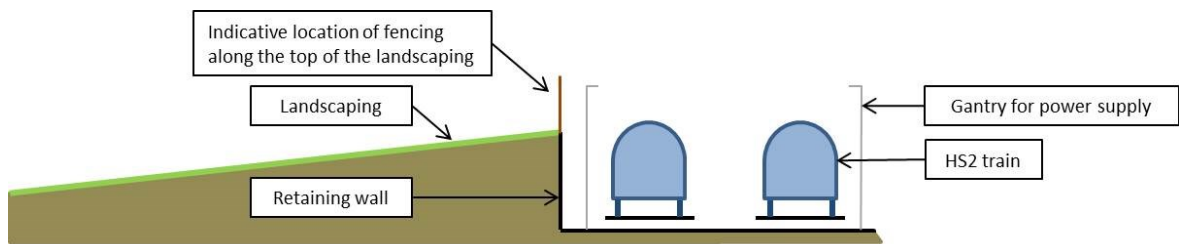
Changes in the noise impacts from the consultation route have come about largely due to refinements in the vertical alignment, with the route higher in some places and lower in others. For the preferred route as a whole between Fradley and Crewe, the scheme refinements have resulted in an increase in the number of dwellings potentially with a noticeable noise increase when compared with the consultation route (650 compared with 500). There are few changes predicted for the numbers of high noise levels or dwellings potentially qualifying for noise insulation.

Some places would have slightly more noticeable noise impacts, and other places slightly fewer. Slight noise decreases are expected at Ingestre ⑧ where the route has been lowered. The retaining wall mitigates most noise impacts at Hopton ⑲, as the green tunnel did before, but because the route has been raised, small increases from the consultation scheme would occur. Slight increases are expected at Swynnerton ⑥ and Madeley ⑦ where the alignment is slightly higher. Slight decreases would occur at Whitmore ⑳ due to the extension of the tunnel at this location. Small increases at Chorlton ⑤ and at Basford ③ would arise as a result of the changes to the junction arrangements with the WCML.

4.5. Landscape and visual impacts

- 4.5.1. The appraisal of landscape and visual impacts relied on analysis of maps and use of aerial imagery, and drew on familiarisation of the affected areas gained through site visits.
- 4.5.2. North-east of Handsacre the railway runs on a viaduct over the Bourne Brook ⑩ causing landscape and visual impacts. A second long viaduct over the River Trent ⑪ and maintenance loops on embankment would adversely affect the landscape character of the valley and cause visual impacts at Pipe Ridware ⑬ and on the 'Way for the Millennium' long-distance footpath ⑫. Continuing north-west, embanked sections near Moreton ⑭ would have local impacts on landscape character. In particular, the embankment past Stockwell Heath ⑮, the cutting to its south-east and the associated loss of ancient hedgerows and trees would have a locally major landscape impact, as well as causing visual impacts on parts of Stockwell Heath and the North Staffordshire Way long-distance footpath ⑯.
- 4.5.3. At Great Haywood ④, a viaduct and embankments across the Trent Valley would introduce new elements in the landscape, affecting its character and resulting in visual impacts on the River Trent and the Trent and Mersey Canal, and particularly at the Great Haywood Marina. With the deeper cutting past Ingestre ⑧, the scheme footprint is broadened from the consultation design resulting in increased landscape impacts south of the village and through Ingestre Golf Course ⑰.
- 4.5.4. The route past Stafford and close to Staffordshire Showground ④⑦ is largely in cutting. At Hopton ⑲, the raised alignment over the Kingston Brook precludes the raised green tunnel that was proposed at consultation; so instead, a retaining wall on the Hopton side has been introduced. This would provide a similar level of landscape and visual mitigation, while also reducing the necessary earthworks and landscaping that would have been required with the tunnel (see Figure 4.1). Detailed mitigation will be designed at a later stage.

Figure 4-1 – Indicative cross section of retaining wall at Hopton



Indicative cross section of retaining wall and landscaping at Hopton (not to scale)

- 4.5.5. Further north and west, an embankment passes through the hamlet of Marston, 18 which would affect its character and setting and cause visual impacts.
- 4.5.6. The route passes in deep cutting through the flanks of Peasley Bank and Pire Hill south of Stone 20 and north of Swynnerton 6, disrupting this section of countryside. The slightly higher viaduct over the M6 and embankment to its north-west, and the impact on woodlands that edge the historic parkland at Swynnerton 21, would continue to affect the wider landscape setting.
- 4.5.7. The route continues through the undulating and wooded landscape between Swynnerton and Madeley. Major local landscape impacts west of Whitmore 22 would remain, but these are reduced from the consultation scheme due to the lower Meece viaduct, an additional cut-and-cover tunnel south of the bored tunnel under Whitmore Heath 23, and the use of partially retained cut through Whitmore Wood 24. Visual impacts would affect parts of Shelton under Harley 25 and Whitmore.
- 4.5.8. The route then enters the valley of the River Lea where a higher viaduct crossing of the WCML and River Lea 27 has increased both landscape and visual impacts.
- 4.5.9. South of Madeley 7, a deep cutting approaching the southern tunnel portal would affect landscape character. North of Madeley the railway crosses the floodplain of Checkley Brook 26, fragmenting attractive landscapes west of the WCML. Visual impacts on residents resulting from the alignment at Chorlton 5 and Hough 49 would reduce due to the alteration and general lowering of the junction of HS2 with the WCML.

Key changes from the consultation scheme

- Increased landscape and visual impacts due to higher embankments and viaducts over the Bourne Brook ¹⁰ and River Trent ¹¹ floodplains and raised maintenance loops at Pipe Ridware ¹³.
- Increased landscape impacts due to a larger scheme footprint near Ingestre ⁸.
- Design changes have been made past Hopton ¹⁹, although overall impacts are expected to remain broadly similar to those from the consultation scheme, subject to further design during the EIA.
- Higher embankments east and north of Swynnerton ⁶ with additional landscape effects.
- Reduced (though still major) landscape impacts south east of Whitmore Heath ²³ due to the lower route, longer tunnel and reduced footprint through Whitmore Wood ²⁴.
- Increased landscape and visual impacts from the raised viaduct over the River Lea and WCML ²⁷.
- Decreases in visual impacts at Chorlton ⁵ and Hough ⁴⁹ due to the alterations and lowering of the Crewe junction.

4.6. Cultural heritage

- 4.6.1. The appraisal of cultural heritage impacts relied on analysis of maps and use of aerial imagery, and drew on familiarisation of the affected areas gained through site visits. It took account of designated heritage assets including World Heritage Sites, Listed Buildings, Conservation Areas, Registered Parks and Gardens, Registered Battlefields and Scheduled Monuments.
- 4.6.2. The route passes to the south of Moreton House ²⁸, a Grade II Listed late 18th century house. To its south are surviving elements of a designed garden with views across surrounding farmland, which forms part of the setting of the house.
- 4.6.3. The railway then crosses the Trent and Mersey Canal north of Great Haywood ⁴. The 19th century canal is designated a Conservation Area and the HS2 crossing would affect its setting. The longer viaduct here is not expected to have a greatly different impact than the consultation route.
- 4.6.4. The Registered Battlefield of Hopton Heath (1643) ²⁹ north-east of Stafford is avoided and the route is comprehensively screened from this important site by the existing landscape.
- 4.6.5. Following the viaduct crossing of the M6, the route continues on embankment to the south and east of Swynnerton Conservation Area ²¹. Although heavily screened by vegetation, there is likely to be an impact on the setting of both the Conservation Area and wider associated historic parkland.
- 4.6.6. The route passes to the south of Hey House ³⁰, a Grade II Listed 18th century small country house. To its south and west are surviving remains of former parkland and a late 19th century lodge, both of which are considered to have associated historic value. Past Hey House the alignment is 3m higher than the consultation scheme. The scheme would result in the demolition of the lodge and would also harm the associated former parkland. These are not designated heritage assets in their own right, but are all part of the setting of the house.

Key changes from the consultation scheme

- Impact on Grade II Listed Moreton House ²⁸, previously reported as minor, is now considered potentially moderate based on an increased understanding of the local area.
- Impact on Grade II Listed Hey House ³⁰, previously reported as minor, is now considered potentially moderate due to a slightly raised route and based on an increased understanding of the local area.

4.7. Biodiversity and wildlife

- 4.7.1. The appraisal of ecological impacts relied on analysis of maps and use of aerial imagery. It took account of key designations including European and international designations (Special Areas of Conservation, Special Protection Areas and Ramsar sites). It also considered key statutory designations at the national level, including Sites of Special Scientific Interest, National Nature Reserves and Local Nature Reserves. The appraisal also drew on other nationally available data sets including the Ancient Woodland Inventory and the list of Habitats of Principal Importance for the conservation of biodiversity in England.
- 4.7.2. Pasturefields Salt Marsh ³¹ is a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) north-west of Rugeley, which forms the only significant remaining example in the UK of a natural salt spring with inland salt marsh vegetation. HS2 Ltd has undertaken substantial work analysing the risks presented to this site, in conjunction with Natural England and the Environment Agency. Amongst other considerations, the consultation route was selected on the basis of it having no likely significant effect on the marsh's conservation status. The minor changes in vertical alignment past Ingestre would have no implications for these earlier conclusions.
- 4.7.3. There are seven main clusters of Habitats of Principal Importance intersected by the route, which include areas of habitat that are directly affected resulting in habitat loss and fragmentation. Clusters of woodland habitats would be affected at four locations ³², as well as more isolated areas elsewhere, and coastal and floodplain grazing marsh ³³ habitats at two locations along the southern part of the route. An area containing lowland meadow ³⁴, and purple moor grass and rush pasture Habitats of Principal Importance are also directly affected.
- 4.7.4. One Ancient Woodland, Whitmore Wood ²⁴, would be directly affected. The impact would remain significant given the central alignment through the wood, but permanent landtake has been reduced through the use of a partially retained cutting. Although this would still result in the loss of an estimated 15% of the wood, this compares with an estimated 25% loss resulting from the consultation scheme.

Key changes from the consultation scheme

- Reduced landtake to Whitmore Wood Ancient Woodland ²⁴.

4.8. Water resources and flood risk

- 4.8.1. The consultation route considered Environment Agency flood zones along major watercourses. Further work has since been undertaken to understand the clearance at all watercourse crossings along the line of route, as these can give rise to flood risk and potential non-compliance with the Water Framework Directive (WFD) if not considered adequately at an early stage in the design. The clearance

at each watercourse crossing has been assessed against updated design requirements and where available, updated topographic data.

- 4.8.2. Where clearance over or under the watercourse was insufficient compared with the design requirements, the alignment has been adjusted where practical. This has resulted in the heights of viaducts and embankments increasing in a number of locations in order to achieve sufficient clearance over the watercourse. This would reduce flood risk, other hydrological and ecological impacts as well as providing operational benefits to the railway in terms of maintenance requirements.
- 4.8.3. The WFD has been a key consideration for the updated design requirements. At a later stage of development, any proposed work which could influence the hydromorphology, ecology or water quality of any classified water resources will require an assessment under the WFD. This assessment will need to demonstrate how potentially adverse impacts will be mitigated and, where possible, how the status of the water body will be enhanced in order to ensure that the scheme does not prevent the WFD objectives from being achieved for any wet water body potentially affected by it.

Watercourse diversions

- 4.8.4. Close working between the scheme engineers and Temple-RSK’s water specialists has been successful in avoiding the need for permanent watercourse diversions along most of the route. However, the need for permanent diversions to four minor rivers is still envisaged at this stage. The affected rivers comprise:
- a tributary of Bentley Brook 35;
 - a tributary of Moreton Brook 36;
 - a tributary of the Trent 37; and
 - a tributary of the Lea 38.

Flood risk

- 4.8.5. The route crosses floodplains at several locations. Generally, these crossings are on viaduct or a clear-span bridge to minimise the potential loss of flood storage and obstruction to flood flows, and so reduce flood risk. Five floodplains (Flood Zone 3) are crossed for more than 100m as shown in Table 4-2. A series of viaducts are currently proposed at these locations.

Table 4-2 – Floodplain crossings over 100m

Watercourse name	Viaduct name	Viaduct length	Floodplain crossing
Bourne Brook 10	Bourne Brook viaduct	730m	715m
River Trent* 11	River Trent viaduct	1,875m	1,277m
Luth Burn 39			125m
River Trent* 4	Trent and Mersey viaduct	670m	497m
Meece Brook 40	Meece Brook viaduct	270m	211m

* Classified by the Environment Agency as a Main River

- 4.8.6. The preferred route crosses a major river, the Trent, at two locations. It involves a further 46 crossings of minor watercourses, a few of which are designated main rivers by the Environment Agency, namely Curborough Brook (also known as Pyford Brook) 41, River Lea 42 and Gresty Brook 43. It also involves one crossing of the Trent and Mersey Canal 4.

- 4.8.7. There is a risk of flooding at the depot south of Crewe, where the operational site boundary lies alongside the Gresty Brook and over a number of small watercourses.
- 4.8.8. In all cases, HS2 Ltd will continue to work closely with the Environment Agency, lead local flood authorities, internal drainage boards and other relevant parties to establish the most practical and effective solution for each crossing of the floodplain and other watercourses.
- 4.8.9. The EIA will also assess the potential impacts from groundwater flooding, surface water (pluvial) flooding and artificial waterbodies flooding, which have not been addressed at this stage.

Groundwater

- 4.8.10. There are two locations where the route passes through areas of more sensitive groundwater, potentially affecting abstraction boreholes used to provide public potable water supply.
- 4.8.11. The route crosses a Source Protection Zone (SPZ) 2 associated with three Swynnerton abstraction boreholes ⁴⁴. Part of this is in cutting which is likely to be quite shallow (maximum depth of 1.4m). Consequently, notwithstanding any potential impacts during construction and the protrusion of any deep foundations (which will be assessed by the EIA), it is unlikely that the route would adversely affect the groundwater abstraction at the boreholes.
- 4.8.12. South of Whitmore ²² the route passes mostly at or above ground level through both SPZ1 and SPZ2, using a mixture of embankment, at grade and viaduct, and a short section of shallow cutting (to a maximum depth of 2.3m). As a result it is unlikely to have any significant impact on the groundwater flow regime. However, the route passes very close to the Whitmore abstraction point ⁴⁵ and the associated pump house. Measures will be explored with the Environment Agency and the water company to mitigate potential impacts on public water supply.

Key changes from the consultation scheme

- All watercourse crossings along the route between Fradley and Crewe have now been assessed against updated design requirements. This has resulted in both increases and decreases in the vertical alignment at a number of locations compared with the consultation route.
- Approximately 200m reduction in length of tunnel or cutting through SPZ 1 and SPZ 2 due to raised alignment east of Swynnerton

4.9. Land use resources

Agricultural landtake

- 4.9.1. The AoS process has sought to limit the loss of the highest quality Grade 1 and 2 agricultural land. High-level agricultural land classification maps show that, while no Grade 1 land is crossed, an estimated 6.2 miles (9.9km) of the route would be through land classified as Grade 2, notably between Chorlton and Basford ³. The depot south of Crewe ¹ occupies approximately 4.6ha of land shown classified as Grade 2, although part of the site has already been built on with existing rail sidings and further development is underway as part of Basford West.

Green Belt land

- 4.9.2. As with the consultation scheme, the main area of Green Belt land crossed by the preferred route occurs between the M6 and just north of Whitmore Wood ²⁴ for a total distance of about 8 miles (13km).

Landfill sites

- 4.9.3. As with the consultation scheme, the 2013 Sustainability Statement reported 13 disused (non-operational) landfill sites within 250m of the route. Higher risks were identified for one of the disused sites, based on the type and length of crossing, the size of the landfill and its recorded contents. The site ⁴⁷, designated for non-hazardous waste and crossed by cutting for about 100m, is a Stafford County Showground tip at Beacon Hill, north-east of Stafford.

Mineral sites

- 4.9.4. The AoS identified two registered minerals sites that are recorded as active and that would be crossed by the route to Crewe. Hurstwood Pit ⁴⁸ is a small pit located to the east of Colton. Aerial photos indicate that it is not currently used, as it appears to be re-vegetated. Cash's Pit ⁹, north of Swynnerton, would also be directly affected. Similarly, this small pit appears to be fairly mature woodland.

No key changes from the consultation scheme

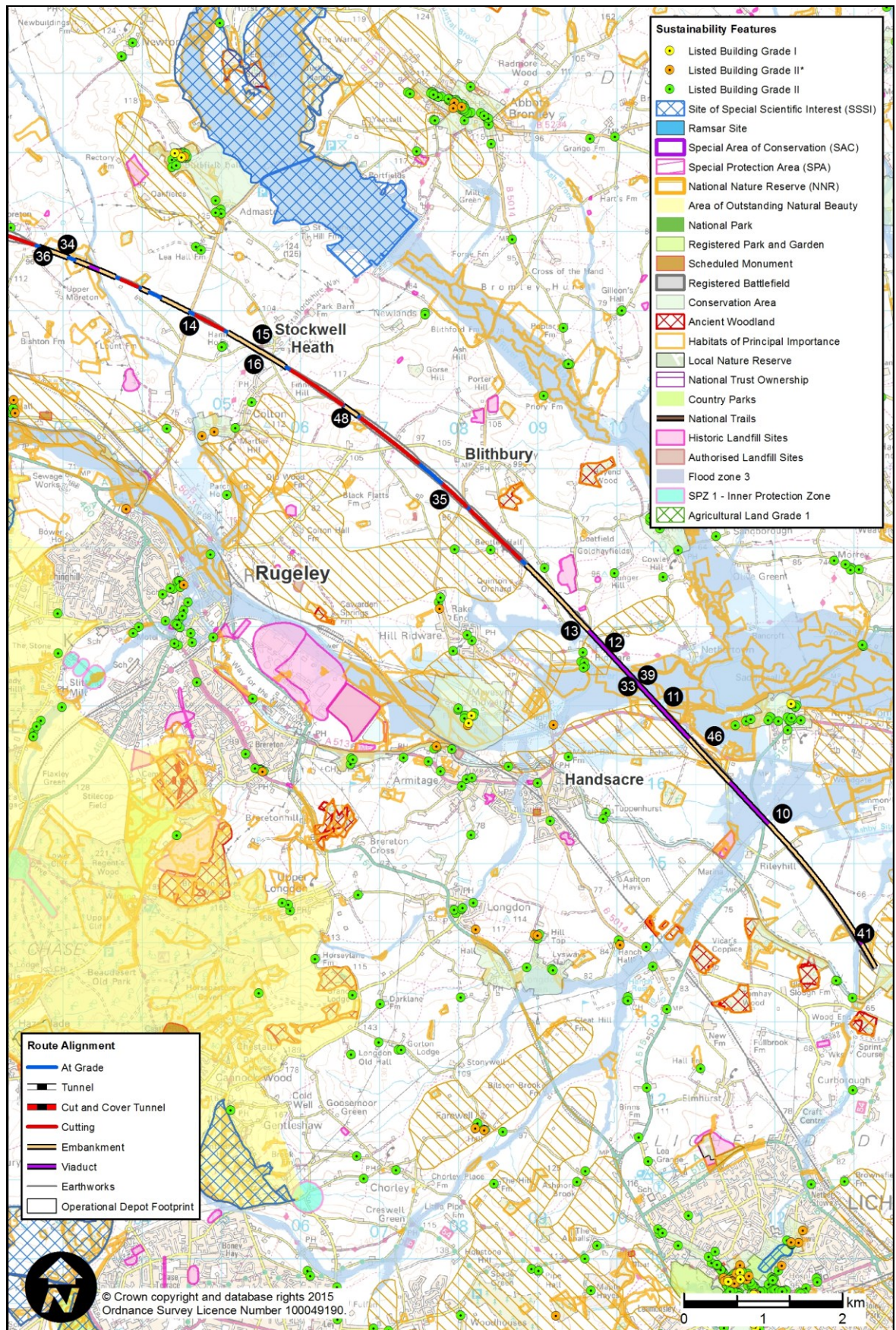
4.10. Excavated materials and material resource

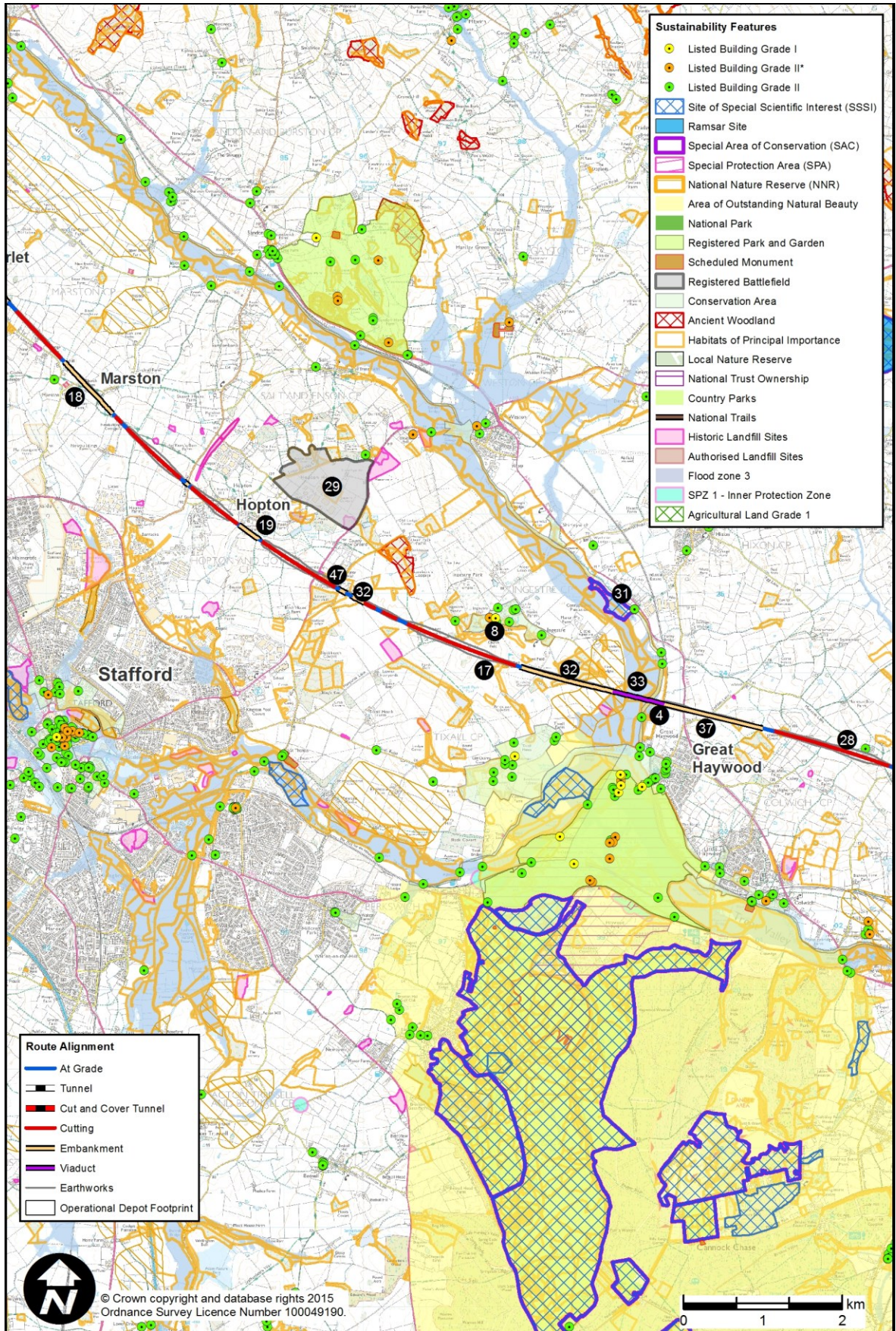
- 4.10.1. A figure for excavated materials was provided by HS2 Ltd, derived from estimates of materials removed from cuttings and tunnels balanced against estimates used for railway embankments. It does not at this stage take account of any additional mitigation or other earthworks.
- 4.10.2. The estimate for excavated material arising on the preferred route between Fradley and Crewe is 4.2 million cubic metres, of which about 0.3 million cubic metres would be from tunnelling. In practice, much of this material will be used in the construction of bunds and landscaping, as well as other earthworks required for the scheme, so reducing the need for imported materials and also reducing the amount of excavated material requiring management off-site.
- 4.10.3. The estimated quantities of bulk building material required for construction of the proposed scheme would comprise an estimated 100,000 tonnes of steel and 630,000 tonnes of concrete.

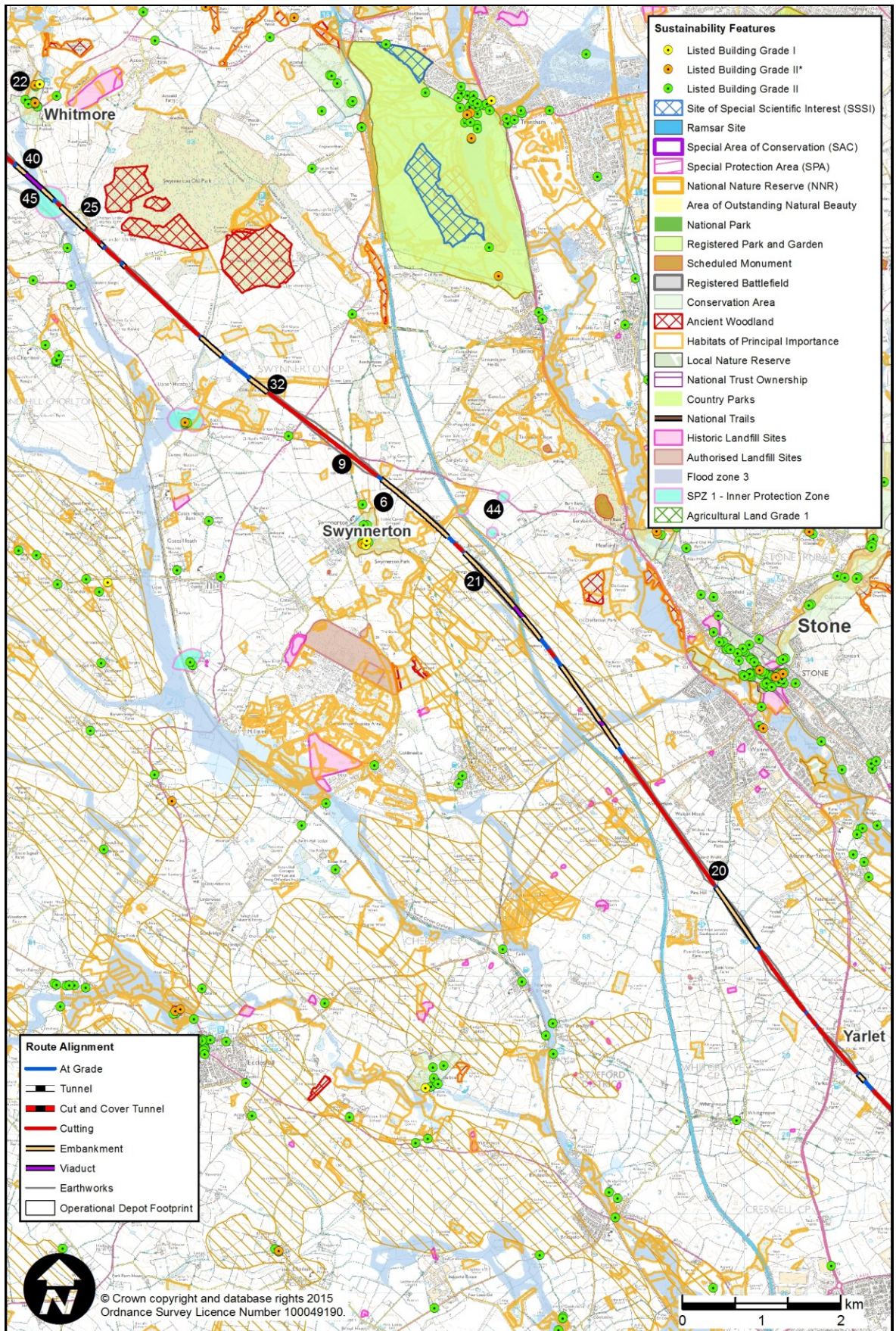
Key changes from the consultation scheme

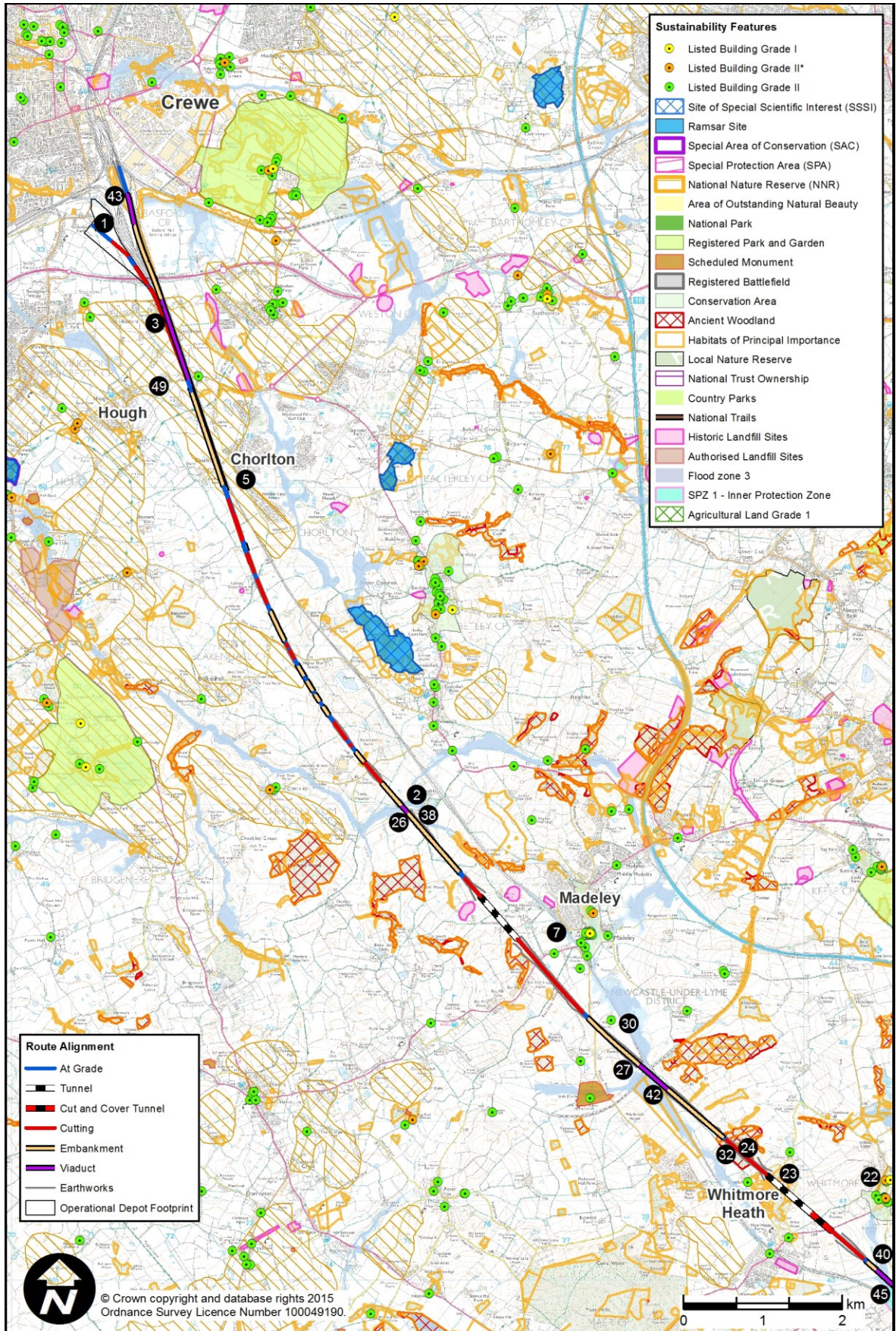
- An estimated 3 million cubic metres less excavated material. This is due to a number of factors including: raising of the route particularly in the south at the maintenance loops; and changes in the design requirements (e.g. tunnel diameters)
- An estimated 50,000 tonnes less concrete required.

5. Sustainability reference maps









6. Summary Table

	Consultation scheme	Preferred scheme
Route characteristics (km, rounded to one decimal place)		
Total	62.1	62.0
At grade	5.0	5.4
Bored tunnel	1.4	1.4
Cut-and-cover tunnel	0.0	0.4
Green tunnel	0.5	0.0
Cutting	26.7	24.7
Viaduct/bridges	7.0	6.5
Embankment	21.5	23.7
Property and settlements		
Total demolitions (including residential)	20	19
<i>Demolitions (residential)</i>	<i>18</i>	<i>18</i>
<i>Demolitions (community)</i>	<i>0</i>	<i>0</i>
<i>Demolitions (commercial/retail)</i>	<i>2</i>	<i>1</i>
<i>Demolitions (manufacturing/industrial)</i>	<i>0</i>	<i>0</i>
Isolation (number of dwellings)	15	15
Noise		
Potential dwellings subject to noticeable noise increase without additional mitigation	2800	3300
Potential dwellings subject to noticeable noise increase with additional mitigation	500	650
Landscape		
AONB crossed at surface (km)	0	0
Cultural heritage⁵		
Scheduled Monuments directly affected	0	0
Registered Battlefields directly affected	0	0
Listed structures directly affected*	0	0
Registered Parks and Gardens directly affected	0	0
Conservation Areas directly affected	1	1
Biodiversity and wildlife		
Natura 2000 sites affected	0	0
SSSIs directly affected	0	0
Habitats of Principal Importance directly affected	7	7
Ancient Woodlands directly affected	1	1
Water resources and flood risk		
Major rivers diverted	0	0
Route through Flood Zone 3 (km)	2.4	2.4
Cutting or tunnel through SPZ (km)	0.4	0.2

⁵ For cultural heritage, direct effects refer to physical effects by partial or total demolition or by landtake.

	Consultation scheme	Preferred scheme
Land use resource		
Active landfills crossed	0	0
Grade 1 (and 2) agricultural land (km)	0 (9.9)	0 (9.9)
Excavated materials and material use		
Excavated material (million cubic metres)	7.1	4.2
Concrete (thousand tonnes)	680	630
Steel (thousand tonnes)	100	100



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