In Parliament – Session 2021 - 2022

HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix CT-003-00000

Cross-topic

Alternatives report

M97

HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix CT-003-00000

Cross-topic

Alternatives report

M97

Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

High Speed Two (HS2) Limited
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA

Telephone: 08081 434 434

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

A report prepared for High Speed Two (HS2) Limited:

ARUP+ ERM | FOSTER + PARTNERS | JACOBS
RAMBOLL | TYPSA | COSTAIN

MWJV
Mott MacDonald | WSP

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact High Speed Two (HS2) Limited.

recycle

Printed in Great Britain on paper containing 100% recycled fibre.

Contents

Figures

1 Introduction

1.1 Introduction to High Speed Two

1.1.1 High Speed Two (HS2) is a new high speed railway proposed by the Government to connect major cities in Britain. It will transform intercity and long distance passenger rail travel in the UK, providing the first major increase in intercity rail capacity for over a century and freeing up substantial capacity for rail travel and freight on the conventional rail network. London, Birmingham, Manchester and cities in the Midlands, the North and Scotland will be served by high speed trains running at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph)) on HS2 lines and on the existing conventional rail network. As part of the Proposed Scheme, new stations will be built at Manchester Piccadilly and Manchester Airport in addition to the stations in London and the West Midlands included in HS2 Phase One.

1.1.2 In January 2012, following a consultation exercise, the Government announced its intention to develop a Y-shaped high speed rail network, which would be brought forward in two phases. The 2012 decision confirmed the Government's preferred route for a high speed line between London and the West Midlands, called Phase One. In November 2013, HS2 Ltd deposited a hybrid Bill in Parliament to seek powers for the construction and operation of Phase One. The High Speed Rail (London – West Midlands) Act received Royal Assent in February 2017 with main works commencing in April 2020. Phase One will have a staged opening between 2029 and 2033.

1.1.3 In January 2013, the Government announced its initial preferred route for Phase Two between the West Midlands, Leeds and Manchester. Following some minor amendments, the proposed route was subject to a seven-month public consultation from July 2013 until January 2014.

1.1.4 In two reports, HS2 Plus[1] and Rebalancing Britain[2], the then HS2 Ltd Chairman, Sir David Higgins, recommended accelerating the section of the Phase Two route between the West Midlands and Crewe to deliver some of the benefits that HS2 will bring to the region and the north of England and Scotland sooner. In the November 2015 Command Paper High Speed Two: East and West: The next steps to Crewe and beyond[3], the Government announced its

[1] High Speed Two Ltd (2014), *HS2 Plus – A report by David Higgins*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374695/HS2_Plus_-_A_report_by_David_Higgins.pdf.

[2] High Speed Two Ltd (2014), *Rebalancing Britain – From HS2 towards a national transport strategy*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374709/Rebalancing_Britain_-_From_HS2_towards_a_national_transport_strategy.pdf.

[3] Department for Transport (2015), *High Speed Two: East and West: The next steps to Crewe and beyond November 2015*. Cm 9157. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480712/hs2-east-and-west.pdf.

intention to bring forward the route between the West Midlands and Crewe, and set out the preferred line of route for what is known as Phase 2a. Phase 2a comprises the section of the route between the West Midlands and Crewe. The High Speed Rail (West Midlands – Crewe) Bill, together with an ES, was prepared for the Phase 2a proposals and deposited in Parliament in July 2017. The High Speed Rail (West Midlands – Crewe) Bill received Royal Assent in February 2021.

1.1.5 On 15 November 2016 the Government set out the majority of its preferred route[4] between Crewe and Manchester and between the West Midlands and Leeds, referred to as the full Phase 2b scheme and to complete what was referred to as the 'Y network'. Alongside the preferred route of the full Phase 2b scheme, the Government also announced a consultation on seven route refinement areas.

1.1.6 On 17 July 2017, the Government announced a decision on these refinements and confirmed the remainder of the preferred route for the full Phase 2b scheme. The full Phase 2b scheme announced comprised the route from:

- Crewe to Manchester (approximately 85km (52 miles) in length), with a connection onto the West Coast Main Line (WCML) (referred to as the 'Phase 2b Western Leg'); and
- the West Midlands to Leeds via the East Midlands and South Yorkshire (referred to as the 'Phase 2b Eastern Leg'). The Phase 2b Eastern Leg is not the subject of this Bill and this ES.

1.1.7 On 11 October 2018, HS2 Ltd launched two parallel consultations on the working draft ES and the working draft Equality Impact Assessment (EQIA) Report for the full Phase 2b scheme (including both Eastern Leg and Western Leg).

1.1.8 On 6 June 2019, the Government launched a national consultation on 11 proposed design refinements to the full Phase 2b scheme. These refinements included proposed infrastructure for HS2 to accommodate future potential Northern Powerhouse Rail (NPR) services.

1.1.9 In August 2019, the Government announced that Douglas Oakervee would chair an independent review of HS2, referred to as the 'Oakervee Review'. The review was asked to assemble and test all the existing evidence in order to allow the Government to make properly informed decisions on the future of all phases of the HS2 project.

1.1.10 The Oakervee Review, published on 11 February 2020[5], concluded that the HS2 project should proceed, based on a number of recommendations. These included the need for

[4] Department for Transport (2016), *High Speed Two: From Crewe to Manchester, the West Midlands to Leeds and beyond*. Cm 9355, November 2016. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568208/high-speed-two-crewe-manchester-west-midlands-leeds-web-version.pdf.

[5] Oakervee, D, (2020), *Oakervee review of HS2.* February 2020. Available online at: https://www.gov.uk/government/publications/oakervee-review-of-hs2.

Phase 2b to be considered as part of an Integrated Rail Plan (IRP) for the North and Midlands and for the full Phase 2b scheme be split into smaller sections.

1.1.11 In February 2020 the Government recommitted to providing better rail connectivity between London, the Midlands and the North, ensuring all parts of the country benefit from opportunities for economic development and prosperity. The Government committed to preparing an IRP (including consideration of the Eastern and Western Legs), informed by a 'Rail Needs Assessment' undertaken by the National Infrastructure Commission (NIC).

1.1.12 At that time the Government also announced[6] its decision to proceed with the legislation to allow for the development of the Phase 2b Western Leg (the Proposed Scheme) separately and that, subject to the IRP, the full Phase 2b scheme could be legislated for in two or more hybrid Bills. This ensured work on the HS2 project continued whilst the IRP was being developed, to minimise delay. Figure 1 shows the HS2 network and the Crewe Northern Connection.

1.1.13 The IRP was published in late 2021[7]. In terms of the Proposed Scheme, the IRP confirmed that the HS2 Crewe – Manchester hybrid Bill should proceed to deposit in Parliament. The outcomes will be taken into account in the on-going development of the Proposed Scheme.

1.1.14 The conclusions of the IRP will be taken into account in the on-going development of the Western Leg Proposed Scheme.

1.1.15 The Proposed Scheme comprises:

- the HS2 Western Leg from Crewe to Manchester, including:
  - new stations at Manchester Airport and Manchester Piccadilly;
  - a depot north of Crewe;
  - maintenance facilities north of Crewe and at Ashley; and
  - a connection onto the WCML near Bamfurlong;
- the Crewe Northern Connection, connecting the route of the Proposed Scheme with the WCML and enabling future NPR services to connect with HS2;
- provision for the NPR London to Liverpool, Manchester to Liverpool, and Manchester to Leeds junctions, to enable these future NPR routes to connect with HS2; and
- a number of works at locations beyond the Western Leg route corridor, referred to as 'off-route works' which include:
  - works to enable HS2 trains to call at existing stations further north on the WCML; and

[6] Department for Transport (2020), *Terms of reference for an integrated rail plan for the north and midlands*. Available online at: https://www.gov.uk/government/publications/high-speed-north-an-integrated-rail-plan-for-the-north-and-midlands-terms-of-reference/terms-of-reference-for-an-integrated-rail-plan-for-the-north-and-midlands.

[7] Department for Transport (2021), *Integrated Rail Plan for the North and Midlands*. Available online at: https://www.gov.uk/government/publications/integrated-rail-plan-for-the-north-and-the-midlands.

- construction of depots to provide overnight stabling for HS2 trains serving the north of England and Scotland.

1.1.16 On 7 October 2020, the Government provided a Western Leg route-wide update and launched a national consultation on four further proposed design refinements that were relevant to the Phase 2b Western Leg. This included changes to allow the HS2 route to be used by future NPR trains to link cities across the North of England.

1.1.17 The NIC published the Rail Needs Assessment for the Midlands and the North in December 2020[8]. The NIC developed a menu of options for a programme of rail investments in the Midlands and the North, using three different illustrative budget options: focussing on upgrades (baseline budget only); prioritising regional rail links; and prioritising long distance links. The Proposed Scheme was included in the scope of all options.

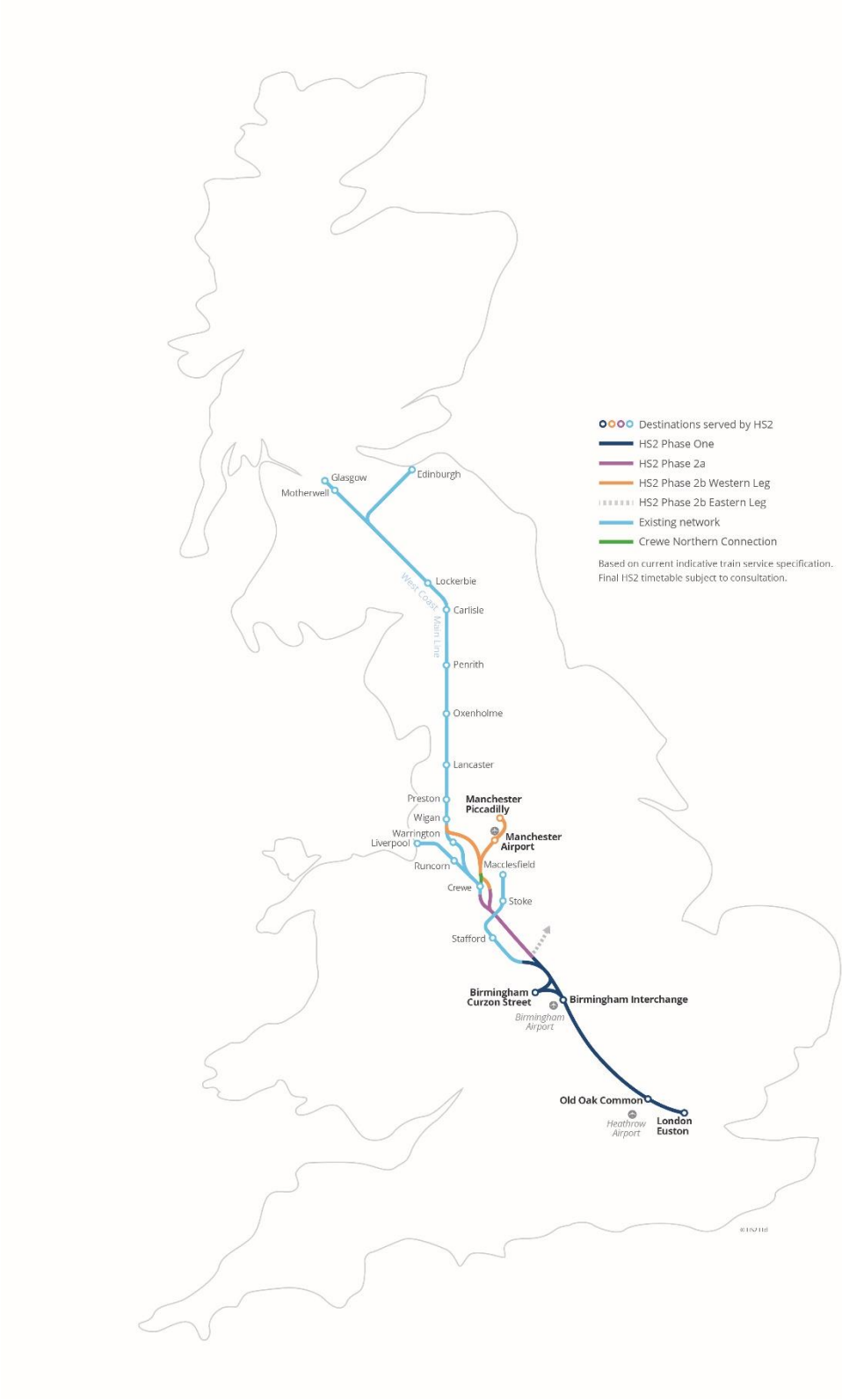
1.1.18 In June 2021 HS2 Ltd published a route wide update[9] of the Proposed Scheme and included the latest design proposals.

1.1.19 As announced by Government, the powers for the Proposed Scheme are being sought through a hybrid Bill named the High Speed Rail (Crewe - Manchester) Bill, with the aim of receiving Royal Assent at the end of 2024, construction assumed to commence in 2025, and operation assumed to start in 2038.

[8] National Infrastructure Commission (2020), *Rail Needs Assessment for Midlands and the North Final Report.* Available online at: https://nic.org.uk/app/uploads/RNA-Final-Report-15122020.pdf.

[9] HS2 route wide update (2021), Available online at: https://www.hs2.org.uk/what-is-hs2/phase-2b/.

Figure 1: The HS2 network and Crewe Northern Connection



1.2 Purpose of this report

1.2.1 The consideration of reasonable alternatives forms a statutory requirement of EIA reporting. The Town and Country Planning (Environmental Impact Assessment) Regulations 2017[10] require an ES to include:

'A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.'

1.2.2 Further, as part of a requirement of the Bill, Parliamentary Standing Order 27A[11] [12] requires:

'A report which identifies, describes and evaluates reasonable alternatives to the works authorised by the bill, taking into account the objectives and geographical scope of the bill.'

1.2.3 This report describes the evolution of the Proposed Scheme to date, summarising its objectives and requirements, and identifies the strategic alternatives, route-wide rail alternatives, reasonable route corridor alternatives and reasonable local alternatives to the main elements of the Proposed Scheme which have been studied. In each case, this report indicates the main reasons for selecting the chosen option over another, which ultimately resulted in the Proposed Scheme.

1.3 Structure of this report

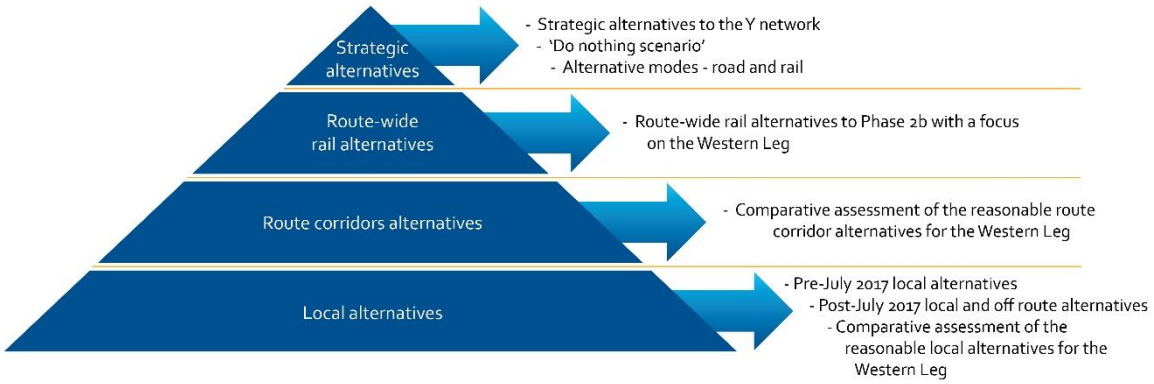
1.3.1 The reasonable alternatives studied by Government and HS2 Ltd are set out in accordance with the hierarchy shown in Figure 2.

[10] *The Town and Country Planning (Environmental Impact Assessment) Regulations 2017.* (S.I 2017 No. 571), London, Her Majesty's Stationery Office. Available online at: http://www.legislation.gov.uk/uksi/2017/571/pdfs/uksi_20170571_en.pdf.

[11] House of Commons (2019), *Standing Order 27A relating to private business (environmental assessment)* House of Commons. Available online at: https://www.parliament.uk/business/publications/commons/sessional-orders-private1/.

[12] House of Lords (2018), *Standing Orders - private Business*, House of Lords. Available online at: https://www.parliament.uk/documents/publications-records/House-of-Lords-Publications/Standing-Orders-Private/privord02.pdf.

Figure 2: Hierarchy of reasonable alternatives studied



1.3.2 Part I of this report presents a brief summary of the strategic alternatives to the high speed rail network (the Y network incorporating Phase One and Phase Two) that are outlined in more detail in the Phase One alternatives report (2013)[13]. Part I then discusses the reasonable strategic alternatives to the full Phase 2b scheme, including the consideration of a 'do nothing' scenario (i.e. not proceeding with the Proposed Scheme) and the strategic alternatives to the Proposed Scheme, including consideration of alternative modes of transport (i.e. road and air). The report then sets out the route-wide rail alternatives to the Proposed Scheme, including consideration of high speed and conventional rail options.

1.3.3 Part II of this report summarises the reasonable route corridor alternatives to the full Phase 2b scheme studied by Government and HS2 Ltd. The main reasons for the decisions taken on the preferred route presented for public consultation in 2013/2014, 2016/2017 and the Design Refinements Consultation in 2019 are set out, together with a comparison of environmental impacts.

1.3.4 Part III describes the reasonable local alternatives considered and the main reasons for the decisions taken before and after the announcement of the 2017 preferred route to Manchester and Leeds. This includes local alternatives arising from the Design Refinements Consultation process. Part III also presents a comparison of environmental impacts for the reasonable local alternatives.

1.3.5 The reasonable alternatives considered for the borrow pits, all located within the Wimboldsley to Lostock Gralam (MA02) area, are reported separately within Sections 5 and 6 in the detailed Borrow Pit Report (Volume 5: Appendix CT-008-00000).

[13] High Speed Two Ltd (2013), *High Speed Rail (London – West Midlands) Environmental Statement, Volume 5, Technical Appendices. Alternatives Report (CT-002-000).* Available online at: https://www.gov.uk/government/publications/hs2-phase-one-environmental-statement-volume-5-alternatives-report.

Part I

2 Strategic alternatives

2.1 Strategic alternatives to high speed rail previously studied

2.1.1 The Government concluded that action is needed to meet the future travel needs of Britain and 'doing nothing' is not an option. The Government's case for HS2 is set out in Volume 1, Introduction and methodology, Section 2.

2.1.2 Before deciding to proceed with HS2, a wide range of options to address Britain's inter-urban transport challenges were reviewed. These included domestic aviation, new motorways, a new conventional speed railway as well as upgrades to existing roads and conventional lines.

2.1.3 The potential for capacity upgrades to the existing conventional rail network was explored. The Government rejected this option as further upgrades would not provide the scale of capacity increase and connectivity needed to fulfil the Government's objectives[14]. This would also fail to meet Government objectives for future performance of the conventional rail network and would cause considerable disruption to existing train services during construction.

2.1.4 High speed rail has some of the lowest carbon emissions of any intercity transport option. The capacity of London's airports is limited and providing for future growth in international travel will be a significant challenge on its own without factoring in the need to serve additional demand for domestic air services. HS2 will provide a low carbon alternative for passengers and increase and spread capacity demand for domestic journeys.

2.1.5 The Government decided not to give further consideration to major new motorways as an alternative to HS2. This is because high speed rail is preferable in terms of increasing capacity, connectivity and sustainability of intercity travel, while decreasing journey times and providing carbon free services as a significant part of a zero carbon multimodal transport network.

2.1.6 The cost of a new conventional speed railway would be almost as high as that of high speed rail without delivering the reduced journey times and would have only marginally fewer environmental impacts. For these reasons, a new conventional railway option was rejected.

[14] Department for Transport (2017), *High Speed Two, Phase Two Strategic Case.* Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/629393/high-speed-two-phase-two-strategic-case.pdf.

2.1.7 Prior to the introduction of the Phase One hybrid Bill into Parliament in November 2013, the Government considered and reported on alternative configurations of the high speed rail network. The Government's conclusion and reasons for promoting the Y network were reported in the Command Paper, High Speed Rail: Investing in Britain's Future report (2012)[15] and subsequently in the Phase One alternatives report (2013) deposited in Parliament alongside the Phase One hybrid Bill. The Phase One hybrid Bill was enacted in February 2017 and construction works on Phase One have commenced.

2.2 Strategic alternatives to Phase 2b

Doing nothing

2.2.1 As referenced in Section 2.1 of this report, consideration of 'doing nothing' for the Y network is provided in the Phase One alternatives report (2013). For the Phase 2b Western Leg, the 'do nothing' scenario implies not delivering the Proposed Scheme between Crewe and Manchester, nor connections to the WCML. This scenario would therefore not provide:

- additional new rail network capacity to meet long term rail demand (which will also enhance resilience and reliability);
- increased train services to key markets;
- reduced journey times;
- improved rail connectivity to the northern cities and Scotland, from and to, the West Midlands and London;
- the ability for other strategic transport investment programmes, including NPR and Crewe Hub, to realise ambitions to deliver improved connectivity, reduced journey times, greater capacity and reliability on train services between the cities of the North and the West Midlands;
- support for economic growth in the West Midlands and the North; and
- a vital contribution to the UK's environmental targets.

2.2.2 The Government concluded that action is required to meet the forecast demand for inter-city travel, to reduce crowding, to address the growing rail congestion on Britain's inter-city rail network, to support economic growth and environmental targets. 'Doing nothing' is therefore not considered an option.

Alternative modes – air or road

2.2.3 The Government considers that the medium and long term trajectory of the predicted growth in rail travel will create a need over the next 20 to 30 years for additional capacity to

[15] Department for Transport (2012), *High Speed Rail: Investing in Britain's Future – Decisions and Next Steps*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3648/hs2-decisions-and-next-steps.pdf.

cater for inter-city journeys between London and the major cities in the Midlands, the north of England and Scotland. It does not, however, believe transferring rail demand to road or domestic aviation to be an appropriate solution. Rather than building additional roads or airports, the Government considers that it is the rail network which needs to be in a position to play the lead role in delivering new capacity and that a clear case exists for this new capacity to be a new high speed rail network. HS2 will be capable of operating carbon free services as a significant part of a zero carbon multimodal transport network.

3 Route-wide rail alternatives

3.1 Background

3.1.1 In line with the requirements of the HM Treasury Green Book[16], the DfT considered alternatives to the full Phase 2b scheme throughout its development to ensure the case for it is robust. As part of the development of a strategic outline business case for Phase 2b, the DfT commissioned a series of reports to develop and appraise potential route-wide rail alternatives.

3.1.2 The Phase 2b strategic alternatives report (2016)[17] for the full Phase 2b scheme, was completed by Atkins in November 2016, and updated previous work completed on route-wide rail alternatives by Atkins in 2013[18], taking account of design updates including the decision by Government to deliver Phase 2a ahead of the remainder of Phase Two. The report identified upgrades to existing rail infrastructure as alternatives and analysed how these would perform compared to the full Phase 2b scheme infrastructure and train services.

3.1.3 The DfT specified that the appraisal of rail alternatives be undertaken against the Government's strategic objectives for HS2, and in particular, Phase 2b. In addition to the consideration of costs, the following was considered at high level:

- generation of additional network capacity that could be used for other future services;
- on train/seating capacity and crowding;
- reliability and punctuality;
- disruption during construction; and
- environmental impacts.

3.1.4 Within the scope of the remit above, the rail alternatives were required to represent a range of costs and solutions.

3.1.5 Following the Oakervee Review and the subsequent announcement by Government in February 2020 for a Phase 2b Western Leg Bill, the DfT commissioned Mott MacDonald to undertake a study to identify potential route-wide rail alternatives to the Phase 2b Western

[16] HM Treasury (2020), *The Green Book: Appraisal and Evaluation in Central Government*. Available online at: http://webarchive.nationalarchives.gov.uk/20080305121602/http://www.hm-treasury.gov.uk/media/3/F/green_book_260907.pdf.

[17] Atkins (2016), *Strategic Alternatives to HS2 Phase 2b. A report for the Department for Transport*. Available online at: https://www.gov.uk/government/publications/strategic-alternatives-to-hs2-phase-2b.

[18] Atkins (2013), *HS2 Strategic Alternatives: Final Report*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253456/hs2-strategic-alternatives.pdf.

Leg.[19] This report builds on and updates the work completed on the Phase 2b Western Leg route-wide rail alternatives by Atkins in 2016 and additionally includes consideration of early stage engineering feasibility, indicative journey times and track capacity and indicative infrastructure costs.

3.2 Alternatives studied (2016)

Study assumptions

3.2.1 The 2016 study appraised the route-wide rail alternatives to the full Phase 2b scheme. To do this Atkins developed five options that all sought, to various degrees, to overcome capacity and journey time limitations on the WCML on the Western Leg of the route, and on the East Coast Main Line (ECML) and Midland Mainline (MML) on the Eastern Leg of the route. The options considered a range of different combinations of infrastructure upgrades to the existing conventional network and sections of new track to deliver improved journey times and similar train frequencies to the 2016 preferred route to Manchester and Leeds, as far as reasonably practicable. Design development by Network Rail on some rail schemes, including upgrades to the existing conventional rail network, were assumed to be 'committed' Government projects and taken into consideration. As such, the findings and conclusions summarised below are based on the conventional network at the time of the study, including any committed schemes.

3.2.2 A train service specification (TSS) was produced for the operation of the route-wide rail alternatives, as considered in the Phase 2b strategic alternatives report, which delivered a comparable level of connectivity to the proposed full Phase 2b scheme TSS. This allowed a consistent approach between the route-wide rail alternatives and the methodology applied to the Phase 2b Western Leg[20].

3.2.3 On the Western Leg to Manchester, it was assumed that Phase 2a will have been built. As a result, the sections of the route-wide rail alternatives proposed as alternatives to the Phase 2b Western Leg were constrained to a single, similar option along the WCML north of Crewe. Train services from Birmingham could only be accommodated at Manchester Victoria Station, not Manchester Piccadilly Station. It was necessary to utilise Manchester Victoria Station to deliver sufficient capacity and to provide the same number of services as the full Phase 2b service pattern, which could not otherwise be accommodated on the approach to, or at, Manchester Piccadilly Station.

[19] Mott MacDonald, (2021), Strategic Alternatives to High Speed 2 Phase 2b, West Coast Main Line, Final Report. Pending publication.

[20] Following the route-wide rail alternatives options study completed by Atkins in 2016, the Phase 2b service pattern was revised. The service pattern produced for the route-wide rail alternatives is considered not to be materially affected by the revision to the Phase 2b service pattern. As a result, the route-wide rail alternatives options can be compared to both the 2016 preferred route to Manchester and Leeds and the Proposed Scheme.

3.2.4 The 2016 study also included route-wide rail alternatives for the Phase 2b Eastern Leg to Leeds. For completeness this is summarised briefly here but the Phase 2b Eastern Leg is not the subject of this Bill and this ES. Atkins concluded that all the route-wide rail alternatives would have required a new section of high speed line from Phase One to the Birmingham to Derby Railway, which would have needed to be electrified and upgraded. All the alternatives in the study would have served the East Midlands via Derby and Nottingham. The study set out a number of different ways of reaching Nottingham, Leeds and Edinburgh via upgrades to the existing conventional lines, all of which would have served Sheffield Midland Station via existing line upgrades. The study also included a high level environmental appraisal.

3.2.5 The route-wide rail alternatives were discussed and agreed at a series of workshops with the DfT, Network Rail and HS2 Ltd. High level analysis of the journey times, costs, capacity and disruption was undertaken for the different options. The analysis used models and methodologies similar to those used for analysis of the 2016 preferred route to Manchester and Leeds as far as practicable, acknowledging that the route-wide rail alternatives were comparatively less developed. The route-wide rail alternatives were compared to the 2016 preferred route to Manchester and Leeds and a 'do minimum' (Phase 2a) scenario[21].

Options description

3.2.6 As part of the route-wide rail alternatives to the full Phase 2b scheme considered by Atkins in 2016, five options (Option 1, Option 2S, Option 2L, Option 3 and Option 4) were developed and assessed, which comprised various infrastructure upgrades and interventions. For the Eastern Leg to Leeds, the five options reflected the different ways of reaching Nottingham, Leeds and Edinburgh, whereas for the Western Leg to Manchester, one single option was considered based on infrastructure upgrades to the WCML north of Crewe, with slight TSS variations to take into account the options considered for the Eastern Leg to Leeds. Option 1 was based on upgrading the ECML and elements of WCML, whilst Options 2 to 4 were based on constructing a section of high speed line between Sheffield and Leeds, with Option 2S and Option 2L representing different lengths of high speed line.

3.2.7 A summary of the five options to the Phase 2b Western Leg is provided below. Further details on these options are given in the Phase 2b strategic alternatives report (2016).

[21] The 'do nothing' scenario provides a model for the operation of train services from 2033 assuming the Proposed Scheme does not go ahead and provides a reference against which the 'do something' options can be compared. The 'do minimum' operational train timetable assumptions are based on future committed schemes only and assumes that Phase One and Phase 2a will have been built.

High Speed Two Ltd (2016), *HS2 Phase Two Assumptions Report: PLANET Framework Model version 6.1c*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/574740/Planet_Framework_Model_Assumptions_Report.pdf.

Option 1

3.2.8 Option 1 would require upgrades to the WCML north of Crewe and would provide (as would Option 4) one additional service to Manchester relative to Options 2S, 2L and 3. The key elements of this option, relevant to the Phase 2b Western Leg, are summarised as follows:

- partial four tracking of the Crewe (Wilmslow) – Weaver Junction on the WCML and provision of an alternative freight route via Sandbach;
- substantial grade separation between Crewe and Preston on the WCML and some platform lengthening so trains can split and join at both stations; and
- a chord from Phase One that would allow two trains per hour to connect with the WCML Stoke branch via Stone to Manchester Piccadilly Station.

Option 2S and Option 2L

3.2.9 Like Option 1, both Options 2S and 2L Western Leg train services would run along the WCML, although the Stoke via Stone chord would not be required as only one conventional train per hour would operate via Stoke between Manchester and London Euston Station. The WCML services would broadly match the TSS at the time of the study, albeit at a lower speed and sometimes with less capacity per train.

Option 3

3.2.10 Option 3 would require the least upgrades to the existing conventional network when compared to the other route-wide rail alternatives. It would be the same as Option 2S except that Edinburgh, like Glasgow, would be reached via a joint service from London Euston Station, as per the TSS at the time of the study, except the WCML would be joined north of Crewe.

Option 4

3.2.11 Option 4 was the same as Option 2S.

Appraisal of alternatives

Journey times

3.2.12 The route-wide rail alternatives would deliver substantially faster journey times than the 'do minimum' (with Phase 2a) scenario to many of the key destinations included within the study. However, the Phase 2b Western Leg would offer the fastest journey times between London and Manchester. The differences in journey times to other destinations such as Edinburgh and Glasgow were less pronounced. To compensate for slower running speeds, the route-wide rail alternatives would rely on changes to the stopping pattern and/or the

removal of splitting and joining[22] of high speed services. The Phase 2b Western Leg would deliver substantially faster journey times between cities in the North and the Midlands compared to existing journey times. The route-wide rail alternatives would not match this connectivity and the longer journey times would not meet the Government's strategic objectives for HS2 to the same extent in terms of the level of economic benefits that the Phase 2b Western Leg would bring.

Additional network capacity

3.2.13 In most cases, 'spare' network capacity would be generated where the route-wide rail alternatives provide upgrades or infrastructure to facilitate the running of extra trains or line speed improvements. In addition, the route-wide rail alternatives would provide a short freight route on the WCML which would release further capacity. In comparison, the Phase 2b Western Leg would generate 'spare' capacity both on its own high speed network and on the conventional network. This is because the number of conventional trains on existing intercity routes would be fewer than is currently run, as services switch to using the high speed line.

3.2.14 In summary, therefore, both the Phase 2b Western Leg and the route-wide rail alternatives would create extra capacity on the national conventional rail network for other services. However, only the Phase 2b Western Leg would create extra capacity for potential additional high speed services north of Birmingham and would therefore better meet the Government's strategic objectives for HS2.

Train seating capacity and crowding

3.2.15 The route-wide rail alternatives would provide more train seating than the 'do minimum' scenario, but fewer seats than the Phase 2b Western Leg to some key destination cities.

3.2.16 The Phase 2b Western Leg would, operate significantly longer trains (400m in length) than the route-wide rail alternatives to Manchester and therefore would provide more seating overall to this destination.

3.2.17 In order to provide extra capacity, further infrastructure investment would be required to lengthen trains running on the route-wide rail alternative options, although it would be possible to run 260m trains on certain sections of the alternative rail options. The Phase 2b Western Leg would operate shorter trains (200m long) than the route-wide rail alternatives to destinations including Liverpool, Glasgow and Edinburgh.

Reliability and punctuality

3.2.18 Network resilience would be less for the route-wide rail alternatives than for the Phase 2b Western Leg because the route-wide rail alternatives would require greater use of the

[22] A splitting train separates into two trains partway along its route, so as to serve two destinations. The services will usually 'join' on the return journey.

existing rail network. The Phase 2b Western Leg would have new high speed lines designed and built to modern standards of resilience.

3.2.19 No benefits were identified for the punctuality and reliability on the existing conventional network from infrastructure investment proposed for the route-wide rail alternatives or from the released capacity generated by the Phase 2b Western Leg for new train paths on the congested WCML. Further, no benefits were identified for any increase or reduction in the splitting or joining of services. The route-wide rail alternatives would typically be less punctual and less reliable than the Phase 2b Western Leg as the alternative rail options would increase the number of trains per hour from London and Birmingham in each direction from Phase One and Phase 2a and onto the conventional network.

Disruption

3.2.20 Network Rail undertook an assessment of the disruption impact of constructing the route-wide rail alternatives and, in summary, concluded that across the existing conventional network, the route-wide rail alternatives would each require between approximately 710 and 725 week night closures and some potential weekend closures.

3.2.21 Overall, no route-wide rail alternative was identified that would not be substantially disruptive. However, the total disruption impact associated with the construction of the route-wide rail alternatives would not necessarily make them undeliverable. The cost of disruption and compensation were taken into account in the capital and operational expenditure forecasts for the route-wide rail alternatives.

Environmental impacts

3.2.22 A high level appraisal of environmental impacts was undertaken. The route-wide rail alternatives would be delivered primarily through upgrades and alterations to sections of the existing conventional network within, or adjacent to, existing railway land. As a result, the works to construct the different elements of the route-wide rail alternatives would not always require further land. The route-wide rail alternatives would therefore have fewer environmental impacts overall than the Phase 2b Western Leg.

3.2.23 The most notable works requiring land to construct the Phase 2b Western Leg route-wide rail alternatives related to the Stone to Phase One chord alternative. The high level environmental appraisal identified that the Stone to Phase One chord (Options 1 and 4), while avoiding the Pasturefields Salt Marsh Special Area of Conservation (SAC)/Site of Special Scientific Interest (SSSI), may have an adverse impact on the complex water table in the area.

Conclusions

3.2.24 Compared with the conventional network at the time of the study by Atkins in 2016, the route-wide rail alternatives could provide significant improvements in journey times. However, the Phase 2b Western Leg would deliver substantially faster journey times between cities in the North and the Midlands, which could not be matched by the route-wide

rail alternatives. As a result, the route-wide rail alternatives would not meet the Government's strategic objectives for HS2 to the same extent in terms of the level of economic benefits that the Phase 2b Western Leg would bring.

3.2.25 Additional network capacity would be generated by the route-wide rail alternatives where infrastructure or upgrades would be provided to facilitate the running of extra trains or line speed improvements and through the extension of freight routes. The Phase 2b Western Leg would, however, generate substantially greater capacity both on the high speed line and also on the conventional network and would therefore better meet the Government's strategic objectives.

3.2.26 The route-wide rail alternatives would change the service offered and the frequency of destinations served and therefore either could approximately meet or slightly exceed the train frequencies of the Phase 2b Western Leg. However, in total the Phase 2b Western Leg would operate substantially longer trains (400m in length) than the route-wide rail alternatives to key destinations and would therefore provide more seating overall to these destinations, thus better meeting the Government's strategic objectives.

3.2.27 The route-wide rail alternatives would require substantially fewer new lines to be constructed compared to the Phase 2b Western Leg, however, as a result, network resilience would be less for the route-wide rail alternatives because the Phase 2b Western Leg would be built to a higher resilience standard than existing conventional lines. The route-wide rail alternatives would typically be less punctual and less reliable than the Phase 2b Western Leg and would increase the number of trains per hour from London and Birmingham in each direction to use the existing conventional network. The route-wide rail alternatives would not meet the Government's strategic objectives for HS2 in regard to punctuality and reliability.

3.2.28 The route-wide rail alternatives would be delivered primarily through upgrades and alterations to specific sections of the existing conventional network, within or adjacent to, existing railway land. The route-wide rail alternatives would therefore have fewer environmental impacts overall than the Phase 2b Western Leg.

3.2.29 Overall, the effectiveness of the different sections of the route-wide rail alternatives as alternatives to the Phase 2b Western Leg varied. On the alternative route to the Phase 2b Western Leg, which utilised the WCML for all the route-wide rail alternatives, no other conventional network alternative was identified that could connect to Manchester Piccadilly Station that would not be substantially disruptive to the existing conventional network. It would be difficult to increase train speeds sufficiently for the route-wide rail alternatives along the WCML. Train services for the route-wide rail alternatives from Birmingham could only be accommodated at Manchester Victoria Station and not Manchester Piccadilly Station. The alternatives relied on using the existing routes into Manchester, which are highly capacity constrained and would not offer the levels of reliability that HS2 passengers might reasonably expect.

3.2.30 Although not a factor for consideration at the time of the appraisal in 2016, Midlands Connect and Transport for the North (TfN) propose to use additional capacity created by the

full Phase 2b scheme as a first step to transforming and connecting the economies of the Midlands and the North. This would rely, in particular, on some sections of the Phase 2b Western Leg that would not be built as part of the route-wide rail alternatives. It follows, therefore, that the aspirations of Midlands Connect and TfN would likely cost more and be more disruptive or difficult to achieve utilising the route-wide rail alternatives.

3.2.31 In conclusion, the study identified that there is no route-wide rail alternative that could deliver the same level of benefit for Britain, stand the test of time and provide the same level of capacity, connectivity and service that the Phase 2b Western Leg would in pursuit of the Government's strategic objectives for HS2. As these alternatives did not meet these strategic objectives, they were not taken forward. Consequently, the Phase 2b Western Leg emerged as the preferred scheme as it best meets the Government's strategic objectives.

3.3 Alternatives studied (2021)

Study assumptions

3.3.1 Following the Oakervee Review and the subsequent announcement by Government in February 2020 for the High Speed Rail (Crewe – Manchester) Bill, Mott MacDonald developed two groups of route-wide rail options that sought, to various degrees, to overcome capacity and journey time limitations on the WCML. This work took into consideration the options and findings of the previous work undertaken by Atkins in 2016 and considered a range of different combinations of infrastructure upgrades to the existing conventional network to deliver improved journey times, service frequency and capacity, similar to the 2013 confirmed route for the Proposed Scheme.

3.3.2 A TSS was produced for the operation of the Western Leg route-wide rail alternative which would deliver a comparable level of connectivity to the proposed Phase 2b Western Leg TSS. This allowed a consistent approach between the route-wide rail alternatives and the methodology applied to the Phase 2b Western Leg.

3.3.3 As for the Atkins 2016 study, for the alternatives to the Phase 2b Western Leg, it was assumed that Phase 2a will have been built and as a result, the route-wide rail alternatives were focused on a single, similar option along the WCML north of Crewe.

3.3.4 The study did not consider connection to NPR, a third party scheme, which would rely on the passive provision for junctions to connect to sections of the Proposed Scheme.

Options description

3.3.5 Two groups of Western Leg route-wide rail alternatives capable of delivering the Phase 2b Western Leg TSS, and comprising various infrastructure upgrades and interventions to existing rail infrastructure, were considered as follows:

- alternatives to the Phase 2b Western Leg between Knutsford and Golborne (also referred to as the Golborne link); and

- alternatives to the Phase 2b Western Leg between Crewe and Manchester.

3.3.6 The alternatives to the route between Knutsford and Golborne would all require substantial upgrades to the WCML north of Crewe. The alternatives to the route between Crewe and Manchester would require substantial upgrades of the WCML into Manchester Piccadilly station and would not provide train services to Manchester Airport.

Alternatives to the Knutsford to Golborne alignment

3.3.7 Four rail alternatives to the Knutsford to Golborne alignment were appraised that would differ in terms of likely service punctuality/resilience, construction complexity, cost and environmental impacts. These can be summarised as:

- Option A1: Crewe to Weaver Junction south section (between Crewe and Hartford) four-tracking;
- Option A2: Crewe to Weaver Junction north section (between Hartford and Weaver Junction) four-tracking, together with a doubling of sections of the Middlewich Line and the provision of a Northwich Line to WCML down chord to accommodate freight traffic;
- Option A3: combined WCML south and north sections four tracking between Crewe and Weaver Junction, and the provision of a Northwich Line-WCML down chord to accommodate freight traffic; and
- Option A4: Four tracking the WCML in full between Crewe and Weaver Junction, together with a Northwich Line-WCML down chord to accommodate freight traffic.

Alternatives to the Crewe to Manchester alignment

3.3.8 Two rail alternatives to the Phase 2b Western Leg between Crewe and Manchester were appraised that would differ in terms of likely service punctuality/resilience, construction complexity, cost and environmental impacts. Neither alternative would be able to serve Manchester Airport nor accommodate proposed NPR services. The alternatives can be summarised as:

- Option B1 - minimum package: provision of new platforms at Manchester Piccadilly Station, grade separation of Slade Lane Junction, and four tracking of the WCML between Goostrey Junction and Chelford Junction; and
- Option B2 - full package: all of the minimum package upgrades, plus grade separation of Heaton Norris and Edgely rail junctions, speed improvements to Cheedle Hulme Junction and extra platform capacity at Stockport Station.

Appraisal of alternatives

Journey times

3.3.9 The route-wide rail alternatives for the Knutsford to Golborne alignment would deliver substantially faster journey times than the 'do minimum' (with Phase 2a) scenario to

Edinburgh and Scotland, but a similar journey time to Preston, Wigan and Warrington. However, when the alternatives are compared to the Phase 2b Western Leg, the Phase 2b Western Leg would offer the fastest journey times to the aforementioned destinations.

3.3.10 The route-wide rail alternatives for the Crewe to Manchester alignment would deliver faster journey times than the 'do minimum' (with Phase 2a) scenario between Birmingham and Manchester Piccadilly, but a similar journey time between London and Manchester Piccadilly. When the alternatives are compared to the Phase 2b Western Leg, the Phase 2b Western Leg would offer the fastest journey times to the aforementioned destinations. The Phase 2b Western Leg would also serve a new station at Manchester Airport.

3.3.11 Overall, the route-wide rail alternatives would not meet the Government's strategic objectives for HS2 to the same extent that the Phase 2b Western Leg would bring in terms of journey time and economic benefits.

Additional network capacity

3.3.12 The route-wide alternatives to the Knutsford to Golborne alignment would not create significant additional network capacity. WCML capacity utilisation is related to the numbers of trains using a section of track. Between Crewe and Weaver Junction, for Options A1 to A2 which would have the least infrastructure upgrades and interventions, WCML capacity use would be higher than the Phase 2b Western Leg. By comparison, use of WCML capacity between Crewe and Weaver junction for Options A3 and A4 would be similar or slightly lower compared to the Phase 2b Western Leg because these options would include more infrastructure upgrades and interventions than Options A1 and A2.

3.3.13 The route-wide alternatives for the Crewe to Manchester alignment would also not create significant additional network capacity and therefore would also not support proposals currently being developed under the NPR programme without further substantial investment in Manchester stations and their approaches.

Train seating capacity and crowding

3.3.14 The route-wide rail alternatives to the Knutsford to Golborne alignment would deliver the same number of seats to Scotland as per the Phase 2b Western Leg. The route-wide rail alternatives for the Crewe to Manchester alignment would also deliver the same number of seats as the Phase 2b Western Leg into Manchester Piccadilly but would not serve Manchester Airport and its wider catchment. The study did not assess levels of crowding.

Reliability and punctuality

3.3.15 Network resilience would be less for all the route-wide rail alternatives compared to the Phase 2b Western Leg because the route-wide rail alternatives would require greater use of, and dependence on, the existing rail network. Train services may therefore be less reliable and punctual, and the opportunity to utilise released capacity for other purposes would be negligible.

3.3.16 For the Knutsford to Golborne alternatives, WCML capacity use between Crewe and Weaver Junction would be higher in Options A1 to A2 when compared to what they would be for the Phase 2b Western Leg, exacerbating reliability and punctuality risks. Whilst capacity utilisation would be similar or slightly less in Options A3 to A4, potential future growth of rail services on this corridor would be restricted without further intervention to avoid potential worsening of reliability and punctuality.

3.3.17 For the Crewe to Manchester alternatives, both the minimum and maximum intervention packages could give an overall improvement in punctuality/resilience versus the do-minimum scenario of HS2 Phase 2a, but would not be able to match the level of reliability and punctuality offered by the addition of the Phase 2b Western Leg.

Disruption

3.3.18 The Mott MacDonald 2021 study summarised high level construction works required for the Knutsford to Golborne alternatives and the potential for disruption to the existing rail network during construction. It identified that for those options requiring progressively greater upgrade works and associated possessions/blockades, construction complexity and the potential for disruption would be progressively greater. In summary:

- Option A1: would require a significant length of blockade (of at least four days), in addition to weekend/overnight possessions of the WCML between Crewe and Hartford;
- Option A2: would require a combination of weekend possessions, with likely one Bank holiday possession of the WCML between Hartford and Weaver junction. Sections of the Middlewich Line would be double tracked and require a line blockade to construct. Construction of a proposed Hartford Northwich-WCML down chord which would require several weekend and weeknight possessions to complete;
- Option A3: Would require a significant length of blockade (of at least four days), in addition to weekend/overnight possessions of the WCML between Crewe and Hartford. A combination of weekend possessions, likely including one bank holiday possession, would be required between Hartford and Weaver Junction. Construction of a proposed Hartford Northwich-WCML down chord which would require several weekend and weeknight possessions; and
- Option A4: full four tracking upgrade of the WCML between Crewe and Weaver Junction would require a bank holiday or Christmas possession together with weekend possessions, in addition to the blockades/possessions required for Option A3.

3.3.19 The report also summarised high level construction works required for the alternatives between Crewe and Manchester Piccadilly Station and the potential for disruption to the existing rail network during construction. In summary:

- Option B1 (minimum intervention package):
  - additional platforms at Manchester Piccadilly would disrupt existing rail services and require a Christmas blockade to construct;
  - grade separation of Slade Lane Junction would require an Easter blockade; and

  - upgrades between Goostrey Junction to Chelford Junction would require weekend possessions.
- Option B2 (full intervention package) – in addition to the works and associated possessions/blockades required for the minimum intervention package:
  - grade separation of Heaton Norris Junction would require an Easter blockade as well as other potential weeknight or weekend possessions;
  - upgrades to Stockport Station could require platform possessions, disrupting local rail service;
  - grade separation of Edgeley Junction would require a significant blockade of up to eight weeks; and
  - rail upgrades near Cheadle Hulme would require up to three unspecified possessions.

3.3.20 Overall, no route-wide rail alternative was identified on the Phase 2b Western Leg that would not be substantially more disruptive to the existing rail network when compared to the construction of the Phase 2b Western Leg. However, the total disruption impact associated with the construction of the route-wide rail alternatives would not necessarily make them undeliverable.

Environmental impacts

3.3.21 The following section provides an initial high level indication of the environmentally sensitive features and impacts, as identified by the Mott MacDonald 2021 study, which could potentially be affected by the route-wide rail alternatives.

Alternatives to the Knutsford to Golborne alignment

3.3.22 The potential impacts for individual sections of the route-wide rail alternatives between Knutsford and Golborne is summarised below. For all sections, there is potential for greater noise impacts on nearby residential properties due to changes in train services/frequencies and visual impacts due the loss of existing lineside vegetation/screening and the installation of new rail infrastructure including rail lines and modified footbridges.

3.3.23 The upgrades to sections of the WCML between Crewe and Hartford to four tracks as required for Options A1, A3 and A4, would require the installation of two additional tracks within the existing rail corridor. The Grade II listed Royal Vale Viaduct, which crosses the River Weaver, would require modification. The wider surrounding area has some sensitive features including Eaton Bank Wood and Hey's Wood, and the Bowl Barrow, which are designated as ancient woodlands. A scheduled monument is present (Bowl Barrow 160m north-east of Moultonbank Farm) located approximately 450m north of Moulton Farm Access Bridge. This section of the route-wide rail alternatives is also situated within Flood Zone 3.

3.3.24 The upgrades to the WCML between Hartford and Weaver Junction ('Crewe – Weaver Junction north section') to four-tracks, as required for Options A2 and A4, would require the

installation of two additional tracks and track extension works, within the existing rail corridor. The provision of new platforms on sections of the WCML between Hartford and Weaver Junction, including a new platform at Hartford Station would also be required within the existing rail corridor. These works may have an impact on the Grade II* listed Dutton Railway Viaduct, which passes over the River Weaver, a main river located within Flood Zone 3. The entire stretch of the WCML between Hartford and Weaver Junction is also located within the Liverpool, Manchester and West Yorkshire green belt. The wider surrounding area has multiple listed buildings, the nearest of which is the Grade II listed, Ash house, located approximately 70m southwest by Chapel Lane. Hazel Pear Wood is located approximately 80m northeast. Towards the northern extent of the works by Dutton Viaduct, there are two ancient woodlands (Park Brow and an unnamed ancient woodland), the closest of which is located approximately 250m north of Dutton Viaduct.

3.3.25 The upgrades to the Middlewich line, as required by Option A2, would require the installation of one additional track within part of the existing rail corridor. This option would cross three main rivers (Sanderson Brook, River Dane, Trent and Mersey Canal). The area surrounding the three watercourses are defined as Flood Zone 3. The wider surroundings have multiple listed buildings identified, the closest to the rail route is the Grade II Listed Murgatroyd Club, located approximately 100m southwest of the route. There are three scheduled monuments identified, the closest of which is Murgatroyd's Brine Works, located within 10m southwest of the route (southeast of Middlewich Town by Brooks Lane). There are five historical landfills located within 500m of the site, the closest of which is 'Land Off Cledford Lane' located within 10m southwest of the route (south of Middlewich). There is an authorised landfill present, Veolia ES (UK) Limited located approximately 300m west. The Cheshire East Air Quality Management Area (AQMA) would be located approximately 360m west (at Middlewich). Lastly, there is an unnamed ancient woodland present, located approximately 180m northeast of the route (northwest of Sandbach).

3.3.26 A new section of route, the Hartford to Northwich Down Chord, would be constructed for Options A2 and A4 as part of the route-wide rail alternatives works. This has potential to result in significant changes to the setting and visual amenity along the section of new route due to the presence of new infrastructure and potential disturbance to the Handforth Brook watercourse. There is also the potential for construction noise impacts to nearby residential properties such as the farm on Hodge Lane and impacts on pedestrians, cyclists and vehicles using Hodge Lane, who may experience disruption during the construction of the rail route. Two Grade II listed buildings were identified. These are the Barn 20 metres west of Hodge Lane Farmhouse and Hodge Lane Farmhouse, located approximately 60m and 80m east of the route respectively. The area located approximately 500m northwest of the route is designated as a Flood Zone 3.

Alternatives to the Crewe to Manchester alignment

3.3.27 The proposed route-wide rail alternatives between Crewe and Manchester would pass multiple rivers designated as main rivers. There are six listed buildings identified along the proposed route-wide rail alternatives. These are: the 1867 buildings at Crewe Railway

Station, Twemlow Viaduct, the Railway Boundary Post 7m east of Twemlow Viaduct, Railway Viaduct 200 metres west of Bate Mill House and the Eastern Railway Viaduct over the River Bollin (all which are Grade II listed), and also the Railway Viaduct (Grade II*) along with the Train Shed and Undercroft at Manchester Piccadilly Station (which are both Grade II listed). To the north of Goostrey Station, the route-wide rail alternatives would pass through the Liverpool, Manchester and West Yorkshire green belt. The route-wide rail alternatives would pass through multiple AQMA designations particularly as the route goes beyond Cheadle Hulme.

3.3.28 Within 500m of the proposed route-wide rail alternatives, there are multiple listed buildings identified, the closest would be the Grade II listed Wycliffe Congregational Hotel, located approximately 20m to the east (at Stockport). There are also four scheduled monuments identified within 500m, the closest of which would be 'Chorley Old Hall moated site and four fishponds', located within 350m west of the route-wide rail alternatives (north-east of Alderley Edge).

3.3.29 There are multiple historical landfills located within 500m of the route-wide rail alternatives, the closest of which is Adswood Road Civic Amenity Site located within 20m south-east (towards the north-east of Cheadle Hulme). There are two authorised landfill present, 3C Waste Ltd located approximately 10m north-west (towards the north of Crewe) and Biffa Waste Services, located 20m south-east of the route-wide rail alternatives (towards the north of Cheadle Hulme).

3.3.30 There are multiple AQMAs within 500m of the route-wide rail alternatives, these are situated in the urban areas of Crewe and Manchester.

Conclusions

3.3.31 The analysis completed by Mott MacDonald suggests that the Phase 2b Western Leg TSS service frequency could be delivered by the route-wide rail alternatives between Knutsford and Golborne through upgrades of the conventional network as an alternative to the Phase 2b Western Leg. Key service characteristics such as journey time, frequency and potentially punctuality would improve when compared to a 'do minimum' scenario (with Phase 2a but no Phase 2b Western Leg provision), but all of the benefits of constructing the Phase 2b Western Leg would not be provided, specifically:

- high speed journey times (e.g. London Euston - Glasgow Central) would be around 10 minutes slower; and
- WCML capacity utilisation between Crewe and Weaver junction would be higher for Options A1 and A2. However, train services may therefore be less punctual and the opportunity to utilise released capacity for other purposes would reduce. Whilst capacity utilisation would be similar or slightly less in Options A3 to A4, potential future growth of rail services on this corridor would be restricted without further intervention to avoid potential worsening of reliability and punctuality.

3.3.32 A major upgrade of the existing Crewe – Manchester Piccadilly rail corridor as part of the route-wide rail alternatives could deliver a comparable number of services to the Phase 2b Western Leg and an overall improvement in punctuality/resilience versus the do-minimum scenario where only HS2 Phase 2a is delivered. However, even with the maximum infrastructure specification these upgrades as part of the route-wide rail alternatives cannot deliver a number of the key benefits of the Phase 2b Western Leg, specifically:

- HS2 journey times to/from central Manchester would be around only three minutes faster than under Phase 2a, and therefore around 20 minutes slower than under the Phase 2b Western Leg;
- Manchester Airport and the wider catchment area would not be connected to the HS2 network;
- emerging plans for NPR, which would utilise platforms at Manchester Piccadilly High Speed Station, and the route of the Phase 2b Western Leg towards Crewe;
- the opportunity to make use of substantial released track capacity would be lost; and
- given the scale of some of the alternative interventions proposed along the WCML, disruption to existing rail services during construction may be greater than for the Phase 2b Western Leg.

3.3.33 While the route-wide rail alternatives and the Phase 2b Western Leg would provide similar levels of capacity and seating provision for services to Scotland and into Manchester Piccadilly, they would not however serve Manchester Airport and its wider catchment nor provide the capacity and seating provision to this area that the Phase 2b Western Leg would.

3.3.34 Overall, no route-wide rail alternative was identified to the Phase 2b Western Leg that would not be substantially disruptive. However, the total disruption impact associated with the construction of the route-wide rail alternatives would not necessarily make them undeliverable.

3.3.35 Environmental impacts associated with the construction of the route-wide rail alternatives would be less than for the Phase 2b Western Leg as the upgrade works would be undertaken mainly within the existing rail corridor.

Part II

4 Route corridor alternatives

4.1 Background

4.1.1 Part II of this report describes the development of the Phase 2b Western Leg since autumn 2010. This section describes the evolution of the Proposed Scheme and the reasonable route corridor alternatives that have been studied, focussing on the appraisal of sustainability process and sifting.

4.1.2 Consideration of sustainability (including environmental impacts) has been integral to the development of the Proposed Scheme throughout the appraisal process. Since the initial option development, HS2 Ltd has continued to develop route and station proposals that seek to avoid or reduce environmental and community impacts within the engineering and cost considerations of Phase 2b.

4.1.3 The proposed routes presented for public consultation in 2013/2014 and in 2016/2017 have emerged from many combinations of route options. The 2017 preferred route to Manchester, and subsequently the route that emerged from the design development and Design Refinement Consultation processes is, on balance, considered to best meet objectives for passenger demand, ease of construction, journey time, sustainability and cost.

4.2 Sifting of options

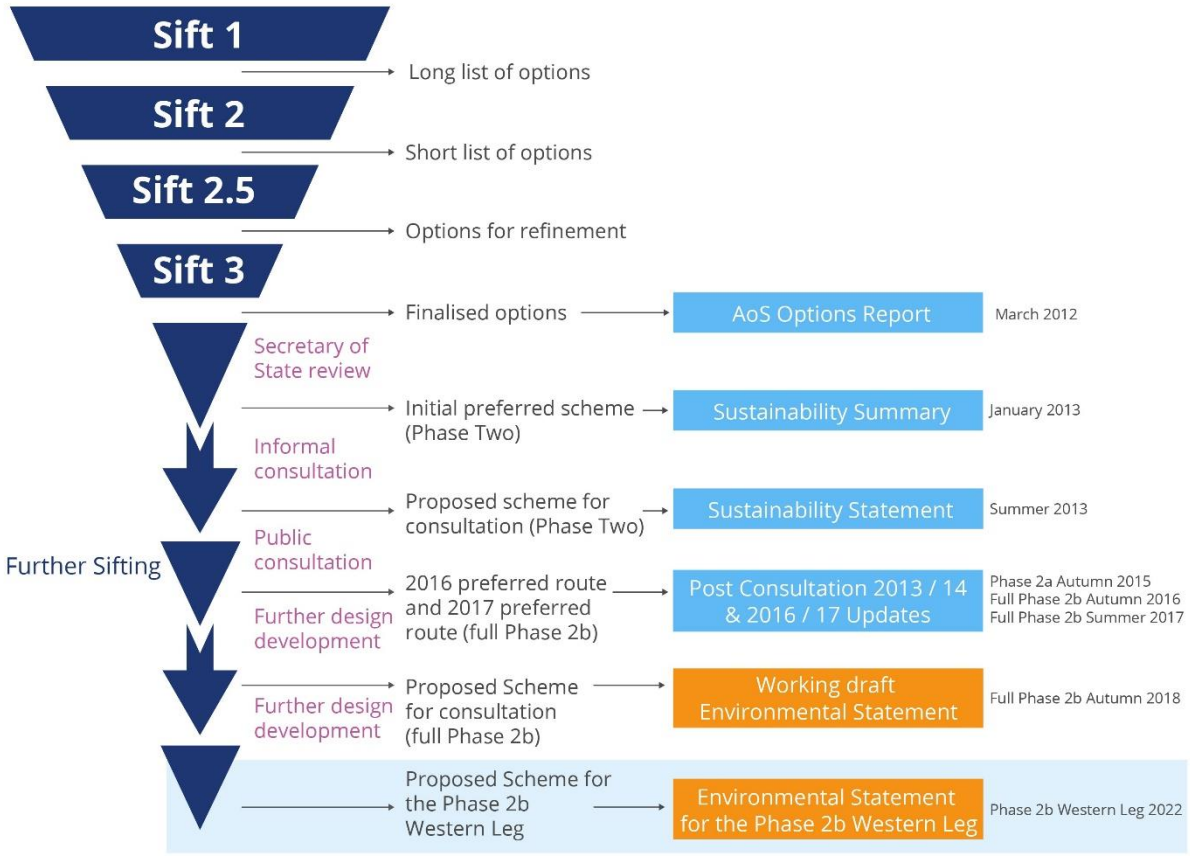
4.2.1 The Proposed Scheme has developed through a refinement process referred to as sifting. The sifting process consisted of a sequentially more detailed appraisal of route options. At the end of each appraisal stage or sift, sustainability performance was formally studied alongside other cost, operational and engineering information by HS2 Ltd, who identified preferred options for progression to the next level of design. The selected options were then subject to the next sift for more detailed appraisal.

4.2.2 As part of the appraisal of sustainability performance, the following environmental factors were considered: climatic factors and adaptability; greenhouse gases; landscape; townscape and cultural heritage; biodiversity and geodiversity; water resources; flood risk; air quality; noise and vibration; community integrity; accessibility; health and well-being; security and safety; economic prosperity; economic welfare; soil and land resources; waste generation; and resource use.

4.2.3 A summary of the sifting process and outputs is shown in Figure 3. The process started with a long list of potential options. The sequence of subsequent sifts was aimed at reducing the number of options under consideration (e.g. by avoiding centres of population and/or key environmental features). In the later sifts, the predicted impacts of the remaining options were further mitigated by refining the vertical and/or horizontal alignments and by

introducing certain structures, such as viaducts or cuttings with retained walls, where appropriate. In this way, the route development process has ensured that mitigation, so far as reasonably practicable, is inherent within the design from the outset.

Figure 3: The sifting process

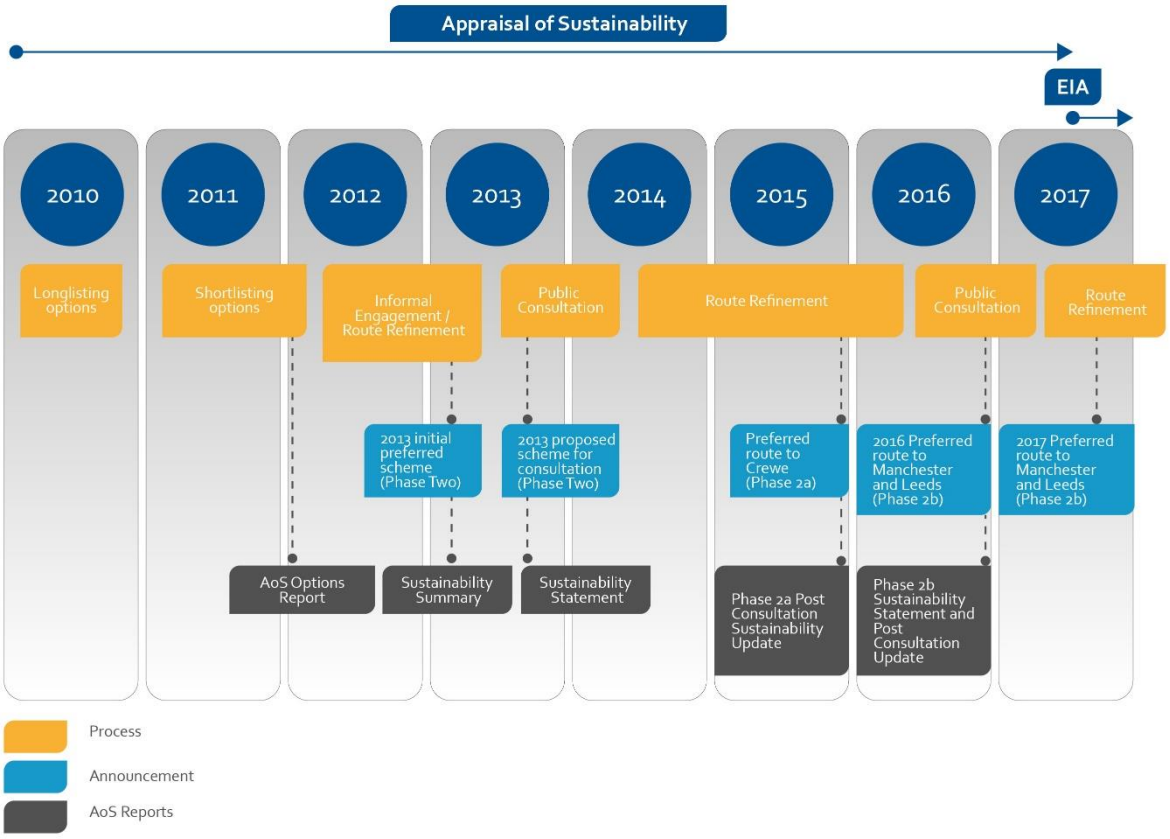


4.3 Route development

Overview

4.3.1 This section provides a summary of the key milestones of the sift process, consultation process and outputs produced as part of the development of alternatives and the preferred options over time, leading up to the EIA process for the Phase 2b Western Leg. This is illustrated by Figure 4. A summary of the development of the Phase 2b Western Leg is also provided.

Figure 4: Milestones and outputs from the appraisal of sustainability sifting process between 2010 and July 2017



Options for Phase Two of the high speed rail network (March 2012)

4.3.2 In January 2012, the Government announced its decision to deliver a new national high speed rail network and its preference for a Y-shaped configuration. The Options for Phase Two report (2012)[23] documents the first step in the development of Phase Two. The report sets out options and the refinement process undertaken for the routes between the West Midlands to Manchester and Leeds with stations in South Yorkshire and East Midlands and a direct high speed line serving a station at Heathrow. The report also describes options for serving cities beyond the network, with direct trains serving cities such as Liverpool, Newcastle, Glasgow and Edinburgh. The report provided the Government with choices for the future development of Phase Two and the underpinning evidence to facilitate future engagement and decision making.

[23] High Speed Two Ltd (2012), *Options for Phase Two of the high speed rail network.* A report to Government by HS2 Ltd. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/68965/options-for-phase-two-of-the-high-speed-rail-network.pdf.

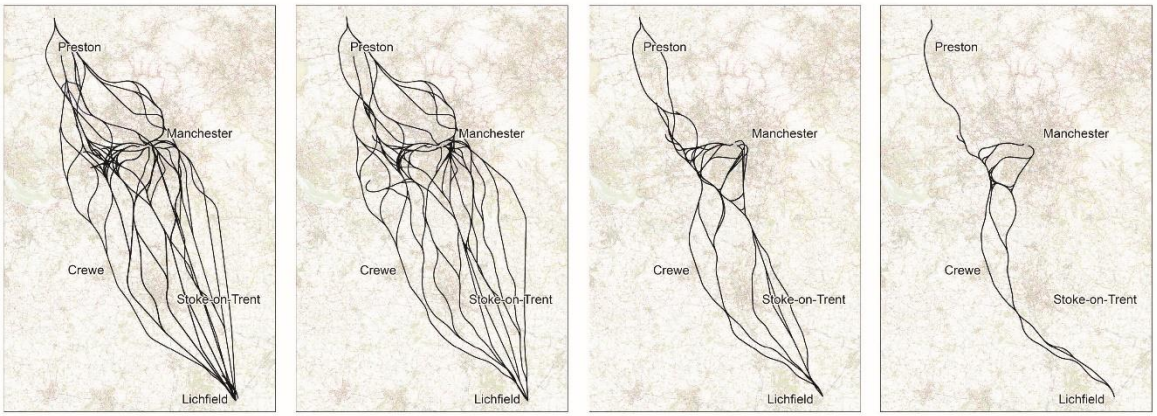
Appraisal of sustainability options report (March 2012)

4.3.3 Following the announcement of the Government's preference for a Y-shaped high speed rail configuration, further work was undertaken to investigate various route, station and depot options that could deliver the Western and Eastern Legs (i.e. Phase Two). A process of sifting (see Section 4.2) was utilised to refine a long list of options and route combinations. The evolution of the options for the Phase 2b Western Leg is shown in Figure 5.

4.3.4 The initial route options appraisal for the Phase 2b Western Leg focussed on the sifting of route corridors from the West Midlands (connecting with Phase One near Lichfield) through to Manchester, and connecting with the WCML.

4.3.5 The Options for Phase Two – appraisal of sustainability report (2012)[24] describes the outcomes from the initial sifting process and describes the performance of those options that were considered to best meet the remit set by Government[25]. The report focused on 42 separate route sections for the Phase 2b Western Leg to Manchester and 32 for the Eastern Leg to Leeds, which could be used to create up to 144 and 112 possible route combinations respectively. The 74 route sections presented in the report had been sifted and selected from several hundred through the earlier route options appraisal process described previously.

Figure 5: The evolution of the options for the Phase 2b Western Leg



[24] Temple-ERM (2012), *Options for Phase Two of the high speed network – Appraisal of Sustainability*. Available online at: https://www.gov.uk/government/publications/options-for-phase-two-of-the-high-speed-rail-network-appraisal-of-sustainability.

[25] Department of Transport (2010), *Remit for HS2 Ltd. A letter from the Secretary of State to the Chairman of HS2 Ltd*. Available online at: http://assets.hs2.org.uk/sites/default/files/inserts/HS2%20Ltd%20remit%20170310.pdf.

4.3.6 The report did not identify a preferred route option but provided information on the sustainability performance of different possible route options between common node points on a comparable basis to help Government identify the 2013 initial preferred scheme[26].

4.3.7 Following the submission of advice to Government that was published within the Options for Phase Two report (2012), the Secretary of State (SoS) met with council leaders to discuss station options and separately visited areas potentially affected by some of the route options. This led to further refinement and route development. A number of design reviews were undertaken by HS2 Ltd to consider whether improvements could be made in terms of cost, simplification of construction and sustainability, often prompted by requests from the SoS following the informal engagement and site visits. From these design reviews, alternatives to route sections emerged which were subject to a further level of appraisal. Following this work, the Government selected the 2013 initial preferred scheme, as published in the High speed rail: investing in Britain's future – Phase Two report (2013)[27] and as outlined in the Phase Two initial preferred scheme sustainability summary (2013)[28].

Sustainability summary (January 2013)

4.3.8 The Phase Two initial preferred scheme sustainability summary (2013) described the potential impacts of the 2013 initial preferred scheme on people and the environment. It presented the findings of the ongoing appraisal of sustainability work at that point in time.

4.3.9 The Western Leg of the 2013 initial preferred scheme to Manchester would ultimately connect with the WCML at two locations (Crewe and Golborne). It would include a terminus high speed station in Manchester city centre, as well as a further high speed station at Manchester Airport. An infrastructure maintenance depot (IMD) at Basford, south of Crewe, and rolling stock depot (RSD) near Golborne were also identified as being required[29].

4.3.10 Following publication of the Phase Two initial preferred scheme sustainability summary (2013), engagement took place with a number of key stakeholders and MPs, particularly those potentially affected by the route. As a result, a small number of further refinements were made to the route. These refinements culminated in the 2013 proposed scheme for

[26] The recommendations for a preferred route option are provided within: High Speed Two Ltd (2012), *Options for Phase Two of the high speed rail network - A report to Government by HS2 Ltd.* Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/68965/options-for-phase-two-of-the-high-speed-rail-network.pdf.

[27] Department of Transport (2013), *High Speed Rail: Investing in Britain's Future – Phase Two: The route to Leeds, Manchester and beyond*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69738/hs2-phase-two-command-paper.pdf.

[28] Temple-ERM (2013), *HS2 Phase Two Initial Preferred Scheme - Sustainability Summary*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/68971/hs2-phase-two-initial-preferred-scheme-sustainability-summary.pdf.

[29] The IMD at Crewe was subsequently relocated near to Stone in the form of an infrastructure maintenance base- rail (IMB-R), which is part of the HS2 Phase 2a hybrid Bill. The rolling stock depot at Golborne was subsequently relocated to Crewe north.

consultation. The sustainability appraisal of the 2013 proposed scheme for consultation is described in the Phase Two sustainability statement (2013)[30].

Sustainability statement (July 2013)

4.3.11 The Phase Two sustainability statement (2013) was prepared to assist with public consultation by explaining the appraisal of sustainability process and how sustainability has informed the selection and design of the scheme, the potential impacts of the consultation scheme and the alternatives considered.

4.3.12 In relation to the Phase 2b Western Leg, the 2013 proposed scheme for consultation included a new high speed station near Manchester Airport, a new high speed station adjacent to the existing station at Manchester Piccadilly and a connection to the WCML north of Golborne. Two depots were proposed; south of Crewe (Basford) for the IMD and near to the WCML connection north of Golborne for the RSD.

4.3.13 The public consultation ran from July 2013 to January 2014, with a series of supporting information events along the route between October 2013 and January 2014.

Refinements to the 2013 proposed scheme for consultation

4.3.14 In response to the feedback received during consultation and as a result of the experience gained from Phase One, HS2 Ltd investigated a number of areas for possible refinements (termed local alternatives) to the 2013 proposed scheme for consultation. Further revisions were driven by an initiative to improve the technical performance of the design and to consider cost efficiencies.

4.3.15 In support of the ongoing Phase One design, HS2 Ltd prepared a series of updated standards that the design of both Phase One and Phase Two were required to meet. The requirements took into consideration developing industry best practice, optimal passenger comfort and long-term operational considerations, such as maintainability, safety and durability. The requirements applied to Phase Two principally related to the camber and gradient of the track alignment, as well as the structural clearance over or under roads, other railways, watercourses and floodplains.

[30] High Speed Two Ltd (2013), *Consultation on the route from the West Midlands to Manchester, Leeds and beyond, Sustainability Statement Volume 1: main report of the Appraisal of Sustainability A report by Temple-ERM for HS2 Ltd (July 2013).* Available online at: https://www.gov.uk/government/publications/hs2-phase-two-consultation-sustainability-statement.

4.3.16 The 2013/14 consultation process and a summary of the issues raised are documented in the independent High speed rail: investing in Britain's future – consultation report (2014)[31] that was published alongside the decision document HS2 from Crewe to Manchester, the West Midlands to Leeds and beyond report (2016) and the Summary of route refinements report[32] in November 2016. Options were developed to address the issues that were raised during consultation. These were then appraised and those that were feasible when considered alongside other scheme requirements were progressed. In addition, other minor scheme revisions arose from the need to incorporate these geographically specific route refinements (arising from both the consultation process and application of design requirements) back into the overall scheme design.

Sustainability report, Phase Two post-consultation update: West Midlands to Crewe (November 2015)

4.3.17 In March 2014, Sir David Higgins, the Chairman of HS2 Ltd, recommended bringing forward development of a section of the Phase Two route between the West Midlands and Crewe, thus separating the route of the 2013 proposed scheme for consultation on the Western Leg to Manchester in two. In November 2015, the Government having considered a number of options for accelerating part of the route, announced its intention to bring forward the construction of the section of route connecting the West Midlands to Crewe, known as the 2015 preferred route to Crewe.

4.3.18 The Sustainability report, Phase Two post-consultation update: West Midlands to Crewe (2015)[33] was published in November 2015, documenting the post consultation updates and changes. The 2015 preferred route to Crewe subsequently became Phase 2a. The announcement of the 2015 preferred route to Crewe (Phase 2a) in November 2015 included a connection with Phase One north of Lichfield through to a connection with the WCML near the A500 south of Crewe, and included an IMD at Basford.

[31] Ipsos MORI Social Research Institute (2014), *High Speed Rail: Investing in Britain's Future. Consultation on the route from the West Midlands to Manchester, Leeds and beyond*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/480397/P2LoR_Ipsos_MORI_FINAL_REPORT.pdf.pdf.

[32] High Speed Two Ltd (2016), *High Speed Two Phase 2b Crewe to Manchester West Midlands to Leeds Summary of route refinements 2016*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/569186/D13_HS2_PHASE_2b_Summary_Report_web_FINAL.pdf.

[33] Temple-RSK (2015), *High Speed Rail: Preferred Route to Crewe Sustainability Report - Phase Two Post-Consultation Update*: West Midlands to Crewe. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480667/Sustainability_Report_Phase_Two_Post-Consultation_Update_West_Midlands_Crewe.pdf.

Sustainability statement including post-consultation update Phase 2b (November 2016)

4.3.19 In November 2016, the Government announced the 2016 preferred route to Manchester and Leeds (from Crewe to Manchester, including a connection to the WCML and from the West Midlands to Leeds, including a connection to the ECML). This was based on updated design standards and refinements made to the route following the 2013/2014 consultation and the recommendations outlined within the Sheffield and South Yorkshire report (2016). In some locations, substantial changes had been made to the route previously presented in the 2013 proposed scheme for consultation.

4.3.20 The Phase 2b preferred route sustainability statement (2016)[34] was published documenting the post-consultation changes to Phase 2b, together with the associated potential sustainability performance. As a result of these changes, a further period of public consultation between November 2016 and March 2017 was launched alongside the announcement of the preferred route for Phase 2b. The consultation focused on seven sections of route across both the Eastern and Western Legs to Leeds and Manchester respectively.

4.3.21 On the Western Leg between Crewe and Manchester, the route refinement consultation areas consisted of:

- moving the proposed RSD from a site near Golborne to a site north of Crewe;
- changing the route over approximately 26km between Middlewich and Pickmere; and
- changing the alignment of the route on the approach to Manchester Piccadilly Station, including the location of the tunnel portal, and as a result, the alignment of the Manchester tunnel.

From Crewe to Manchester, West Midlands to Leeds and beyond – Phase 2b route decision (July 2017)

4.3.22 Following the period of public consultation on the seven sections of route held between November 2016 and March 2017, route refinement work was undertaken to address specific consultee concerns raised during the consultation period[35] and subsequently HS2 Ltd

[34] Temple-RSK (2016), *High Speed Rail: Phase 2b Preferred Route - Sustainability Statement including Post Consultation Update*. Available online at: https://www.gov.uk/government/publications/hs2-phase-2b-sustainability-statement-2016.

[35] Dialogue by Design (2017), *High Speed Two Phase 2b: Crewe to Manchester & West Midlands to Leeds Route Refinement Consultation 2016, a summary of consultation responses*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/629018/HST10_RR2016_SummaryReport_140717.pdf.

provided advice on the different options considered to the Government[36]. In July 2017, the Government announced the 2017 preferred route to Manchester and Leeds (HS2 from Crewe to Manchester, the West Midlands to Leeds and beyond report (2017))[37]. Decisions were confirmed for six of the seven proposed changes with the exception of one change related to the Eastern Leg.

4.4 Establishment of route corridors between the West Midlands and Manchester

Introduction

4.4.1 The following sections provide an historical overview of the development of the route corridors identified during the evolution of the full Phase Two scheme between the West Midlands and Manchester between 2010 and July 2017, from which the Proposed Scheme has emerged. This includes the route of Phase 2a between the West Midlands and Crewe, which has subsequently received Royal Assent.

Manchester routes – options short listing

4.4.2 The initial short list of route options to Manchester undertaken between 2010 and 2012 was broken down into 11 groups, based on the geography and functionality offered. The groups, which are described within the Options for Phase Two – appraisal of sustainability report (2012) and within Options for Phase Two report (2012), would commence with a connection with Phase One north of Lichfield, through to central Manchester, with connections on the WCML as far north as Preston. Each group contained a number of individual route sections that could be aggregated together in a variety of combinations to form longer routes. These are outlined in the following sections and illustrated in Figure 6, together with the main reasons why they were or were not progressed further. Within each group, individual route options were either recommended for further refinement or discounted on the basis of sustainability, cost, engineering and/or operational concerns. At each phase of appraisal, new options were considered within the groups owing to greater understanding of the key constraints and where potential viable solutions were identified. The geographical grouping of options used to describe and appraise the initial options short list and the options for further refinement was not used beyond this next phase of options appraisal.

[36] High Speed Two Ltd (2017), *High Speed Two Phase 2b Crewe to Manchester West Midlands to Leeds Route refinements - HS2 Ltd's advice to Government*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/628605/CS848_Phase_2b_201617_Route_Refinement_Advice_FINAL_WEB_170713.pdf.

[37] Department for Transport (2017), *High Speed Two: From Crewe to Manchester, West Midlands to Leeds and beyond – Phase 2b Route Decision*. *Moving Britain Ahead*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/668511/high-speed-two-from-crewe-to-manchester-west-midlands-to-leeds-and-beyond-phase-2b-route-decision-web-version.pdf.

Short listed options

Peak District group

4.4.3 The group comprised three routes (at the most easterly part of the route corridor) which would connect Lichfield with Dunkinfield, south-east of Manchester. The group would have had a direct impact on the Peak District National Park, which would have been crossed for a substantial distance by all three routes. Opportunities for mitigation would have been limited, and to avoid the National Park, would have required a section of tunnel of at least 20km in length. The northern half of the group would have had a direct impact on one Grade II* registered park and garden (Lyme Park), 14 SSSI, one Special Protection Area (SPA) (Peak District Moors – South Pennine Moors Phase 1), two SAC (South Pennine Moors, Peak District Dales) and over 20 Grade II listed structures. The southern half of the group would have had significant landscape and visual impacts. Due to these environmental impacts, no corridors from the Peak District group were progressed for further refinement. In addition, these routes would not perform favourably compared to more westerly options in terms of cost and journey time.

Churnet Valley group

4.4.4 The group would connect east of Cheadle with Macclesfield. It would have had a direct impact on three SSSI (Churnet Valley, Dimmings Dale and Ranger). The group would have required a large viaduct to cross the Churnet Valley SSSI resulting in significant landscape and visual impacts. Opportunities for mitigation would have been limited. The section of route crossing the Churnet Valley from the Peak District was not taken forward because there was an alternative option from Lichfield that would pass to the west of Uttoxeter, which performed more favourably in terms of sustainability and cost. One corridor was progressed for further refinement from the Churnet Valley group.

Central (power) corridor group

4.4.5 The corridor comprised one route which would connect Lichfield with south of Macclesfield. The corridor would have crossed one Ramsar site (Midland Meres and Mosses Phase 1), one SAC (West Midlands Mosses), one SSSI and a National Nature Reserve (NNR) (Chartley Moss). The route would have had a direct impact on two scheduled monuments (Blithewood Moated Site and Paynsley Hall Moated Site) and the southern half of the route would have had significant landscape and visual impacts. This corridor was progressed for further refinement from the central (power) corridor group.

East of Stoke group

4.4.6 The group comprised a single corridor that would connect the north-east side of Stoke-on-Trent at Brereton Heath, just west of Congleton. This group would require a high number of residential property demolitions, mainly at Biddulph and Norton Green. The group would have a direct impact on one SSSI (Roe Park Woods) and indirect impacts on six SSSI

(Bagmere, Brookhouses Moss, Ford Green Reedbed, Gannister Quarry, Holly Banks, River Dane) and two Ramsar sites (Midland Meres and Mosses Phase 1 and 2). This corridor was progressed for further refinement.

West of Stoke group

4.4.7 The group comprised a single corridor that would connect north of Stone with Over Peover, which would pass partly in tunnel west of Stoke-on-Trent. The group would have required a comparatively high number of residential property demolitions and a significant number of properties would have experienced noise impacts, particularly at Stone and Stoke-on-Trent. The group would have required six crossings of, and had a potential impact on, the River Trent (a major river) and would have crossed the Trent and Mersey Canal. It would have also had a direct impact on one SSSI (River Dane) and two Grade II registered parks and gardens (Rode Hall, Peover Hall). The route would also have an indirect impact on three scheduled monuments, five Grade II* listed structures and one Grade II* registered park and garden (Trentham Gardens). No corridors were progressed for further refinement from the west of Stoke group due to the substantial number of demolitions and noise impacts at Stone and Stoke-on-Trent, in addition to the high costs associated with the tunnel to the west of Stoke-on-Trent.

Eastern approaches group

4.4.8 The group comprised a number of approaches connecting core route options at Macclesfield with high speed stations in east Manchester. Some of the approaches split to the north to connect with city centre station options. The surface routes would have required a high number of residential demolitions and significant numbers of properties would have experienced noise impacts in south and east Manchester. The group would have crossed the Peak District National Park (two eastern most routes only) and Reddish Vale Country Park. The group would also have had an impact on two scheduled monuments, three Grade II* listed structures, one Grade II* registered park and garden (Adlington Hall) and two Grade II registered parks and gardens (Philips Park, Philips Park Cemetery). All surface route options into eastern stations were not short listed due to high cost and poor sustainability performance, including high numbers of demolitions required. Only tunnel options were taken into the next stage.

Western approaches group

4.4.9 The group comprised five approaches, which would connect core route options with high speed stations in the west of Manchester. These approaches would extend north from either Lymm (two approaches), Altrincham (two approaches) or north-east of Holmes Chapel (eastern most approach), to connect with St. George's. The group would have required a high number of residential demolitions (Urmston, West Didsbury and Newall Green) and as a result some options were progressed for further refinement and re-designed as tunnel approaches. The group would have crossed one SSSI (Dunham Park) and also had an impact on the Dunham Massey National Trust site, two Grade II* registered parks and gardens

(Tatton Park, Dunham Massey), three Grade II registered parks and gardens (Alexandra Park, Wythenshawe Park, Manchester Southern Cemetery), one Grade II* listed structure (Barton Bridge), one Grade I listed structure (Church of All Saints) and one scheduled monument (Bowl Barrow). A number of route sections from the different approaches of this group were progressed for further refinement. Three core western approach options were not progressed because alternative routes within this group performed more favourably on all accounts.

South Manchester spine group

4.4.10 The group connected Wilmslow (south of Manchester) with Wigan and would have linked routes from Birmingham to Manchester and the WCML via a long tunnel under Manchester Airport. The group would have crossed one SAC (Manchester Mosses, which includes Risley Moss SSSI), a SSSI (Brookheys Covert) and the Manchester Ship Canal resulting in landscape and visual impacts. The group would have also had landscape and visual impacts where it crossed the Pennington Flash Country Park on viaduct. Mitigation considered included bypassing the country park (the southern-most spine route). However, a high number of residential properties would have experienced noise impacts and there would have been a high number of residential demolitions at Golborne. Given the substantial cost of tunnelling and the potentially poor sustainability performance further north, these route options were not taken forward. Other groups provided better route corridor options.

WCML, Warrington and Wigan connections group

4.4.11 The group connected Warrington, Wigan and the WCML with the core Birmingham to Manchester routes. The group was from Northwich to the south, and Altrincham and Knutsford to the south-east, north to Preston. The group would have required residential demolitions in built-up areas, including at Euxton, Coppull, Orrell, Abram, Hartford and Warrington. The group would have crossed two SSSI (Abram Flashes, Woolston Eyes) and would have had impacts on two Grade II registered parks and gardens (Tabley House, Avenham Park) and three Grade II* listed structures (Lower House Farmhouse, Lightshaw Hall, Church of All Saints). No route sections from this group were progressed for further refinement.

West Pennine Hills group

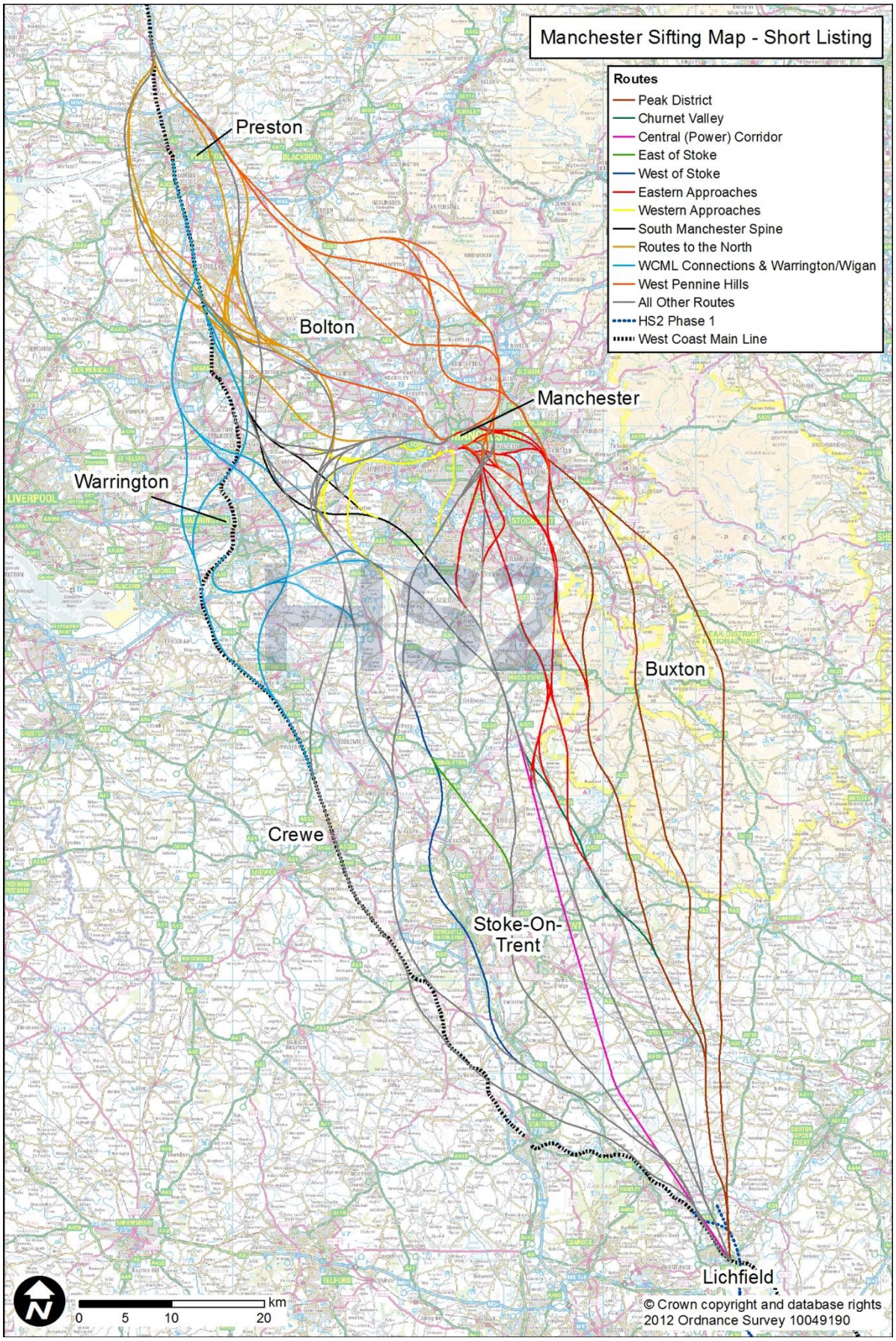
4.4.12 The group connected Manchester with north-east of Preston, with the exception of one route which would have followed the M61 corridor to Westhoughton. The group would have required a high number of residential demolitions, particularly to the north of Manchester and have had a direct impact on two SSSI (Rochdale Canal, Red Scar and Tun Brook Woods), one SAC (Rochdale Canal), two Grade II registered parks and gardens (Hoghton Tower, Heaton Park) and a National Trust site (Stubbins Estate). Opportunities for mitigation would have been limited in urban areas without extensive tunnelling. The group would require substantial lengths of tunnels and structures and also performed poorly from a

sustainability perspective, with significant demolition numbers and impacts on a SAC and two SSSI. Options from this group were not progressed for further refinement.

Routes to the north of Preston group

4.4.13 The group connected routes from Golborne and west Manchester to the WCML north of Preston, with some routes skirting around east and west of Preston. The group would have had a direct impact on three scheduled monuments (the Moat House, Bretters Farm, moated site at Arley Hall). It would have crossed the River Ribble, at a point approximately 2.2km upstream of the Ribble and Alt Estuaries Ramsar site and crossed several other major rivers and canals (River Yarrow, Bridgewater Canal, Leeds and Liverpool Canal, Lancaster Canal, Millennium Ribble Link), resulting in visual impacts on users of waterway footpaths. The group would have had an indirect impact on one SSSI (Red Moss), one Grade I listed structure and 13 Grade II* listed structures. The options that would connect to the WCML south of Preston performed less favourably when compared to the options connecting to the north of Preston in terms of construction complexity, sustainability and journey time so these routes were not progressed. However, a number of route sections from this group were progressed for further refinement.

Figure 6: Manchester routes short listing options



Manchester routes – options for further refinement

4.4.14 Manchester route options that were subject to further refinement are shown in Figure 7. These were either route sections that were progressed from the initial sifting process or new route options identified. The geographical grouping of options used to describe and appraise the initial options short list and the options for further refinement was not used beyond this next phase of optioneering. Those individual route sections that were progressed beyond this stage and further refined are presented in Options for Phase Two – appraisal of sustainability report (2012). This section briefly describes the main route corridors subject to further refinement.

Churnet Valley group

4.4.15 This comprised a single corridor connecting Lichfield with Macclesfield that would pass to the west of Leek. The corridor would have crossed one SSSI (Churnet Valley), one area of National Trust land (Hawksmoor), two canals (Trent and Mersey Canal, Caldon Canal) and three major rivers (Dane, Team and Blithe), which may have also required works. The corridor would have had major landscape and visual impacts on the surrounding area (which includes the Peak District National Park and Churnet Valley). This route corridor was not progressed predominantly due to the cost of structures and tunnels required to negotiate through the Churnet Valley and surrounding hills and also due to the likely environmental impacts associated with this route.

Central (power) corridor group

4.4.16 The group, which was progressed, would broadly follow the overhead power lines between Lichfield and a point in Manchester city centre, comprised a short corridor that would pass to the east of Stoke-on-Trent, connecting Gratwich (west of Uttoxeter) to Bradshaw (west of Leek). The corridor would have had direct impacts on several floodplains, including crossing the Caldon Canal and River Blithe. The group would have had visual impacts on open landscape at its southern extent where it would pass through rural countryside.

East of Stoke group

4.4.17 The group comprised a single corridor connecting Lichfield with Macclesfield that would pass in tunnel through Stoke-on-Trent (on the east side). The corridor would have had impacts on three conservation areas (Hilderstone, Trent and Mersey Canal, Macclesfield Canal), seven biodiversity action plan (BAP) habitats and five ancient woodlands, together with indirect impacts on seven Natura 2000 sites (within 10km). The route would have also crossed one abstraction site (at Moddershall; 3,500m^3/day). The corridor would have had major visual impacts on a National Trust site (Congleton Cloud), a Grade II* registered park and garden (Gawsworth Old Hall), three scheduled monuments (Gawsworth Hall Gardens, Hilderstone Hall, moated site at Great Hartwell Farm) and over 40 Grade II listed structures. Although this

route performed better compared to other route corridors through this area, it was not taken forward primarily due to higher costs compared to other options.

Eastern approaches group

4.4.18 The group comprised five approaches into east Manchester. All approaches diverged from a core route option between Macclesfield and Altrincham to terminate at one of three eastern city centre station options. All the approaches would have required tunnels from the outskirts of Manchester. The group would have required a high number of residential demolitions at Mottram St Andrews, Dean Row and at Alderley Edge and a significant number of properties would have also experienced noise impacts. There would also have been landscape and visual impacts at Alderley Edge. The group would have crossed a National Trust site (Hare Hill) and there would have been impacts on the setting of a Grade II* registered park and garden and scheduled monument (Gawsworth Old Hall). The approach routes to the high speed station options at Baird Street and Manchester Victoria were not progressed because these station options were not taken forward. The other options for eastern approaches were not progressed because of the substantial cost associated with sections of tunnel being required.

Western approaches group

4.4.19 The group comprised six approaches[38] to terminus station options located in the west of Manchester. The group diverged from the main route option at one of four locations: near the M6 crossover (west of Tatton Park); south-west of Altrincham (north of Rostherne Mere); to the north-east of Lymm; or east of Culcheth. Although all routes in this group would include approximately 4 to 6km tunnels on the approach to the terminals, the group would have required a high number of residential demolitions including some at Eccles (in an area of high deprivation).

4.4.20 The group would have crossed a National Trust site (Dunham Massey) and would have had a visual impact on the associated Grade II* registered park and garden. The group would have had impacts on one scheduled monument (a promontory fort), one Grade II* listed structure (Barton Bridge) and would have passed close to two SAC (Manchester Mosses, Rixton Clay Pits). The group would have also had indirect impacts on two Ramsar sites (Rostherne Mere (also an NNR) and Midland Meres and Mosses Phase 1) and eight SSSI (Abram Flashes, Rixton Clay Pits, Risley Moss, Holcroft Moss, Astley and Bedford Mosses, Rostherne Mere, Bryn Marsh and Ince Moss, Dunham Massey). Three approach options (the western-most three) would have crossed, and had a major visual impact on, the Manchester Ship Canal.

4.4.21 Of the western approaches, the route furthest to the west was not progressed due to it performing poorly from a cost and sustainability perspective with no balancing journey time benefits. The western approach option furthest to the east was not progressed as it would

[38] Five approaches were originally considered. However, more approaches were added as the optioneering process evolved.

include a tunnel underneath Urmston and would have a particularly high cost when compared to alternative options.

4.4.22 Two new approach routes were proposed and developed to the same level as the others at this stage. One was a route via the River Mersey Valley corridor and then a tunnel to the high speed station options at Manchester Piccadilly, which was assessed to perform better overall than alternatives to Piccadilly. The other was a route via the M62 corridor that would serve high speed station options in Salford, which would mainly run on the surface and have a comparatively short section of tunnel. In total, four approach routes were taken forward, all of them would be in tunnel from the city outskirts.

WCML connections group

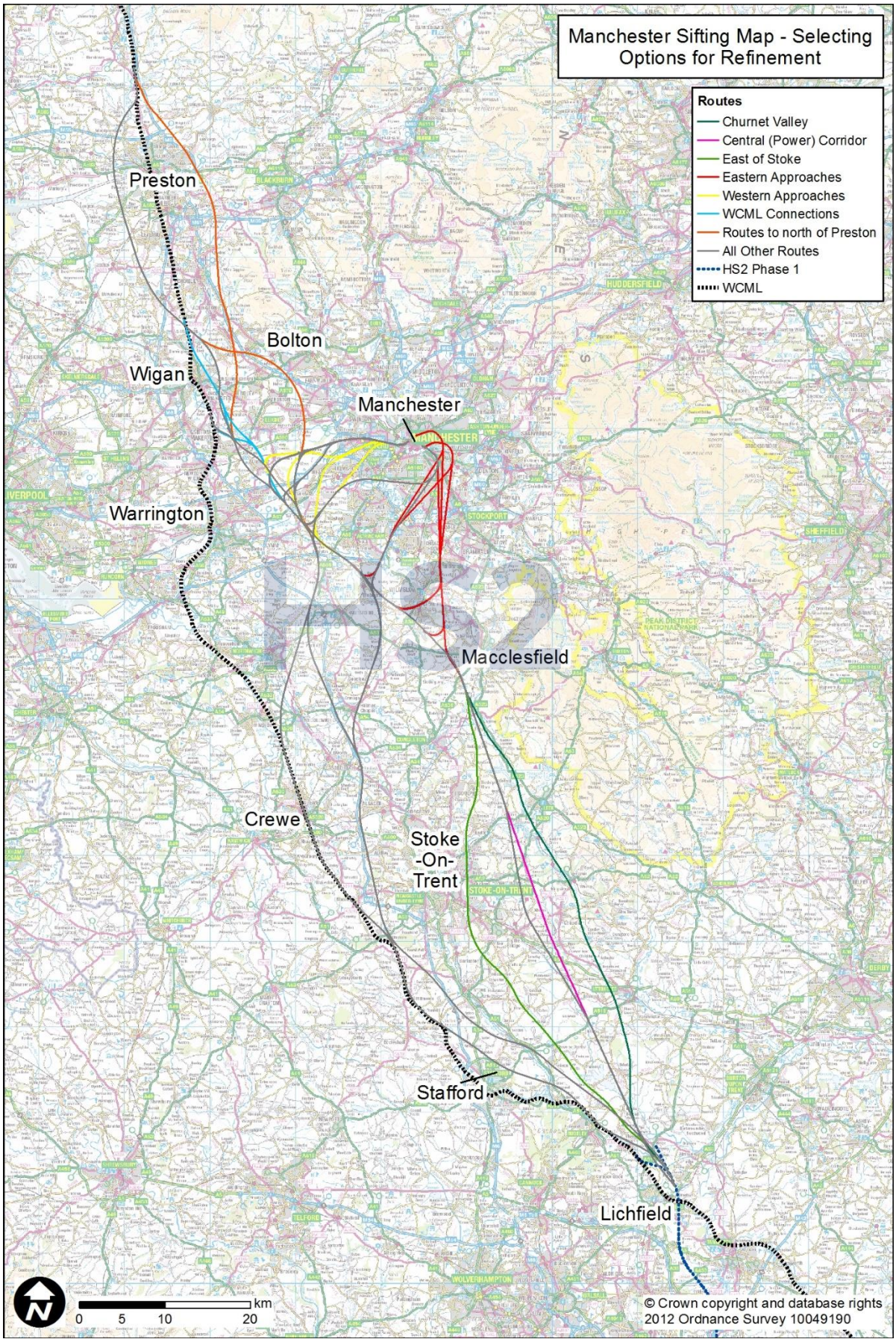
4.4.23 The group was from east of Warrington to south of Coppull and would connect the Birmingham to Manchester line of route to the WCML. The group would have crossed the Pennington Flash Country Park on viaduct and would have had a major impact on the landscape. A number of properties would have experienced noise impacts. The group would have required residential demolitions at Hollins Green and would have had a direct impact on one scheduled monument (Haigh Sough). The group would have had indirect impacts on two SAC (Manchester Mosses, Rixton Clay Pits) and five SSSI (Abram Flashes, Bryn Marsh and Ince Moss, Holcroft Moss, Risley Moss and Rixton Clay Pits).

Routes to north of Preston group

4.4.24 The group comprised three routes connecting with the WCML. Two of the routes originated to the south-west of Altrincham to terminate to the east and west of Aspull. The third route would connect Golborne to the WCML north of Preston that would run east of the M61. The group would have required residential demolitions at Tyldesley, Horwich, Crankwood and Wheelton. The group would have had direct impacts on one SSSI (Red Scar and Tunbrook Woods), a National Trust site (Dunham Massey), Worthington Lakes Country Park and would have had indirect impacts on two SAC (Manchester Mosses, Rixton Clay Pits) and an Area of Outstanding Natural Beauty (Forest of Bowland). The group would have also had visual impacts on the Ribble Valley, Dunham Park SSSI and Dunham Massey Grade II* Registered Park and Garden.

4.4.25 Only one route, running from the west of Manchester to the north-west of Preston was progressed for further development. The routes to the west of Bolton and the east of Preston were not taken forward due to costly lengths of tunnels and structures and also relatively poor sustainability performance.

Figure 7: Manchester routes sifting map – selecting options for refinement



Options not progressed to finalised option stage

4.4.26 The two groups outlined below were alternatives to the preferred route within each of the spine and central (power) corridor groups that emerged at the end of the selection process detailed above. These groups were not progressed to a full sift (i.e. to the highest level of engineering design detail and appraisal at this stage of the process) due to the notably better performance of the final options. The routes are shown in Figure 8.

Central (power) corridor route

4.4.27 This route was the most easterly route remaining at the final options stage and commonly referred to as the Eastern route option. As this was the only remaining route option to the east it was investigated in some detail but was not fully developed as a final option. The route would run from Lichfield to Mobberley and would pass to the east of Stoke-on-Trent and to the west of Leek and Macclesfield. The route would require high embankments and cuttings, some lengths of high viaduct, and several short sections of tunnel to pass through the hilly landscape.

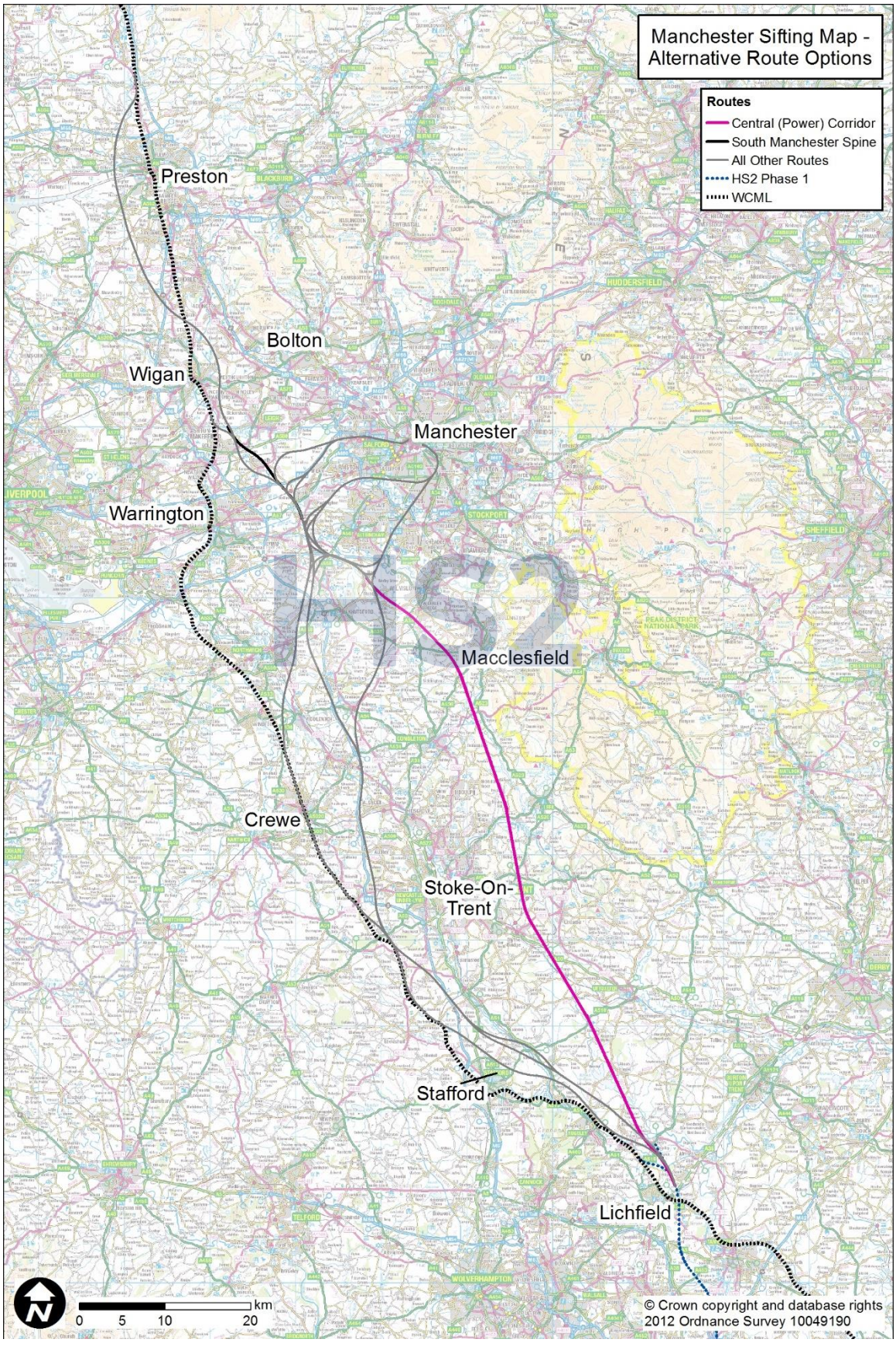
4.4.28 The route would pass within 2km of the Peak District National Park affecting views from higher ground. There would have been five major river diversions (four affecting the River Blithe and one affecting the River Dane) and approximately 17km of the route in cut or tunnel would have crossed important aquifers. The route would have had direct impacts on approximately 20 ancient woodlands. It would also have required some residential demolitions (with approximately 13 at Key Green). There would have been noise impacts on some residential properties, a visual impact on Dane Valley and indirect impacts on three scheduled monuments, four Grade II* listed structures and two Grade II* registered parks and gardens (Gawsworth Old Hall, Tatton Park).

4.4.29 The considerable number of structures and earthworks required for this route would be costly. This option would also present a number of sustainability impacts, including potential water and ecology impacts on Blithfield Reservoir, landscape and heritage impacts in relation to Congleton Cloud and landscape and heritage impacts on Gawsworth Old Hall. This option was not developed primarily because of its higher cost compared to the final options.

Manchester spine route (tunnel under Lowton)

4.4.30 This route would be located to the north-east of Lymm and would run north-west past Pennington Flash Country Park to terminate at Crankwood, north-east of Golborne. The route would have had a direct impact on a groundwater source protection zone (SPZ) 1 and public borehole at Lowton Common. It would have required residential demolitions and there would have been vibration impacts for residents at Lowton Common. It would have had an indirect impact on Manchester Mosses SAC (part which is Holcroft Moss SSSI).

Figure 8: Manchester routes sifting map – alternative route options (not progressed to finalised option stage)



Preferred route from Crewe to Manchester – route corridor appraisal

Establishment of the preferred route from Crewe to Manchester

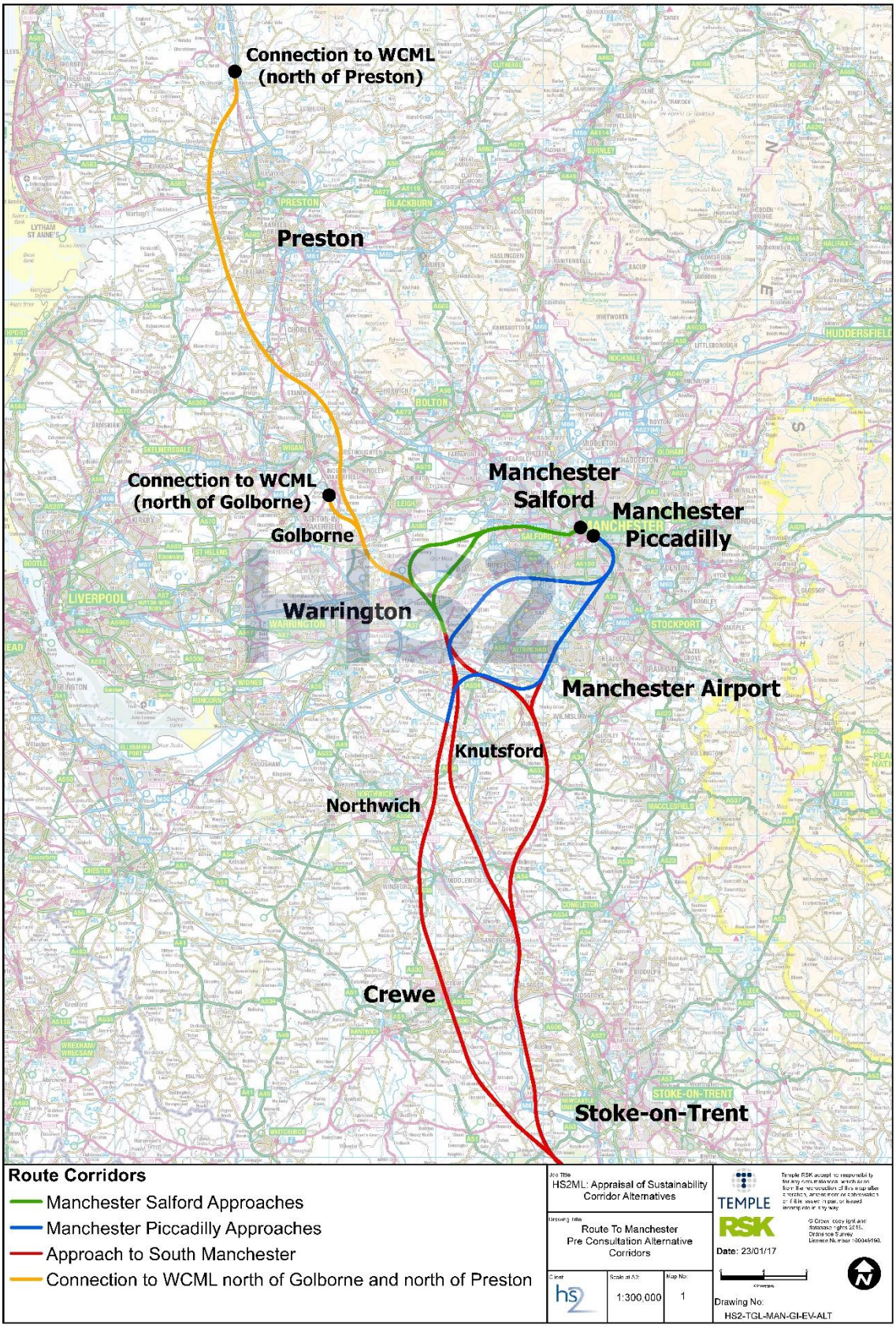
4.4.31 Route options appraisal between 2010 and 2012 focused on establishing a preferred route from the West Midlands to Manchester. In 2013, the Government announced the 2013 proposed scheme for consultation which proposed a route to Manchester via Crewe as the best overall option to meet the Government's objectives.

4.4.32 In March 2014, Sir David Higgins recommended bringing forward the delivery of the Phase Two route from the West Midlands to Crewe, splitting the route into two sections (Phase 2a and the full Phase 2b scheme). The Phase 2b Western Leg route would include a tunnel under Crewe and would head north through Cheshire to a junction at Hoo Green. This junction would have provided a spur to a terminus station at Manchester Piccadilly via a new high speed interchange station near Manchester Airport and a route north to a connection with the WCML north of Golborne.

4.4.33 Whilst the route via Crewe had emerged as the preferred route and has subsequently received Royal Assent via the High Speed Rail (West Midlands - Crewe) Act 2021 for Phase 2a, considerations prior to 2013 within the Options for Phase Two – appraisal of sustainability *report* (2012) included routes that bypassed Crewe to the east and provided alternative approaches into Manchester. Those routes comprised three groups of alternative corridors from a common point south of Crewe (near Swynnerton) through to Manchester and Golborne. These comprised the following (as shown in Figure 9):

- approaches to south Manchester;
- approaches to a high speed station at Manchester Piccadilly; and
- approaches to a high speed station at Manchester Salford.

Figure 9: Reasonable alternative route corridors to Manchester (pre-consultation 2013/2014)



Reasonable alternative route corridors from Crewe to Manchester

Establishing a preferred terminus station

4.4.34 As described in High speed rail: investing in Britain's future – Phase Two report (2013), the Government's initial preferred option was for a terminus station adjacent to Manchester Piccadilly. Manchester Piccadilly was selected on the basis of a combination of engineering, sustainability, cost and/or operational factors.

4.4.35 Following on from an initial sifting process, three options were considered in more detail for the provision of a city centre terminus station (Figure 10). The options considered were Manchester Piccadilly platform 1 (Option 1a), Salford Central Middlewood (Option 9b) and Salford combined station (Option 19). These options, and those considered as part of the sifting process, are described in more detail within the Options for Phase Two – appraisal of sustainability report (2012).

Manchester Piccadilly platform 1 (Option 1a)

4.4.36 The Manchester Piccadilly platform 1 station option (Option 1a) would consist of four elevated platforms parallel with, and alongside, platform 1 of the existing Manchester Piccadilly Station. High speed concourse facilities would be located at ground level, beneath the elevated platforms. Passengers would be able to transfer directly between the existing conventional line and high speed concourses. A new combined conventional line and high speed forecourt and car park was proposed. The station option would be constructed in phases owing to the constrained nature of the site and to reduce disruption.

4.4.37 The station is served by six train operating companies serving intercity routes, the south coast of England and northern England on the conventional rail network. The station provides interchange for existing Metrolink tram services and bus services, and benefits from good connections to major highways.

4.4.38 Construction of the station option, at the time of this appraisal of sustainability sift, would require the demolition of approximately 47 residential dwellings within one building on Chapel Town Street. It would have a major impact on the setting of the existing train shed at Manchester Piccadilly Station (Grade II listed), a minor impact on the setting of the Grade II former goods office and would impact the setting of the Whitworth Street and Stevenson Square conservation areas. Provision of a high speed station at this location would, however, support strategic growth in the area.

Salford Central Middlewood (Option 9b)

4.4.39 This station option (Option 9b) would be located adjacent to the western side of the existing Salford Central Station on a brownfield site known as Middlewood Locks. Salford Central Station would be retained in its original configuration. The station option would require four elevated platforms with concourse facilities located beneath. A new multi-storey car park

would be located directly opposite the concourse. Passenger interchange between the existing conventional line services at Salford Central Station and the high speed station would require a walk of up to 500m. The high speed station would be constructed in phases to reduce disruption.

4.4.40 Salford Central Station provides regional rail services to the north and west and connects with Manchester Victoria Station to the east. Future planned works could include Salford Central Station in the Manchester loop which would link Manchester Victoria, Manchester Piccadilly and Manchester Airport. There are good connections to major highways and local bus services, but has poor connectivity to existing Metrolink services and to Manchester city centre, with the nearest Metrolink stop at Deansgate, approximately a 15 minute walk away.

4.4.41 The station option and throat (the part of the station where the approach tracks divide into platform tracks) would result in the demolition of approximately 225 residential dwellings, of which 211 are within one apartment block on Middlewood Street. The station option would have some visual impact on Middlewood Locks and may impact views from a high-rise development in Rodney Street. The Grade II listed former Royal Bank of Scotland building would be demolished and there would be a potential impact on the views and setting of a Grade I listed railway bridge.

4.4.42 The station option would support the strategic growth of Greater Manchester due to its location. However, the orientation of the proposed option in a west-east direction would have the potential to sever parts of central Salford to the north of the station option from the main areas of economic activity in central Manchester/Salford. This would not be consistent with the aim of developing the area and joining the two cities. It would also remove a section of the Bury Canal. However, the station option would support proposals for a riverside park by relocating Trinity Way.

Salford combined station (Option 19)

4.4.43 This station option (Option 19) would provide for a combined high speed and existing conventional rail interchange station at the existing Salford Central Station. The combined station would deliver four high speed platforms and either two or four conventional rail platforms. A new combined concourse and multi-story car park would be located beneath the elevated platforms, to the east of Trinity Way. The combined station would be constructed in phases to reduce disruption.

4.4.44 This station option would offer access to the same regional conventional rail services as for Option 9b. The combined station option would offer quicker interchange between high speed and conventional rail services. The combined station option would provide good connections to major highways and local bus services, although the Metrolink services would be approximately 15 minutes' walk away.

4.4.45 This combined station option and throat would result in the demolition of approximately 363 residential dwellings located on Rodney Street, Chapel Street and Middlewood Street and a section of existing brick arched viaduct. Chapel Street Hope and United Reform Church and the Chester's Salford Brewery, both Grade II listed buildings, would be

demolished. The combined station would adversely affect views from high rise flats in Rodney Street and the adjacent conservation areas and impact the historic townscape character. The combined station option would support the strategic growth of Greater Manchester due to its location. As with Option 9b, this combined station option has the potential to sever parts of central Salford to the north of the existing station from the main areas of economic activity in central Manchester/Salford.

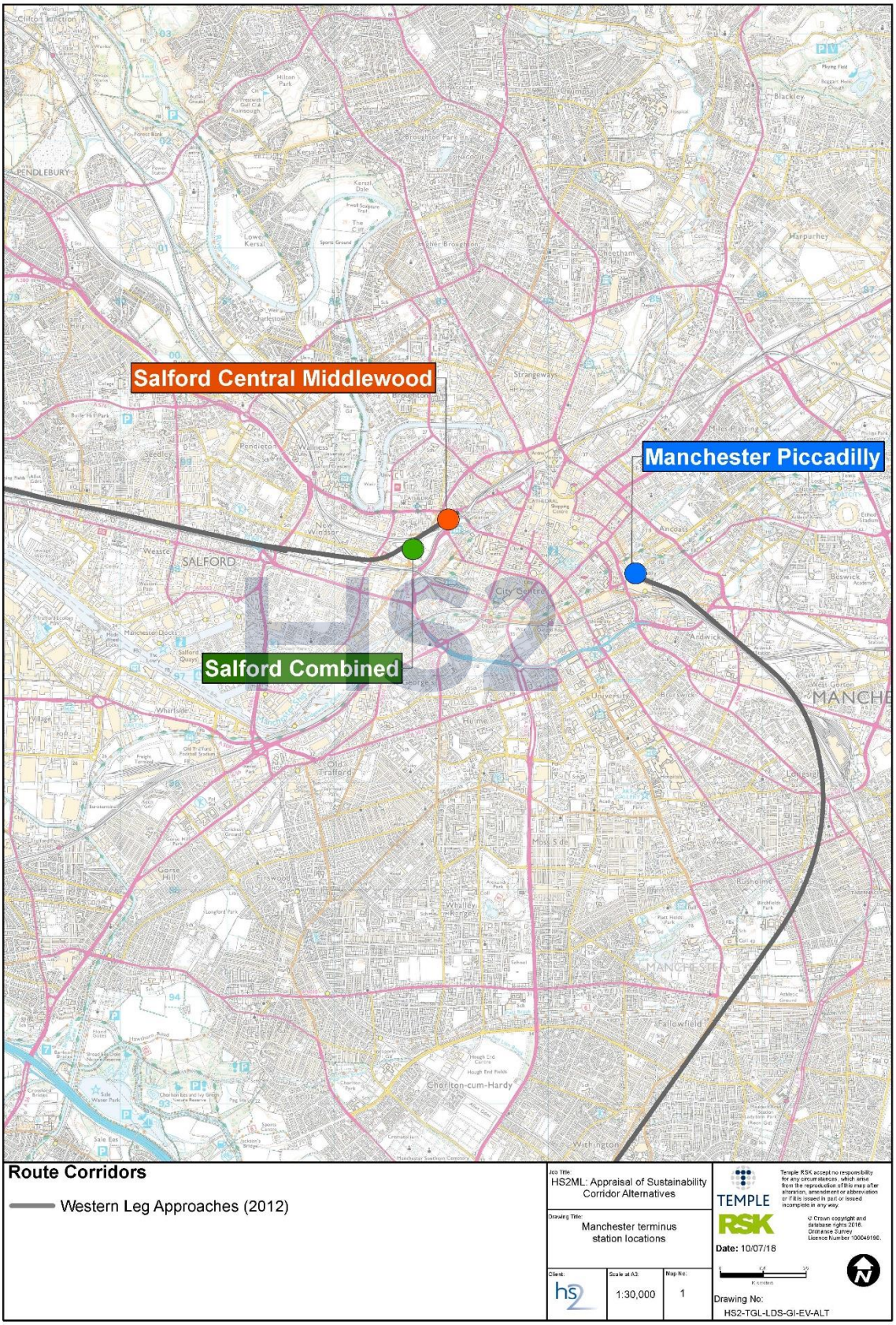
Options appraisal

4.4.46 Demand in Manchester is such that either Salford or Piccadilly would be suitable locations. However, overall Manchester Piccadilly would provide connectivity to a wider range of public transport links, including interchange with the existing conventional rail network, allowing the wider region to be served, including Manchester Airport, and would attract demand from the whole of the Manchester area. As a result, a high speed station at Manchester Piccadilly would offer the best potential benefits and revenue. Whilst the station and approach combined would be marginally more costly to construct than either of the two Salford options, the greater cost would be substantially outweighed by the benefits it would deliver. All three options would require demolitions, although the impact would be higher for the two Salford options.

4.4.47 Approaching Manchester from the west would also mean that a high speed interchange station serving Manchester Airport would not be viable. The consideration of connectivity with principal airports was part of the Government's original remit for HS2 and a station at Manchester Airport would also enable the capture of the Stockport and south Manchester demand markets.

4.4.48 Overall, Manchester Piccadilly, with its city centre location and its connectivity to the wider region, was considered to be the best location for a high speed city centre station. The selection of Manchester Piccadilly as the preferred location for a high speed station informed the approach options into central Manchester.

Figure 10: Manchester terminus stations



Approaches to south Manchester

4.4.49 Three main corridor approaches (A, B and C) to the southern outskirts of Manchester were considered (Figure 11). Each was an aggregation of individual route sections that were developed to the same set of engineering standards and subjected to an equivalent level of appraisal.

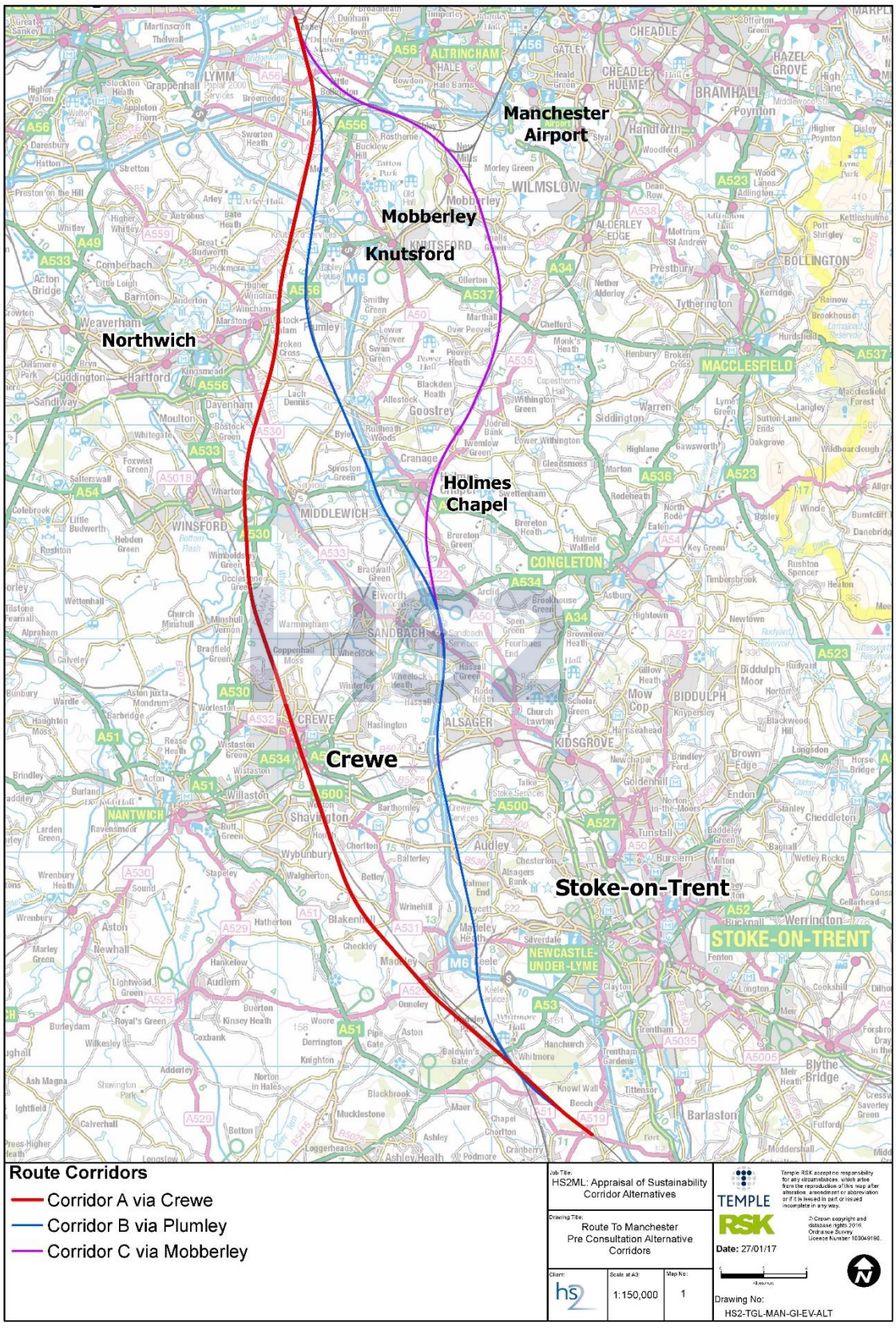
4.4.50 All three route corridors commenced at a common node point at Swynnerton. From there each route would head north, taking different routes across the Cheshire plain and covering up to 50km in length. Approaching south Manchester, each corridor would provide connectivity with alternative approaches into both Manchester Piccadilly and Manchester Salford, as well as onward connectivity with the WCML north of Golborne. All options would provide the opportunity for a high speed interchange station to the north of Manchester Airport. The route corridors are described in more detail in Options for Phase Two – appraisal of sustainability report (2012).

4.4.51 Corridor A via Crewe would pass Swynnerton to the west of Madeley and would approach Crewe from the south alongside the WCML. A junction onto the WCML would be provided near Chorlton, whilst the route would continue north in a bored tunnel under Crewe. The route would emerge from tunnel north of Crewe and follow the WCML before diverging and would head north between Winsford and Middlewich. Continuing north, the route would cross the A556 east of Lostock Gralam, cross the M6 and then M56 to the north-east of High Legh.

4.4.52 Corridor B via Plumley would also commence at Swynnerton but would take a route to the east of Madeley and would roughly follow the M6 north to the west of Newcastle-under-Lyme and close to the western edge of Alsager. Heading north it would continue to broadly follow the M6 corridor, would pass between Middlewich and Holmes Chapel before heading north-west to the east of Knutsford and converging with Corridor A to the east of High Legh.

4.4.53 Corridor C via Mobberley would follow a similar route to Corridor B, east of Madeley and would broadly follow the M6 east of Alsager. East of Sandbach, this route would diverge from the route of Corridor B, taking a route to the east of Holmes Chapel and would approach Manchester from the east close to the village of Mobberley. The route would skirt the south of Manchester and head west, to the north of Rostherne Mere, before converging with the route of Corridor A to the north-east of Lymm.

Figure 11: Approaches to south Manchester



Selection of the preferred approach to South Manchester

4.4.54 As described in High speed rail: investing in Britain's future – Phase Two report (2013), the Government's initial preferred option for this route was Corridor A via Crewe. This was due to the greater strategic benefit of connecting with the WCML near Crewe, as this would provide connectivity to north-west England (including Chester, Liverpool and Warrington) and north Wales. This route would also perform more favourably from a sustainability perspective compared with the other alternative routes, as it would require fewer demolitions and would be further away from a number of settlements across the Cheshire plain.

4.4.55 Corridors B and C were not progressed due to a combination of cost, engineering and/or sustainability grounds. From a sustainability perspective, this included impacts on communities (noise, visual and property impacts) given the proximity to a number of high population areas (including Alsager, Sandbach, Holmes Chapel and Mobberley) and rural settlements, as well as direct impacts and impacts on the setting of a number of heritage assets (listed buildings and scheduled monuments). These, and further sustainability considerations, are detailed within the Options for Phase Two – appraisal of sustainability report (2012).

4.4.56 These options also included potential provision for a high speed station near to Stoke-on-Trent alongside the M6 which would serve the dispersed rail demand around Stoke-on-Trent and Crewe. However, it would be unlikely to attract a high proportion of passengers to, or from, the urban areas of Stoke-on-Trent and Crewe, where people would be likely to continue using existing conventional lines to London. Further analysis at that time, suggested that the benefits would be less than the costs to construct the high speed station. Stoke-on-Trent City Council developed a further option in this area and suggested that a new high speed station could be built as an addition to the WCML connection to the south of Crewe. Analysis showed that, although it would generate additional benefits for Stoke-on-Trent and its surrounding area, these would fall short of the additional cost required to construct a high speed station in this location.

Establishing an interchange station

4.4.57 As per the remit set by Government, options for interchange stations including access to major airports were considered. A long list of options was developed.

4.4.58 Following on from the initial sifting process, five options were considered in more detail for the provision of a high speed interchange station (Figure 12). The options considered were Manchester Airport Davenport Green (Option 4e), Manchester Airport north-south (Option 4c), Manchester Airport east-west (Option 4d), Knutsford – Sandbach to Golborne M6 route (Option 5) and Knutsford – Crewe to Golborne western route (Option 5a). These options and sifting process are described in more detail within the Options for Phase Two report (2012).

Manchester Airport Davenport Green (Option 4e)

4.4.59 This option would provide a connection to Manchester Airport, but only if the terminating station in Manchester was at Piccadilly. It would be located underground at the airport and south Manchester tunnelled approach. The cost of serving the station (not including the station cost) would add substantial costs compared to the alternative, lower cost approach (Mersey and tunnel), to Manchester Piccadilly. Trains would not be able to call at this station before heading north on the route to the WCML connection, as would be possible with the Knutsford options, for example.

4.4.60 The high speed station would have one central platform to serve the two stopping high speed lines. The concourse facilities would be at surface, above the platform. A four storey car park would be constructed adjacent to the southern half of the platforms to the west. The high speed station would be accessed from highways via a new section of link road. This option would be closest to the airport out of a number of locations in the area that were considered. Bus services or a people mover would be needed as a transfer between the station option and the airport.

4.4.61 This option would be constructed within green belt. However, development proposals associated with the airport would be complementary to the development of this option. Approximately 300 jobs could be supported by a station in this location. At the time of the appraisal, it was assessed that this option would give rise to a moderate visual impact on residential areas nearby. Three demolitions of residential dwellings would potentially be required for the station and its related infrastructure.

4.4.62 This option and supporting infrastructure was estimated to be the lowest cost of the five options developed at that stage.

Manchester Airport north-south (Option 4c)

4.4.63 As for Option 4e, this option would provide a link to Manchester Airport and would be located near the airport with the south Manchester tunnel approach to Manchester Piccadilly. Trains would not be able to call at this high speed station if they were travelling north on the through route to the WCML connection.

4.4.64 This option would be located approximately 2km to the south-west of the Manchester Airport terminal area, just to the south-west of junction 6 of the M56. This option would provide two platforms on either side of the HS2 route. It would be constructed in cutting, with the platforms approximately 10m below ground. The concourse would be at ground level and a four storey car park would be located above ground to the east of the station. A people mover would be needed as a transfer between the station option and the airport. Alternatively, a conventional rail connection from the nearby Chester to Altrincham Railway Line could be built, although this was not factored into the design or costing for this station option. The location for the station option would have good access to the road network, although new connections to the M56 would be required along with capacity increases. The nearest existing station would be Ashley approximately 2.6km away.

4.4.65 The location would be in green belt. However, it is immediately to the west of the proposed extension areas of the Airport Development Area shown in Manchester City Council's draft core strategy at the time (also known as Airport City in other plans), which is identified for release from green belt. The station would also support the Enterprise Zone status of the airport. It was estimated that 600 jobs would be supported by a station at this location.

4.4.66 Approximately nine residential dwellings would need to be demolished for the construction of the station option and its related infrastructure. In addition, the Grade II listed Yew Tree House would also need to be demolished. Due to the relatively flat nature of the area, the station option at ground level and the four storey car park would result in visual impacts for those living in the Halebank area, but this is in context of the station option being on the other side of the motorway from the settlement. The station option and its associated infrastructure would impact on Sunbank Wood, which is an ancient woodland and BAP habitat. The four tracks required to accommodate the station option would impact a small area of Flood Zone 3 (land with a high probability of flooding).

4.4.67 This station option was not the lowest cost option for the approach to Manchester Piccadilly. The Manchester Airport north-south option would cost substantially more to build than the Manchester Airport Davenport Green option.

Manchester Airport east-west (Option 4d),

4.4.68 This station option would provide a link to Manchester Airport. It would be located on the Sandbach to Golborne route option. Trains could call at this station before serving Manchester city centre or before heading northwards to connect with the WCML. The other two main route options north of Crewe/Sandbach could not serve this station option. The Mersey approach would be used after calling at this option to access a station near Manchester Piccadilly. Either of the approaches to a Salford station could also be used.

4.4.69 The station option would be located adjacent to the Chester to Altrincham Line, approximately 1.5km south of the M56 and approximately 4km to the south-west of the Manchester Airport terminal area. The station option would be elevated approximately 3m above ground level. The high speed station concourse would be at ground level underneath the platforms and tracks. A crossover between platforms would be required above the platform level. The distance between the concourse and terminal one at the airport would be approximately 7km. An above ground car park to the east of the station option would be provided. A connection to Manchester Airport would be provided via a people mover system, as with the two above options. A conventional rail link could be provided as an alternative with a connection to the existing conventional line and to the airport.

4.4.70 To provide access to the road network, a junction would need to be constructed to the M56. A new road would be constructed to link between the station option and the new motorway junction. A new bus service would need to be introduced to serve the station option. Traffic related to the station option would require capacity enhancement on the M56.

4.4.71 The station option would be located on a greenfield site within the green belt. This station option and associated infrastructure would likely require the demolition of 11 residential

dwellings and a Grade II listed structure. Given the location and distance from the Enterprise Zone around the airport, this option was unlikely to support associated developments and job creation. Given the elevated nature of the station option, it would impact views from the surrounding hamlets and countryside which is relatively flat. In addition, the beginning of the section of four tracked route approaching the station option from the south would be within the Mobberley Conservation Area. The station option would directly impact two ancient woodlands, which are also wet woodland BAP habitats (Arden House Wood and Hancocks Bank).

4.4.72 The Manchester Airport east-west option would be the most costly of the five interchange options to the south of Manchester, substantially more costly than the Manchester Airport Davenport Green option.

Knutsford – Sandbach to Golborne M6 route (Option 5) and Knutsford – Crewe to Golborne western route (Option 5a)

4.4.73 Two very similar station options close to each other were considered, both located to the west of Knutsford. These two station options were developed in the area to serve the two main route options that would pass through this area. Option 5 would be located on the Sandbach to Golborne M6 route and Option 5a would be located on the Crewe to Golborne western route. Services heading into any station option in Manchester, via any of the approaches or heading north to connect to the WCML would be able to call at both station options. This would include any conventional compatible services continuing north after connecting to the WCML.

4.4.74 Option 5 would be approximately 1km to the south of junction 19 of the M6 on a greenfield site. Option 5a would be slightly to the north-west of Option 5, also on a greenfield site approximately 1.4km to the west of junction 19 of the M6. The platforms for both options would need to be elevated above ground level by approximately 4m as the route would be elevated, with an elevated concourse area above the tracks. A four storey above ground car park to the east of both of the station options would be provided.

4.4.75 Highway access to both of the station options would be via a new road constructed to connect with the A556. This road would link to junction 19 of the M6 and further north to the M56. Both motorways can be congested at peak times and traffic to the station options would potentially create further congestion. Bus services along the A556 would be diverted to serve either station option. There would not be access to the existing conventional line at either location, as the nearest station would be Plumley, approximately 4km away on the Chester to Altrincham Line.

4.4.76 Both options would be located within green belt. Option 5 would require the demolition of approximately three residential dwellings. Given the relatively flat nature of the surrounding landscape and that the station option and approaching sections of four tracks would be elevated, there would be some visual impact on the Grade II Tabley House Registered Park and Garden as well as views from Knutsford and surrounding hamlets. The four tracked

section to the south of the station option would cut through Round and Rinks Wood, an ancient woodland.

4.4.77 Option 5a would require the demolition of approximately four residential dwellings. This station option is a little further away from Tabley House Registered Park and Garden and the outskirts of Knutsford than Option 5. There would be visual impact on views from surrounding hamlets. The station option and the four tracks required to accommodate it would impact on a small area of Flood Zone 3 (land with a high probability of flooding).

4.4.78 The cost of both Knutsford options would be more than the Manchester Airport Davenport Green option.

Options appraisal

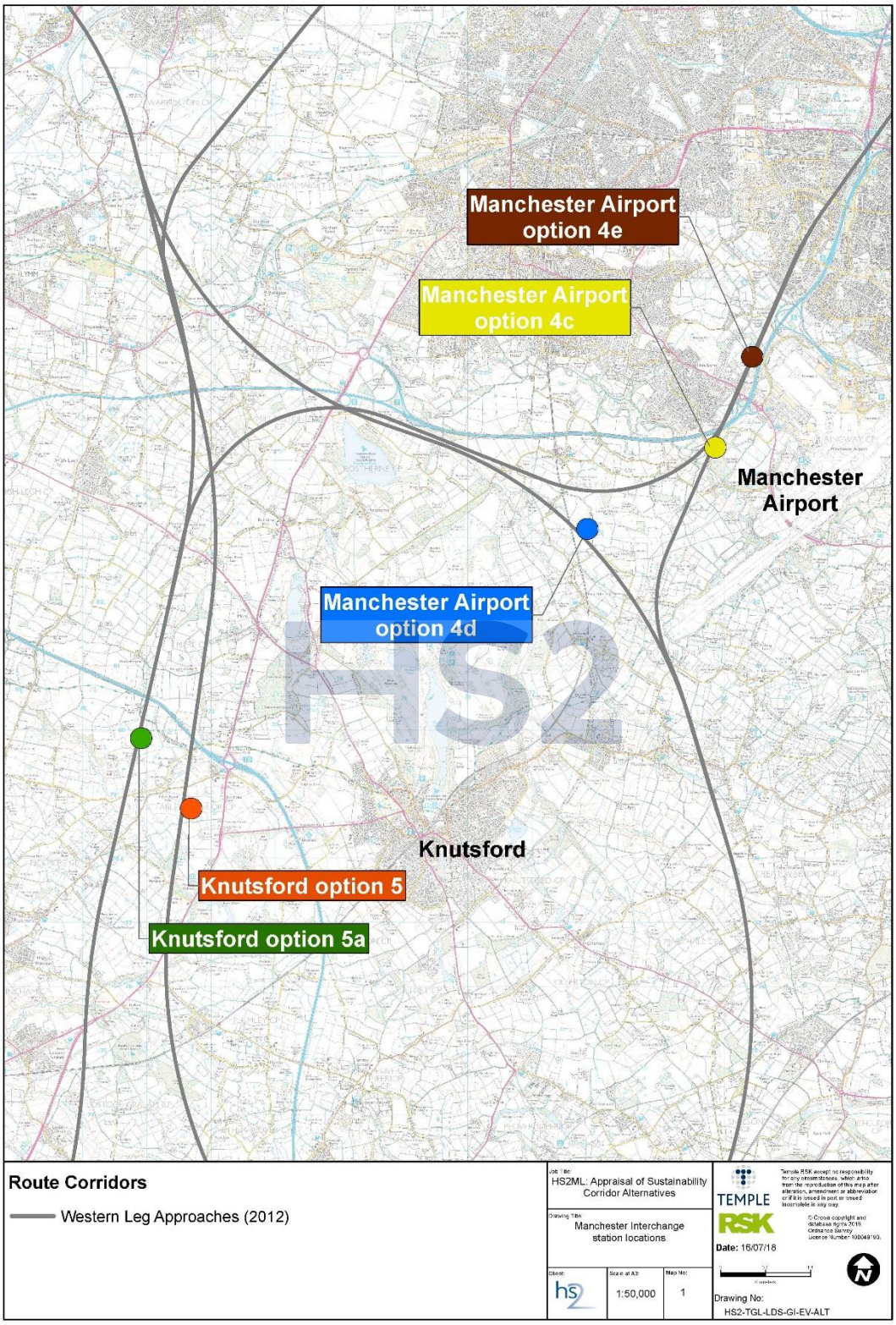
4.4.79 An interchange station on the outskirts of Manchester would provide a more accessible option than Manchester Piccadilly station for markets located in south Manchester and Cheshire. Services which stop at the interchange station, however, would take longer to reach the city centre station.

4.4.80 A key consideration in determining the optimum location for a Manchester interchange station was the relative access times from the key target markets of south Manchester, Trafford, Stockport and north Cheshire. A station located towards the northern extent of this catchment would offer better access to the core market than one further south at a location such as Knutsford. However, the station options in Knutsford would benefit from connectivity to the M6.

4.4.81 In terms of the station options, Manchester Airport Davenport Green offered the best connectivity and proximity to Manchester Airport and could be delivered at the lowest cost. This station option could be accessed from all three main route options, but only from one approach, the airport and south Manchester tunnel.

4.4.82 The combination of a high speed station at Manchester Piccadilly and an interchange station to the south of Manchester in the vicinity of Manchester Airport would attract the largest number of passengers compared to other combinations of station options.

Figure 12: Manchester interchange station



Proposed route to the WCML

4.4.83 From the junction with the Manchester spur at Hoo Green, the HS2 WCML connection would pass under the M56 and would rise onto embankment and viaduct across the Bollin Valley. It would cross the farmed former moss land around the southern edge of Greater Manchester and would continue across the Bridgewater Canal. The route would bear north-west in a shallow cutting before rising onto a viaduct over Coroners Wood Ancient Woodland and the Manchester Ship Canal, close to Hollins Green, Cadishead and Glazebrook. The route would continue on embankment for several kilometres across farmland between Warrington and Irlam, avoiding Risley Moss and Holcroft Moss SAC and SSSI. It would cross the M62 before bearing west towards Culcheth, intersecting the edge of Risley landfill, although not affecting the active deposition cells. Entering cutting, the route would pass to the south of Culcheth through the Taylor Business Park. The route would continue north through Culcheth Linear Park before rising over the Liverpool to Manchester Line. The route would descend into cutting beneath the A580, between Lowton St Mary's and Lowton Common, before rising onto a low embankment and bearing west to the north of Golborne. The route would converge with the WCML at Bamfurlong, south of Abram Flashes SSSI and Pennington Flash Country Park. The junction with the WCML would allow connection with conventional stations further north, including Wigan, Preston, Lancaster, Glasgow and Edinburgh.

Reasonable alternative – Connection to WCML north of Preston

4.4.84 Further to the long and short listing stages described earlier in this report, the main alternative considered for a connection to the WCML north of Golborne was a route running north of Preston (as shown on Figure 9) with a connection to the WCML near Brock, in addition to the connection near Bamfurlong. However, whilst extending the WCML connection further north would deliver a journey saving for services to Scotland, it would come at substantial additional cost and would introduce significant additional sustainability impacts. It was considered that the benefits gained from the further journey time savings and markets captured would need to outweigh these substantial costs.

4.4.85 The southern section of the alternative connection to the WCML would follow the same alignment as the connection to the WCML north of Golborne (the preferred option). This alternative route would retain the WCML connection at (Golborne) Lily Lane, with the alternative connection to the WCML commencing where it would diverge north of Lowton. The route would pass west of Pennington Flash Country Park, cross the WCML between Standish and Coppull and would continue north-west of the WCML on a mix of cutting, embankment and viaduct. Passing through dispersed settlements, including New Longton and Hutton, the route would approach the River Ribble on viaduct, cross the navigable river estuary and remaining elevated before descending into a cutting south of the M55. The route would cross the M55 and interchange between cutting, embankment and viaduct, including two crossings of the Lancaster Canal. An option for the inclusion of an elevated station was considered south of the M55, which would be located on greenfield land with an approach to the in cutting and continuing north over the M55. Approaching the connection with the WCML, the route would descend into cutting and would join the WCML by a junction

at different levels, which would also require a realignment of the WCML to the east to facilitate the connection.

4.4.86 In comparison to the WCML connection north of Golborne, the alternative inclusion of an additional connection north of Preston near Brock would require approximately 63 additional demolitions. This alternative option would also impact the setting of up to three scheduled monuments and up to six Grade II listed buildings. In addition, there would be impacts on Arely Wood and Little Wood ancient woodlands as well as a number of BAP habitats. Given the length of the alternative connection (almost 46km), it would come close to a number of rural communities, such as Coppull Moor, Crankwood Hindley, Hutton and Ince-in Makerfield, which would result in noise, visual and landscape impacts. The elevated crossings of the Ribble River and Lancaster Canal (twice) would also introduce landscape and visual impacts, with a direct impact also on the Haigh Conservation Area. These impacts are all in addition to the proposed connection with the WMCL north of Golborne.

4.4.87 Whilst the connection to the WCML north of Preston would deliver journey time improvements between London and Glasgow and could provide a new parkway station on the outskirts of Preston, it was considered that the benefits gained from the journey time savings and new markets captured did not outweigh the substantial costs and additional sustainability impacts. For these reasons, it was determined that the alternative connection to the WCML north of Preston did not deliver sufficient economic or journey time benefits to offset the higher costs, sustainability impacts and lower regional connectivity.

Approaches to Manchester Piccadilly High Speed station

4.4.88 Two main approaches (Corridors D and E) to Manchester Piccadilly High Speed station were considered. Both would approach the terminus from the east side of the city centre. Each would have compatibility with all three corridor approaches from south Manchester and is illustrated in Figure 13. The route corridors are described in more detail in the Options for Phase Two – appraisal of sustainability report (2012).

4.4.89 Corridor D via the Mersey Valley would commence to the east of High Legh. A junction close to Mossbrow would provide an onward connection with the WCML north of Golborne and a spur into Manchester via the Mersey Valley. This would take a route from Mossbrow north-east, skirting the southern edge of Partington and Carrington before heading directly east following the River Mersey south of Stretford. The route would be in tunnel approaching Chorlton, after which the tunnel would head north beneath Rusholme and emerge at West Gorton alongside the existing conventional line into Piccadilly. Manchester Piccadilly High Speed station would be located parallel to, and immediately north of, Manchester Piccadilly Station.

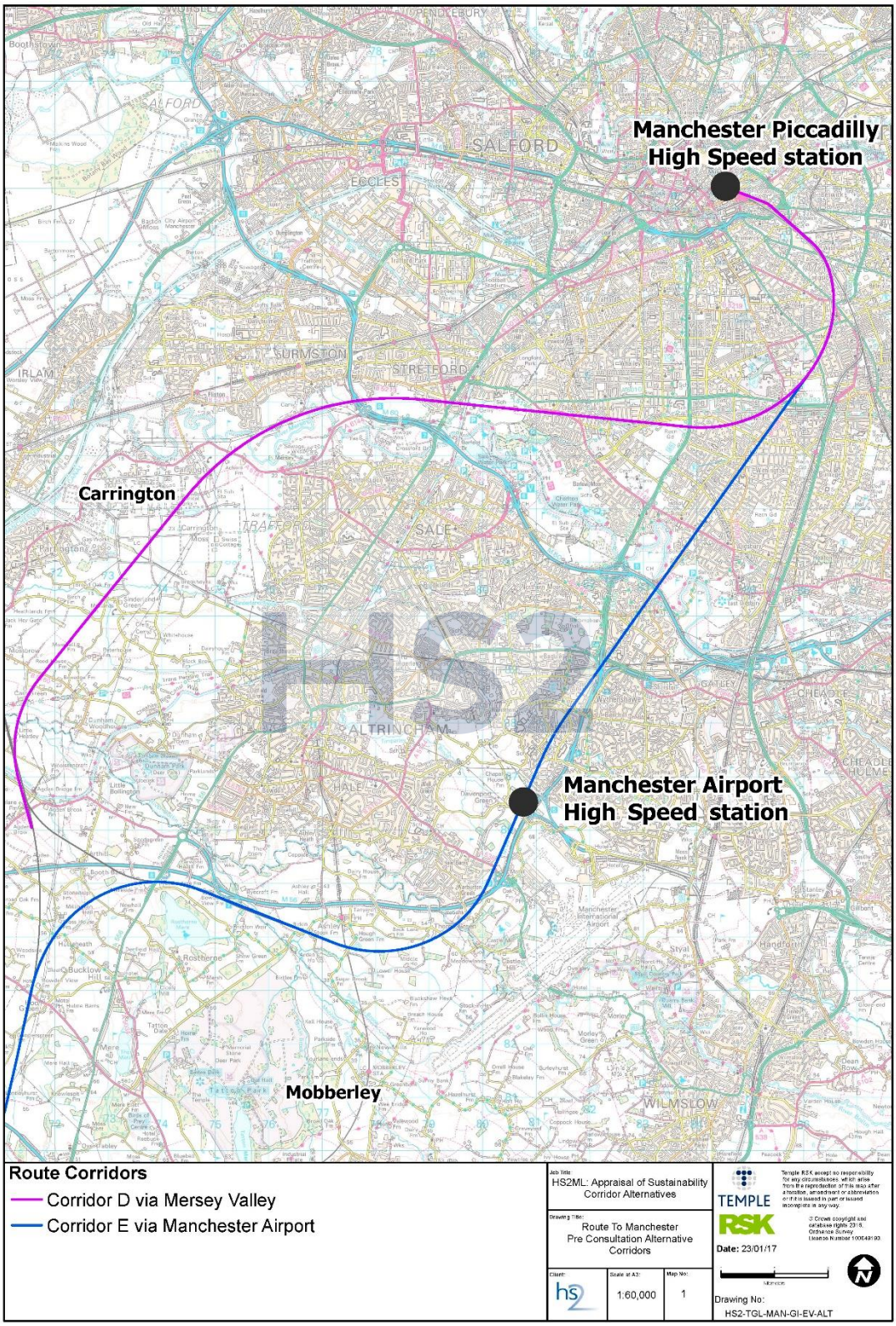
4.4.90 Corridor E via Manchester Airport would commence at Hoo Green and would branch to the east and would pass to the north of Rostherne Mere and Tatton Park before turning north near Thorns Green and Davenport Green, where provision would be included for a high speed interchange station to the north of Manchester Airport. An approximately 12km tunnel would then take the route below Wythenshawe and Withington before surfacing near

West Gorton and would run parallel to the existing conventional line approaching Manchester Piccadilly High Speed station. Similar to Option D, Manchester Piccadilly High Speed station would be located parallel to, and immediately north of, the existing station. The route would continue north from Hoo Green and would provide onward connectivity with the WCML north of Golborne.

Selection of a preferred approach to Manchester Piccadilly

4.4.91 As described in High speed rail: investing in Britain's future – Phase Two report (2013), the Government's initial preferred option for this route was Corridor E via a high speed station interchange station serving Manchester Airport. The approach via the Mersey Valley (Corridor D) had a number of engineering and sustainability constraints, particularly around Mersey Valley and the associated floodplain. These included a potential diversion of the River Mersey and landscape and visual impacts along the valley. This corridor would also require construction through a number of active and historic landfill sites. The approach via Manchester Airport (Corridor E) would be comparatively faster into Manchester Piccadilly and while it would be more costly to construct would provide more benefits associated with serving Manchester Airport.

Figure 13: Approaches to Manchester Piccadilly



Approach into a high speed station at Salford

4.4.92 As described above, Salford was considered the most reasonable alternative to a high speed terminus station at Manchester Piccadilly, with two station options proposed at Salford Central Middlewood and as part of a remodelled Salford Central Station. Both would be located in a similar geographical area and could align with Corridor F via Irlam or Corridor G via Chat Moss, as illustrated in Figure 14. The approaches into a high speed station at Salford are described within the Options for Phase Two – appraisal of sustainability report (2012).

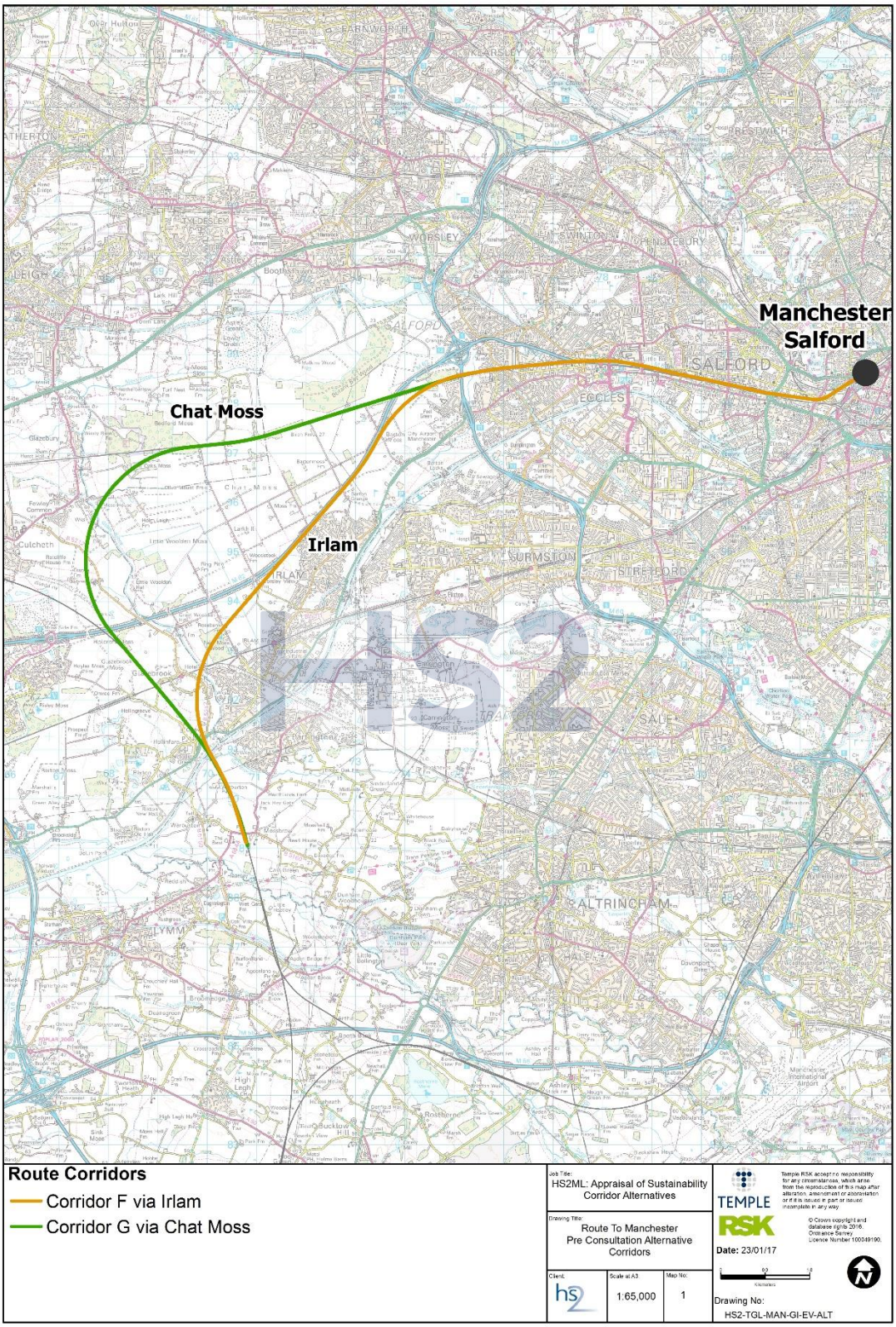
4.4.93 Whilst still providing an onward connection to the WCML north of Golborne, a high speed station at Salford would require an approach from the west of Manchester. A junction between the HS2 WCML connection and spur to Manchester would be required to the north of the Manchester Ship Canal.

4.4.94 There were two main corridor alternatives for an approach into a high speed station at Salford. Corridor F via Irlam would require a junction immediately north of the Manchester Ship Canal crossing, and then the Manchester spur would head east and to the north of Cadishead and follow the M62 approaching Eccles. The route would remain at surface through Eccles alongside the existing conventional line into Manchester before entering a tunnel to pass under Albert Road and would emerge to the west of the existing Salford Central Station.

4.4.95 The second alternative, Corridor G via Chat Moss, would require a junction further north to the south of Culcheth close to where the route would cross the M62. The spur into Manchester would then head east alongside the Liverpool to Manchester Line (Chat Moss) on the northern side before crossing the M62 for a second time. The route would then follow a similar approach to Corridor F into Salford from Eccles, using a tunnel to approach a high speed station at either Salford Central Station or Salford Central Middlewood.

4.4.96 The high speed station at Salford and the corresponding approach corridors were not taken forward because the high speed station at Manchester Piccadilly was selected as the preferred terminus station. The approach corridors to a high speed station at Salford would also not serve a high speed interchange station at Manchester Airport and would therefore not capture the demand from Stockport and south Manchester.

Figure 14: Approaches to Manchester Salford



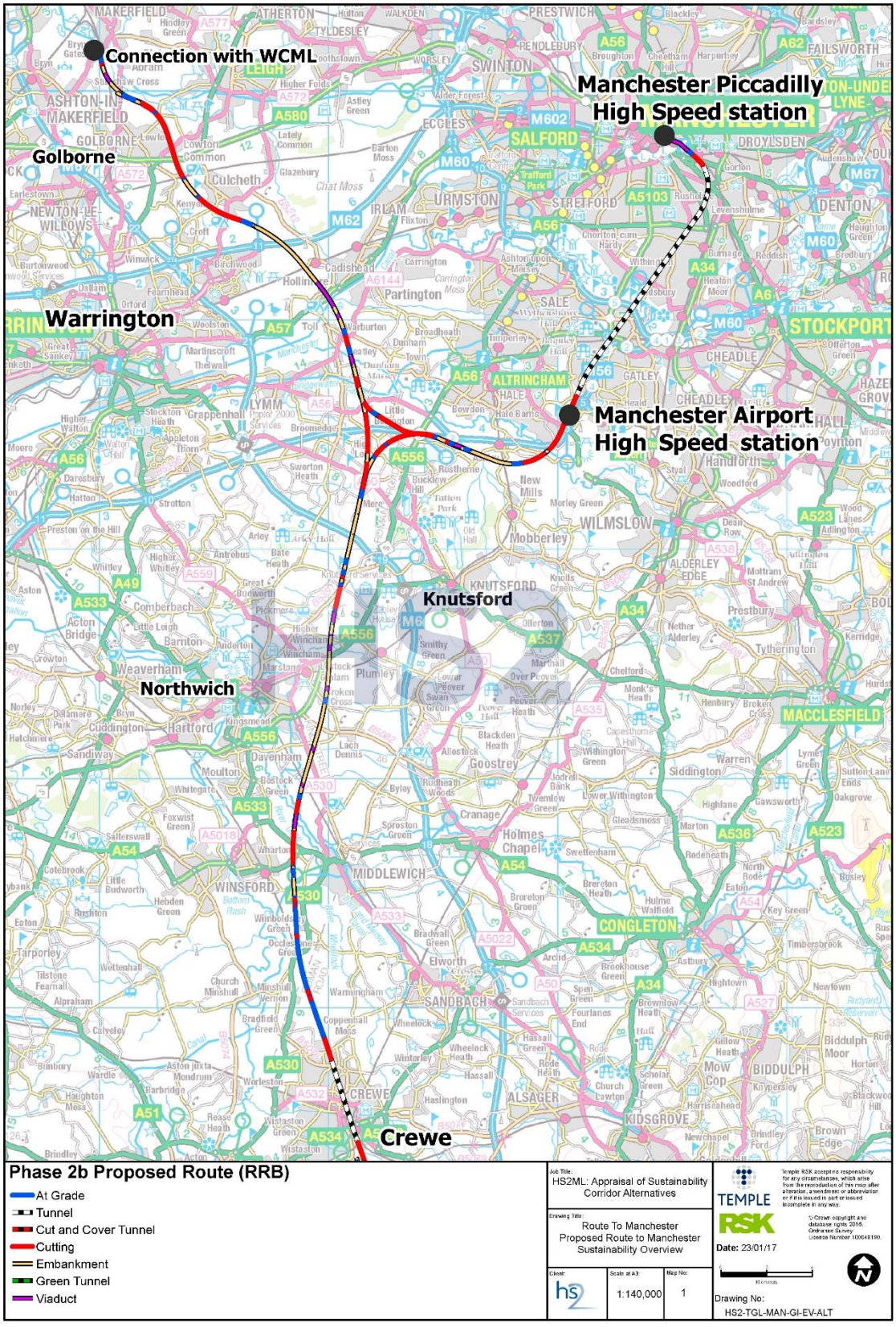
Proposed route to Manchester Piccadilly (from the connection with Phase 2a)

4.4.97 The proposed route to Manchester comprising Corridor A via Crewe and Corridor E via Manchester Airport, together with a connection on to the WCML north of Golborne, was published for consultation in 2013 within the Phase Two initial preferred scheme sustainability summary (2013). Changes have since been made to the 2013 proposed scheme for consultation in response to consultation feedback and because of a number of engineering and/or environmental reasons.

4.4.98 In addition to the consideration of local alternatives along the Western Leg to Manchester, further work was undertaken to re-visit the previous alternative approach to Manchester Piccadilly via the Mersey Valley. This was in response to consultation feedback and further design and assessment to ensure that, on balance, the best possible options were progressed.

4.4.99 The following sections describing the proposed route to Manchester Piccadilly and the alternative via a Mersey approach, provide further detail on the development of this alternative corridor and the comparisons against the preferred option at the time of appraisal (Figure 15). The Mersey approach was treated the same way as any other post-consultation refinement and compared against the preferred route for the equivalent sections.

Figure 15: Proposed HS2 Phase 2b Western Leg (July 2013)



Proposed route to Manchester Piccadilly – route description

4.4.100 The description below provides a review of the 2013 proposed scheme for consultation. The proposed route was compared with an alternative corridor approach into Manchester Piccadilly (Figure 16). Further refinements were made to the route as part of subsequent design development described later in the report.

4.4.101 The route to Manchester would commence north of the A500, immediately south of Crewe and would connect to Phase 2a[39]. The route would approach the Crewe Station in a bored tunnel and would continue under central Crewe before surfacing north of Bradfield Road. The route would emerge from tunnel through the town's northern outskirts and on the east side of the WCML, maintaining this alignment as far as Walley's Green. Near the A530 the route would move away from the WCML and would continue north across the Cheshire plain. The route would pass between Winsford and Middlewich and continue north on a series of embankments and viaducts and would cross the River Dane and Trent and Mersey Canal Conservation Area. The route would continue north and would pass to the east of Lostock Green and Lostock Gralam on a mix of viaduct and embankment. The route would be on embankment for several kilometres across farmland east of Higher Wincham and Pickmere before crossing over the M6 to Hoo Green, where the Manchester junction would be located.

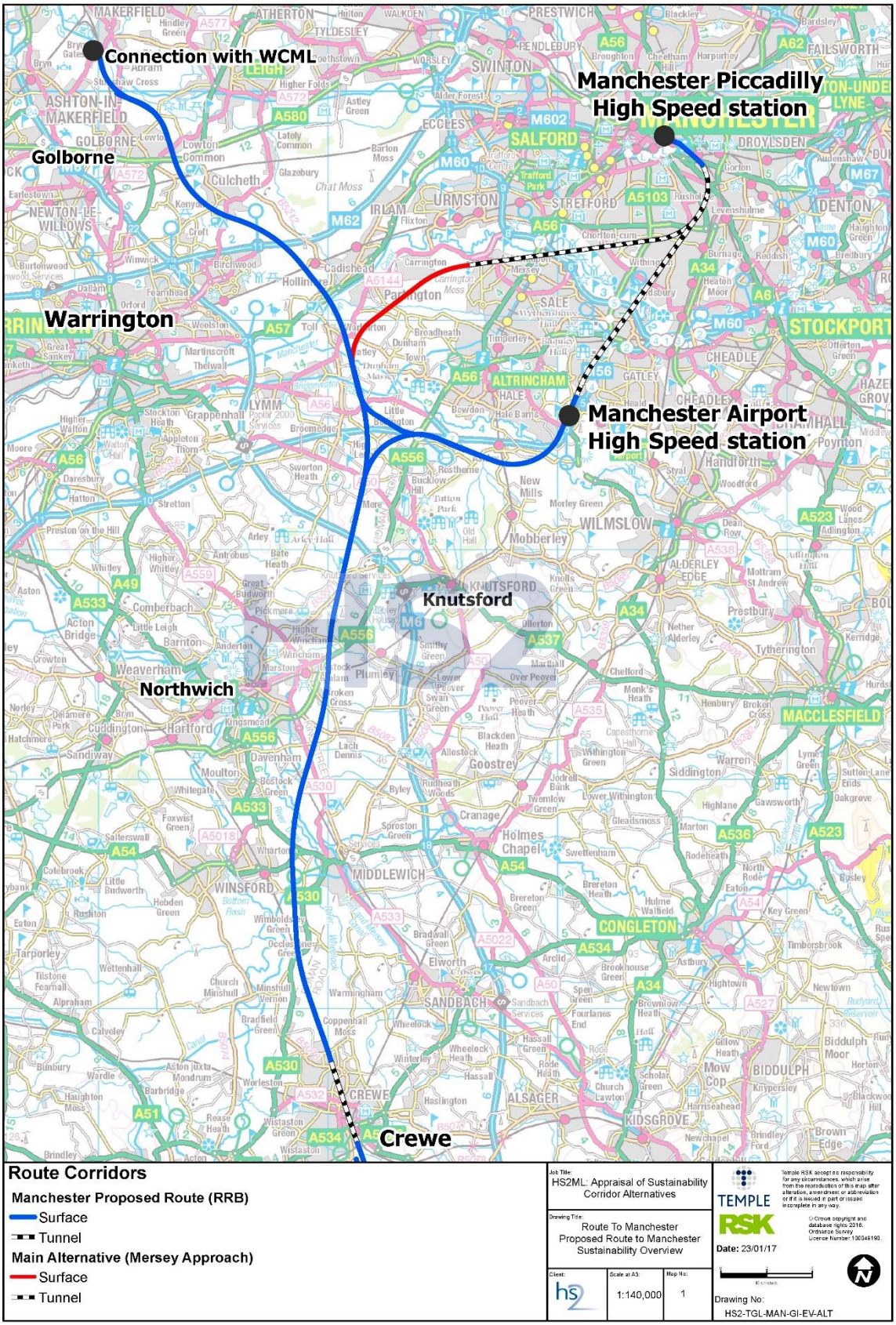
4.4.102 The HS2 WCML connection would continue north and a spur to Manchester would bear east towards the high speed station at Manchester Airport.

4.4.103 From the Manchester junction at Hoo Green, the HS2 Manchester spur would pass east and to the north of Rostherne Mere in cutting before crossing Blackburn Brook, Birkin Brook and the River Bollin to the south of Ashley. The route would then head north-east in cutting through the settlements of Thorns Green, Halebank and the edge of Warburton Green approaching the proposed high speed station at Manchester Airport. The high speed station at Manchester Airport would be located within green belt close to Davenport Green. Immediately north of the high speed station, the route would enter a bored tunnel approximately 12km long beneath much of southern Manchester before re-surfacing at West Gorton. The route would then rise onto embankment and viaduct approaching Manchester Piccadilly High Speed station.

4.4.104 The terminus station would be built alongside the existing station at Manchester Piccadilly. The high speed station would provide for interchange with existing public transport, and improved pedestrian access in the area as well as offering substantial potential for supporting local economic activity and development.

[39] The connection with Phase 2a changed following a decision to extend the tunnel under Crewe by 2.55km further south as part of the Phase 2a hybrid Bill process.

Figure 16: Proposed route to Manchester Piccadilly and reasonable alternative



Reasonable alternative – Mersey approach

4.4.105 An alternative route approaching Manchester Piccadilly High Speed station centred principally on the Mersey approach, a corridor initially considered as part of the Options for Phase Two – Appraisal of Sustainability report (2012), which was reviewed again following the 2013/2014 consultation.

4.4.106 The Mersey approach was refined and focused on variations in tunnel length and the route under south Manchester, together with the location of the tunnel portal. Consideration was also given to reduce intersecting a series of landfills along and around the Mersey Valley as well as the River Mersey. A review was also conducted into the possibility of including a high speed interchange station in the south Manchester area.

4.4.107 A direct comparison was made between the 2013 proposed scheme for consultation and the Mersey approach. As the Mersey approach shares the same route with the 2013 proposed scheme for consultation from Crewe to the Manchester Ship Canal, the route section directly south of the Manchester junction was removed from the comparison. Figure 17 shows both routes and the extents of comparison.

4.4.108 The Mersey approach included a similar connection to the WCML north of Golborne as that of the 2013 proposed scheme for consultation. However, the junction for the Manchester spur would be located further north, immediately after the crossing of the Bridgewater Canal, east of Lymm. The spur would then branch north-east to the south of Mossbrow on a mix of viaduct, embankment and cutting before rising onto embankment south of Partington, which would run within the boundary of National Trust land. A double viaduct crossing of the River Bollin would be required causing landscape and visual impacts east of the village of Heatley. A short viaduct crossing of the Red Brook would be followed by a long stretch of embankment where the route would continue north-west bisecting a development site at Carrington.

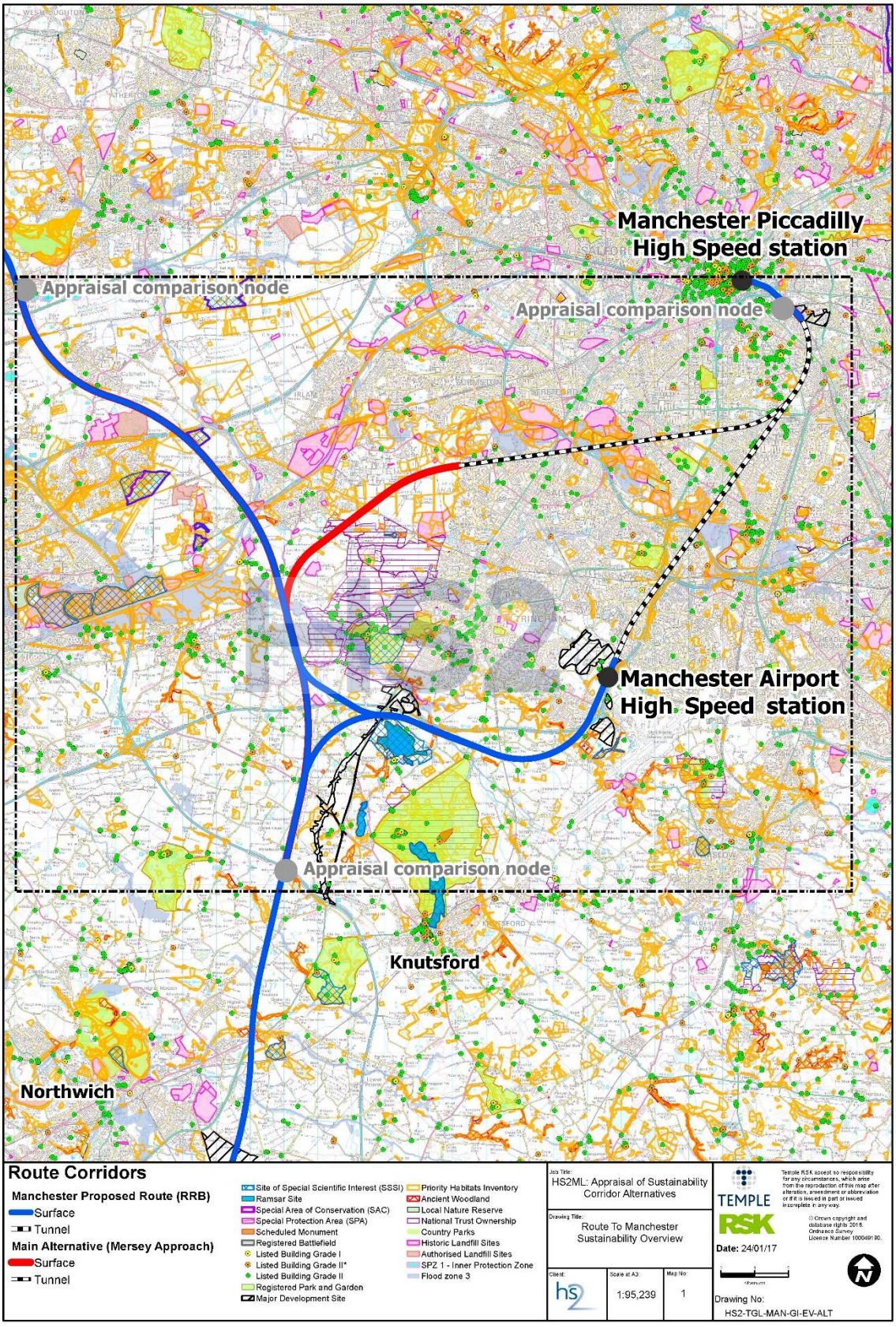
4.4.109 To reduce the impacts on the Mersey Valley, the refined alternative approach would pass into tunnel on the edge of the main urban area approaching Trafford, thus avoiding the Mersey Valley and associated flood risk, landscape and visual impacts further north. The route would continue east in bored tunnel for just under 14km, below Sale, Chorlton and Fallowfield before heading north under Rusholme and emerging from tunnel at West Gorton, on the eastern side of the existing conventional line approaching Manchester Piccadilly Station. Approaching Manchester Piccadilly Station, the Mersey approach would follow a similar horizontal and vertical profile of the 2013 proposed scheme for consultation, with the same impacts at West Gorton and the station.

4.4.110 The Mersey approach also provided opportunity to explore a depot at Carrington as an alternative to depot options at Golborne and north Crewe (considered as part of the 2013 post-consultation local refinements). The Carrington depot would be situated to the north of the spur into Manchester, within a development site at Carrington. A connection onto the existing conventional line would be achieved by re-opening a disused line east of Partington and connecting onto the existing conventional line at Glazebrook. This connection would

also require the reinstatement of an additional crossing of the Manchester Ship Canal, with additional land required from Coroners Wood Ancient Woodland on the approach to the crossing. Visual impacts from the depot would be limited due to the industrial nature of the existing land, although re-establishing the disused line for connectivity with the existing conventional line would introduce new visual impacts at Partington.

4.4.111 Options for a high speed interchange station as part of the Mersey approach were considered near the M6 crossing south of Hoo Green, as well as north and south of the M56, east of High Legh. However, an interchange station in these locations did not perform well in regard to demand, cost and benefits and were therefore not taken forward.

Figure 17: Proposed Manchester Piccadilly station approach and reasonable alternative



Summary of sustainability impacts

4.4.112 Table 1 summarises the sustainability impacts of the proposed route into Manchester Piccadilly via Manchester Airport and the alternative route via Mersey Valley as appraised following the 2013/2014 consultation. The key sustainability constraints are shown on the route comparison map (Figure 17), together with the route sections compared for this appraisal. The summary table includes a full appraisal of impacts of both routes between the node points highlighted on the figure.

Table 1: Proposed route and alternative route via Mersey approach comparison table

Topic area	Proposed route to Manchester via Manchester Airport consultation route with updated design standards applied	Alternative route via Mersey approach
Property and Community Integrity	Demolitions (approximately): 54 residential 46 commercial One community Two industrial **Approximate total: 103**	Demolitions (approximately): 35 residential 41 commercial One community Two industrial **Approximate total: 79**
Noise (annoyance)	Approximately 160	Approximately 190
Landscape and Visual Impacts	Major landscape and visual impacts crossing the Manchester Ship Canal Moderate visual impacts at Ashley and Hale Barns	Major landscape and visual impacts crossing the Manchester Ship Canal Moderate to major landscape in the Bollin Valley
Planning and Development	Direct impact on two development sites (West Gorton, Davenport Green)	Direct impact on two development sites (West Gorton, Carrington)
Cultural Heritage	Direct impact on two Grade II listed buildings (Newchurch Old Refectory, Buckhall) Major impact on the setting of one Grade II listed building (Mere Court) Moderate impact on the setting of two Grade II listed buildings (Ovenback Cottage, The Chapel House)	Direct impact on one Grade II listed building (Newchurch Old Refectory) Major impact on the setting of one Grade II listed building (Mere Court) Moderate impact on the setting of one Grade II listed buildings (Bank Cottage)
Biodiversity and Wildlife	Two ancient woodlands directly affected (Coroners Wood and Hancock's Bank) 31 Habitats of Principal Importance intersected for approximately 1.9km	One ancient woodland directly affected (Coroners Wood) 31 Habitats of Principal Importance intersected for approximately 2.7km
Water Resources and Flood Risk	Four diversions of minor watercourses Two crossing where HS2 Manchester spur could be at risk of river flooding Approximately 800m of route in cut/tunnel through source protection zone 2	Two diversions of minor watercourses Two crossing where HS2 Manchester Spur could be at risk of river flooding Approximately 800m of route in cut/tunnel through source protection zone 2
Land use resources	One active landfill site intersected One historical landfill site intersected 41km of green belt land intersected	One active landfill sites intersected One historical landfill sites intersected 26km of green belt land intersected

Proposed route and alternative route via the Mersey approach summary

4.4.113 The Mersey approach performed comparatively better from a sustainability perspective, including fewer demolitions and fewer impacts on heritage assets, although this approach would bring the route closer to larger population areas and thus more potential noise impacts. The Mersey approach would cost less owing to its shorter route length when compared with the route via Manchester Airport. However, the key driver for the recommended continued progression of the route via Manchester Airport was the opportunities associated with provision of a high speed station at Manchester Airport. Having a high speed station at Manchester Airport was seen by Government and key stakeholders as vital for maximising connectivity to international markets and also for unlocking further development potential, building upon the success of the Airport City Enterprise Zone.

Part III

5 Local alternatives considered before July 2017

5.1 Introduction

5.1.1 This section provides an overview of the alternatives studied and sifted within different geographic areas (refinement areas) following the 2013/2014 consultation and prior to July 2017. It sets out the option chosen for progression and the main reasons to support the decision.

5.1.2 For each refinement area, a decision tree diagram shows the options taken forward to full sift appraisal, with a short description in the diagram and the preferred option highlighted in green. Further options in grey were proposed but were either not progressed or not considered the preferred option for that appraisal stage. Those shown in blue were progressed to the next sift stage.

5.1.3 For each local alternatives studied, each option is appraised in terms of sustainability performance against the preferred option taken forward.

5.2 Crewe to Manchester

Local alternatives considered post 2013/2014 consultation

Introduction

Route refinements – post 2013/2014 consultation

5.2.1 Following the period of public consultation on the 2013 proposed scheme for consultation between July 2013 and January 2014, route refinement work was undertaken. The Western Leg of the 2013 proposed scheme for consultation was divided into geographically based refinement areas that were subject to further design and appraisal. The post 2013/2014 consultation refinement areas were as follows and are shown on Figure 18:

- Crewe surface;
- Middlewich to Pickmere (routes through salt mining areas);
- WCML connections north of Crewe;
- Delta junction zone 1;
- Delta junction zone 2;

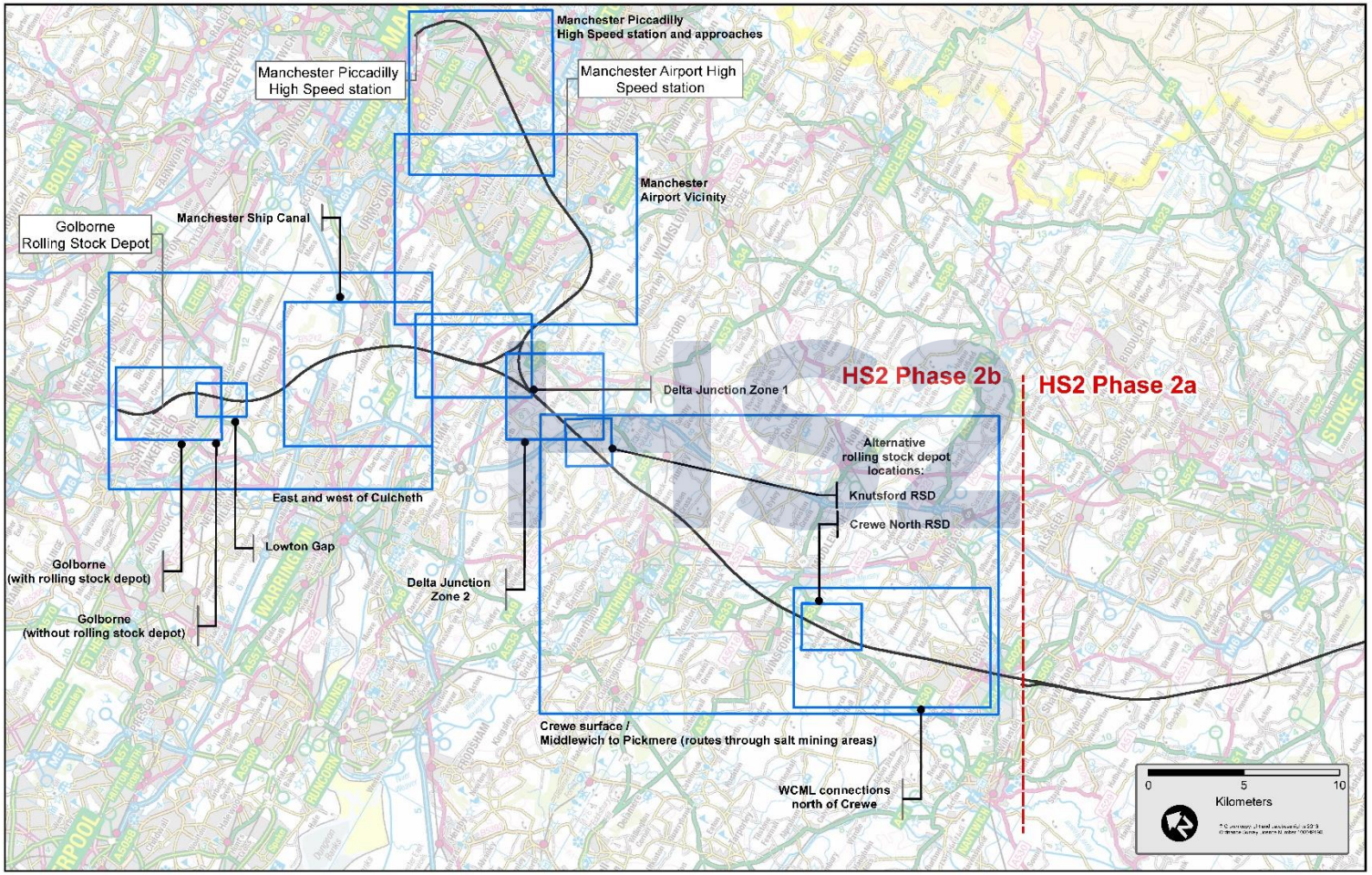
- Manchester Ship Canal;
- East and west of Culcheth;
- Lowton gap;
- Alternative rolling stock depots locations;
- Golborne (without rolling stock depot);
- Maintenance loops at Golborne;
- Manchester Airport vicinity; and
- Manchester Piccadilly High Speed station and approaches.

5.2.2 Post-consultation refinements of the Western Leg focused on discrete sections of route. In some instances, there was an overlap between the refinement areas meaning that certain parts of the route may have been refined multiple times. There were also sections of the route which, following the public consultation in 2013 and 2014, that were not refined. These sections were subject to minor amendments to meet the developing standards and requirements, but not subject to formal refinement.

5.2.3 For the purposes of undertaking post 2013/2014 consultation refinements, the baseline used for comparison is described as the route refinement baseline (RRB), which is similar to the 2013 proposed scheme for consultation but with updated design standards applied. This RRB is shown in dark blue on the tree diagrams with other options considered as part of the initial and intermediate sifts in light blue.

5.2.4 Each of the options were appraised against the RRB. However, the comparison of the impacts are compared against the option that was chosen to be taken forward into the design (the preferred option). In some instances, whilst the preferred option was chosen as the most appropriate at that stage of development, subsequent work may have led to the option being revisited. Where this is the case, it is noted in the relevant sections below.

Figure 18: Local alternatives considered post 2013/2014 consultation

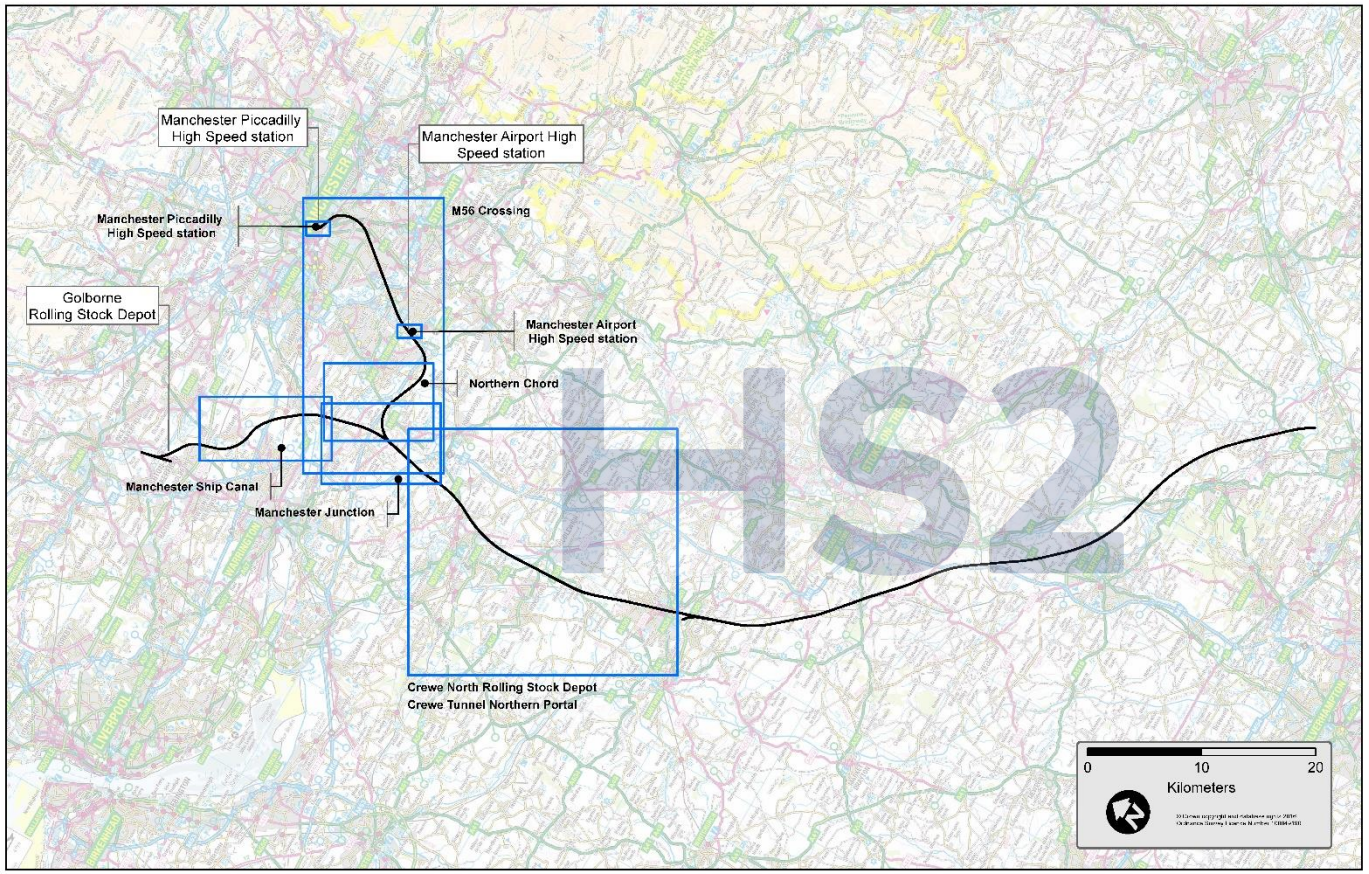


Further route refinements

5.2.5 A series of further refinements were undertaken in late 2015. These refinements addressed comments arising from consultation and ongoing engagement that required further consideration. For these refinements, all options were sifted against the draft refined route (DRR) as the baseline, as opposed to the RRB used during the refinements following the 2013/2014 consultation. The DRR incorporated the preferred route options adopted following the 2013/2014 consultation refinements (listed above). These further refinements considered more detailed changes in areas that had been considered in earlier stages of the sifting process. The further refinement areas were as follows, as shown on Figure 19:

- Crewe tunnel northern portal;
- Manchester junction;
- Northern chord;
- M56 crossing;
- Manchester Ship Canal;
- Crewe north rolling stock depot;
- Manchester Airport High Speed station; and
- Manchester Piccadilly High Speed Station.

Figure 19: Local alternatives for further refinement



Crewe surface

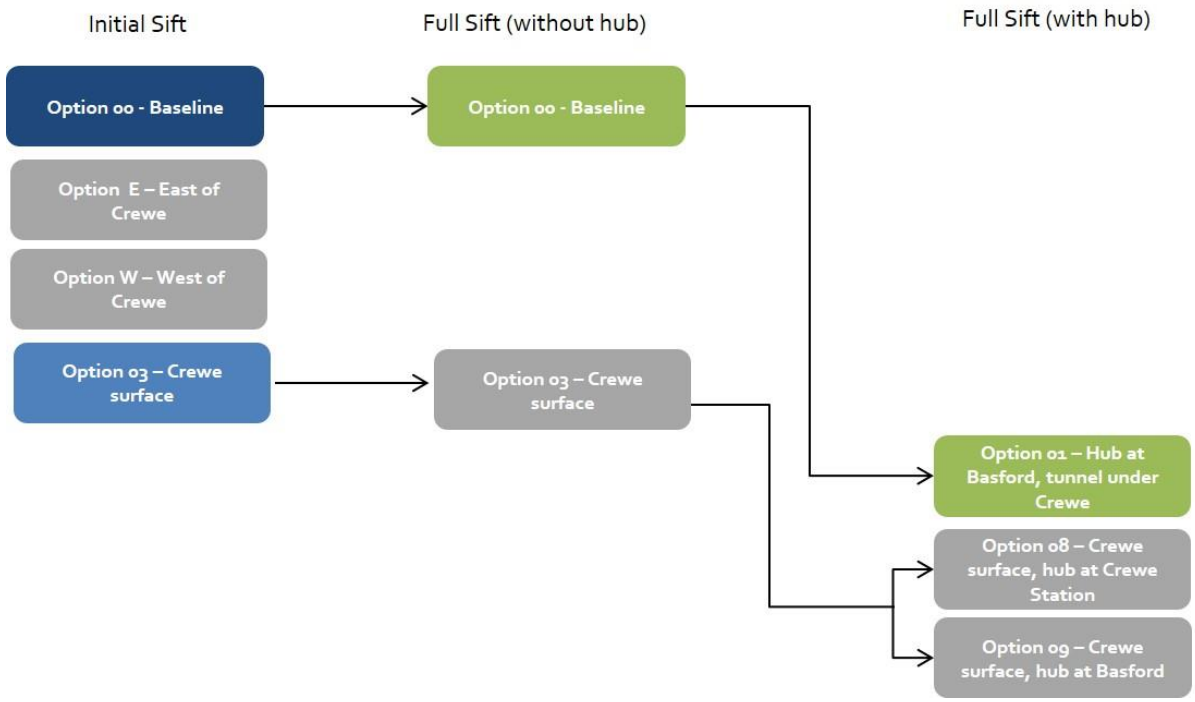
5.2.6 This refinement covered approximately 32km of the route from Chorlton to the M6 crossing north of Pickmere. The focus of the refinement was the area around Crewe, with the route north of Crewe after crossing the A530 the same across all options. The refinement sought initially to explore the possibility of reducing costs associated with the approximately 3.8km tunnel under Crewe with options to run through or around Crewe on the surface. Consideration was also given to the potential integration with Network Rail proposals for a Crewe Hub, providing platforms for connection with Phase 2b at Crewe.

5.2.7 Four options were considered initially for this section of the route. Options exploring routes east and west of Crewe were discounted early on as these routes would have required large deviations to the route in a highly urbanised area with likely speed reductions, complex interface with existing freight lines, and would not provide the required connectivity with the WCML at Crewe. The option would also have required notable numbers of demolitions, had noise and visual impacts and potential impacts on water resources due to interfaces with rivers on both the east and west.

5.2.8 Two options were taken forward after an initial sift appraisal to a full sift appraisal (without Crewe Hub). Following this, a further three options were taken to a full sift following a recommendation for further refinement to take into consideration the likely interface with a Crewe Hub. Further studies were also undertaken to consider road diversions and demolitions.

5.2.9 All options presented at the full sift had the same route to the north of Crewe. The areas to the south of, and through Crewe, varied between the options to allow for two possible locations of a Crewe Hub. All options had a WCML connection and a dedicated HS2 platform at the hub station. The options taken forward in the sift stages are shown in Figure 20 and described in the subsequent paragraphs. The locations of the options are shown in Figure 21.

Figure 20: Local alternatives considered for surface routes through Crewe



5.2.10 For the sift without Crewe Hub, HS2 Ltd determined that Option 00 should be progressed as the preferred option over Option 03. Option 00 would approach Crewe in cutting alongside the WCML and would then be in tunnel under Crewe Station. Option 00 would have fewer sustainability impacts in terms of noise and demolitions, as well as lower construction complexity, less impacts on highway and would cost less than Option 03. Following this sift, Option 00 became Option 01 in order to test a scenario serving a Crewe Hub.

5.2.11 For the sift with a Crewe Hub, the following three options were taken forward to the full sift appraisal:

- Option 01: would approach Crewe in a cutting alongside the WCML before entering an approximately 3.8km bored tunnel under Crewe Station. The bored tunnel would surface towards the northern edge of Crewe, north of Bradfield Road and would then continue north and north-east across the Cheshire Plain. This would include provision for an interface with a potential Crewe Hub at Basford, south of Crewe Station;
- Option 08: would similarly approach Crewe alongside the WCML, but would continue to run in a cutting alongside the WCML through central Crewe. This would include provision for an interface with a potential Crewe Hub at Crewe Station; and
- Option 09: would approach Crewe alongside the WCML but would continue to run in a cutting alongside the WCML through central Crewe. This would include provision for an interface with a potential Crewe Hub near Basford Hall, south of Crewe Station.

5.2.12 HS2 Ltd determined that Option 01 should be progressed as the preferred option. The bored tunnel option would have substantially less sustainability impacts, as well as lower construction complexity relating to running alongside the WCML in cutting, whilst still

providing provision for interfacing with a potential Crewe Hub, if required. In addition, any surface option would have significant impact on the existing road network through Crewe.

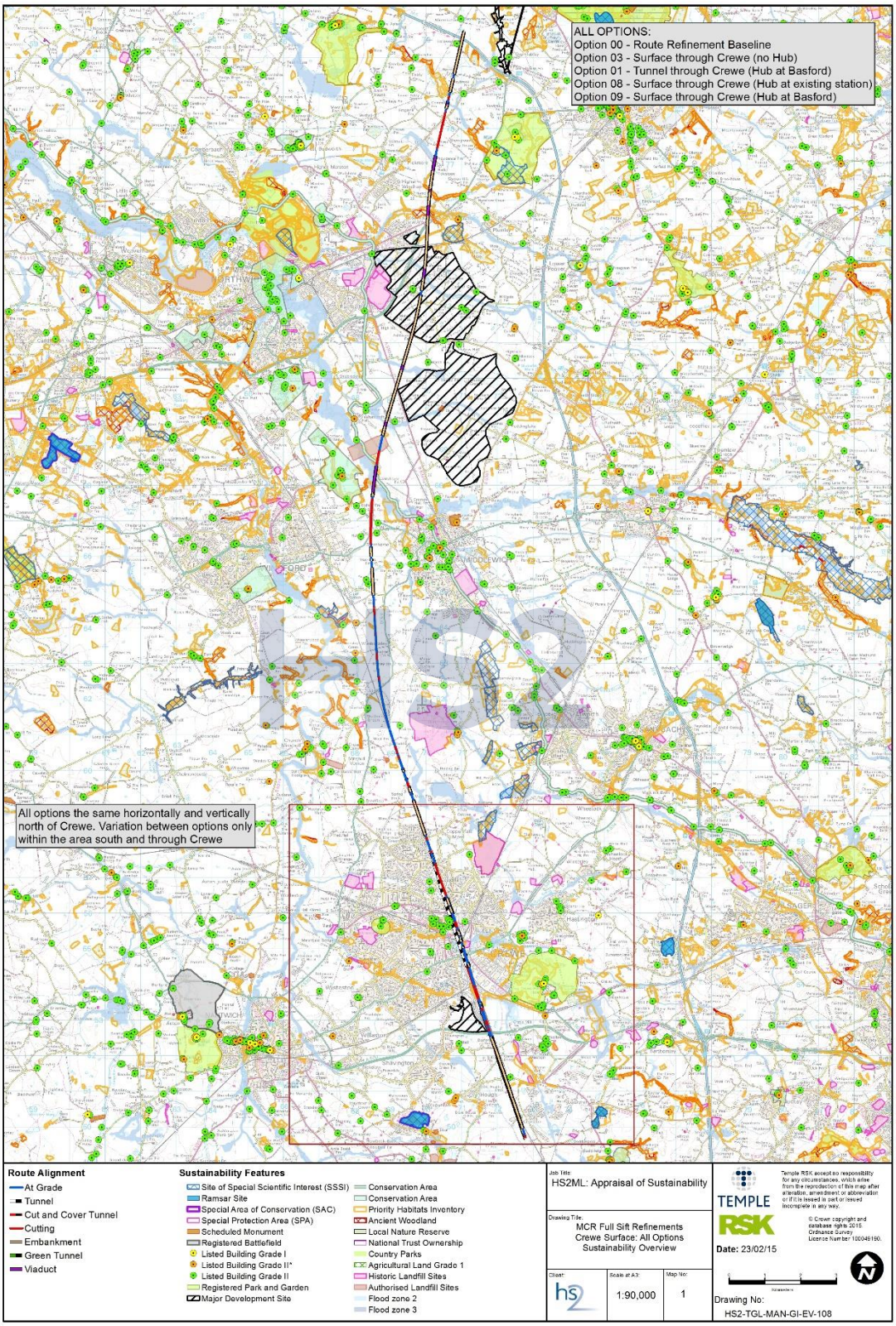
5.2.13 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.14 The preferred option, Option 01, would have moderate landscape and visual impacts, particularly at Chorlton to the south of Crewe where the route would be on a high viaduct before lowering on the approach into Crewe. Before entering the bored tunnel south of Crewe Station, the route would pass in cutting through Gresty Brook, where there would be a risk of river flooding. For the area of route around Crewe, there would be approximately two demolitions, both close to the northern tunnel portal. These impacts were similar to those of the alternative Option 00, which was the previously preferred option.

5.2.15 Option 08 would similarly have moderate landscape and visual impacts around the Chorlton area to the south of Crewe. Whilst this route option would avoid the flood risk associated with crossing Gresty Brook in cutting, the surface route through Crewe would have greater impacts on the community, requiring over approximately 110 demolitions in and around Crewe. Noise impacts would also be higher compared with the preferred option, with the surface route through central Crewe close to a number of residential areas.

5.2.16 Option 09 would, similar to the preferred option, have moderate landscape and visual impacts around the Chorlton area to the south of Crewe. As with Option 08, this route would avoid the flood risk associated with crossing Gresty Brook in cutting. However, similar to Option 08, the surface route through Crewe would have greater impacts on the community, requiring over approximately 90 demolitions in, and around, Crewe. Noise impacts would also be higher compared with the preferred option, with the surface route through central Crewe close to a number of residential areas.

Figure 21: Local alternatives considered for surface routes through Crewe



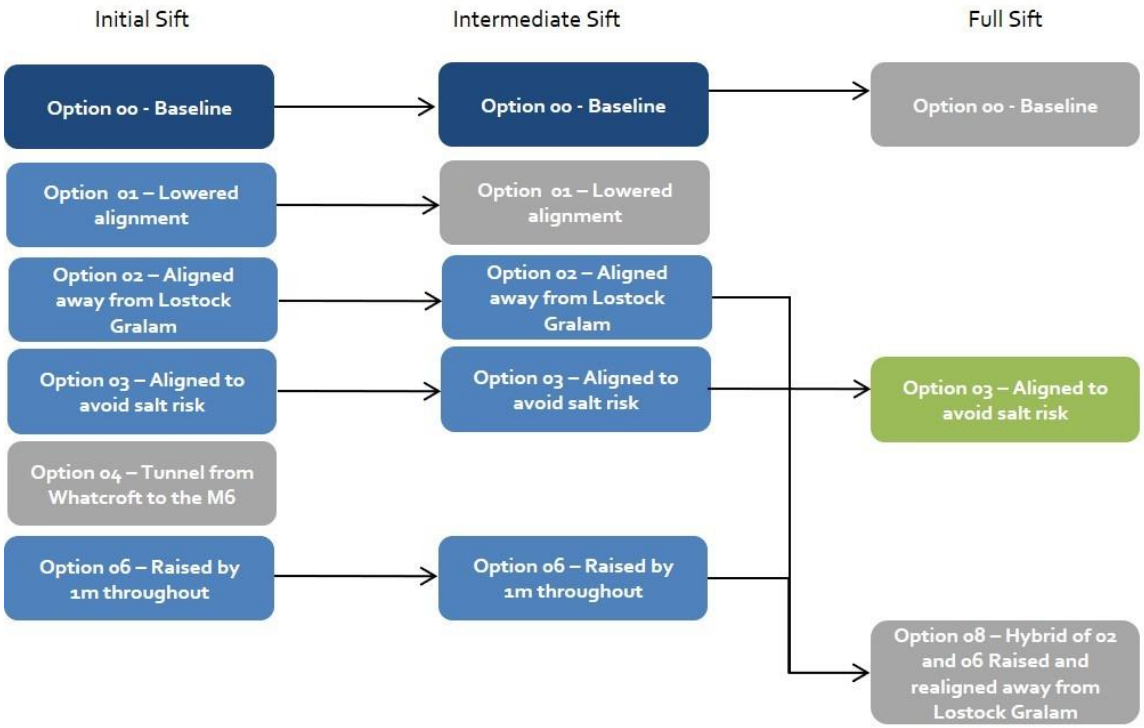
Middlewich to Pickmere (routes through salt mining areas)

5.2.17 This refinement area covered approximately 26km of the route from the tunnel portal south of Crewe to the M6 crossing north of Pickmere. The refinement considerations were to address the concerns over the proximity of the route to the villages of Lostock Green and Lostock Gralam as well as Pickmere Telescope. The refinement also considered the risks associated with the large expanse of salt fields and salt mining north of Crewe and gas storage in the area. As part of the refinement, a further review of alternative route corridors from Crewe heading north-east towards Manchester Airport via Mobberley was undertaken.

5.2.18 HS2 Ltd considered three options as part of alternative routes towards Manchester Airport via Mobberley. These were taken to an intermediate sift based on a review of previous evidence, which reaffirmed the original conclusions that these alternative routes were less viable from a cost, engineering and/or sustainability perspective, when compared with the RRB. A further six options were considered as alternatives to the route across north Cheshire to join with the Manchester junction at Hoo Green. Five options were taken to an intermediate sift, of which two existing options plus a further option were progressed to full sift. These were Options 00, 03 and 08. Option 08 was developed following the intermediate sift and was a hybrid of previously considered Options 02 and 06.

5.2.19 Following more detailed investigation into concerns raised regarding geological salt and gas storage risk, some further refinement work was undertaken. Options previously considered were revisited, with Option 03 brought back into consideration from the earlier intermediate sift. Following this review, three options were considered as part of the July 2014 Middlewich to Pickmere refinements, which sought to address geological salt and gas storage risks. These included the RRB, together with the hybrid Option 08 and a redesigned Option 03. These three options were progressed to a full sift, as shown in Figure 22 and described in the subsequent paragraphs. The location of the options are shown in Figure 23.

Figure 22: Local alternatives considered for Middlewich to Pickmere



5.2.20 The following three options were taken forward to the full sift appraisal:

- Option 00: the RRB would run in a bored tunnel under Crewe, surfacing to the north near Coppenhall alongside the WCML. It would continue northwards in a mix of shallow cutting and at ground level, moving away from the WCML near Wimboldsley and would continue north between Winsford and Middlewich. The route would cross the River Dane and the Trent and Mersey Canal on an approximately 10m high viaduct, before rising onto embankment. The route would turn north-east towards Lostock Gralam, passing to the east of Lostock Green and continue to the west of Pickmere Telescope before entering cutting and then onto embankment approaching the M6;
- Option 03: would be in bored tunnel under Crewe before surfacing near Coppenhall, after which the route section would continue at a minimum height of 1m above ground level. North of Crewe, the route would initially follow a similar route to Option 00 and would head north to the west of Wimboldsley on embankment between Middlewich and Winsford. The route would then continue north and would cross the River Dane on an approximately 26m high viaduct, with three crossings of the Trent and Mersey Canal. Approaching Rudheath, the route would start to head north-east alongside the A556 to the west of Lostock Green and would continue north to the east of Lostock Gralam and Pickmere Telescope. It would continue on embankment over the M6; and
- Option 08: would follow a similar route to Option 00 but upon surfacing north of Crewe would be elevated throughout the length of this section to a minimum height of 1m above ground level. The route would head north of Crewe on low embankment, before on an approximately 26m high viaduct crossing of the River Dane and would continue on a mix of embankment and viaduct towards Lostock Gralam. This route would include an

approximately 60m shift eastwards (compared to the RRB) and would pass Lostock Green and continue north towards and across the M6 on embankment.

5.2.21 Options 03 and 08 were taken forward as viable alternatives, pending further investigation into the salt/brine and gas storage risks. Option 03 was subsequently confirmed as the preferred option due to the lower geological risk associated with avoiding salt mining and gas storage areas.

5.2.22 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.23 Option 03 was considered preferable as it would avoid salt mining and gas storage area and thus would have lower geological impacts, lower construction complexity and maintenance requirements associated with crossing this terrain. However, it was acknowledged that in avoiding these areas, there would be greater landscape, visual, noise and community (demolitions) impacts due to the higher alignment and the proximity to larger population areas.

5.2.24 The preferred option, Option 03 would have moderate to localised major landscape and visual impacts as a result of the higher alignment throughout much of the low-lying Cheshire Plains and proximity to communities. This would include an approximately 26m high crossing of the River Dane, which would impact the landscape character and result in visual impacts to the residents of Lostock Green and Lostock Gralam, with the route on embankment within approximately 200m of both settlements. The triple crossing of the Trent and Mersey Canal would have an impact on the setting of the associated conservation area and have a visual impact on recreational users. A diversion of the River Dane may also be required. The preferred option would also have a direct impact on two ancient woodlands (Leonards and Smokers Wood and Winnington Wood) north of Lostock Green, where the route would cross on high viaduct. Approximately 24 demolitions would be required, including two clusters of residential demolitions near Lostock Green. Coppenhall Moss, Lostock Green, Lostock Gralam, Higher Wincham and Pickmere would all experience noise impacts as a result of the higher route through this area. This option would also clip the western edge of the Keuper Gas Storage development site.

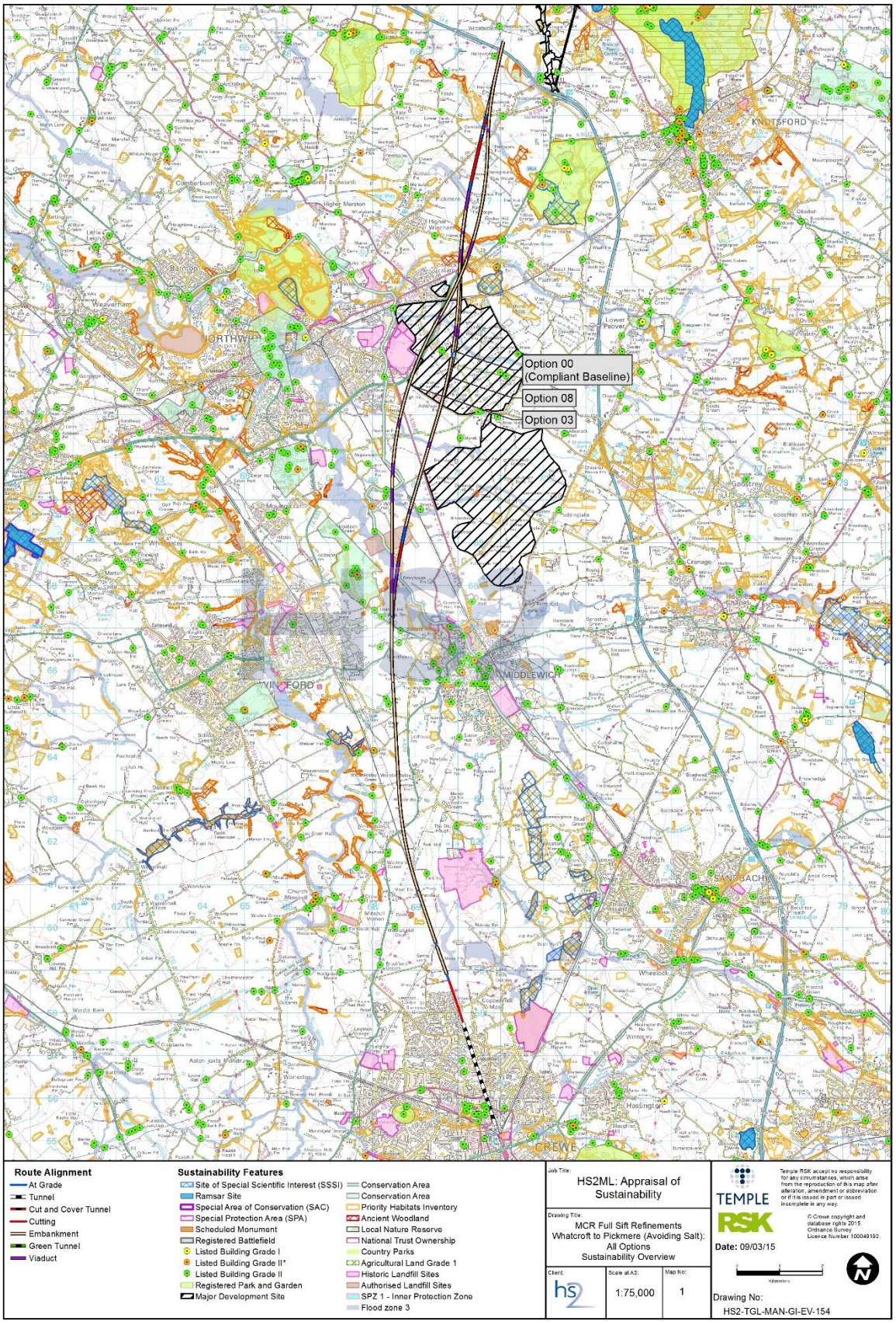
5.2.25 Option 00 (RRB) would have minor to moderate landscape and visual impacts as a result of the structures within a relatively flat rural landscape, although less of an impact compared with the preferred option due to the greater distance from settlements along the route and lower alignment throughout. There would be only one crossing of the Trent and Mersey Canal, compared with the three crossings of the preferred option, although similar to the preferred route, there would be an impact on two ancient woodlands (Leonards and Smokers Wood and Winnington Wood). Option 00 would cross through the middle of the Keuper Gas Storage development site. Option 00 would require approximately 11 demolitions, which would be fewer than the preferred option.

5.2.26 Option 08 would have moderate landscape and visual impacts as a result of being raised along its length upon surfacing north of Crewe. Following a broadly similar route to Option 00, it would have a single crossing of the Trent and Mersey Canal. There would be visual

impacts at Lostock Green and Lostock Gralam with the route on high embankment, similar to the preferred option. Similar to the preferred option, this route would have a direct impact on two ancient woodlands (Leonards and Smokers Wood and Winnington Wood). The route would cross the centre of the Keuper Gas Storage development site, unlike the preferred option, which would clip the western edge. Option 00 would require approximately 11 demolitions, which would be fewer than the preferred option.

5.2.27 Further consideration is given in Section 6.3 to local alternatives identified after July 2017 for the route of the Proposed Scheme through salt deposits of the Cheshire plain and between Lostock Green and Lostock Gralam. The opportunity to reduce the height of the embankments, and therefore, reduce the volume of earthworks and associated construction traffic and shorten the duration of construction impacts was considered, whilst retaining provision of a 1m clearance over existing ground level in response to existing geological conditions.

Figure 23: Local alternatives considered for Middlewich to Pickmere

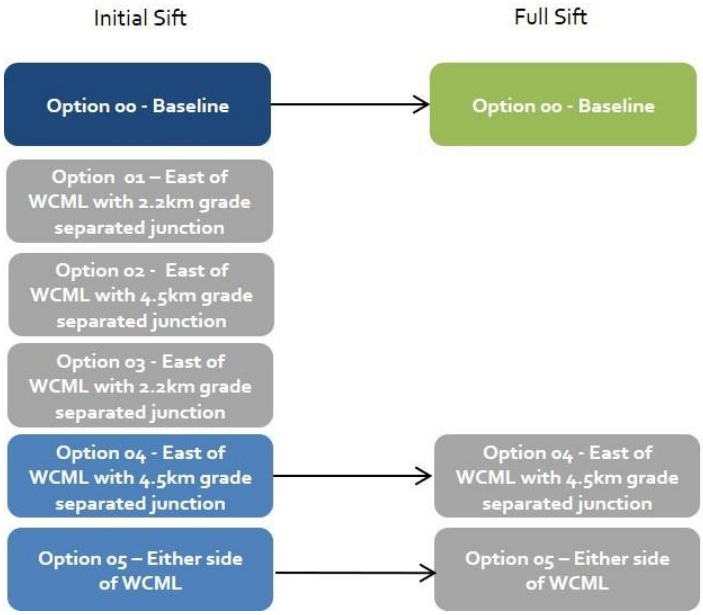


WCML connections north of Crewe

5.2.28 This refinement area covered approximately 15km of the route from Crewe to Whatcroft. Reponses to the consultation requested the provision of high speed services from Crewe to Manchester and other destinations to the North. To facilitate this, the opportunity for a WCML connection to the north of Crewe, similar to the connection to the south of Crewe, was examined to enable the northbound conventional compatible services to stop at Crewe Station before returning to the route towards Manchester and the North.

5.2.29 A total of six options were proposed, including four with junctions at different levels. Three options were not considered reasonable on the basis of cost, engineering and/or sustainability grounds. The options taken forward in the sift stages are shown in Figure 24 and described in the subsequent paragraphs. The locations of the options are shown in Figure 25.

Figure 24: Local alternatives considered for WCML connections north of Crewe



5.2.30 The following three options were taken forward to the full sift appraisal:

- Option 00: the RRB would include a bored tunnel under Crewe, which would surface near Coppenhall alongside the WCML. The route would continue northwards in a mix of shallow cutting and at ground level to the west of Warmingham. No provision for a connection onto the WCML to the north of Crewe would be provided;
- Option 04: the route would follow a similar route to Option 00 and would include a bored tunnel under Crewe, surfacing near Coppenhall alongside and to the east of the WCML. A connection to the WCML would be provided in the form of a junction at different levels, crossing over the WCML; and
- Option 05: the route would include a tunnel under Crewe, surfacing near Coppenhall. Upon surfacing, the route would run either side of the WCML with connections on either side.

5.2.31 HS2 Ltd determined that Option 00 should be taken forward as the preferred option as there was, at that time, no requirement to provide a connection to the WCML to the north of Crewe. However, if a WCML connection north of Crewe were to be introduced, there would be a preference for a configuration similar to Option 04 as this would provide a more viable engineering configuration for connecting with the WCML.

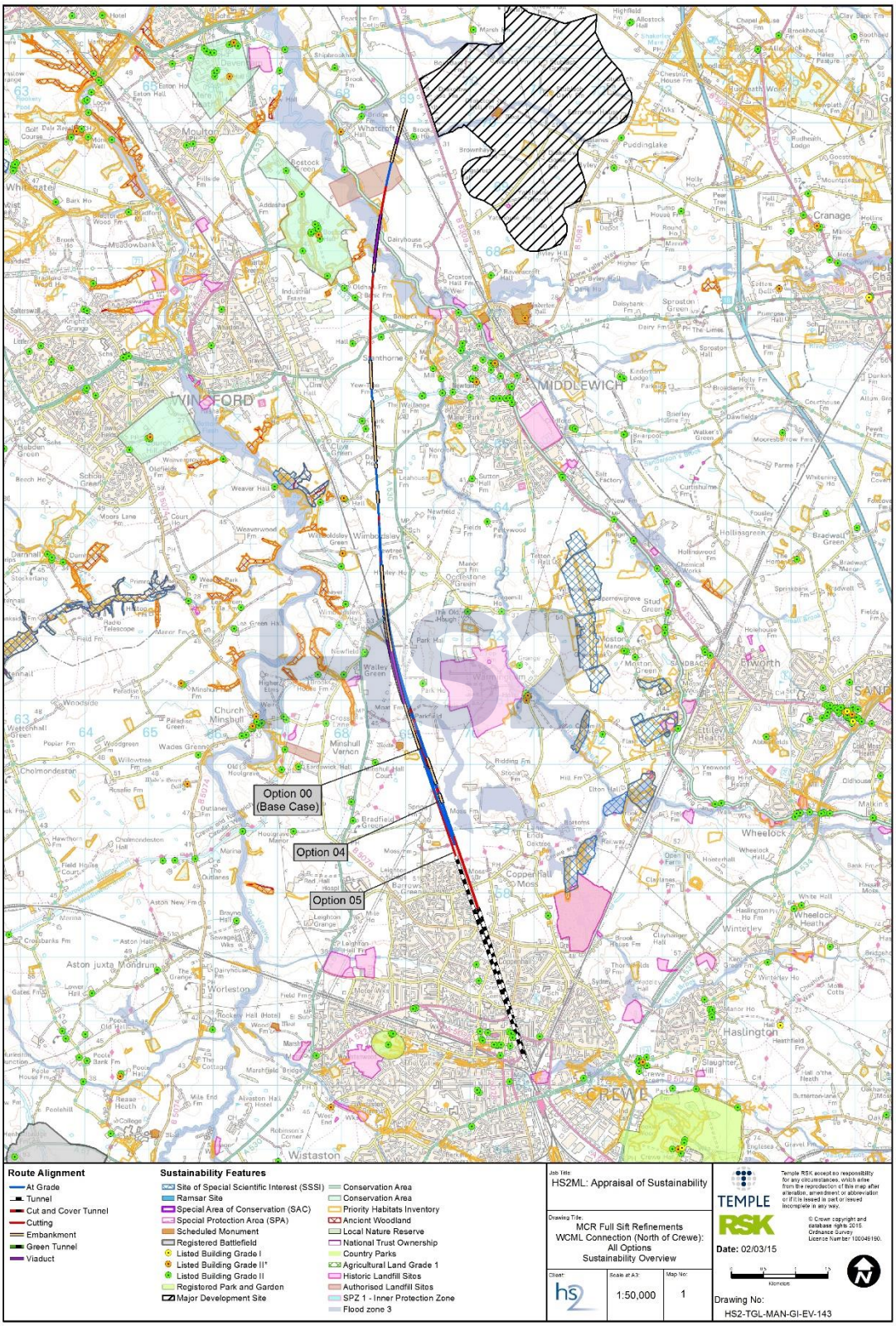
5.2.32 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.33 The preferred option, Option 00, would have minor to moderate visual impacts, predominantly north of Crewe near Coppenhall, where the route would exit the bored tunnel and would run on low embankment past the residential area to the west of Crewe. There would also be some noise impacts in the same area.

5.2.34 Option 04, compared to the preferred option, would have greater landscape and visual impacts as a result of the junction at different levels to the north of Crewe, particularly for residents at Coppenhall. Noise impacts would be similar to the preferred option.

5.2.35 Option 05, similar to the preferred option, would have minor to moderate visual impacts north of Crewe where the route would surface close to the residential outskirts of Crewe. As a result of the connection configuration, more land would be required either side of the route compared with both the preferred option and Option 04.

Figure 25: Local alternatives considered for WCML connections north of Crewe

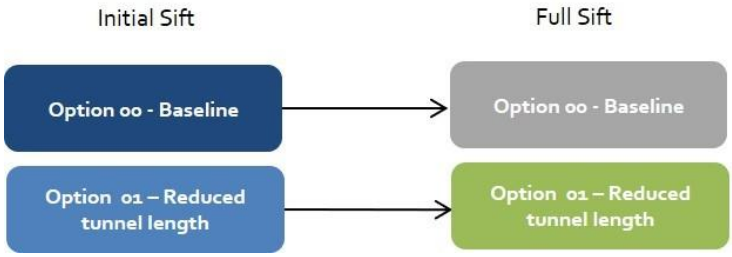


Crewe tunnel northern portal (further refinement)

5.2.36 This refinement covered approximately 2km of the route and was focused around the northern portal location for the tunnel under Crewe. The refinements considered reducing the length of the tunnel under Crewe (following changes in design requirements) and improving the crossing of Fowle Brook.

5.2.37 Two options were proposed for this section of the route, both of which were taken to a full sift appraisal. The options taken forward in the sift stages are shown in Figure 26 and described in the subsequent paragraphs. The locations of the options are shown in Figure 27.

Figure 26: Local alternatives considered for Crewe tunnel northern portal



5.2.38 The following two options were taken forward to the full sift appraisal:

- Option 00: the DRR would descend into a cutting south of Crewe and then into twin bored tunnel under Crewe, emerging on the northern outskirts of the town near Parkers Road; and
- Option 01: would follow a similar route to the DRR, but with a shorter tunnel under Crewe, with the northern tunnel portal further south by approximately 265m.

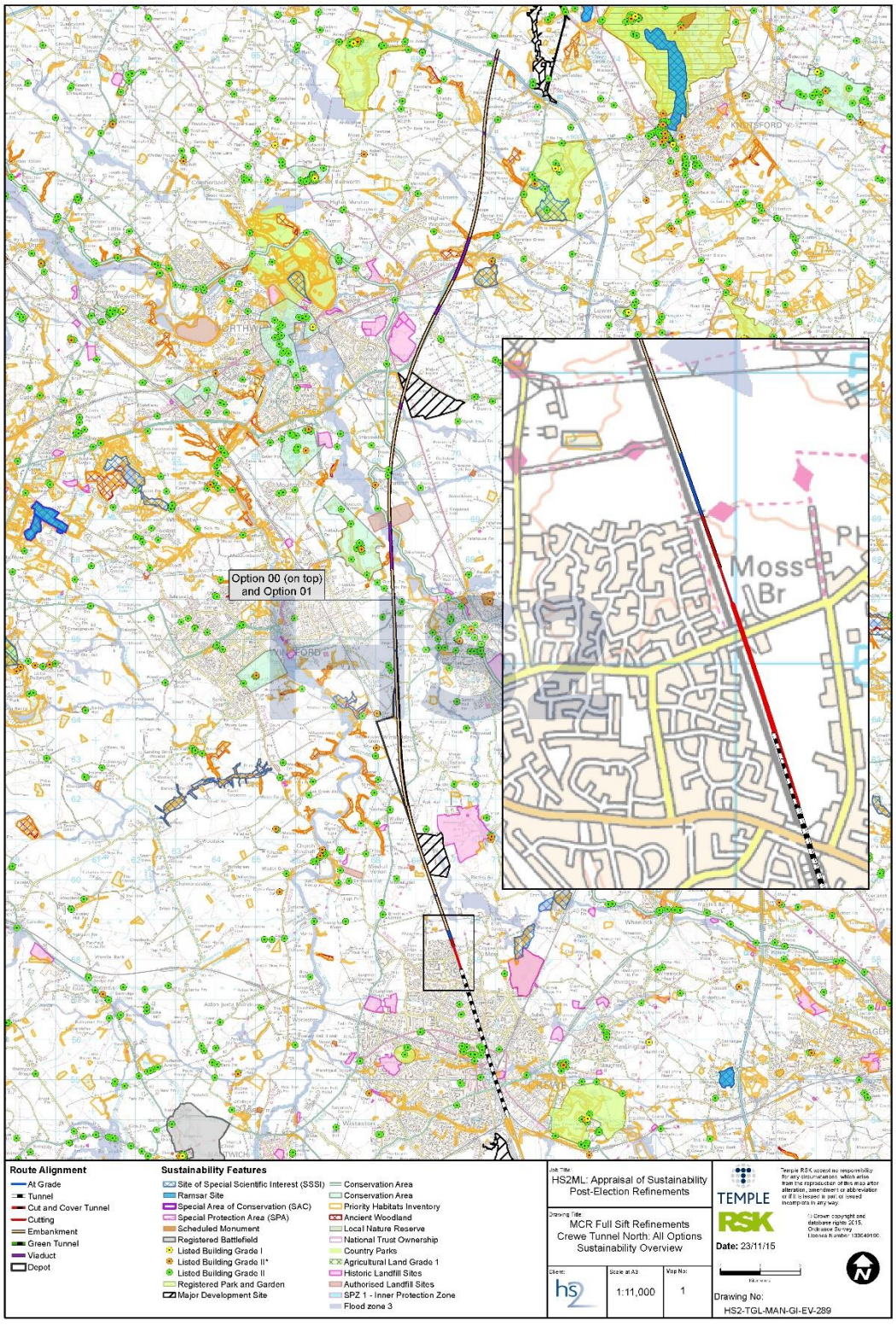
5.2.39 HS2 Ltd determined that Option 01 should be progressed as the preferred option because of the shorter tunnel length and the improved crossing of Fowle Brook. This option would also cost less.

5.2.40 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.41 The preferred option, Option 01, would have slightly greater noise and visual impacts for residents on the northern outskirts of Crewe when compared with Option 00 due to the shorter tunnel. Option 01 would, however, have a lower flood risk associated with crossing the Fowle Brook due to the tunnel surfacing sooner north of Crewe.

5.2.42 Further consideration is given in Section 6.2 to local alternatives identified after July 2017 for the location of the Crewe tunnel north portal. Opportunities were considered to reduce the depth and length of the portal structure to reduce construction costs and the land required.

Figure 27: Local alternatives considered for Crewe tunnel northern portal (further refinement)



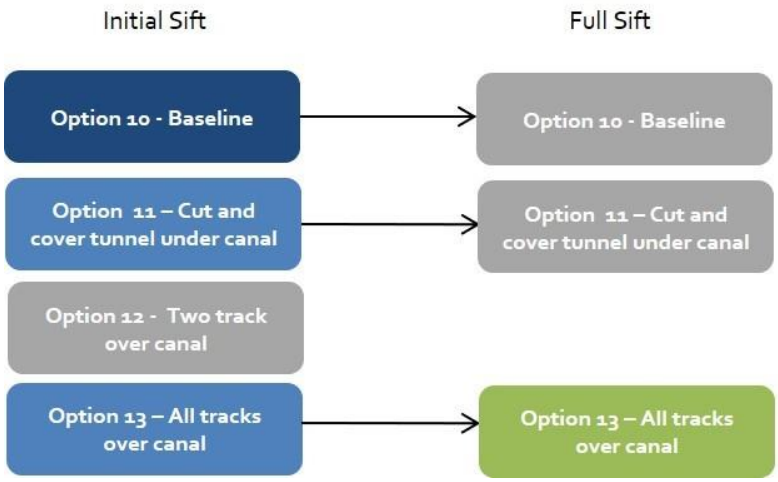
Delta junction zone 1

5.2.43 This refinement covered approximately 13km of the route from both Rostherne and Hoo Green to Heatley, the northern end of the delta junction that would, at that point in design development, have connected Manchester Airport and Manchester Piccadilly with the WCML at Golborne.

5.2.44 The refinement addressed concerns raised during consultation regarding the crossing of the Bridgewater Canal and Agden Brook, particularly in relation to the provision of adequate clearance, navigational visibility and visual impacts.

5.2.45 Four options were initially considered, with one of these not progressed to full sift on the basis of cost, engineering and/or sustainability grounds. The three options taken forward to full sift are shown in Figure 28 and described in the subsequent paragraphs. The locations of the options are shown in Figure 29.

Figure 28: Local alternatives considered for delta junction zone 1



5.2.46 The following three options were taken forward to the full sift appraisal:

- Option 10: the RRB, the east-west chord would run in deep cutting under the M56 before rising onto viaduct over Agden Brook and then crossing the Bridgewater Canal in a deep cut and cover tunnel. The route heading north would cross the Bridgewater Canal on embankment before the two lines route converge further to the north near Heatley having crossed the River Bollin on viaduct;
- Option 11: would follow a similar horizontal profile as Option 10 with a deep cutting under the M56. However, unlike Option 10, both the route heading north and east-west chord would be in cut and cover tunnels under the Bridgewater Canal, before similarly converging to the north near Heatley having crossed the River Bollin on viaduct; and
- Option 13: the east- west chord would follow a similar route as Option 10 under the M56, but at half the depth of cutting, before crossing the Agden Brook on viaduct and then rising to an embankment over the Bridgewater Canal. The route heading north would

cross the Bridgewater Canal on embankment before the two lines route converge further to the north near Heatley having crossed the River Bollin on viaduct.

5.2.47 HS2 Ltd determined that Option 13 should be progressed as the preferred option. It was progressed on the basis that the alternatives would have similar impacts on the environment but would have greater cost or include construction complexities associated with a section of cut and cover tunnel in a floodplain under the Bridgewater Canal.

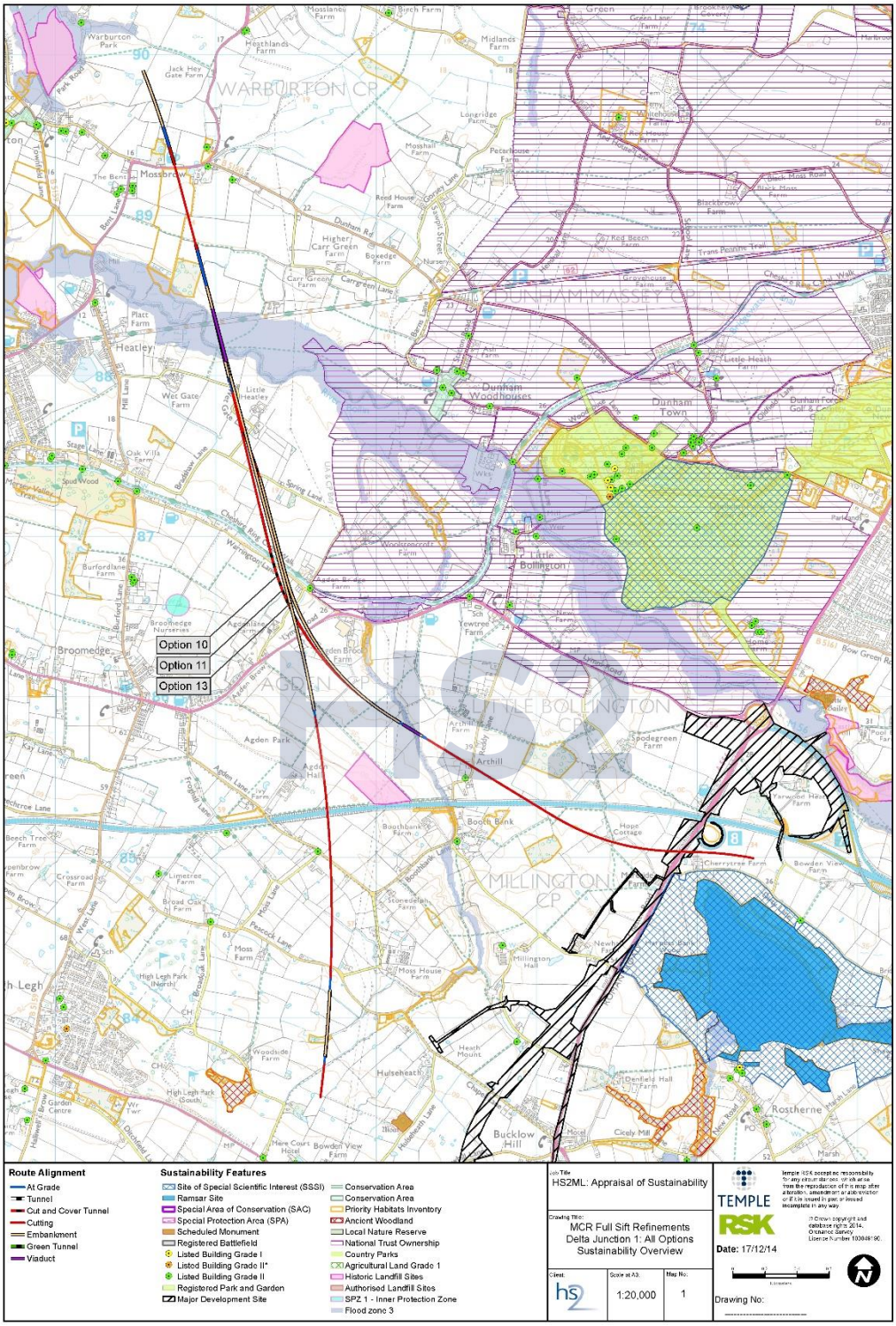
5.2.48 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.49 The preferred option, Option 13, would have moderate landscape and visual impacts as a result of the embankment structure and crossing over the Bridgewater Canal and viaduct over the River Bollin, would affect the recreational users of the canal and would intrude on the open floodplain character of the Bollin Valley. Whilst the route would cross under the M56 in cutting, it would not be as deep as either Option 10 or Option 11. There would be a moderate impact on the setting of the Grade II listed Oven Back Cottage and Chapel House, both within approximately 40m of the route. The route would also cross the development site for the proposed realignment of the A556.

5.2.50 Option 10 would also have moderate landscape and visual impacts to recreational users of the Bridgewater Canal and the open floodplain character of the Bollin Valley as a result of the deep cutting under the M56 (approximately 20m below existing ground level) and the embankment and viaduct crossings of the Bridgewater Canal and River Bollin. Similar to the preferred option, there would be a moderate impact on the setting of the Grade II listed Oven Back Cottage and Chapel House, both within approximately 40m of the route. The route would also cross the development site of the proposed realignment of the A556. Noise impacts would be slightly lower when compared with both the preferred option due to the cut and cover tunnel under the canal.

5.2.51 Option 11 would have moderate landscape and visual impacts on the open floodplain character of the Bollin Valley as a result of the deep cutting under the M56 (over 20m below existing ground level) and the viaduct crossing of the River Bollin further north. Similar to the preferred option, there would be a moderate impact on the setting of the Grade II listed Oven Back Cottage and Chapel House, both within approximately 40m of the route. The route would also cross the development site for the proposed realignment of the A556.

Figure 29: Local alternatives considered for delta junction zone 1

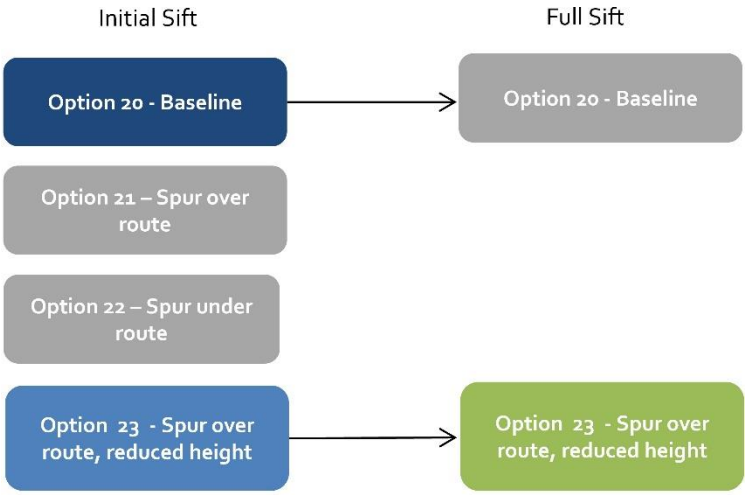


Delta junction zone 2

5.2.52 This refinement covered approximately 11km of the route. The route would run from Pickmere to Hulseheath and would also include the start of the HS2 WCML connection towards Golborne. The refinements considered reducing the impacts of the delta junction between the HS2 WCML connection and the HS2 Manchester spur.

5.2.53 Four options were considered for this section of the route, with two of these not progressed on the basis of cost, engineering and/or sustainability grounds. The options taken forward in the sift stages are shown in Figure 30 and described in the subsequent paragraphs. The locations of the options are shown in Figure 31.

Figure 30: Local alternatives considered for delta junction zone 2



5.2.54 The following two options were taken forward to the full sift appraisal:

- Option 20: the RRB spur to Manchester would pass over both the HS2 WCML connection and the A50 at the junction of the HS2 WCML connection and the HS2 Manchester spur at Hoo Green; and
- Option 23: would follow a similar route to Option 20, but the line of the HS2 Manchester spur would pass under the HS2 WCML connection, with a lower overall height of the junction connections.

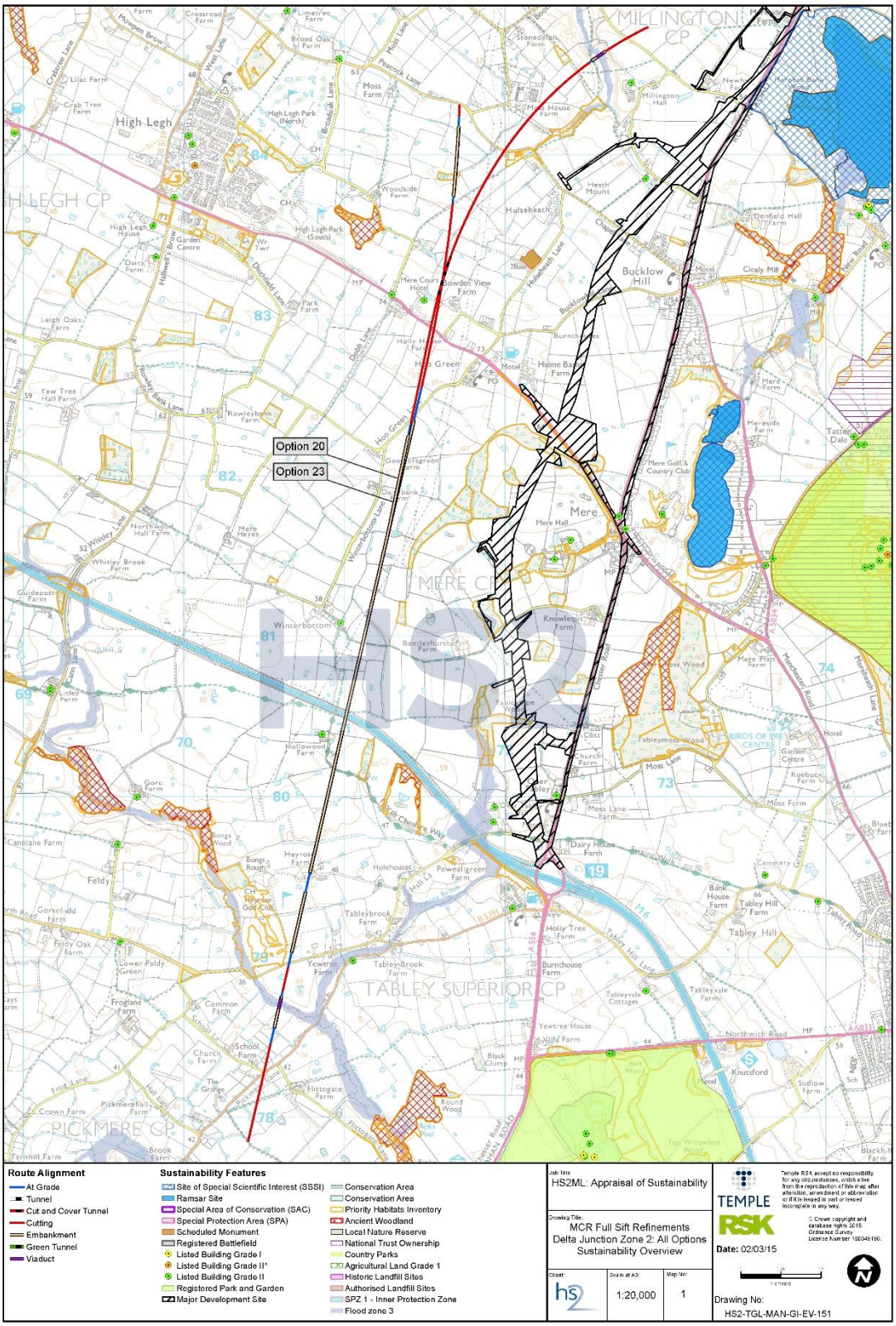
5.2.55 HS2 Ltd determined that Option 23 should be progressed as the preferred option owing to less visual impacts from the lower junction configuration and the height needed to raise the A50 under Option 20.

5.2.56 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.57 The preferred option, Option 23, would have minor to moderate visual impacts as a result of sections of embankment within the flat open landscape, as well crossing the eastern edge of the golf course at Heyrose Golf Club, which would impact the users of the golf course. There would be a moderate to major impact on the setting of the Grade II listed Mere Court Hotel, adjacent to the Manchester junction, with land required from the hotel car park.

5.2.58 Option 20 would have moderate landscape and visual impacts as a result of sections of embankment within the flat open landscape and the junction configuration, as well as crossing the eastern edge of the golf course at Heyrose Golf Club. Similar to the preferred option, there would be a moderate to major impact on the setting of the Grade II listed Mere Court Hotel, adjacent to the Manchester junction, with land required from the car park.

Figure 31: Local alternatives considered for delta junction zone 2

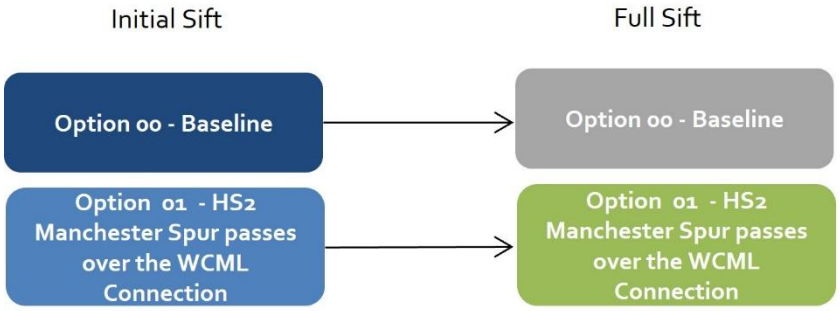


Manchester junction (further refinement)

5.2.59 This refinement covered approximately 16km of the Manchester junction close to Hoo Green, which comprises sections of the route, the HS2 WCML connection and the HS2 Manchester spur. This refinement built upon the previous refinement of the delta junction, which reviewed the junction configuration between the HS2 WCML connection and the HS2 Manchester spur. The further refinements were considered to improve watercourse clearance of Millington Clough at the grade separated junction between the HS2 WCML connection and the HS2 Manchester spur.

5.2.60 Two options were progressed to full sift appraisal. The options taken forward in the sift stages are shown in Figure 32 and described in the subsequent paragraphs. The locations of the options are shown in Figure 33.

Figure 32: Local alternatives considered for Manchester junction



5.2.61 The following two options were taken forward to the full sift appraisal:

- Option 00: the DRR would cross the M6 and continue north, approaching Hoo Green and the Manchester junction, descending into deep cutting. The HS2 Manchester spur would pass under the HS2 WCML connection and would head north-east towards Manchester in cutting, which would pass under Millington Clough, with limited clearance; and
- Option 01: would similarly cross the M6 and would continue north and approach the junction at Hoo Green in a cutting. The HS2 Manchester spur would pass over the HS2 WCML connection and continue north-east towards Manchester and over Millington Clough, which could be culverted under the spur.

5.2.62 HS2 Ltd determined that Option 01 was the preferred option to be taken forward on the basis of the crossing interface with Millington Clough.

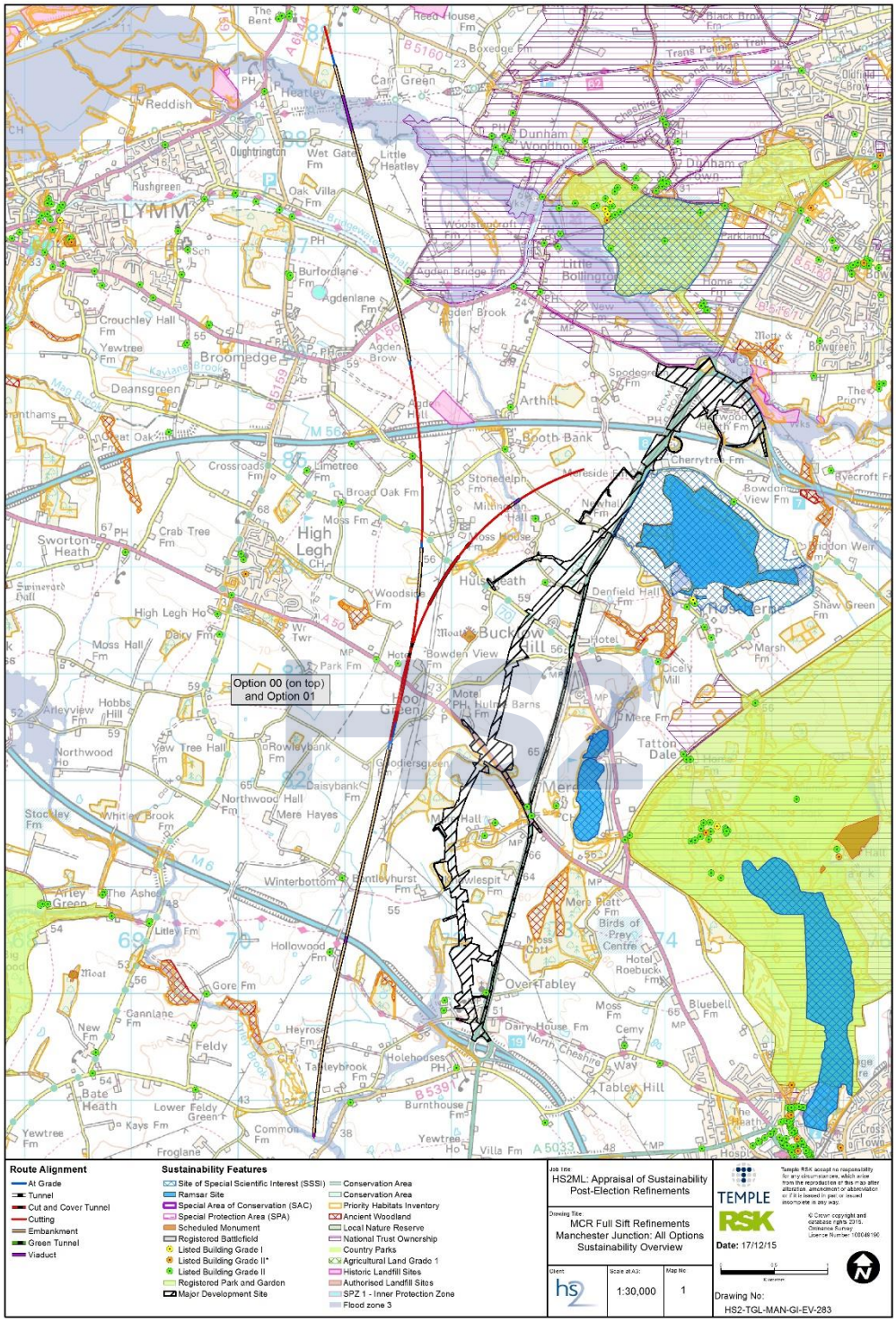
5.2.63 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.64 The preferred option, Option 01, would have moderate to localised major landscape impacts as a result of the deep cutting close to Hoo Green where the Manchester junction would be located. There would also be an impact on the setting of the Grade II listed Mere Court Hotel to the east of the junction, with land required from the associated car park. Further north along the HS2 WCML connection, there would also be an impact on the setting of the Grade II listed Ovenback Cottage due to the proximity of a deep cutting where the route would

approach the M56, as with Option 00. Visual impacts associated with the M6 and Bridgewater Canal crossings near Winterbottom would be the same for both options. On the HS2 Manchester spur, the proposed crossing and culverting of Millington Clough watercourse would have a lower flood risk.

5.2.65 Option 00 would have moderate to localised major landscape impacts, similar to the preferred route. There would similarly be an impact on the setting of the Grade II listed Mere Court Hotel at Hoo Green, although the land required from the car park would be less than the preferred option. There would also be an impact on the setting of the Grade II listed Ovenback Cottage due to the proximity of a deep cutting where the route would approach the M56, as with the preferred option. Visual impacts associated with the M6 and Bridgewater Canal crossings near Winterbottom would be the same for both the preferred and alternative option. On the HS2 Manchester spur, the proposed crossing under Millington Clough watercourse would potentially require diversion of the watercourse, which would result in a higher flood risk.

Figure 33: Local alternatives considered for Manchester junction

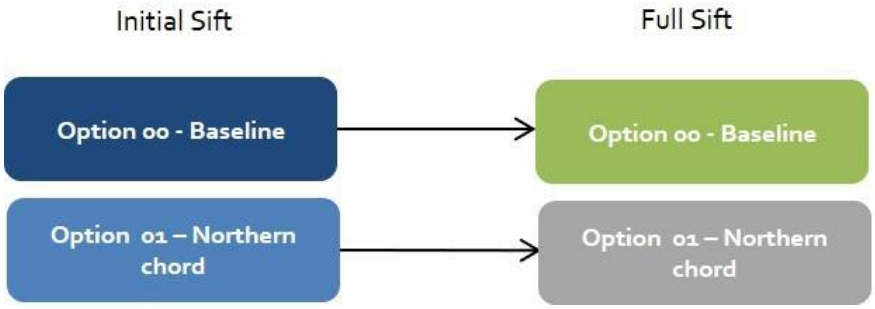


Northern chord (further refinement)

5.2.66 This refinement covered approximately 8km of the route from south of Ashley to the crossing of the Bridgewater Canal near Mossbrow. The refinement considered the requirement for the northern chord of the Manchester delta junction following the decision to relocate the RSD from Golborne to Crewe north (described under the Crewe north RSD (further refinement) section) and the associated costs.

5.2.67 Two options were taken to a full sift appraisal. The options taken forward in the sift stages are shown in Figure 34 and described in the subsequent paragraphs. The locations of the options are shown in Figure 35.

Figure 34: Local alternatives considered for the northern chord



5.2.68 The following two options were taken forward to the full sift appraisal:

- Option 00: the DRR would have no northern chord and would remove the requirement for connections at different levels with the HS2 Manchester spur and the HS2 WCML connection at either end; and
- Option 01: would include a northern chord, which would run from a connection with the HS2 Manchester spur north of Rostherne, to a connection with the HS2 WCML connection towards Golborne, near Little Heatley. Junctions at either end would be at different levels, each requiring a different configuration for the spur and HS2 WCML connection.

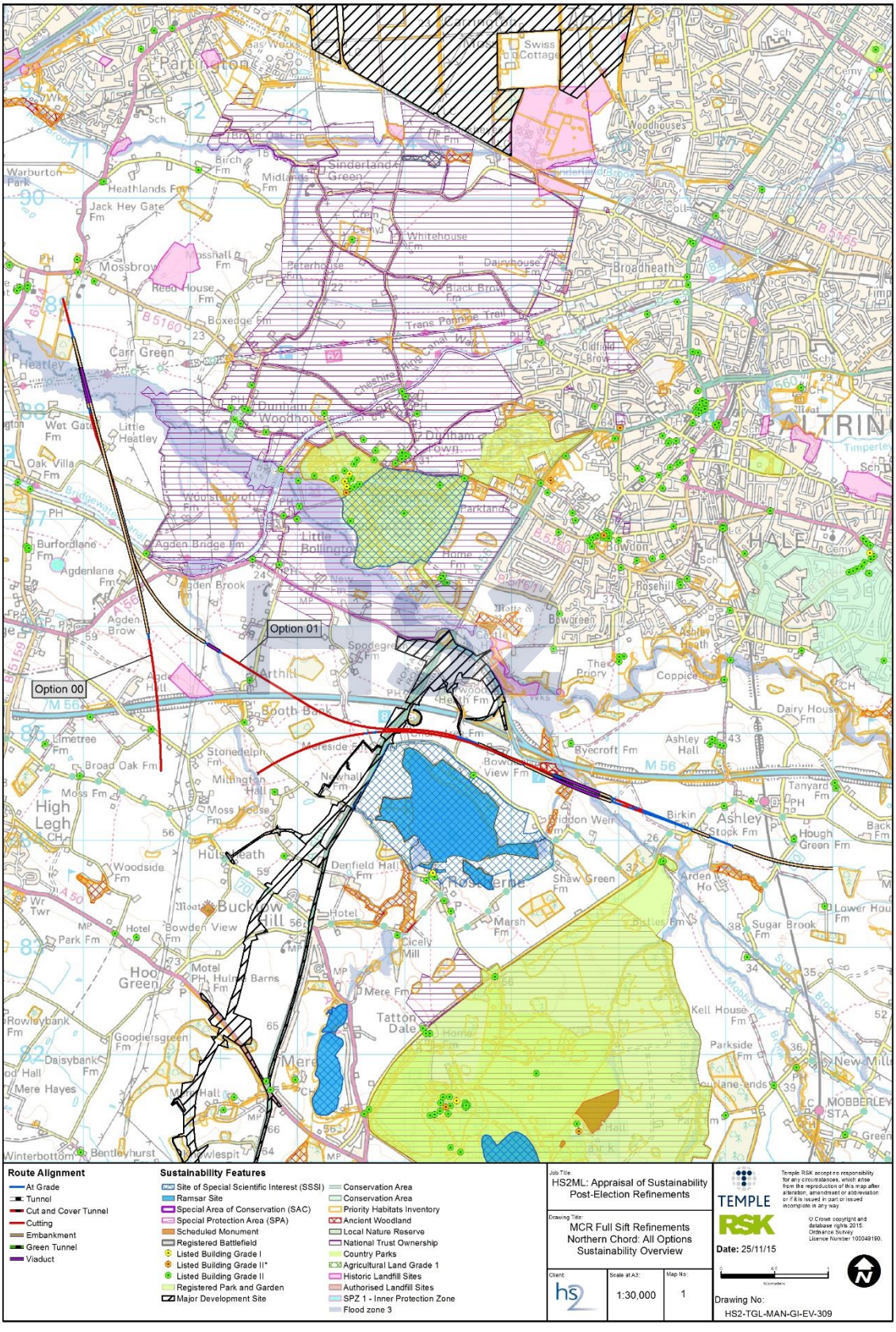
5.2.69 HS2 Ltd determined that the northern chord was not required to support the RSD, which was relocated to Crewe north. The chord previously facilitated the movement of rolling stock from Manchester to the RSD at Golborne.

5.2.70 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.71 The preferred option, Option 00, would have moderate to localised major landscape and visual impacts south of Little Bollington and north of Rostherne Mere, as well as a direct impact on Hancock's Bank Ancient Woodland. The crossing of the Bridgewater Canal would impact recreational users of the canal near Little Heatley, although this would be less than Option 01. Whilst there would be noise impacts and demolitions, these would be fewer than Option 01.

5.2.72 Option 01 would have major landscape and visual impacts, particularly associated with the junctions at different levels near Rostherne Mere and Little Heatley. There would also be a greater impact on recreational users of the Bridgewater Canal as a result of the high crossing near Little Heatley. There would be a moderate impact on the setting of the Grade II listed Chapel House near Booth Bank due to the proximity of the northern chord in deep cutting. Option 01 would also require more land through Hancock's Bank Ancient Woodland. Approximately five more demolitions would be required as a result of the chord, when compared to Option 00, which would have approximately six demolitions. Option 01 would also have slightly more noise impacts.

Figure 35: Local alternatives considered for the northern chord

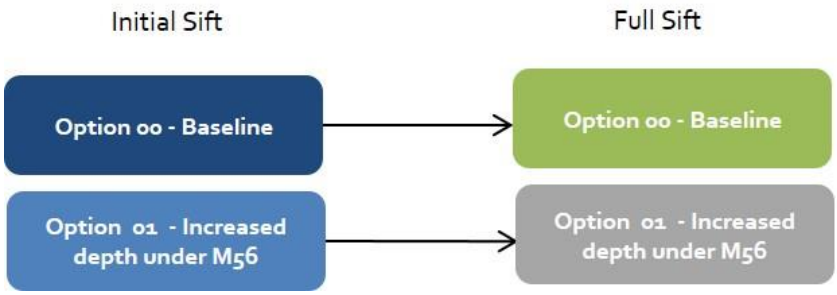


M56 crossing (further refinement)

5.2.73 This refinement covered a route section of approximately 25km. However, the focus of the refinement was on an approximately 4km route section from Thorns Green to the Manchester Airport High Speed station and, in particular, on the crossing under the M56 approaching the station.

5.2.74 Two options were taken to a full sift level of appraisal. The options taken forward in the sift stages are shown in Figure 36 and described in the subsequent paragraphs. The locations of the options are shown in Figure 37.

Figure 36: Local alternatives considered for the M56 crossing



5.2.75 The following two options were taken forward to the full sift appraisal:

- Option 00: the DRR would be in cutting through Thorns Green and Halebank up to 9m below the existing ground level and would head east and north-east. Continuing north under the M56 and approaching Manchester Airport High Speed station, the route would be in cutting at depths of approximately 14 to 20m below existing ground level. The crossing under the M56 may require a motorway diversion or realignment; and
- Option 01: would follow a similar route to Option 00 but a greater depth of cutting by up to 4m. The greater clearance under the M56 would allow for a potentially favourable engineering solution for the crossing of the motorway (jacked-box construction) and less need for a motorway diversion.

5.2.76 HS2 Ltd determined that Option 00 was the preferred option to be taken forward at that stage of the design phase. At the time of the appraisal, it was identified that construction options and the potential for lowering the route, where feasible, would be considered during the design development. Further engagement with Highways England would also be undertaken to understand the future aspirations for this section of the M56.

5.2.77 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.78 The preferred option, Option 00, would result in moderate landscape impacts due to the deep cutting through Thorns Green and Halebank and the viaduct crossing of the River Bollin. The approach to the Manchester Airport High Speed station would require the demolition of the Grade II listed Buckhall.

5.2.79 Similar to the preferred option, Option 01 would result in moderate landscape impacts, although these would be greater than those of Option 00 due to the greater depth of cuttings and associated land required. As with the preferred option, this route would require the demolition of the Grade II listed Buckhall. Noise and property impacts for both options would be largely similar.

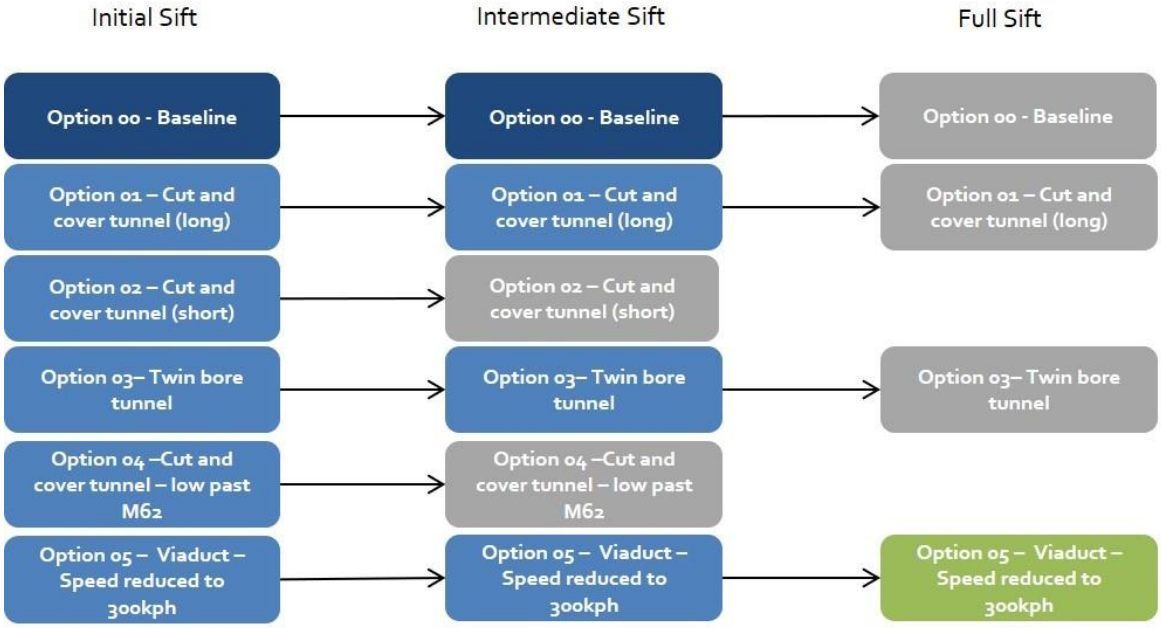
Figure 37: Local alternatives considered for the M56 crossing

Manchester Ship Canal

5.2.80 This refinement area covered approximately 12km of the route along the HS2 WCML connection towards Golborne. This route section would run from Mossbrow across the Manchester Ship Canal and west of Culcheth to Lowton. Whilst the route section would cover approximately 12km, this refinement was focused on the southern section over the Manchester Ship Canal. This refinement sought to reduce landscape, visual and noise impacts where the route would cross the Manchester Ship Canal.

5.2.81 Six options were considered for this section of the route, with two not progressed on the basis of cost, engineering and/or sustainability grounds. The options taken forward in the sift stages are shown in Figure 38 and described in the subsequent paragraphs. The locations of the options are shown in Figure 39.

Figure 38: Local alternatives considered for Manchester Ship Canal



5.2.82 The following four options were taken forward to the full sift appraisal:

- Option 00: the RRB would approach the Manchester Ship Canal on embankment and would cross the canal on a viaduct (approximately 28m high). The route would then be on embankment north of the canal and would pass to the west of Holcroft Moss on a combination of embankment and low viaduct before crossing the M62. The route would continue on low embankment past Risley landfill before continuing north-west of Culcheth. The line speed over the canal would be 345kph (214mph);
- Option 01: would follow a similar route to Option 00 but would cross under the Manchester Ship Canal in an approximately 2km long cut and cover box structure and would surface south of the M62 before rising onto embankment past Holcroft Moss and crossing over the M62. Further to the north, west of Culcheth, the route would follow a similar vertical and horizontal alignment to Option 00. The line speed under the canal would be 345kph (214mph);

- Option 03: would follow a similar route to Option 00 but would cross under the Manchester Ship Canal in an approximately 3.2km bored tunnel and would surface south of the M62 before rising onto embankment past Holcroft Moss and would cross over the M62. Further to the north, west of Culcheth, the route would follow a similar alignment to Option 00. The line speed under the canal would be 345kph (214mph); and
- Option 05: would follow a similar route to Option 00 but with a line speed to 300kph (186mph) on the crossing over the canal. The height of the embankments either side of the canal could be lowered. Similar to Option 00, north of the Manchester Ship Canal, the route would continue on embankment and low viaduct past Holcroft Moss and over the M62 before following a similar alignment to Option 00.

5.2.83 HS2 Ltd determined that Option 05 be taken forward as the preferred option. Whilst this would still incorporate a high viaduct crossing of the Manchester Ship Canal, the lower line speed on the canal crossing would allow for lower embankments either side of the canal. This would also lower the noise impacts. Options to cross under the canal would potentially require a diversion of the canal, which would result in greater construction complexity and higher cost. The height of the canal crossing was based on clearance requirements at the time of design.

5.2.84 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

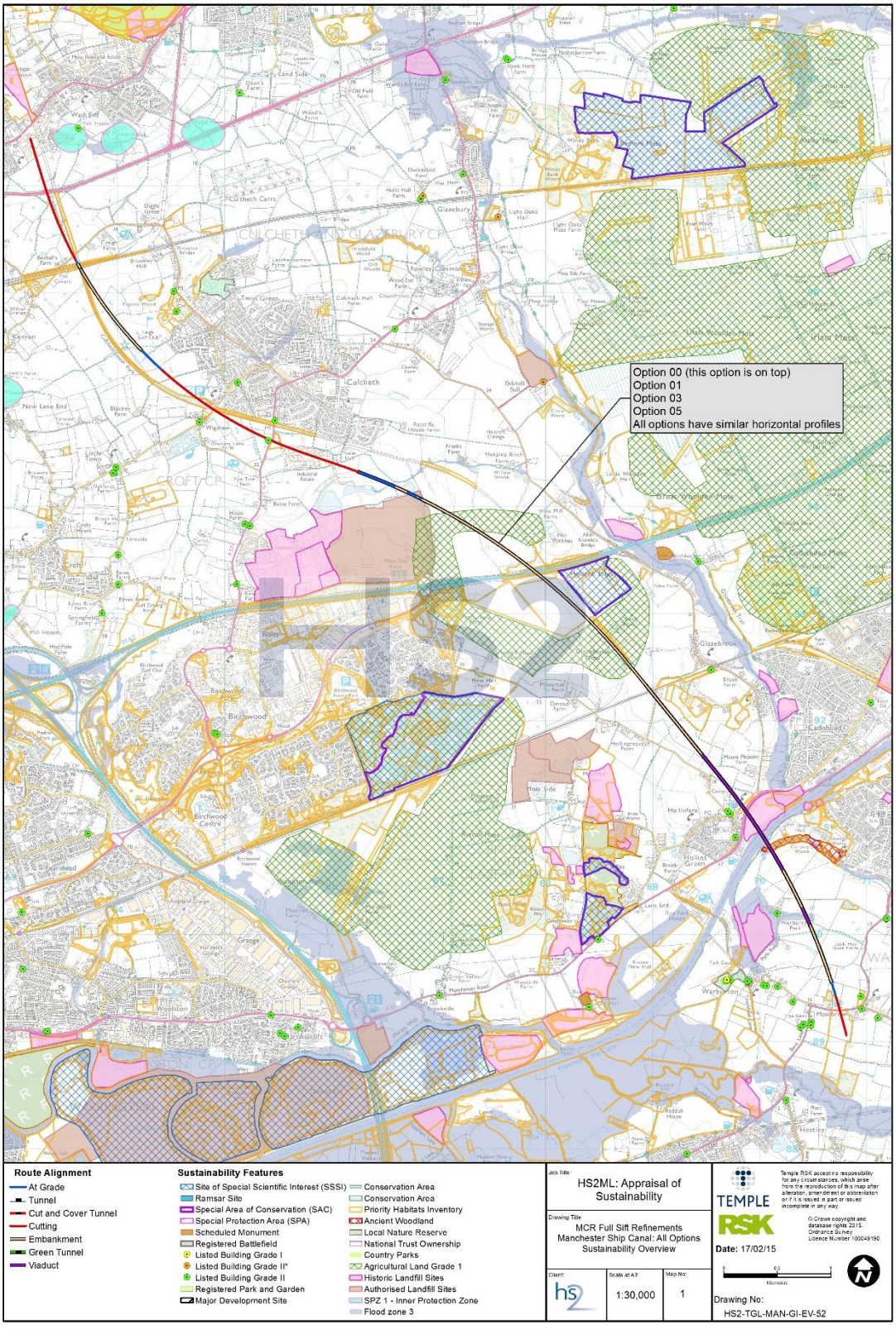
5.2.85 The preferred option, Option 05, would have major landscape and visual impacts as a result of the high viaduct crossing of the Manchester Ship Canal. The embankments either side of the canal crossing would have moderate landscape, visual, townscape and noise impacts, particularly for the residents of Hollins Green, Partington and Glazebrook. Approaching the canal, the route would cross Coroners Wood Ancient Woodland on viaduct, and to the north of the crossing, would pass to the west of Holcroft Moss SSSI within approximately 100m. North of the M62 crossing, the route would clip the edge of Risley landfill on low embankment, but would avoid the active deposition areas. West of Culcheth, the route would have a direct impact on the Grade II listed Newchurch Old Refectory, cross Culcheth Linear Park and clip the edge of Leigh Golf Club.

5.2.86 Similar to the preferred option, Option 00, would have major landscape and visual impacts as a result of the high viaduct crossing of the Manchester Ship Canal. The high embankments either side of the canal crossing would have moderate landscape, visual and townscape impacts, particularly for the residents of Hollins Green, Partington and Glazebrook, although noise impacts would be greater compared to the preferred option. Similar to the preferred option, the route would cross Coroners Wood Ancient Woodland on viaduct and would pass within approximately 100m of Holcroft Moss SSSI. Similar to the preferred route, north of the M62 crossing, the route would clip the edge of Risley landfill on low embankment, but avoid the active deposition areas. West of Culcheth, the route would similarly have a direct impact on the Grade II listed Newchurch Old Refectory, would cross Culcheth Linear Park and clip the edge of Leigh Golf Club.

5.2.87 Option 01 would have minor to moderate landscape and townscape impacts associated predominantly with the section of route to the north of the M62, approaching Culcheth. The cut and cover crossing under the Manchester Ship Canal would require land from Coroners Wood Ancient Woodland to the south. This cut and cover crossing under the Manchester Ship Canal would potentially be in difficult ground conditions and also have major hydrological impacts associated with construction of the cut and cover tunnel through an area of significant hydrological activity and high flood risk. This may require a diversion of the canal as well as box structure under the Warrington Railway north of the canal. Similar to the preferred option, the route would clip the edge of Risley landfill on low embankment but avoid the active deposition areas. West of Culcheth, the route would have a direct impact on the Grade II listed Newchurch Old Refectory, cross Culcheth Linear Park and clip the edge of Leigh Golf Club, similar to the preferred option. Noise impacts would be less than the preferred option as a result of much of the route being at, or below ground level.

5.2.88 Option 03 would have minor to moderate landscape and townscape impacts associated predominantly with the section of route to the north of the M62, approaching Culcheth. The bored tunnel crossing under the Manchester Ship Canal would require land from Coroners Wood Ancient Woodland. This would also have major hydrological impacts associated with construction of the bored tunnel through an area of significant hydrological activity and high flood risk. This option may require a diversion of the canal, with the bored tunnel requiring a vent shaft due to its length. Similar to the preferred option, the route would clip the edge of Risley landfill on low embankment but avoid the active deposition areas. West of Culcheth, the route would have a direct impact on the Grade II listed Newchurch Old Refectory, would cross Culcheth Linear Park and clip the edge of Leigh Golf Club. Noise impacts would be less than the preferred option as a result of much of the route being at or below ground level.

Figure 39: Local alternatives considered for Manchester Ship Canal following the 2013/2014 consultation

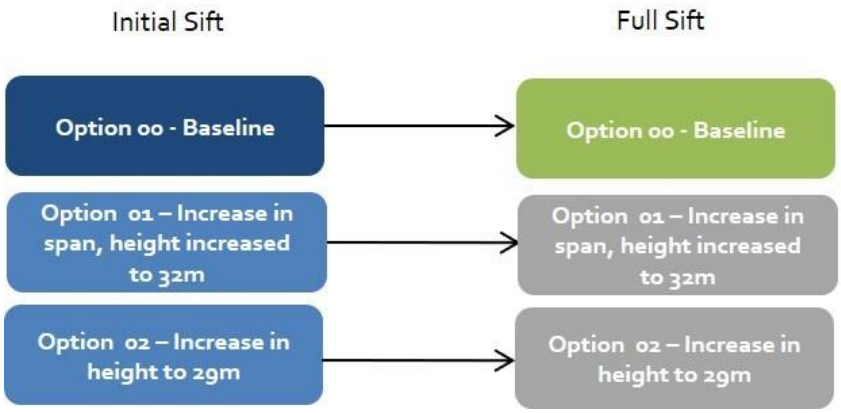


Manchester Ship Canal (further refinement)

5.2.89 This refinement covered approximately 12km of the route from Mossbrow to Lowton, crossing the Manchester Ship Canal. This followed a previous options review for crossing the ship canal (see previous section). The refinements specifically considered the construction complexity relating to the viaduct span and clearance over the canal, following further engagement with Peel Ports Ltd, who operate the ship canal.

5.2.90 Three options were taken to a full sift appraisal. The options taken forward in the sift stages are shown in Figure 40 and described in the subsequent paragraphs. The locations of the options are shown in Figure 41.

Figure 40: Local alternatives considered for the Manchester Ship Canal (further refinement)



5.2.91 The following three options were taken forward to the full sift appraisal:

- Option 00: the DRR would include a viaduct span over the canal of approximately 60m and with a rail height of up to 28m above the canal;
- Option 01: would follow the same alignment as Option 00 but would include a longer viaduct span to approximately 120m, with a rail height of up to approximately 32m above the canal; and
- Option 02: would follow the same alignment as Option 00, and a viaduct span of approximately 60m, but with a rail height of up to 29m above the canal.

5.2.92 HS2 Ltd determined that Option 00 was the preferred option to be taken forward at that stage because there was no significant improvement compared to the other options and Option 00 met the HS2 design requirements. At the time of the appraisal, it was noted that construction options and the potential for reviewing the height of the route across the Manchester Ship Canal would be further considered during the design development.

5.2.93 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.94 The preferred option, Option 00, would have major landscape and visual impacts associated with the high crossing of the Manchester Ship Canal, particularly for residents of Hollins

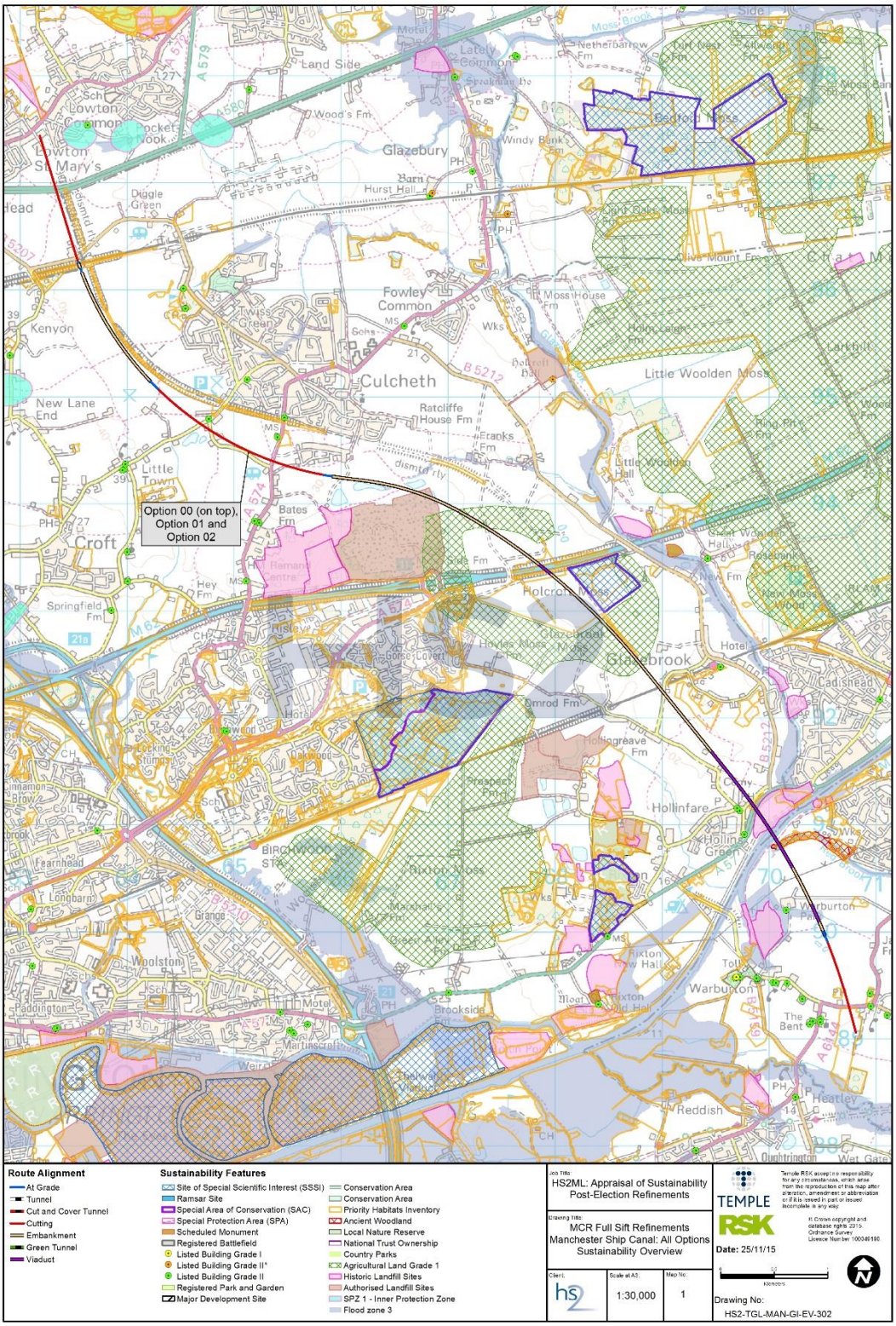
Green, Partington and Glazebrook, where residents would also experience noise impacts. These impacts would be less than Option 01, although similar to Option 02.

5.2.95 Similar to the preferred option, Option 01 would have major landscape and visual impacts associated with high crossing of the Manchester Ship Canal, particularly for residents of Hollins Green, Partington and Glazebrook, where residents would also experience noise impacts. These impacts would be slightly greater when compared with the preferred option due to the higher structure over the canal.

5.2.96 Option 02, similar to the preferred option, would have major landscape and visual impacts associated with the high crossing of the Manchester Ship Canal, particularly for residents of Hollins Green, Partington and Glazebrook, where residents would also experience noise impacts. These impacts would be similar to the preferred option.

5.2.97 Further consideration is given in Section 6.5 to local alternatives identified after July 2017 for the route of the Proposed Scheme across the Manchester Ship Canal. Opportunities to lower the viaduct height are precluded by the operational requirements of the Manchester Ship Canal, although options to move the route eastwards were considered to lessen impacts on Hollinfare Cemetery, the Black Swan public house and residential properties within Hollins Green.

Figure 41: Local alternatives considered for the Manchester Ship Canal (further refinement)

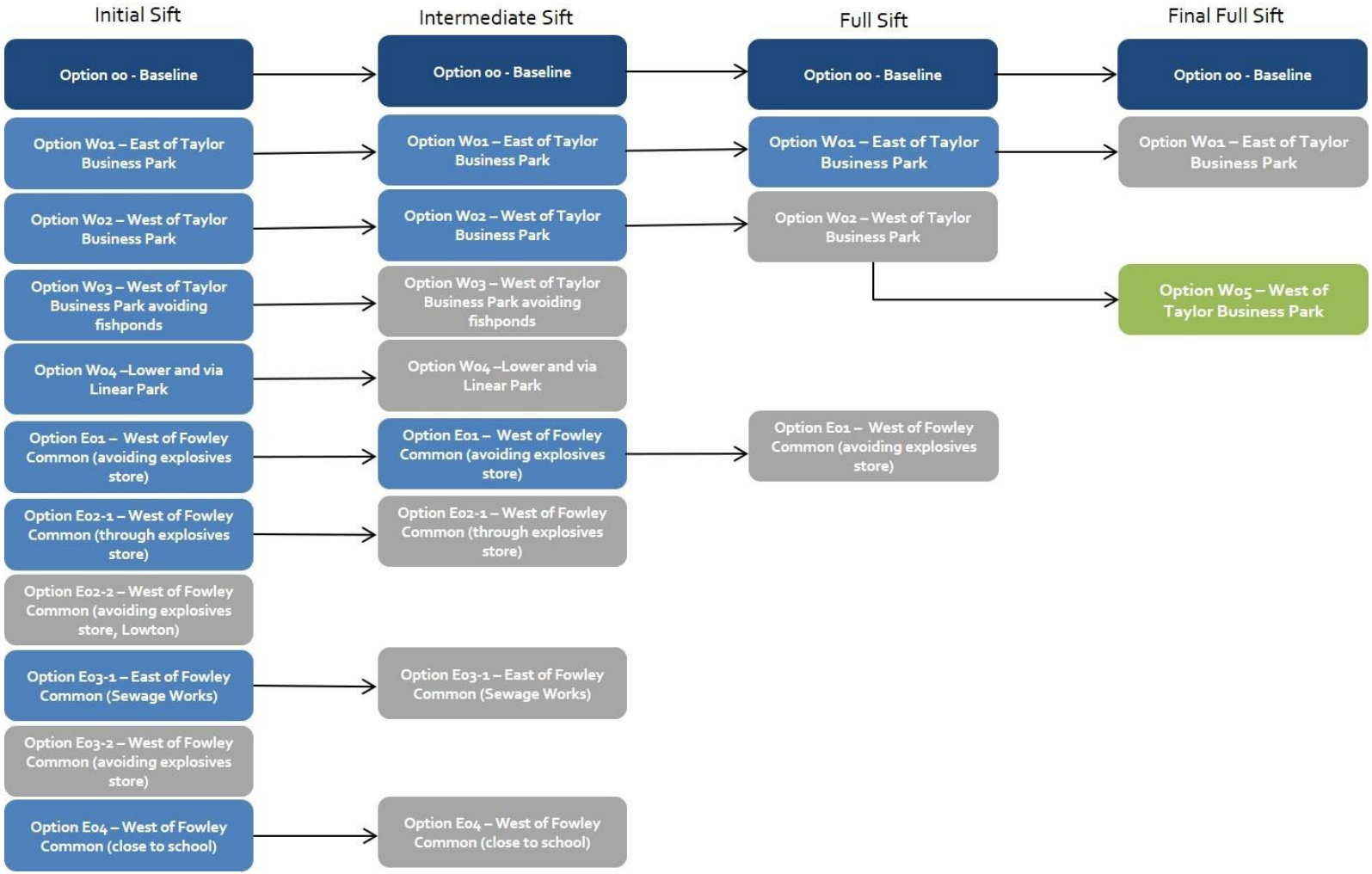


East and west of Culcheth

5.2.98 This refinement area covered approximately 17km of the HS2 WCML connection. This route section would run from Mossbrow, across the Manchester Ship Canal, before the route options would diverge to the east and west of Culcheth and then connect with the WCML north of Golborne. The aim of the refinement was to reduce the impact of the route where it would pass Culcheth, particularly on Taylor Business Park and Culcheth Linear Park.

5.2.99 A total of 11 options were considered for this section of the route, of which nine were progressed to an intermediate sift, with four not considered for further progression on the basis of cost, engineering and/or sustainability grounds. Following the intermediate sift, four options were progressed to full sift, comprising three options to the west of Culcheth and one option to the east. Whilst HS2 Ltd identified a preferred option to the west of Culcheth as the refinement to progress in principle, further work was undertaken on the initial preferred option. The option to the east of Culcheth was not progressed due to a combination of sustainability impacts (including demolitions and noise), engineering challenges and associated costs. The final full sift considered the three options west of Culcheth. The options taken forward in the sift stages are shown in Figure 42 and described in the subsequent paragraphs. The locations of the options are shown in Figure 43.

Figure 42: Local alternatives considered for Culcheth



5.2.100 The following three options were taken forward to the final full sift appraisal:

- Option 00: the RRB would cross the Manchester Ship Canal on high viaduct and would continue to the west of Holcroft Moss and over the M62 before passing to the south and west of Culcheth. The route would continue through the centre of Taylor Business Park in deep cutting before crossing Culcheth Linear Park and clipping the western edge of the golf course at Leigh Golf Club on embankment. The route would then head north, approaching Lowton in cutting before rising onto low embankment heading north-west of Golborne and joining the WCML south of Bamfurlong;
- Option W-01: would follow a broadly similar route to Option 00 over the Manchester Ship Canal and past Holcroft Moss. Approaching Culcheth, whilst remaining on the western side, the route would take a more easterly approach compared with the RRB, which would be approximately 90m closer to Culcheth, skirting to the east of the Taylor Business Park before continuing parallel to, and then across, Culcheth Linear Park. The route would continue north on embankment, clipping the golf course at Leigh Golf Club and would approach Lowton in cutting. It would then rise onto low embankment heading north-west of Golborne to join the WCML south of Bamfurlong; and
- Option W-05: would follow a broadly similar route to Option 00 over the Manchester Ship Canal and past Holcroft Moss. Approaching Culcheth, the route would take a more westerly route (by up to approximately 250m) compared with the RRB, skirting to the west of the Taylor Business Park in a shallow cutting and continuing alongside and over Glaziers Lane, west of Wigshaw. The route would continue north, to the west of Culcheth Linear Park on embankment, and would approach Lowton in cutting before rising onto low embankment heading north-west of Golborne to join the WCML south of Bamfurlong.

5.2.101 HS2 Ltd determined that Option W-05 should be taken forward as the preferred option. This decision was on the basis of it achieving the refinement considerations of moving the route away from Culcheth, avoiding direct impacts on the Taylor Business Park, Culcheth Linear Park and the golf course at Leigh Golf Club, as well as avoiding the demolition of the Grade II listed Newchurch Old Refectory.

5.2.102 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

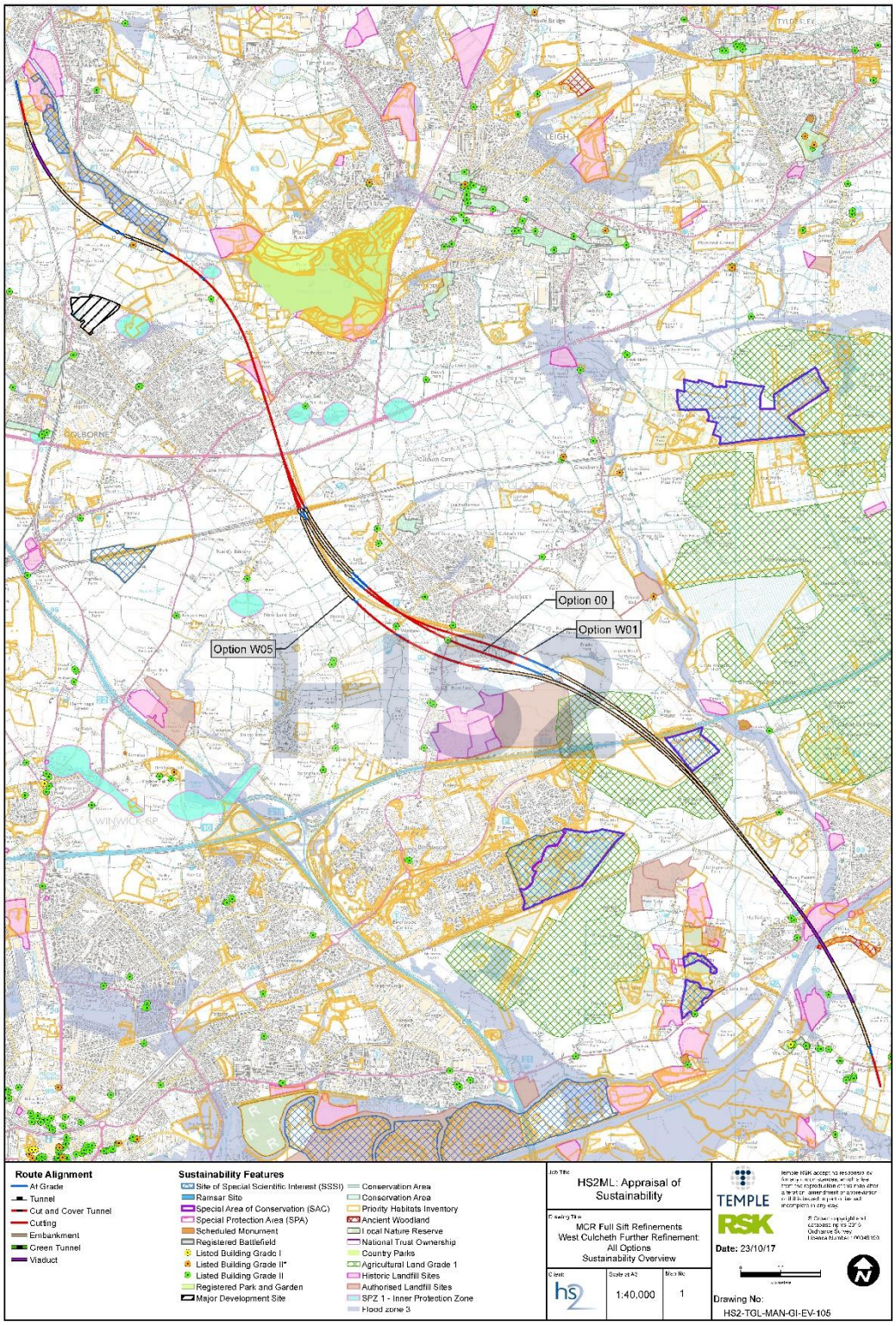
5.2.103 The preferred option, Option W-05, would have minor to moderate visual impacts on residents along the western edge of Culcheth and users of Culcheth Linear Park. South of Culcheth, and similar to all route options, there would be major landscape and visual impacts associated with the high viaduct crossing of the Manchester Ship Canal. To the north, as with all options, the route would clip the eastern extent of Risley landfill but avoid the active deposition areas. There would be some noise impacts south of Culcheth and at Wigshaw, with the route also within approximately 100m of a fishery and associated commercial units where it would cross Glaziers Lane. Impacts on Taylor Business Park, the golf course at Leigh Golf Club and the Grade II listed Newchurch Old Refectory would be

avoided. North of Culcheth, and as with all options, there would be a cluster of demolitions comprising over approximately 20 commercial units as the route would run through Lowton.

5.2.104 Option 00 would have moderate visual impacts on residents along the western edge of Culcheth and users of Culcheth Linear Park. South of Culcheth, and as with all route options, there would be major landscape and visual impacts associated with the viaduct crossing of the Manchester Ship Canal. The route would clip the eastern extent of Risley landfill but would avoid the active deposition areas. There would be greater noise impacts for residents of Culcheth compared with the preferred option. The route would cross the Taylor Business Park in deep cutting, requiring over 20 commercial demolitions. The Grade II listed Newchurch Old Refectory would be demolished and the route would cross Culcheth Linear Park in cutting, with land also required from the golf course at Leigh Golf Club to the north. As with all options, there would be a cluster of demolitions of over approximately 20 commercial units as the route would run through Lowton.

5.2.105 Option W-01, would have moderate visual intrusion for residents on the western edge of Culcheth and users of the Linear Park. South of Culcheth, and applicable to all route options, there would be major landscape and visual impacts associated with the high viaduct crossing of the Manchester Ship Canal. The route would similarly cross the eastern edge of Risley landfill but would avoid any impacts on the active deposition areas. There would be greater noise impacts for residents of Culcheth compared with the preferred option but impacts on Taylor Business Park and the Grade II listed Newchurch Old Refectory would be avoided. The route would cross Culcheth Linear Park in cutting with land also required from the golf course at Leigh Golf Club. As with all options, there would be a cluster of demolitions of over approximately 20 commercial units as the route would run through Lowton.

Figure 43: Local alternatives considered for Culcheth

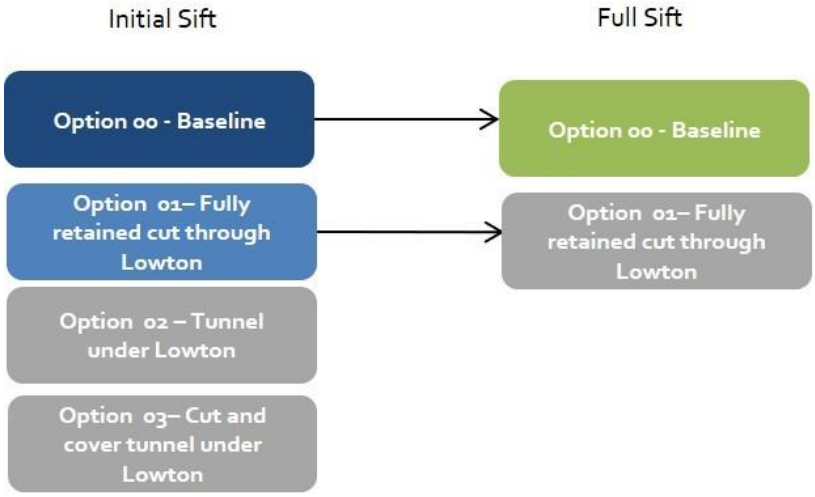


Lowton gap

5.2.106 This refinement area covered approximately 17km of the route from Warburton to Abram, although the focus of the refinement was a short section between Lowton and Lowton Common, termed the Lowton gap. This route refinement sought to define the most appropriate route, where it would pass close to Lowton.

5.2.107 Four options were considered for this section of the route, with two not considered for further progression on the basis of cost, engineering and/or sustainability grounds. The options taken forward in the sift stages are shown in Figure 44 and described in the subsequent paragraphs. The locations of the options are shown in Figure 45.

Figure 44: Local alternatives considered for Lowton



5.2.108 The following two options were taken forward to a full sift appraisal:

- Option 00: the RRB would approach Lowton in cutting between approximately 4 and 8m below existing ground level and up to approximately 70m wide. The route would cross under Newton Road and would continue north through Lowton Common before rising north-east of Golborne; and
- Option 01: would follow the same route as Option 00, however, the cutting would be retained through Lowton and under Newton Road, which would be up to approximately 40m wide. Further to the north, the route would be identical to Option 00.

5.2.109 HS2 Ltd determined that Option 00 should be retained as the preferred option. The alternative option did not have significantly less sustainability impacts to justify the greater cost and construction complexities associated with the retained cut.

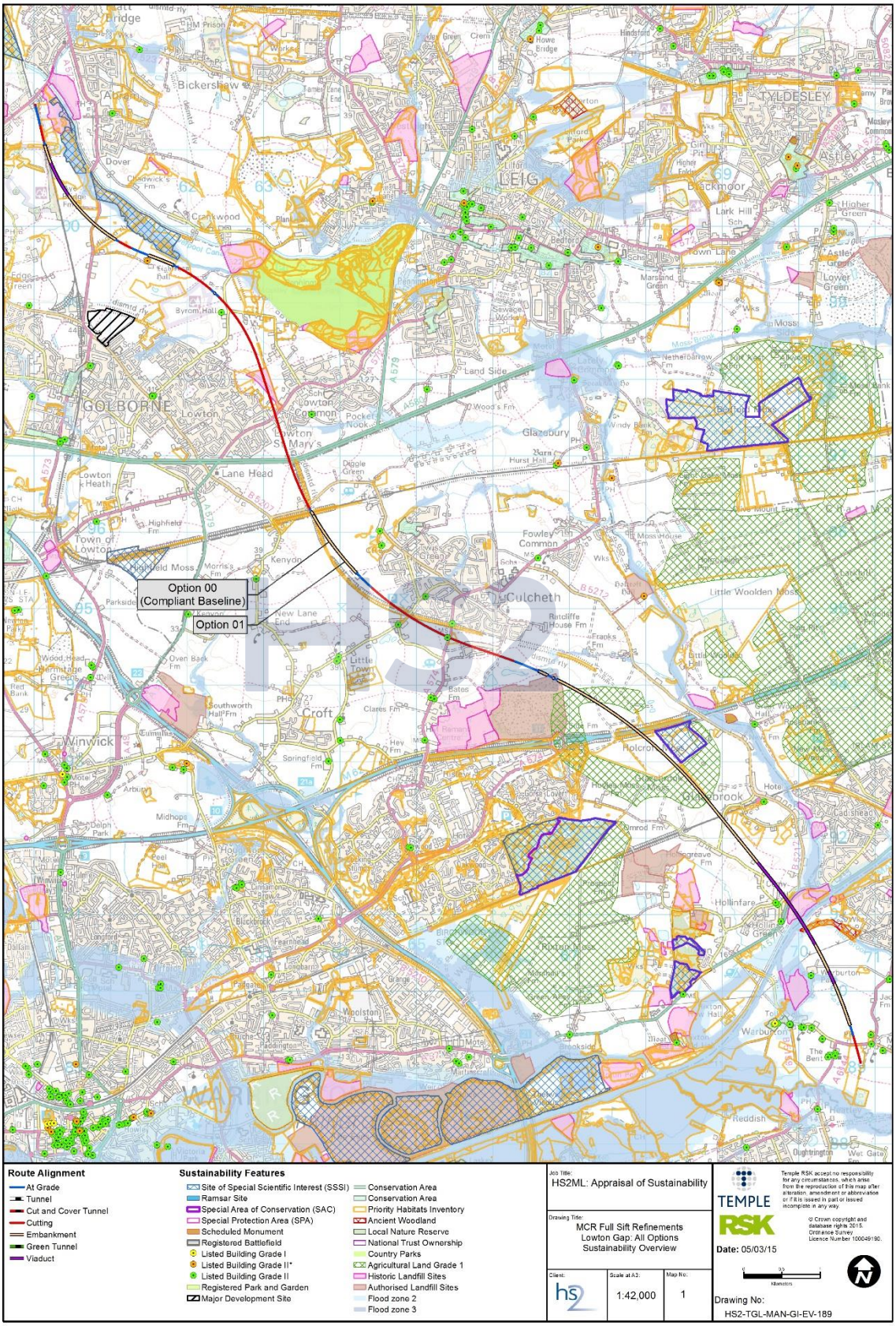
5.2.110 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.111 Option 00, the preferred option, would have some noise impacts for residents at Lowton as the route would pass under Newton Road, although the depth of cutting would limit these impacts. There would also be a cluster of over approximately 20 commercial demolitions

immediately south of Newton Road, with a cluster of approximately five residential property demolitions to the north.

5.2.112 Option 01 would have similar noise impacts for residents at Lowton as the preferred option as the route would also pass under Newton Road, with the depth of cutting limiting the impacts. There would also be a cluster of over approximately 20 commercial demolitions immediately south of Newton Road, although to the north, there would be two fewer residential demolitions as a result of the narrower cutting, when compared with the preferred option.

Figure 45: Local alternatives considered for Lowton



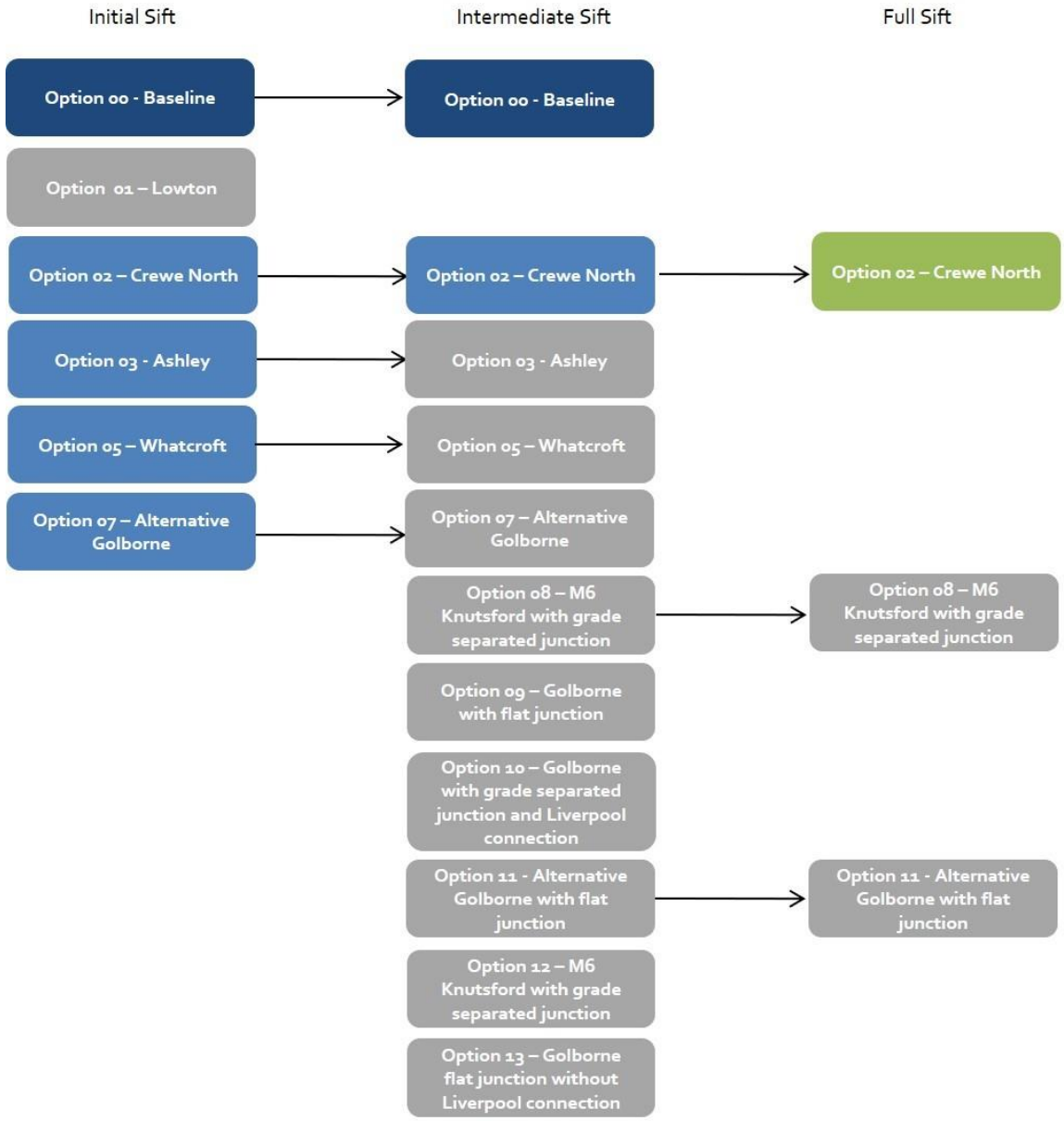
Alternative rolling stock depot locations

5.2.113 This refinement area covered options and alternative locations for the RSD between Crewe, Manchester and the WCML connection near Golborne. The refinement considered the RSD location and layout and sought to address environmental and stakeholder concerns with the existing configuration at Golborne, whilst ensuring compatibility with the wider network operational requirements.

5.2.114 A total of six options were considered initially. A further set of refinements considered specifically the layout of the RSD at Golborne as well as the other preferred locations at Knutsford and Crewe north. HS2 Ltd considered a further option at Knutsford M6, four alternative layouts of the RSD at Golborne and the option previously progressed at Crewe north.

5.2.115 Of the options proposed for Golborne, Option 11 was chosen as the preferred option to be taken forward to the full sift and became the baseline option. This option had an alternative layout and moved the route away from the Grade II* listed Lightshaw Hall and Abram Flashes SSSI, with the associated ground level junction reducing some of the landscape and visual impacts. Options at both Knutsford and Crewe north were also progressed to the full sift. The options taken forward in the sift stages are shown in Figure 46 and described in the subsequent paragraphs. The locations of the options are shown in Figure 47 and Figure 48.

Figure 46: Local alternative locations considered for the depot



5.2.116 The following three options were taken forward to a full sift appraisal:

- Option 02: located north of Crewe, east of Wimboldsley between the route and the WCML. A connection with the route would be provided via a junction at different levels at the northern end of the RSD, close to Stanthorne;
- Option 08: located west of Knutsford, immediately north of where the route would cross the M6. A connection with the route would be provided via a junction at different levels over the route; and
- Option 11: located to the north of Golborne, south of the HS2 WCML connection at Bamfurlong. This RSD would have an alternative internal layout compared with 2013 proposed scheme for consultation option, with the RSD closer to Golborne (and further from Lightshaw Hall), with a ground level junction to the north of the RSD with connections to both the WCML and Liverpool.

5.2.117 HS2 Ltd determined that Option 02 should be taken forward as the preferred option, with further work to be undertaken to find the optimal engineering configuration for Crewe north and re-evaluate the associated costs. This option was selected as it would be centrally located on the Phase 2b Western Leg, provide efficient connectivity to the WCML and cost the least to construct. Relocating the RSD would have less sustainability impacts in the Golborne area, most notably through avoiding a direct impact on the Grade II* listed Lightshaw Hall, which was previously within the RSD site. Furthermore, removal of the depot at Golborne would remove the requirement for a northern chord, thus removing the associated costs and sustainability impacts.

5.2.118 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.119 The preferred option, Option 02, would result in landscape and visual impacts associated with the RSD and connections on residents of Wimboldsley, in addition to the impacts from the route through the area. There would be moderate impacts on the setting of the Grade II* listed Lea Hall and associated Grade II listed Gate Piers, along with minor impacts on the setting of the Grade II* listed Barn, part of Twelve Acres Farmhouse.

5.2.120 Option 11 would have moderate to major cumulative landscape and visual impacts for residents of Golborne as a result of the RSD, depot connections and the HS2 WCML connection. There would also be visual impacts on recreational users of the Leeds and Liverpool Canal and Abram Flashes SSSI to the north of the RSD. There would be moderate impacts on the setting of both the Grade II* listed Lightshaw Hall and Grade II listed Byrom Hall.

5.2.121 Option 08 would have moderate to major landscape and visual impacts as a result of the structures within a predominantly flat open landscape west of Knutsford and Mere Hall. The depot and connections at different levels would have a moderate impact on the setting of the Grade II listed Winterbottom Farmhouse and Hollow Wood Farm.

Figure 47: Local alternatives considered for the depot (part 1 of 2)

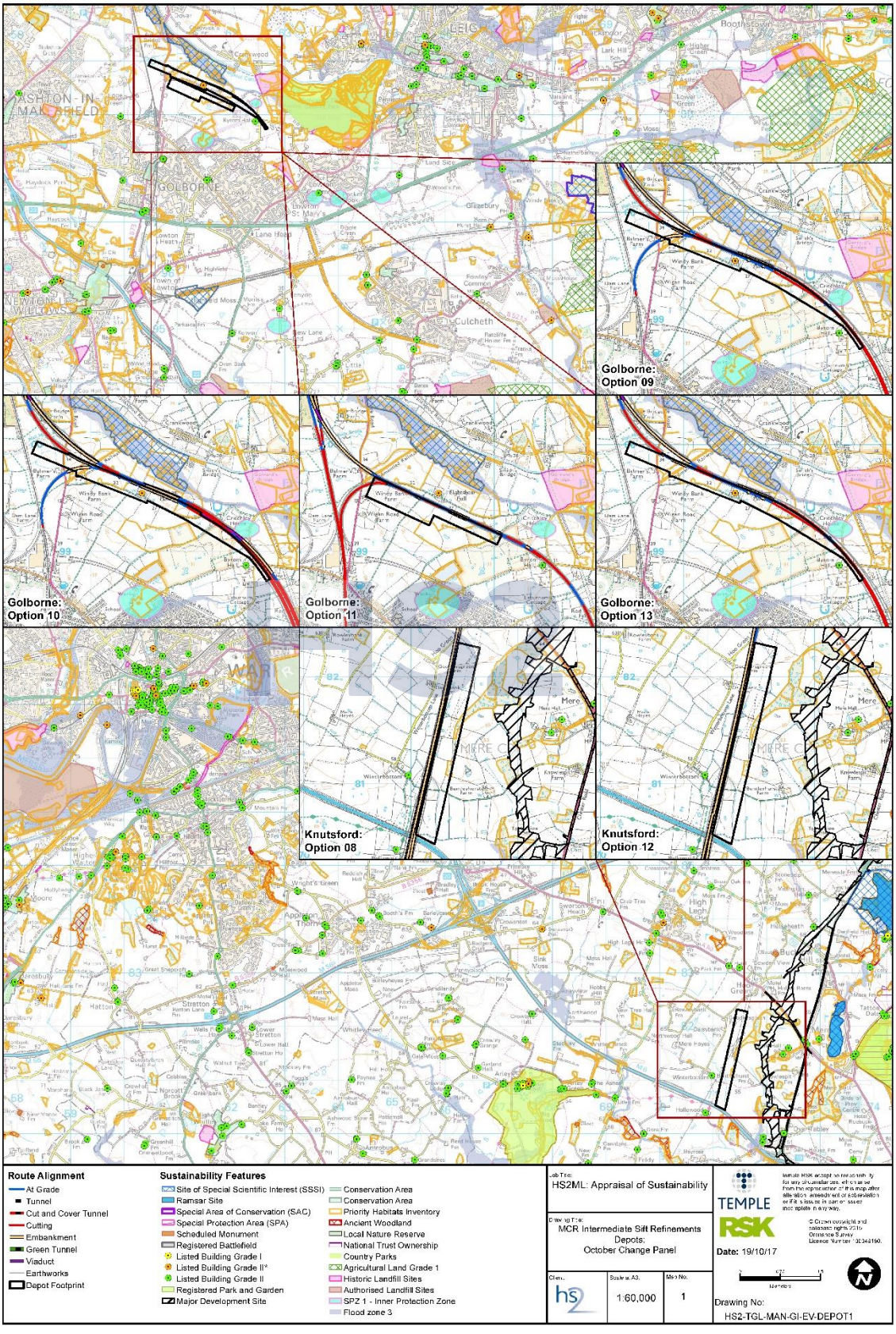
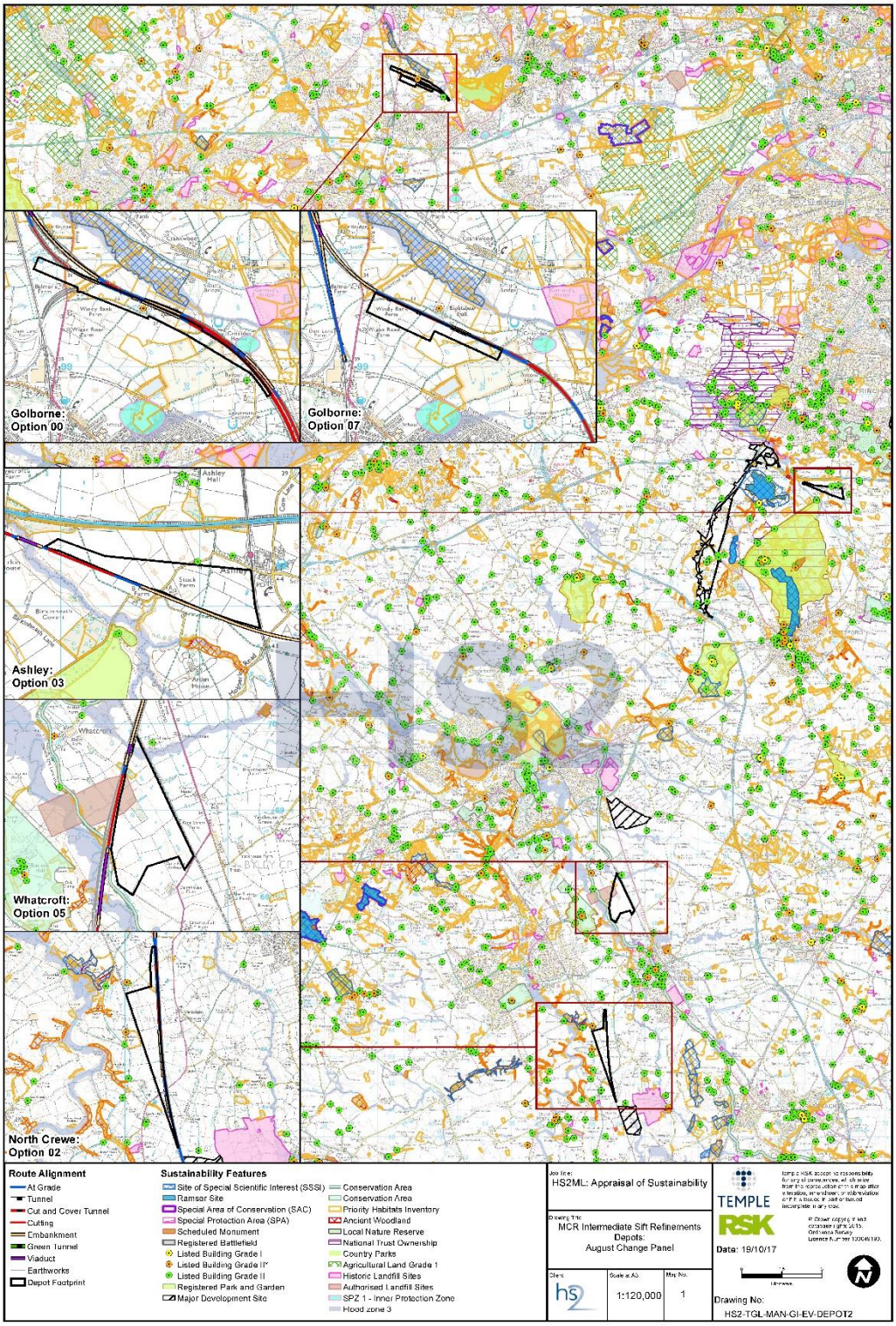


Figure 48: Local alternatives considered for the depot (part 2 of 2)

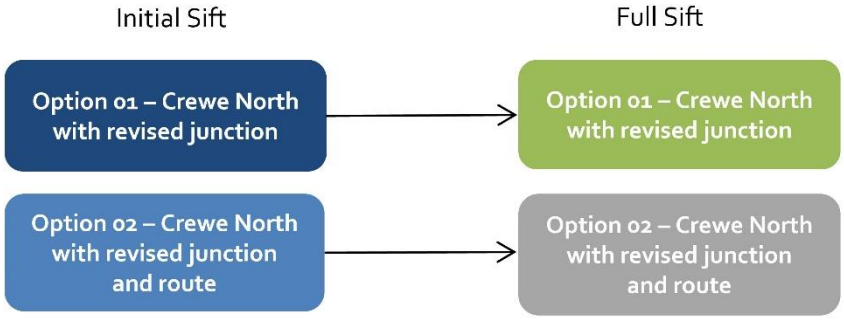


Crewe north rolling stock depot (further refinement)

5.2.122 This refinement covered an area of up to approximately 75ha north of Crewe near Wimboldsley where the route would diverge from the WCML. This follows on from the HS2 Ltd recommendation to Government that the RSD be relocated from Golborne to Crewe north. The refinement considered whether the RSD at Crewe north would be sufficient to meet the updated 2015 depot specification, including the latest stabling requirements.

5.2.123 Two options were considered for this section of the route, both of which were taken to a full sift appraisal. The options taken forward in the sift stages are shown in Figure 49 and described in the subsequent paragraphs. The locations of the options are shown in Figure 50.

Figure 49: Local alternatives considered for Crewe north rolling stock depot



5.2.124 The following two options were taken forward to the full sift appraisal:

- Option 01: a Crewe north RSD with a revised junction layout and operational footprint. No horizontal amendments would be required to the route past Wimboldsley and further north; and
- Option 02: a Crewe north RSD with revised junction layout and operational footprint, as well as revised horizontal alignment that would require the relocation of the route by up to approximately 200m to the east, north of Crewe.

5.2.125 HS2 Ltd determined that Option 01 should be progressed as the preferred option, as the layout of this option would meet the stabling requirement for more trains in line with latest design specification. This option would move the junction for the RSD connections further north to address operational issues without moving the route and RSD closer to Wimboldsley.

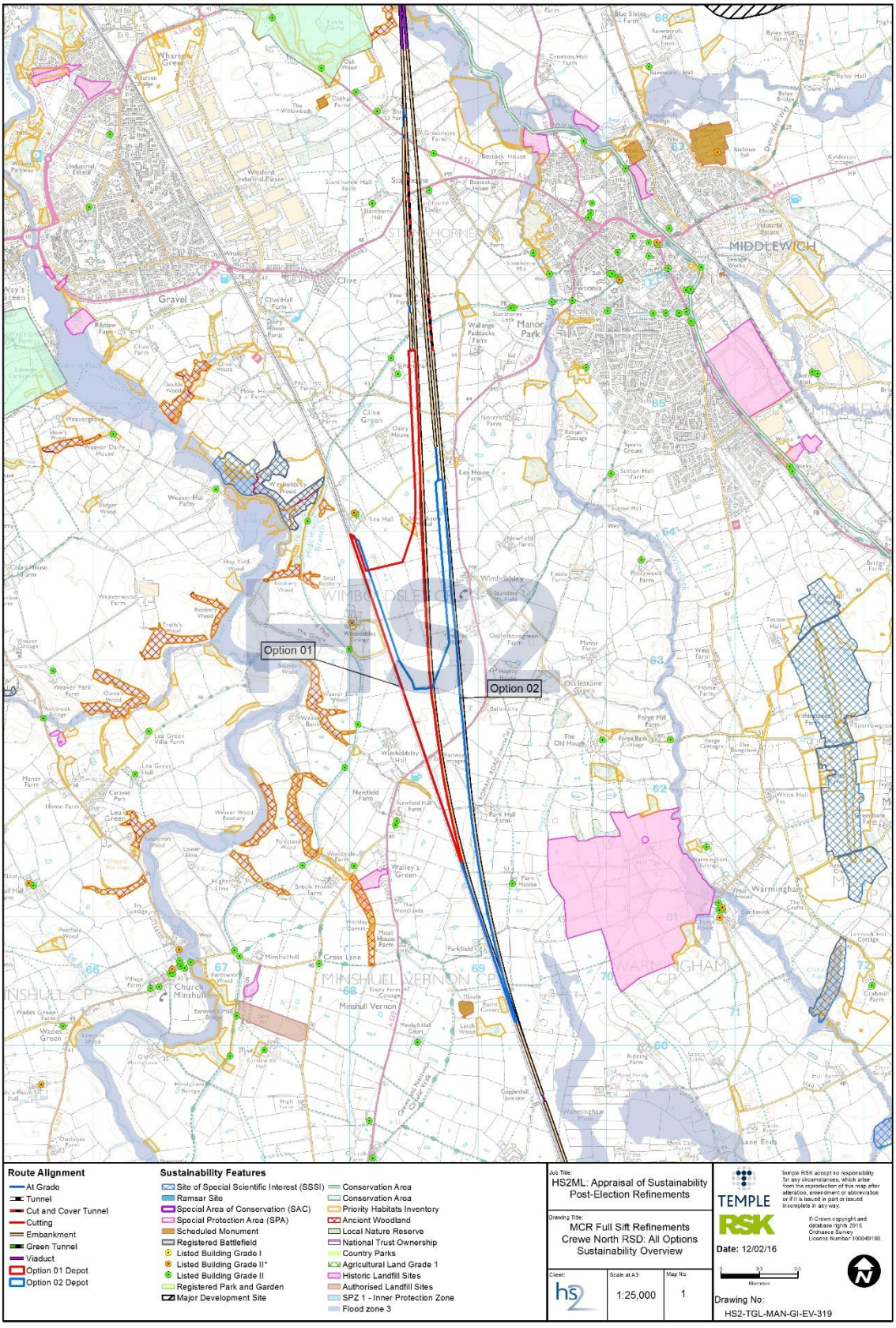
5.2.126 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.127 The preferred option, Option 01, would have major cumulative landscape and visual impacts as a result of the embankment and RSD connections, in a largely flat open rural landscape. There would be visual impacts on residents of Wimboldsley and Stanthorne and there would also be an impact on recreational users of the Shropshire Union Canal. Further north, the triple crossing of the Trent and Mersey Canal within an approximately 2km stretch would impact the setting of the associated conservation area, as well as recreational users of the

canal. There would also be an impact on landscape character associated with the high viaduct crossing of the River Dane (approximately 25m high). There would be a major impact on the setting of the Grade II listed Bridge Canal and Cottage (one listing).

5.2.128 Option 02 would similarly have major cumulative landscape and visual impacts as a result of the embankment associated with the route and RSD connections, in a largely flat open rural landscape. There would be greater visual impacts for residents of Wimboldsley as result of the RSD and the route being approximately 200m closer when compared with the preferred option. Further north towards Stanthorne, there would similarly be an impact on recreational users of the Shropshire Union Canal and major impact on the setting of the Grade II listed Bridge Canal and Cottage (one listing). Further north, the triple crossing of the Trent and Mersey Canal within an approximately 2km stretch would impact the setting of the associated conservation area, as well as recreational users of the canal. There would also be an impact on landscape character associated with the high (approximately 27m) viaduct crossing of the River Dane.

Figure 50: Local alternatives considered for Crewe north rolling stock depot

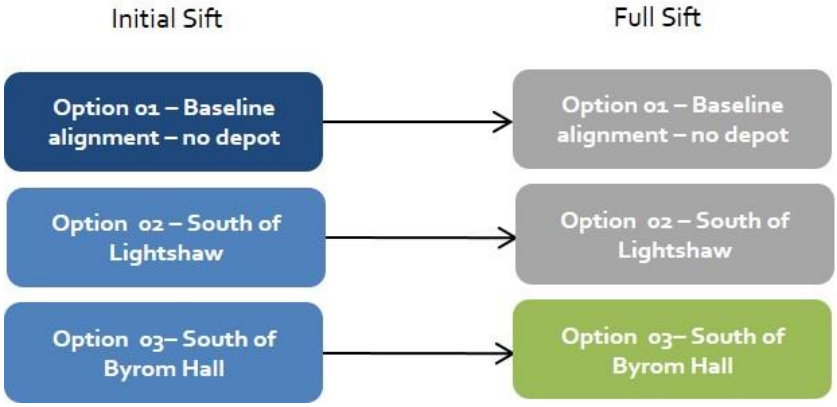


Golborne (without rolling stock depot)

5.2.129 This refinement area covered approximately 8km of the route from the Lowton gap to the WCML connection at Bamfurlong. The area of refinement initially covered Golborne RSD alongside the connection with the WCML at Bamfurlong. However, as the refinement evolved and alternative RSD locations were considered, this refinement focused on optimising this section of the HS2 WCML connection without provision for an RSD at Golborne.

5.2.130 Three options were considered for this section of the route, all of which were progressed to a full sift appraisal. The options taken forward in the sift stages are shown in Figure 51 and described in the subsequent paragraphs. The locations of the options are shown in Figure 51.

Figure 51: Local alternatives considered for Golborne (without depot)



5.2.131 The following three options were taken forward to a full sift appraisal:

- Option 01: would run through Lowton in cutting and would head north-west, to the north of Byrom Hall and Lightshaw Hall, on low embankments and at ground level. The route would continue west before heading north to connect with the WCML at Bamfurlong;
- Option 02: would be similar to Option 01 and would begin in cutting through Lowton and would head north-west to the north of Byrom Hall and south of Lightshaw Hall on low embankments and at ground level. The route would continue north-west, south of Lightshaw Hall, and would head north and connect with the WCML at Bamfurlong; and
- Option 03: would be similar to Option 01, with the route in cutting through Lowton, before heading north-west to the south of Byrom Hall on low embankments and at ground level, approximately 500m closer to Golborne than Option 01. The route would continue north-west, to south of Lightshaw Hall, and would head north to connect with the WCML at Bamfurlong. This option would allow for maintenance loops should they be required at a later date.

5.2.132 HS2 Ltd determined that Option 03 should be taken forward as the preferred option on the basis of the potential to accommodate maintenance loops if they were later required, as well as lower sustainability impacts and in alignment with response to consultation feedback for this area. This included moving the route further away from the Grade II* listed Lightshaw

Hall, as well as further south further away from Abram Flashes SSSI and the Leeds and Liverpool Canal, both well used local recreational areas. This would also result in a greater distance to the Slag Lane abstraction borehole.

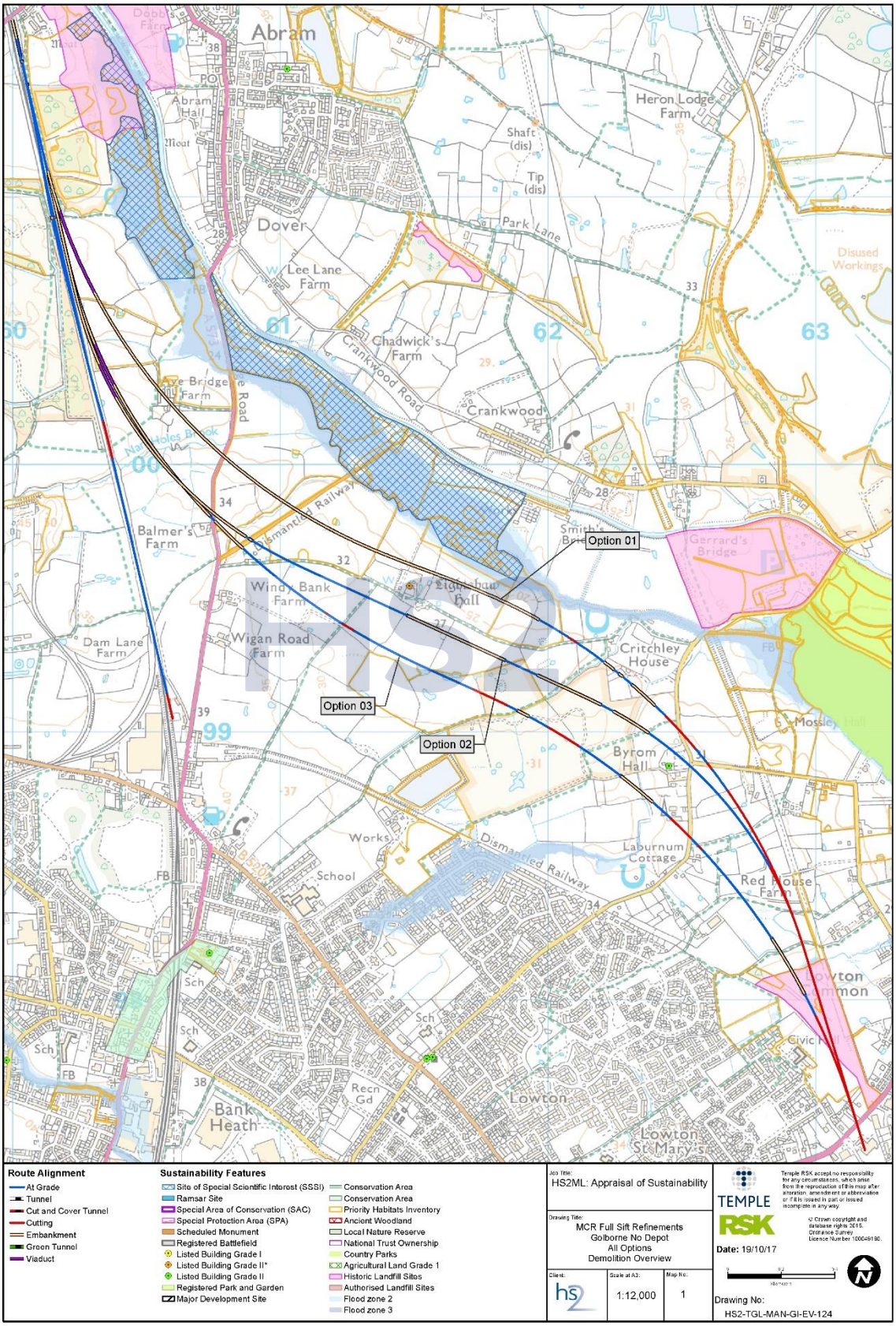
5.2.133 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.134 The preferred option, Option 03, would have minor to moderate landscape and visual impacts for residents of Golborne and recreational users of the Leeds and Liverpool Canal. There would be some visual impacts within this open rural landscape as a result of the high viaduct connection with the WCML south of Bamfurlong. There would be minor impacts on the setting of the Grade II* listed Lightshaw Hall and Grade II listed Byrom Hall, less than the alternative options.

5.2.135 Option 01 would similarly have minor to moderate landscape and visual impacts. Whilst impacts for residents of Golborne would be less than with the preferred option, moving the route further north would have greater visual impacts on recreational users of the Leeds and Liverpool Canal and on the Abram Flashes SSSI. South of Bamfurlong, this option, similar to the preferred option, would have some visual impacts as a result of the high viaduct connection with the WCML in an open rural landscape. This option would have a greater impact on the setting of the Grade II* listed Lightshaw Hall and Grade II listed Byrom Hall as the route would be closer to both buildings.

5.2.136 Option 02 would similarly have minor to moderate landscape and visual impacts. Whilst impacts for residents of Golborne would be slightly less than with the preferred option, moving the route to the north would have greater visual impacts on recreational users of the Leeds and Liverpool Canal and Abram Flashes SSSI. This option would have a greater impact on the setting of the Grade II* listed Lightshaw Hall and Grade II listed Byrom Hall as the route would be closer to both buildings, when compared to the preferred option. South of Bamfurlong, this option, similar to the preferred option, would result in some visual impacts as a result of the high viaduct connection with the WCML in an open rural landscape.

Figure 52: Local alternatives considered for Golborne (without depot)

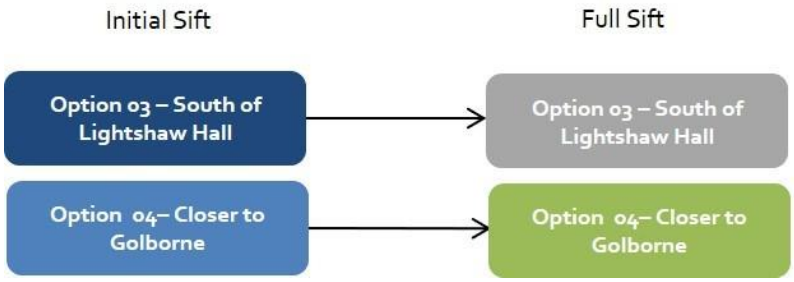


Maintenance loops at Golborne

5.2.137 This refinement area covered approximately 8km of the route from the Lowton gap to the WCML connection at Bamfurlong. The refinements reviewed previous options near Golborne without an RSD (see previous section), but with a focus on the provision of maintenance loops, which would give greater operational resilience to the network. However, since this refinement and, as a result of further design development, the maintenance loops at Golborne were no longer required.

5.2.138 Two options were taken to full sift to explore the Golborne connection without an associated RSD. The options taken forward in the sift stages are shown in Figure 53 and described in the subsequent paragraphs. The locations of the options are shown in Figure 54.

Figure 53: Local alternatives considered for maintenance loops at Golborne (no depot)



5.2.139 The following two options were taken forward to a full sift appraisal:

- Option 03: would run through Lowton in cutting and would then head north-west, to the south of both Byrom Hall and Lightshaw Hall, on low embankments and at ground level. This option would continue west before heading north to a connection with the WCML at Bamfurlong. There would be no provision for maintenance loops with this option; and
- Option 04: would be similar to Option 03 and would begin in cutting through Lowton and would then head north-west to the south of both Byrom Hall and Lightshaw Hall on low embankments and at ground level, closer to Golborne than Option 03. The route would then head north to connect with the WCML at Bamfurlong. This option would include provision for maintenance loops should they be required in the future.

5.2.140 HS2 Ltd determined that Option 04 would be taken forward as the preferred option on the basis that it allowed for the inclusion of maintenance loops if these were to be needed in the future, as well as lower sustainability impacts, and in response to consultation feedback for this area. This included moving the route further away from the Grade II* listed Lightshaw Hall, as well as further south away from Abram Flashes SSSI and the Leeds and Liverpool Canal, both well used local recreational areas. This option would also result in a greater distance to Slag Lane water abstraction borehole.

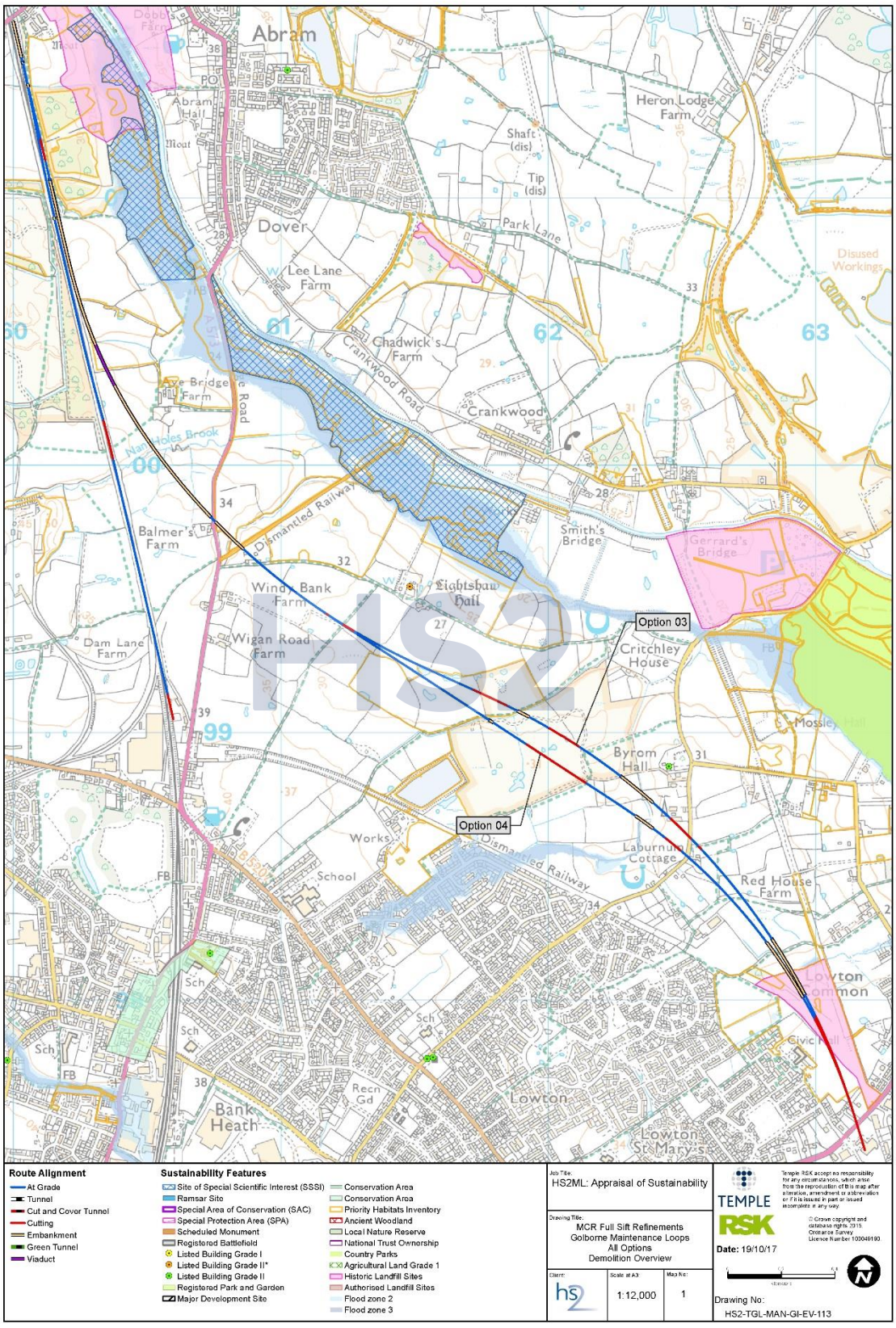
5.2.141 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.142 The preferred option, Option 04, would have minor to moderate landscape and visual impacts for residents of Golborne and recreational users of the Leeds and Liverpool Canal.

There would be some visual impacts within this open rural landscape as a result of the high viaduct connection with the WCML south of Bamfurlong. There would be minor impacts on the setting of the Grade II* listed Lightshaw Hall and Grade II listed Byrom Hall.

5.2.143 Option 03 would similarly have minor to moderate landscape and visual impacts. Whilst impacts for residents of Golborne would be marginally less than with the preferred option, it would move the route closer to both the Grade II listed Byrom Hall and Grade II* listed Lightshaw Hall, which would result in a greater impact to the setting of the Grade II listed Byrom Hall. Approaching Bamfurlong, this option would be similar to the preferred route, with some visual impact as a result of the high viaduct connection with the WCML in an open rural landscape.

Figure 54: Local alternatives considered for maintenance loops at Golborne (no depot)

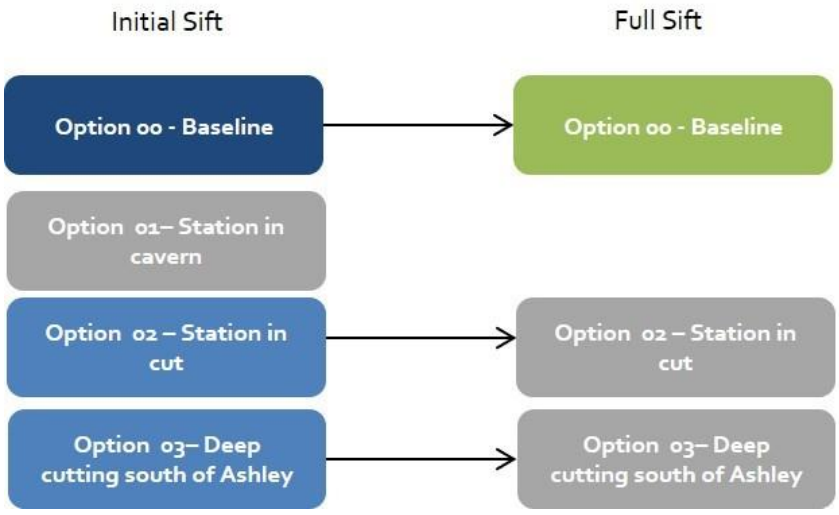


Manchester Airport vicinity

5.2.144 This refinement area covered approximately 19km of the route from Ashley, through the Manchester Airport High Speed station and then an approximately 12.8km tunnel surfacing at West Gorton, east Manchester. The aim of this refinement was to mitigate the impacts close to Tatton Park, Ashley, Rostherne Mere and Manchester Airport.

5.2.145 Four options were proposed for this section of the route, one of which was not progressed past the initial sift as it was not considered reasonable on the basis of engineering, cost and/or sustainability grounds. The options taken forward in the sift stages are shown in Figure 55 and described in the subsequent paragraphs. The locations of the options are shown in Figure 56.

Figure 55: Local alternatives considered for Manchester Airport vicinity



5.2.146 The following three options were taken forward to a full sift appraisal:

- Option 00: the RRB would run in a south-east direction on embankment north of Tatton Park and south of Ashley. The route would then curve north-east past Thorns Green in cutting before crossing the River Bollin and approaching the Manchester Airport High Speed station in deep cutting under the M56. The station would be in a cutting, west of the M56 in green belt, close to Hale Barns. North of Manchester Airport High Speed station and to the east of Davenport Green, the route would be in an approximately 12.8km bored tunnel under the outskirts of south Manchester;
- Option 02: would initially follow a similar route to Option 00 and would pass to the south of Ashley on embankment. However, this route would take a more easterly approach to the Manchester Airport High Speed station and would pass further to the east of Thorns Green and the M56, with Manchester Airport High Speed station in cutting between Manchester Airport and the M56. North of the Manchester Airport High Speed station and to the east of Davenport Green, the route would be in an approximately 12.8km bored tunnel under the outskirts of south Manchester; and
- Option 03 would follow the same route as Option 00 and would run in a south-east direction north of Tatton Park and south of Ashley. However, this route would be lower,

passing south of Ashley, which would allow the route to pass under the Mid-Cheshire Line (as opposed to over with Options 00 and 02). Heading north towards Thorns Green and the Manchester Airport High Speed station, the route would be in a deep cutting, lower than Option 00. The Manchester Airport High Speed station would be in a cutting, west of the M56 in green belt, close to Hale Barns. North of the Manchester Airport High Speed station and to the east of Davenport Green, the route would run under the outskirts of south Manchester into an approximately 12.8km bored tunnel.

5.2.147 HS2 Ltd determined that Option 00 should be progressed as the preferred option on the basis that the alternative options would have similar or greater impacts on the environment or have greater construction complexity and cost more.

5.2.148 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

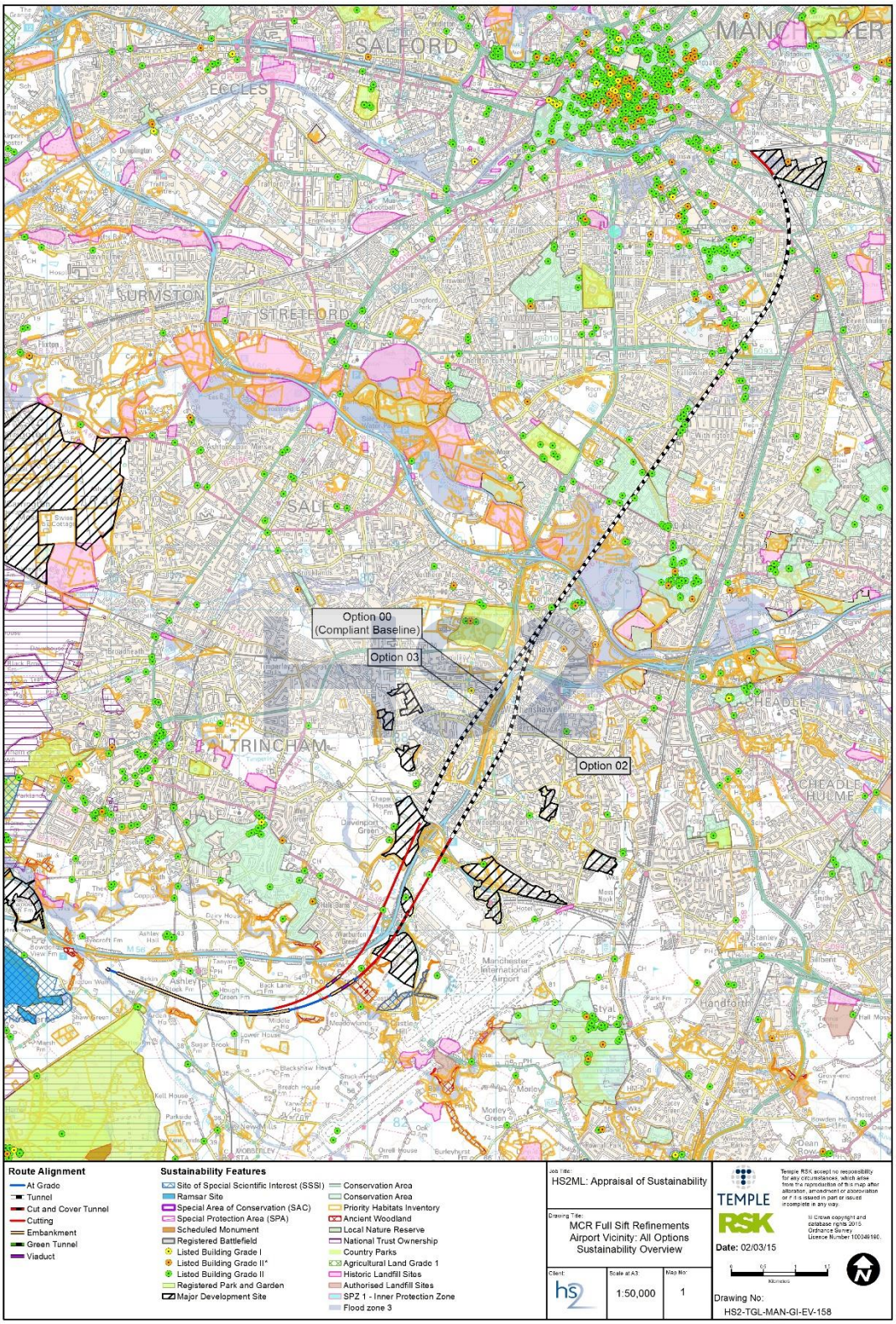
5.2.149 The preferred option, Option 00, would have moderate landscape and visual impacts, particularly for residents of Ashley where the route would pass to the south on embankment, as well as at Hale Barns and Davenport Green owing to the Manchester Airport High Speed station and the approach, which would be in deep cutting. The route would require the demolition of the Grade II listed Buckhall and three clusters of residential demolitions approaching the station, each affecting approximately five properties, including at Hale Barns, Halebank and Thorns Green. North of the Manchester Airport High Speed station, the route would cross Davenport Green development site. Further work would be required to understand how the route would impact the Timperley Brook watercourse and to ensure any flood risk is mitigated.

5.2.150 Option 02 would have similar moderate landscape and visual impacts to Option 00, particularly for residents of Ashley as a result of the embankment to the south. Approaching the Manchester Airport High Speed station, there would be an impact on the setting of the Grade II listed Yew Tree House, which would be avoided by Options 00 and 03. As with the preferred option, the Grade II listed Buckhall would be demolished, however, the approach to the Manchester Airport High Speed station would avoid the three clusters of residential demolitions at Hale Barns, Halebank and Thorns Green. North of the Manchester Airport High Speed station, the route would cross Davenport Green development site and would also impact the Airport Enterprise Zone development site. As a result of the deep cutting, there would be some loss of Sunbank Ancient Woodland. Further work would be required to understand how this route would impact the Timperley Brook watercourse and to ensure flood risk is mitigated.

5.2.151 Option 03 would have fewer visual impacts on residents at Ashley when compared with the preferred option as a result of the lower route south of the village, which would be in cutting. However, further east and north, the deeper cutting would have a greater impact on the landscape character. Similar to the preferred option, this route would require the demolition of the Grade II listed Buckhall and three clusters of residential demolitions approaching the station, each with approximately five properties, including at Hale Barns, Halebank and Thorns Green. North of the Manchester Airport High Speed station, the route

would cross Davenport Green development site. Further work would similarly be required to understand how this route would impact the Timperley Brook watercourse and to ensure any flood risk is mitigated.

Figure 56: Local alternatives considered for Manchester Airport vicinity

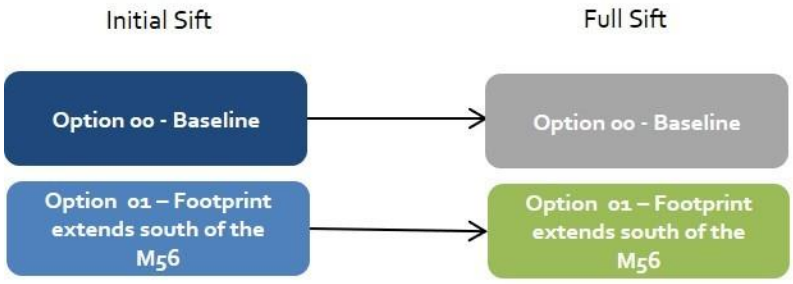


Manchester Airport High Speed station (further refinements)

5.2.152 This refinement considered a review of the operational requirements and layout of the Manchester Airport High Speed station near Warburton Green.

5.2.153 Two options were proposed for this section of the route, both of which were taken to a full sift. The options taken forward in the sift stages are shown in Figure 57 and described in the subsequent paragraphs. The locations of the options are shown in Figure 58.

Figure 57: Local alternatives considered for Manchester Airport High Speed station



5.2.154 The following two options were taken forward for full sift appraisal:

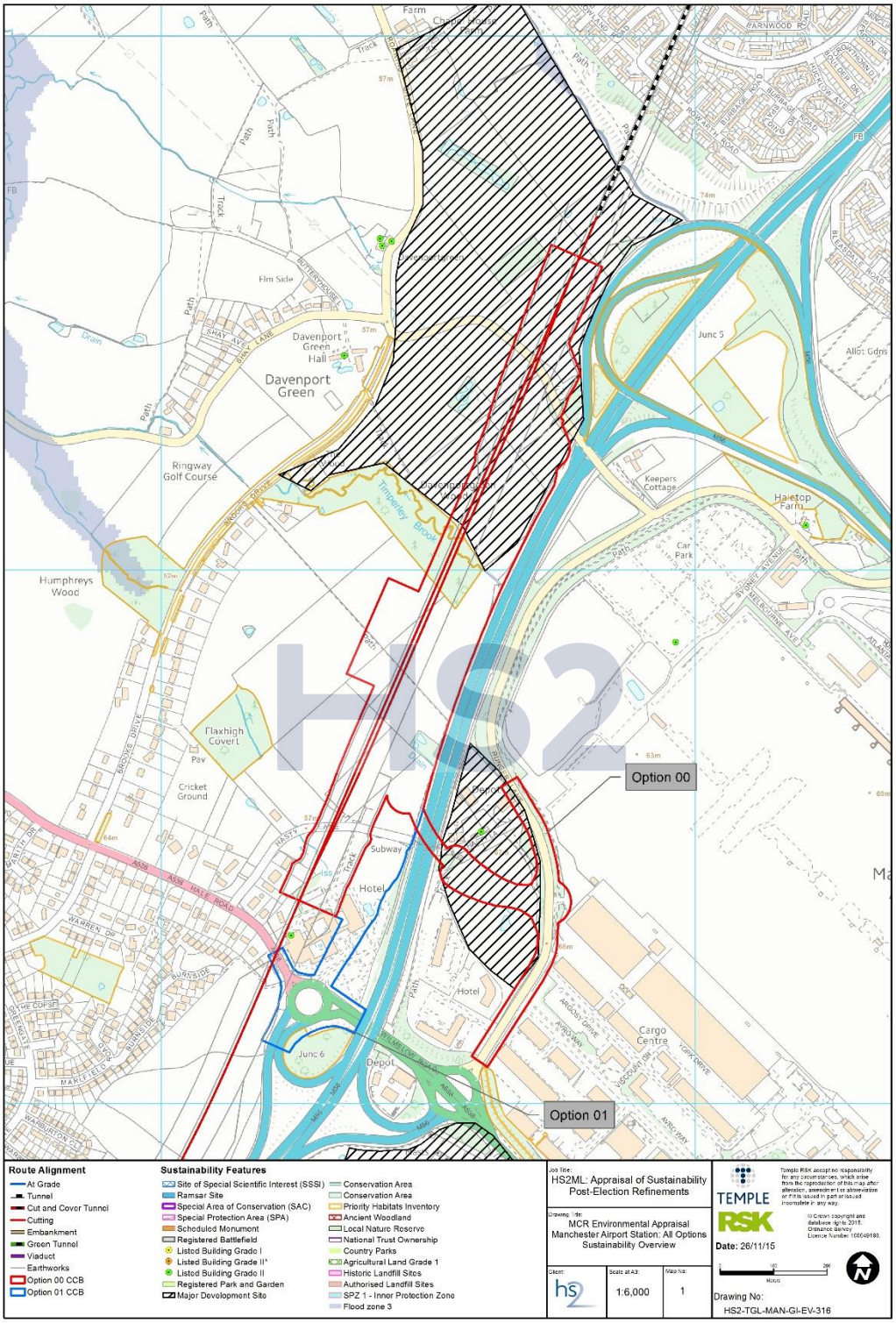
- Option 00: the DRR would provide a high speed station at Manchester Airport in cutting to the west of the M56 and to the east of Hale Barns, but with no provision within the station footprint for connection to the highway network; and
- Option 01: would provide a high speed station at Manchester Airport in cutting to the west of the M56 and to the east of Hale Barns, including provision within the station footprint for highway connections to the M56 junction 6 and A538 Hales Road.

5.2.155 HS2 Ltd determined that Option 01 was the preferred option to be taken forward, ensuring consistency in the design with other proposed stations, which also included connections to the existing highway network.

5.2.156 Both options would have broadly similar impacts and the same number of demolitions, with the station layout, car parks and platforms the same for both options. The preferred option, Option 01, would have a direct impact on the Grade II listed Buckhall and limited landscape and visual impacts owing to the deep cutting and the car park between the HS2 Manchester spur and M56. To the north of the station and approaching the tunnel portal land would be required from the Davenport Green development site.

5.2.157 Further consideration is given in Section 6.7 to local alternatives identified after July 2017 for the route of the Proposed Scheme at Manchester Airport High Speed station. Consideration has been given to the feasibility of raising the level of Manchester Airport High Speed station, with the alignment of the HS2 Manchester spur either over or under the M56. Opportunities were considered to reduce construction costs associated with excavation of large volumes of material to develop the station below ground level.

Figure 58: Local alternatives considered for Manchester Airport High Speed station

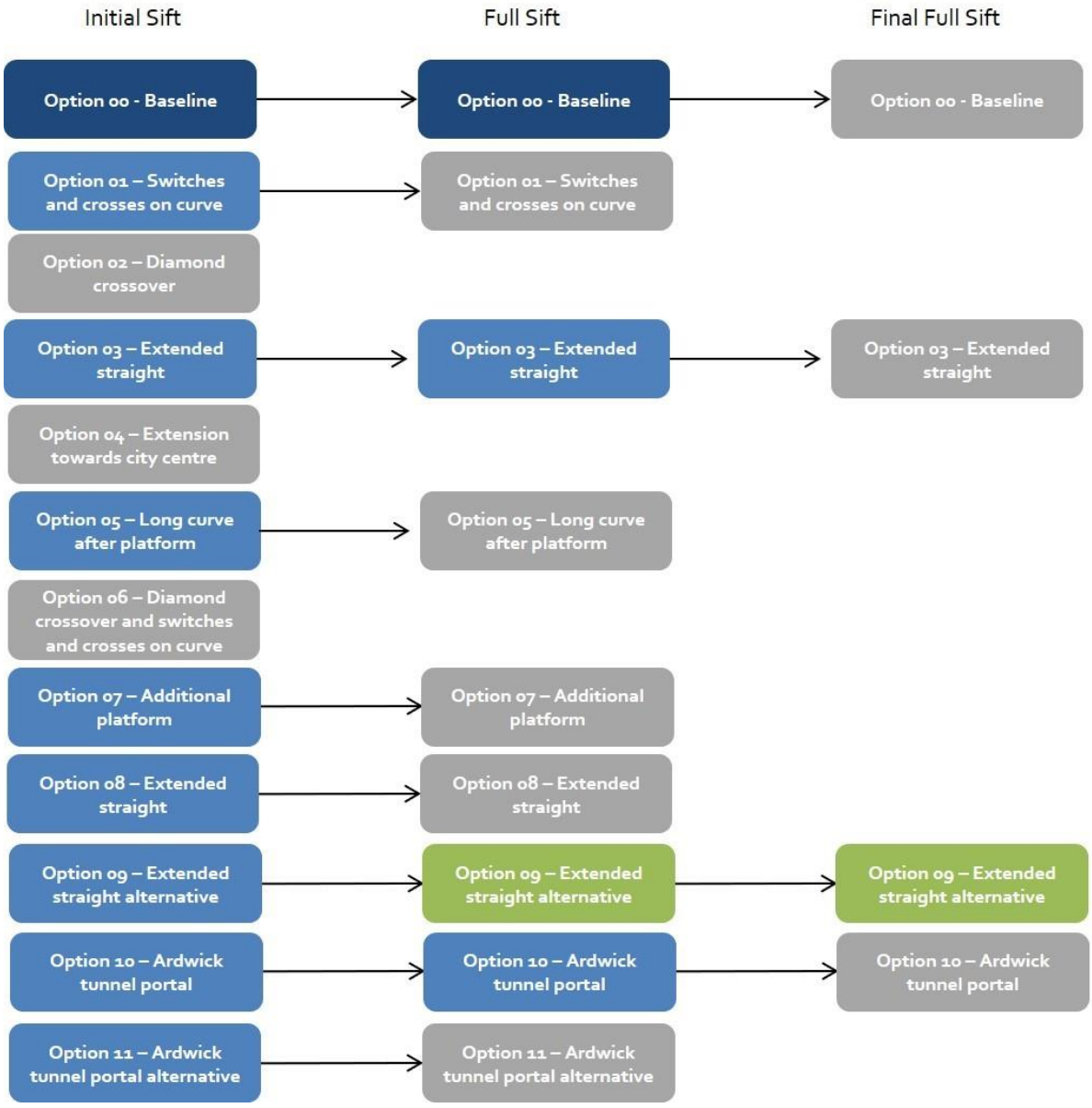


Manchester Piccadilly High Speed station and approaches

5.2.158 This set of refinements covered approximately 14km of the route including the approach to, and layout of, Manchester Piccadilly High Speed station. The refinement focused on optimising the orientation of the platforms and station throat with the aim of reducing the impact on Network Rail assets and reducing the re-occupation time (the minimum time between different trains using platforms) for trains in the station. This refinement also reviewed the demolition of a block of approximately 47 residential properties on Chapeltown Street.

5.2.159 A total of 12 options were considered as part of this refinement area, with new options introduced or revisited at various stages of the optioneering process. A final full sift considered a total of four options. The options taken forward in the sift stages are shown in Figure 59 and described in the subsequent paragraphs. The locations of the options are shown in Figure 60 (station footprint) and Figure 61 (station approaches).

Figure 59: Local alternatives considered for Manchester Piccadilly High Speed station



5.2.160 The following four options were taken forward to the final full sift appraisal:

- Option 00: the RRB would run north-east in an approximately 11.9km bored tunnel from just north of Manchester Piccadilly High Speed station, under much of south Manchester and would surface approximately 500m south of Ardwick Depot. The route would head north-west in a cutting through the western edge of West Gorton and would then continue on viaduct through Ardwick towards Manchester Piccadilly High Speed station alongside the WCML;
- Option 03: would have an extended bored tunnel approximately 12.8km in length approaching Manchester Piccadilly High Speed station, with the tunnel portal approximately 500m further to the north near Ardwick, compared with Option 00. It would similarly approach Manchester Piccadilly High Speed station on viaduct, although

slightly further to the north of Option 00 and thus would require an extended construction footprint, although the platform configuration would be similar to the RRB;

- Option 09: would follow a broadly similar route to Option 03, including a bored tunnel approximately 12.8km in length approaching Manchester Piccadilly High Speed station, with the tunnel portal approximately 500m further to the north at Ardwick Depot. However, the gradient of the tunnel would be less to meet engineering requirements and to help provide simplified vent shaft solutions. It would similarly approach Manchester Piccadilly High Speed station on viaduct, although slightly further to the north of Option 00, which would require an extended construction footprint. This option also has a revised platform configuration to improve the operational performance of trains entering and leaving Manchester Piccadilly High Speed station; and
- Option 10: would follow a broadly similar route to Option 09, including a bored tunnel approximately 12.8km in length approaching Manchester Piccadilly High Speed station, with the tunnel portal at Ardwick Depot. However, the gradient of the tunnel would be less to meet engineering requirements and to help provide simplified vent shaft solutions. As with Option 09, this option would have a revised platform configuration to improve the operational performance of trains entering and leaving the Manchester Piccadilly High Speed station.

5.2.161 HS2 Ltd determined that Option 09 should be progressed as the preferred option. This option would be further away from and have less impacts on, West Gorton and the associated Corn Brook floodplain, the development site at West Gorton and on a cluster of residential demolitions. This option would also provide an improved engineering arrangement at Manchester Piccadilly High Speed station owing to the lower tunnel gradient, simpler vent shaft solution and revised platform configuration, which would improve operational performance of trains.

5.2.162 The sustainability impacts of each of the options are set out below with those of the preferred option presented first.

5.2.163 The preferred option, Option 09, would have minor to moderate landscape character and visual impacts, specifically relating to the large viaduct approaching Manchester Piccadilly High Speed station close to the Medlock Valley, an area of public open space. The Grade II listed Train Shed at Manchester Piccadilly would fall within the boundary of the Manchester Piccadilly High Speed station, although the listed structure would be retained. A cluster of demolitions would be required, including a block of approximately 47 residential properties on Chapeltown Street.

5.2.164 Option 00 would have minor landscape and visual impacts as a result of running alongside the WCML approaching Manchester Piccadilly High Speed station. However, unlike the preferred option, this route would require more demolitions on the station approach as a result of cutting through West Gorton, with a cluster of approximately 22 residential demolitions. Unlike the preferred option, the tunnel portal and sections of cutting would be located within the Corn Brook floodplain, which would result in a flood risk. Land would also

be required from the West Gorton development site, which would be avoided by the preferred option.

5.2.165 Similar to the preferred option, Option 03 would have minor to moderate landscape character and visual impacts specifically relating to the large viaduct approaching Manchester Piccadilly High Speed station close to the Medlock Valley, an area of public open space. Similarly, the Grade II listed Train Shed at Manchester Piccadilly would fall within the Manchester Piccadilly High Speed station boundary, although the listed structure would be retained. A cluster of demolitions would be required as part of the Manchester Piccadilly High Speed station, including a block of approximately 47 residential properties on Chapeltown Street.

5.2.166 Similar to the preferred option, Option 10 would have minor to moderate landscape character and visual impacts specifically relating to the large viaduct approaching Manchester Piccadilly High Speed station close to the Medlock Valley, an area of public open space. Similarly, the Grade II listed Train Shed at Manchester Piccadilly would fall within the Manchester Piccadilly High Speed station boundary, although the structure would be retained. A cluster of demolitions would be required as part of the Manchester Piccadilly High Speed station, including a block of approximately 47 residential properties on Chapeltown Street.

5.2.167 A diversion of the River Medlock would be required, which would be also required for the alternative options.

Figure 60: Local alternative station footprints considered for Manchester Piccadilly High Speed station (part 1 of 2)

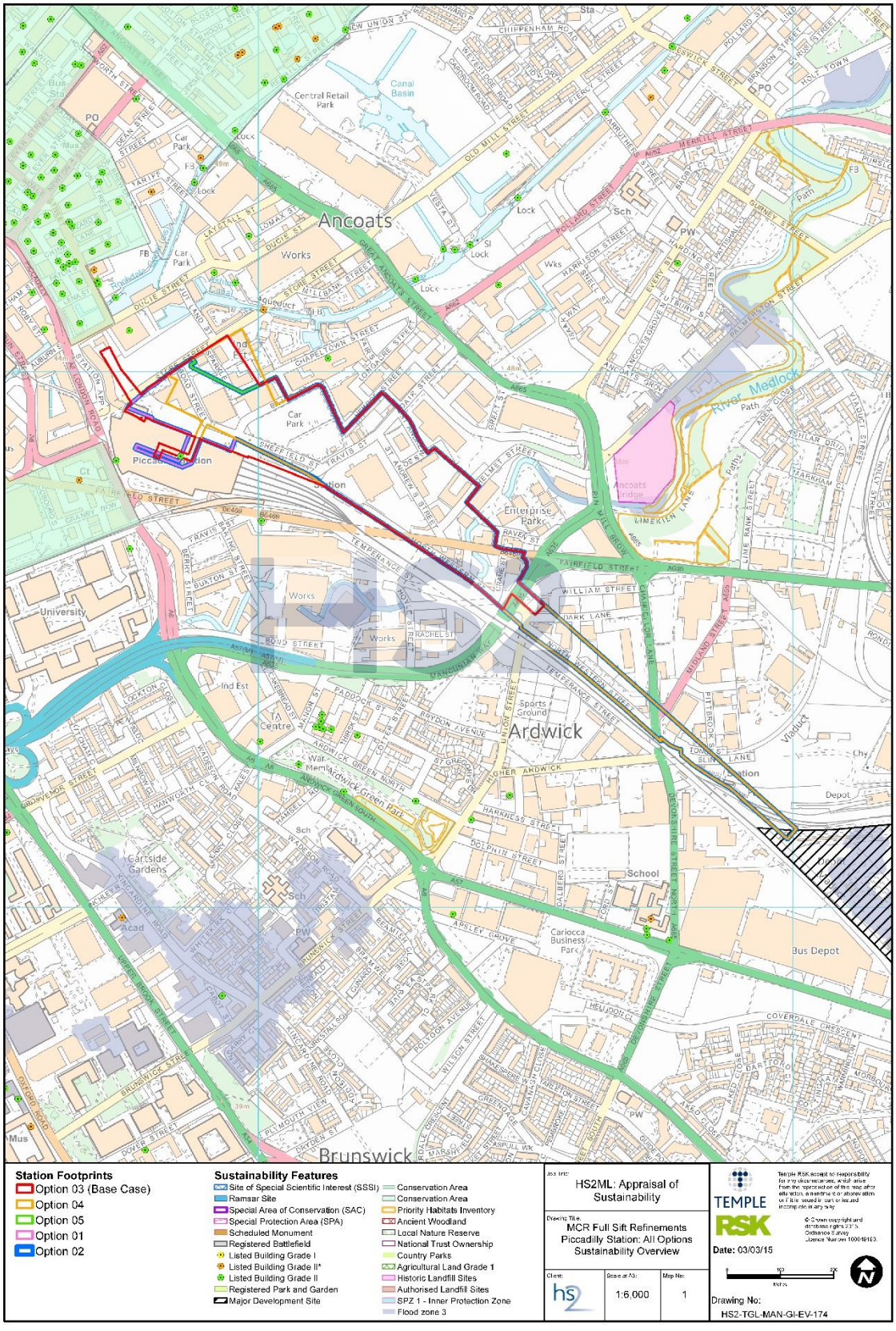
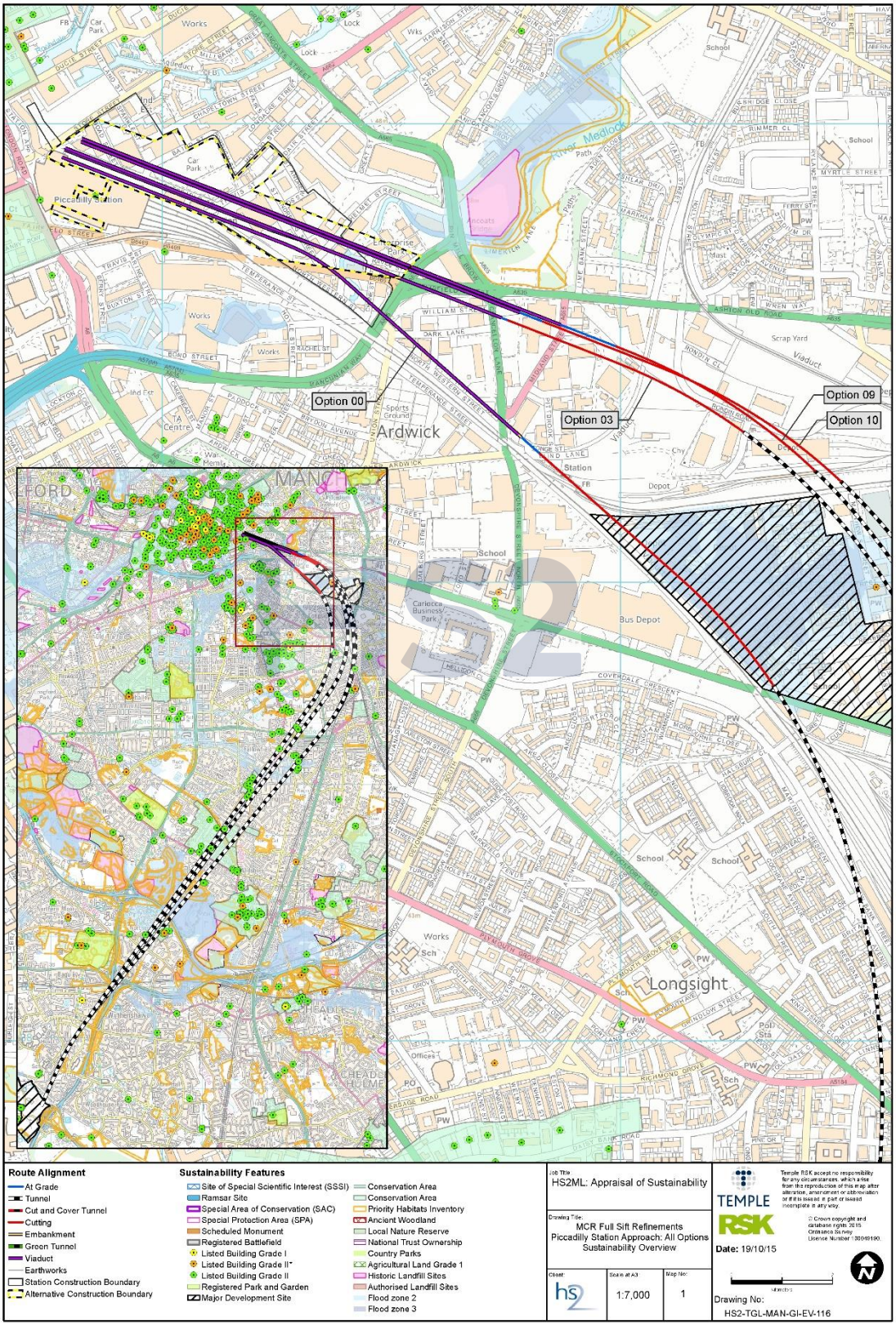


Figure 61: Local alternatives station approaches considered for Manchester Piccadilly High Speed station (part 2 of 2)

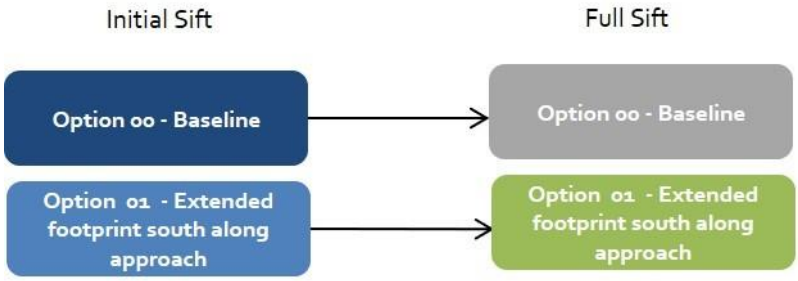


Manchester Piccadilly High Speed station (further refinement)

5.2.168 This refinement considered the footprint and layout of Manchester Piccadilly High Speed station, together with a review of operational requirements, including provision of a greater area of land for possible highway reconfiguration.

5.2.169 Two options were proposed for this section of the route, both of which were taken to a full sift. The options taken forward in the sift stages are shown in Figure 62 and described in the subsequent paragraphs. The locations of the options are shown in Figure 63.

Figure 62: Local alternatives considered for Manchester Piccadilly High Speed station



5.2.170 The following two options were taken forward to the full sift appraisal:

- Option 00: the footprint of Manchester Piccadilly High Speed station would extend towards Mancunian Way, but would have no provision for highway works associated with the crossing of Mancunian Way and Fairfield Street junction within the land required during construction; and
- Option 01: would have a similar layout to Option 00, but the footprint would extend to the east across Mancunian Way and Fairfield Street to take into consideration the reconfiguration of highways.

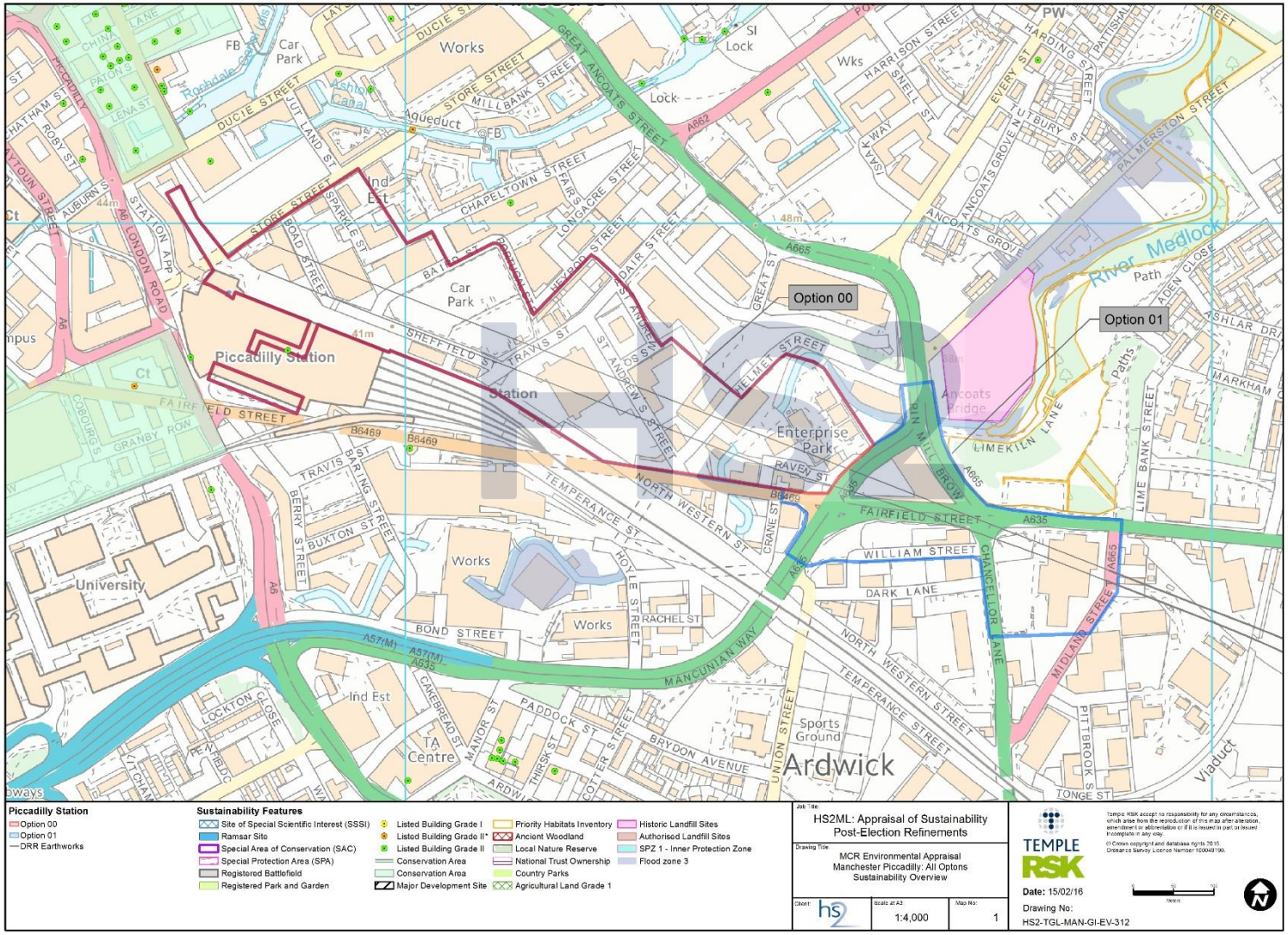
5.2.171 HS2 Ltd determined that Option 01 was the preferred option to be taken forward as it included the provision of a greater area of land sufficient for potential highway reconfiguration required for the crossing of the Mancunian Way and Fairfield Street Junction.

5.2.172 The sustainability impacts of each option were similar, except in terms of demolitions as a result of the difference in station footprint. The preferred option, Option 01, would require a total of approximately 109 demolitions within the Manchester Piccadilly High Speed station boundary; three more commercial demolitions when compared with Option 00. These are the only variations between the two options.

5.2.173 Further consideration is given in Section 6.9 to local alternatives identified after July 2017 for the route of the Proposed Scheme through Manchester Piccadilly High Speed station due to a requirement to increase the number of platforms at Manchester Piccadilly High Speed station from four to six to accommodate NPR services. Consideration has also been given to the land required for the construction and operation of the Manchester Piccadilly High Speed station in order to avoid the site of the New Sheffield Street Boulevard as identified in

the 2017 Manchester City Council HS2 Strategic Regeneration Framework and to maximise economic benefits of the Proposed Scheme in Manchester city centre.

Figure 63: Local alternatives considered for Manchester Piccadilly High Speed station (further refinements)



Post 2016/2017 consultation route refinements

Introduction

5.2.174 Between November 2016 and March 2017, public consultation was held for areas of the Phase 2b route where substantial changes had been made to the route as a result of the route refinement work following the 2013/2014 consultation. On the Western Leg, the consultation route refinement areas were as follows:

- relocating the RSD from near Golborne to north of Crewe;
- changing the route between Middlewich and Pickmere; and
- changing the approach to Manchester Piccadilly High Speed station.

5.2.175 Following the period of public consultation, there was further work to consider potential route refinements, responding to consultee concerns. For the post-consultation (2016/2017) refinements, a baseline option was presented as part of each refinement option. This was the 2016 preferred route to Manchester and Leeds. A summary is provided below for each of the route refinement areas, together with the recommendations adopted. Further detail can be found in the Phase 2b route refinements report (2017)[40].

Crewe north rolling stock depot

5.2.176 In light of consultation feedback, HS2 Ltd reviewed the decisions that had been made previously regarding the location of the Western Leg RSD to ensure that the location north of Crewe remained the optimal solution. This included revisiting the previously discounted options at Golborne and Knutsford. A review of brownfield sites was also undertaken, which confirmed that there were no brownfield sites that met the requirements for the RSD on the line of route.

5.2.177 As a result of this work, HS2 Ltd recommended that the location of the Western Leg RSD should remain north of Crewe, near Wimboldsley, which would deliver a good fit with the requirements for the RSD. Provision of the RSD north of Crewe would allow a connection to the WCML, would be centrally located on the Western Leg and would have fewer sustainability impacts than the alternative options considered, including at Golborne.

5.2.178 Moving the RSD away from Golborne would remove direct impacts on the Grade II* listed Lightshaw Hall and Grade II listed Byrom Hall as well as at Abram Flashes SSSI. There would also be substantially less infrastructure at the junction between the HS2 WCML connection and the HS2 Manchester spur, including the approximately 7km long northern chord and associated junctions. The purpose of the chord was to enable empty trains to move between

[40] High Speed Two Ltd (2017), *High Speed Two Phase 2b Crewe to Manchester West Midlands to Leeds: Route refinements. HS2 Ltd's advice to Government*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/628605/CS848_Phase_2b_201617_Route_Refinement_Advice_FINAL_WEB_170713.pdf.

the RSD and Manchester Piccadilly High Speed station. The relocation of the RSD to north of Crewe would mean that the northern chord would no longer be required, resulting in less land required, less noise and visual impacts in this area, together with lower costs.

Middlewich to Pickmere (routes through salt mining areas)

5.2.179 In response to feedback from the 2016/2017 consultation, HS2 Ltd undertook a strategic review of all previous route options in this area, including the previous route refinement options considered following the 2013/2014 consultation. In addition, consideration was given to alternatives suggested as part of consultation feedback, including a route closer to the M6 corridor, a tunnelled route under Sandbach, a route east of Middlewich and a route that followed the A556.

5.2.180 Previous work undertaken by HS2 Ltd indicated that routes following the M6 corridor would have similar impacts associated with passing over an area of salt and would require a less favourable location for the junction of the HS2 WCML connection and the HS2 Manchester spur. These options would also have community and environmental impacts, including demolitions and impacts on SSSI and heritage assets.

5.2.181 HS2 Ltd also assessed an alternative proposed during the 2016/2017 consultation of extending the proposed tunnel beneath Crewe, taking it deeper into the bedrock below the salt strata, and returning to surface near the M6 crossing. Although this option would have less noise and visual impacts, together with less disruption to the public during construction than the 2016 preferred route, the relatively long and potentially deep tunnelling would cost considerably more than the preferred route. Due to the depth and length of tunnel required, this option could also have greater construction and safety risks. Extending the tunnel would also require relocation of the Western Leg RSD.

5.2.182 HS2 Ltd previous work indicated that a route passing Knutsford would present a range of issues, including a less favourable location for the Manchester junction. Therefore, options were discounted in previous sifting work. Other options that would pass Sandbach or to the east of Middlewich were discounted due to the greater sustainability impacts on Sandbach and Elsworth and poor ground conditions from known brine runs. There would be similar impacts to the 2013 proposed scheme for consultation route with regards to passing through controlled brine and gas storage sites.

5.2.183 HS2 Ltd also considered the scope for lowering the speed of the route in this area to facilitate tighter curves and allow for a more flexible alignment to lower the height and reduce some of the local environmental impacts. This part of the route would be used by direct HS2 services not only to Manchester, but also to the North West and Scotland. Accordingly, the relatively small reductions in speed could have substantial impacts on the overall benefits of HS2.

5.2.184 A review of previous route options (including the alternatives proposed during the 2016/2017 consultation) indicated that the 2016 preferred route to Manchester would have

the least risk regarding the construction, operation and long-term maintenance of HS2 throughout this area.

5.2.185 It was, therefore, decided that the route between Middlewich and Pickmere would remain as per the 2016 preferred route to Manchester. This route would avoid the brining and gas storage infrastructure, such as caverns, wellheads and surface infrastructure and would have lower risk of subsidence from ground movement. The route would be raised in this area to allow for the management of drainage and geological risk and to provide more flexibility for ground stability mitigation options.

5.2.186 Further consideration is given in Section 6.3 to local alternatives identified after July 2017 for the route of the Proposed Scheme through salt deposits of the Cheshire plain and between Lostock Green and Lostock Gralam. The opportunity to reduce the height of the embankment, and therefore, reduce the volume of earthworks and associated construction traffic and shorten the duration of construction impacts was considered, whilst retaining provision of a 1m clearance over existing ground level in response to existing geological conditions.

Manchester Piccadilly High Speed station approach

5.2.187 As a result of the feedback received from the 2016/2017 consultation, HS2 Ltd reviewed the previous route refinement for the approach to Manchester Piccadilly High Speed station, including the Manchester tunnel. Specific options suggested from the consultation included an alternative tunnel alignment to change the location of vent shafts, an underground station at Manchester Piccadilly for high speed services and options that were similar to the 2013 proposed scheme for consultation route that avoided Ardwick Depot.

5.2.188 HS2 Ltd reviewed the consultation response suggesting an alternative tunnel alignment to change the location of the vent shafts. This was not progressed the option as it would require a greater curvature in the tunnel resulting in lower line speed and an increased journey time.

5.2.189 HS2 Ltd did not consider, beyond an initial review, an entirely underground high speed station at Manchester Piccadilly to enable through services north as the proposed HS2 timetable requires Manchester Piccadilly to be a terminus station. An underground box and longer tunnel alignment would be more costly and would present considerable engineering challenges.

5.2.190 Options that were similar to the 2013 proposed scheme for consultation route avoiding Ardwick Depot were previously considered. These options were not taken forward as they would have similar impacts to the 2013 proposed scheme for consultation route, particularly in terms of locating the tunnel portal in a floodplain and the impacts at West Gorton. Another option that avoided the depot was previously considered and discounted as it would require a longer tunnel, longer journey time and would have a higher cost.

5.2.191 As a result of this work, HS2 Ltd recommended that the 2016 preferred route to Manchester tunnel alignment remained the optimal approach into Manchester Piccadilly High Speed

station. This alignment would have a lower flood risk as the tunnel portal would not be located in the Corn Brook floodplain and would have lower construction complexity as the tunnel would be further from existing conventional line viaducts. This alignment would also allow the approach to Manchester Piccadilly to be straightened, which would maximise operational capacity and have lower impact on the existing structures at Manchester Piccadilly Station. The tunnel portal to the north of the TransPennine Express would have less impacts on the existing conventional line during construction. Impacts at West Gorton associated with the 2013 proposed scheme for consultation would also be avoided, including a cluster of residential demolitions, a development site and a primary school.

5.2.192 Further consideration is given in Section 6.9 to local alternatives identified after July 2017 for the route of the Proposed Scheme into Manchester Piccadilly High Speed station due to a requirement to increase the number of platforms at Manchester Piccadilly High Speed station from four to six to accommodate NPR services. Consideration has also been given to the land required for the construction and operation of the Manchester Piccadilly High Speed station in order to avoid the site of the New Sheffield Street Boulevard as identified in the 2017 Manchester City Council HS2 Strategic Regeneration Framework and to maximise economic benefits of the Proposed Scheme in Manchester city centre.

6 Alternatives considered since July 2017

6.1 Introduction

6.1.1 During the design development process since the announcement of the preferred route in July 2017, a series of potential amendments have been identified and reviewed within workshops attended by relevant specialists. During the workshops, a comparison was conducted of each design option, which included consideration of:

- potential environmental impacts: the likely magnitude and nature of potential environmental impacts (e.g. noise and vibration, landscape and visual);
- engineering requirements: the degree of construction complexity of the alternatives and the impact this would have on construction durations; and
- cost: whether the alternatives would be more cost effective or incur additional costs.

6.1.2 Where possible and appropriate, the comparison also considered feedback provided through stakeholder engagement and responses to the consultation between 11 October and 21 December 2018 on the working draft ES and the Design Refinement Consultation from June to September 2019[41].

6.1.3 The following sections detail the reasonable alternatives studied since July 2017 and the main reasons for selecting the option to be taken forward into the Proposed Scheme. Options have been reported in terms of whether they are reasonable against environmental impacts, engineering and construction feasibility, and cost. All dimensions in the following sections are approximate.

6.1.4 In considering the environmental impacts, all EIA topics have been taken into account. However, only those environmental topics where there is a potential for likely significant environmental impacts are reported. In accordance with the EIA Directive[42] (2014/52/EU) that was implemented by the Town and Country Planning (Environmental Impact Assessment) Regulations that came into force on 16 May 2017, the main reasons for selecting the chosen option included in the Proposed Scheme are reported together with a comparison of the likely significant effects of the reasonable alternatives presented against the Proposed Scheme. Detailed assessment of the Proposed Scheme is presented in the relevant Volume 2, Community Area reports.

[41] High Speed Two Ltd (2019), *High Speed Two: Phase 2b Design Refinement Consultation – Moving Britain Ahead*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/807420/hs2-phase-2b-design-refinement-web.pdf.

[42] *Directive 85/337/EEC, as amended by 97/11/EC, 2003/35/EC, 2011/92/EC and 2014/52/EU ('the EIA Directive') of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment.* Strasbourg, European Parliament and European Council.

6.1.5 The 'reasonable' local alternatives considered for the borrow pits, all located within the Wimboldsley to Lostock Gralam (MA02) area, are reported separately within the Borrow Pit Report (Volume 5: Appendix CT-008-00000).

6.2 Hough to Walley's Green (MA01)

Crewe tunnel vent shaft locations

6.2.1 Consideration was given to the location of the Crewe tunnel vent shafts. This followed a decision prior to July 2017 to extend the tunnel and therefore move the entrance to Crewe tunnel, and then subsequently the interface between HS2 Phase 2a and the Proposed Scheme, 2.1km further south as part of HS2 Phase 2a. The increase in the length of the Crewe tunnel resulted in the requirement for a second vent shaft. As a result, options have been considered for the location of this second vent shaft at Cowley Way, as well as further alternative locations for the original vent shaft at Middlewich Street. Both vent shafts will include a headhouse containing ventilation equipment, access lifts and stairs. The compound at the Cowley Way vent shaft will also include an auto-transformer station.

6.2.2 In October 2017, four options for the location of Cowley Way vent shaft and seven options for Middlewich Street vent shaft were identified. However, Cowley Way vent shaft Option 1 would require the Crewe tunnel to be realigned 65m to the east, which was not deemed feasible due to the proximity to the connection with HS2 Phase 2a to the south and the resultant need to also realign HS2 Phase 2a. Middlewich Street vent shaft Option 5 was also found to not be feasible as redevelopment of the Tesco Extra site meant that there was insufficient space. For these reasons neither option was considered any further.

6.2.3 Three options for Cowley Way vent shaft and six options for Middlewich Street vent shaft were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Cowley Way vent shaft:
  - Option 2: located directly above the alignment of the Crewe tunnel, within land between the WCML and railway sidings at Basford, the Basford Hall Sorting Sidings, to the south of the Arriva Train Care facility;
  - Option 3: located directly above the alignment of the Crewe tunnel on land between the Crewe to Shrewsbury Line and the WCML and warehouses located off the A532 Weston Road; and
  - Option 4: within the Crewe Truck Stop site located off Cowley Way and to the east of the WCML and the alignment of the Crewe tunnel.
- Middlewich Street vent shaft:
  - Option 1: located directly above the alignment of the Crewe tunnel, within an area of informal open space off the B5076 Middlewich Street, east of the WCML;
  - Option 2: located directly above the alignment of the Crewe tunnel, within a public car park accessed off Thomas Street adjacent to the east of the WCML;

- Option 3: located directly above the alignment of the Crewe tunnel, within a football pitch that is part of the Cumberland Arena, south of Middlewich Street and adjacent to the east of the WCML;
- Option 4: to the rear of the Total Fitness gym off the A532 Macon Way to the east of the WCML and the alignment of the Crewe tunnel;
- Option 6: to the south and rear of retail premises within the Grand Central Retail Park located off the A532 Weston Road, east of the WCML and the alignment of the Crewe tunnel; and
- Option 7: within an area of public open space at the corner of Broad Street and McLaren Street, west of the WCML and the alignment of the Crewe tunnel.

6.2.4 For the Cowley Way vent shaft, Option 4 was taken forward into the Proposed Scheme (refer to Volume 2, MA01 Map Book: map CT-06-303, G5 toG6). Overall, this is because the Option 4 site would have existing access from the highway, so would avoid the need for new access roads across existing conventional railway lines and the loss of areas of connected woodland habitats. Option 4 would therefore also be less complex and cost less overall to construct compared to Options 2 and 3. Compared to the alternative options however, Option 4 will have greater socio-economic impacts due to the demolition of buildings at Crewe Truck Stop and greater noise impacts during construction as offices and industrial premises are located nearby.

6.2.5 For Middlewich Street vent shaft, Option 1 was taken forward into the Proposed Scheme (refer to Volume 2, MA01 Map Book: map CT-06-304, J5 to J6). On balance Option 1, was selected because it would avoid the demolition of commercial premises (required for Option 2), avoid the permanent loss of a football pitch within the Cumberland Arena (required for Option 3) and permanent loss of a playground and sports pitch within the McLaren Street play area (required for Option 7). Option 1 will also have fewer or similar impacts on ecology associated with habitat loss, on water resources, on landscape given the urban and suburban nature of the site and the presence of existing infrastructure associated with the WCML compared to alternative options. It would also be less complex to construct than Options 4, 6 and 7, all of which would not be directly above the tunnel alignment and would need additional tunnelling works to connect the vent shaft with the tunnel. Option 1 will, however, have greater impacts than some options, in terms of construction noise and potentially air quality as there are residential properties in proximity, on community due to the permanent loss of a small section of public open space, and visual impacts associated with the visibility of the shaft from residential properties on Middlewich Street and for users of footpaths within the remaining area of the public open space.

6.2.6 Table 2 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 2: Consideration of local alternatives for Crewe tunnel vent shaft locations

Option	Outcome of analysis
Cowley Way vent shaft	
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater impacts on ecology during construction due to greater loss of vegetation, deciduous woodland priority habitat and severance of connecting habitat and wildlife corridors; • greater impacts on water quality during construction as closer to the Gresty Brook; • fewer socio-economic impacts as no loss of commercial premises; • fewer noise impacts during construction as no offices nearby; • similar potential impacts on air quality as construction traffic would not need to travel through the Nantwich Road AQMA; and • greater construction costs due to the need to construct a new road access over the existing conventional lines.
Option 3	Comparison of Option 3 against the Proposed Scheme: • greater impacts on ecology during construction due to greater loss of vegetation, priority habitat, severance of connecting habitat and wildlife corridors and demolition of a building that could support roosting bats; • similar impacts on water quality during construction as no watercourses nearby; • fewer socio-economic impacts as no loss of commercial premises; • fewer noise impacts during construction as there are no offices nearby; • greater potential impacts on air quality as construction traffic would travel close to the Nantwich Road AQMA, with potentially greater impacts on receptors within the AQMA already exposed to elevated levels of air pollutants; and • greater construction costs due to the need to construct a new road access over existing conventional railway lines.
Option 4 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer impacts on ecology during construction, as although a building will be demolished that could support roosting bats there will be no loss of deciduous woodland priority habitat and this option will be much less likely to sever wildlife corridors; • similar impacts on water quality during construction to Option 3 and fewer impacts than Option 2 as there will be no watercourses in proximity; • greater socio-economic impacts due to the demolition of buildings at Crewe Truck Stop; • greater noise impacts during construction as offices and industrial premises are located nearby (Seiko UK Ltd, D&G Bus Ltd, MKS Instruments UK Ltd and numerous businesses within Scope House); • similar potential impacts on air quality to Option 2 and fewer impacts than Option 3 as construction traffic will not travel close to the Nantwich Road AQMA; and • fewer construction costs because of existing access from the highway.
Middlewich Street vent shaft	
Option 1 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer impacts on ecology during construction than Options 3, 4 and 6 as there will be less loss of habitat comprising mature trees, scrub and amenity grassland. Similar impacts to Options 2 and 7 as a similar extent and type of habitat will be lost; • similar impacts on flood risk, water quality and water resources during construction compared to Options 2, 3, 6 and 7 as there will be no watercourses nearby. Fewer impacts than Option 4, which will be near to the Valley Brook;

Option	Outcome of analysis
	• fewer socio-economic impacts compared to Options 2 and 6 as the Proposed Scheme will not require the demolition of commercial premises (Option 2) or disrupt access to retail premises (Option 6). Similar impacts to Options 3, 4 and 7, which will also not require demolition of commercial properties; • similar noise impacts to Options 2, 3 and 7 during construction due to residential properties located near to the vent shaft site and greater impacts than Options 4 and 6, which will have no residential properties nearby; • fewer potential impacts on air quality than Options 2 and 6 during construction as construction traffic will not need to travel through the Earle Street AQMA. Similar potential air quality impacts to Options 3 and 7 and greater impacts than Option 4 as construction traffic will pass in proximity to residential properties, a care home and neurological healthcare facility located near to the vent shaft site; • greater impacts on the community than Options 4 and 6 owing to the removal of access to an area of public open space during construction, a small part of which will be permanently lost due to the presence of the vent shaft. Fewer impacts than Options 3, because Option 1 will not result in the permanent loss of a sports pitch. During construction, Option 1 will have fewer impacts than Option 7 on a centre providing sporting and social opportunities for people with physical, sensory or learning disabilities as well as the permanent loss of a playground and sports pitch, although it will have similar impacts during operation. During construction Option 1 will have similar impacts to Option 2, which will restrict access to Cumberland Arena but impacts during operation from Option 2 will be less than Option 1 as there will be no loss of public open space; • fewer impacts on landscape than Option 3 given the urban and suburban nature of the site and the presence of existing infrastructure associated with the WCML. Similar landscape impacts to Options 2,4, 6 and 7; • greater visual impacts than Options 4 and 6, similar impacts to Options 2 and 3 and fewer impacts than Option 7 as the vent shaft will be visible from some residential properties along Middlewich Street and from footpaths through the informal open space within which the vent shaft will be located but it will not be as visible from as many residential properties as Option 7; and • similar construction complexity to Options 2 and 3 but less complex than Options 4, 6 and 7, all of which would not be above the tunnel alignment and therefore would require additional tunnelling works to connect the vent shaft with the Crewe tunnel.
Option 2	Comparison of Option 2 against the Proposed Scheme: • similar impacts on ecology as a similar type and extent of habitat (mature trees bordering the site) would be lost during construction; • similar impacts on flood risk, water quality and water resources during construction as, like the Proposed Scheme, there are no watercourses nearby; • greater socio-economic impacts as this option would require the demolition of commercial premises; • similar noise impacts during construction due to residential properties located near to the vent shaft site; • greater potential impacts on air quality as construction traffic would travel through the Earle Street AQMA; • fewer impacts on community as, although construction works could temporarily affect access to Cumberland Arena as well as reduce the availability of car parking, the Proposed Scheme will result in the permanent loss of public open space; • similar landscape impacts given the urban and suburban nature of the site and the presence of existing infrastructure associated with the WCML;

Option	Outcome of analysis
	• similar visual impacts as, although views from nearby residential properties would be screened by existing vegetation, open views are likely to occur in winter when trees are not in leaf; and • similar construction complexity as the vent shaft would also be above the Crewe tunnel alignment.
Option 3	Comparison of Option 3 against the Proposed Scheme: • greater impacts on ecology as there would be more loss of mature trees to construct the access road to the vent shaft; • similar impacts on flood risk, water quality and water resources during construction as, like the Proposed Scheme, there are no watercourses nearby; • similar socio-economic impacts as this option would not require the demolition of commercial premises. Although Option 3 would result in the loss of a football pitch at Cumberland Arena, a sports facility run in partnership with Cheshire East Council, it is assumed this would not affect the viability of this facility; • similar noise impacts during construction due to residential properties located near to the vent shaft site; • similar potential impacts on air quality during construction as construction traffic would pass residential properties located near to the vent shaft site; • greater impacts on the community due to the permanent loss of a sports pitch at Cumberland Arena; • greater impacts on landscape during construction due to the removal of local landscape features such as an area of mature trees; • similar visual impacts as, although fewer residential properties would have views of the tunnel shaft because it would be partially screened by mature trees and contained by the Cumberland Arena and WCML, the removal of mature vegetation for the access road would open up views from Middlewich Street and residential properties would have views of the access road; and • similar construction complexity as the vent shaft would also be above the Crewe tunnel alignment.
Option 4	Comparison of Option 4 against the Proposed Scheme: • greater impacts on ecology due to the loss of mature trees and woodland, some of which is priority habitat; • greater impacts on flood risk, water quality and water resources during construction as this option would be within Flood Zones 2 and 3 of the Valley Brook; • similar socio-economic impacts as this option would not require the demolition of commercial premises; • fewer noise impacts during construction due to no nearby residential properties; • fewer potential air quality impacts during construction as no nearby residential properties; • fewer impacts on the local community as there would no loss of public open space or any other community facilities; • similar landscape impacts given the urban and suburban nature of the site and the presence of existing infrastructure associated with the WCML; • fewer visual impacts as there would be few commercial buildings with views towards the site, which would be screened by vegetation along the south of the Valley Brook. There would be no residential properties with views to the site; and • greater construction complexity as the vent shaft would not be located above the tunnel alignment and would therefore require greater tunnelling works to connect the vent shaft to the Crewe tunnel.

Option	Outcome of analysis
Option 6	Comparison of Option 6 against the Proposed Scheme: • greater impacts on ecology due to the loss of mature trees; • similar impacts on flood risk, water quality and water resources during construction as, like the Proposed Scheme, there would be no watercourses nearby; • greater socio-economic impacts as this option could disrupt access to retail premises during construction; • fewer noise impacts during construction as there would be no residential properties nearby; • greater potential impacts on air quality as construction traffic would need to travel through the Earle Street AQMA; • fewer impacts on the local community as there would be no loss of public open space or any other community facilities; • similar landscape impacts given the urban and suburban nature of the site and the presence of existing infrastructure associated with the WCML; • fewer visual impacts as views from the south, east and west would likely be screened by vegetation, the WCML and commercial/industrial premises. Views from residential properties further to the north would be screened by buildings within Grand Junction Retail Park; and • greater construction complexity as the vent shaft would not be located above the tunnel alignment and would therefore require greater tunnelling works to connect the vent shaft to the Crewe tunnel.
Option 7	Comparison of Option 7 against the Proposed Scheme: • similar impacts on ecology as a similar extent and type (amenity grassland) of habitat would be lost during construction; • similar impacts on flood risk, water quality and water resources during construction as, like the Proposed Scheme, there would be no watercourses nearby; • similar socio-economic impacts as this option would not require the demolition of commercial premises or disrupt access to retail premises; • similar noise impacts during construction due to residential properties that are located near to the vent shaft site; • similar potential air quality impacts during construction due to construction traffic that would pass residential properties located near to the vent shaft site; • similar impacts on the local community as there would be some permanent loss of public open space but greater impacts during construction due to potential indirect impacts on a centre providing sporting and social opportunities for people with physical, sensory or learning disabilities from construction activities; • similar landscape impacts given the urban and suburban nature of the site and the presence of existing infrastructure associated with the WCML; • greater visual impacts as a greater number of residential properties (McLaren Street and Broad Street) would have open views across the site and there may be views from other properties (Bailey Court, Lingfield Drive and Kempton Avenue) as well as open views from within the public open space; and • greater construction complexity as the vent shaft would not be located above the tunnel alignment and would therefore require greater tunnelling works to connect the vent shaft to the Crewe tunnel.

6.2.7 As a result of further design development following the detailed appraisal described above (and as shown in Volume 2, MA01 Map Book: map CT-06-302, B6 to map CT-06-305, G6), changes were made to the horizontal and vertical alignment of the Crewe tunnel. The depth

of the tunnel was reviewed to avoid an undulating alignment. As a result, a shallower depth of tunnel was adopted, which would also reduce construction costs. This did not require changes to be made to the proposed vent shaft locations. The horizontal alignment of the tunnel was reviewed to ensure that it passed through the preferred location for vent shafts to be compliant with HS2 design standards.

Crewe tunnel north portal relocation

6.2.8 Consideration was given to the location of the Crewe tunnel north portal. The tunnel portal will be 150m in length. There will be a headhouse building, auto-transformer station, telecommunications mast, tunnel portal and maintenance access at this location. Opportunities were considered to reduce the depth and length of the portal structure to reduce construction costs and the land required.

6.2.9 Two options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Sift baseline option: a tunnel portal located 70m north of Bradfield Road at the point where Bradfield Road crosses over the WCML; and
- Option 1: a tunnel portal located 170m north of Bradfield Road at the point where Bradfield Road crosses over the WCML.

6.2.10 Option 1 was taken forward to the Proposed Scheme (refer to Volume 2, MA01 Map Book: map CT-06-305, G6). Option 1 was taken forward because it will avoid the loss of broadleaved woodland, a pond and semi-improved natural grassland and will have fewer visual impacts on residents of properties on Bradfield Road and along Broughton Road, close to the junction with Bradfield Road. Option 1 will also have a shorter construction programme and lower construction costs due to needing to excavate less material from the Crewe North portal (retained cutting).

6.2.11 Table 3 provides a summary of the outcomes of the appraisal of the alternative option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 3: Consideration of local alternatives for Crewe tunnel north portal

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater impacts on ecology as a result of the loss of a small area of broadleaved woodland, pond and semi-improved natural grassland; • greater visual impacts during operation on residents of properties on Broughton Road, close to the junction with North Street and on Bradfield Road, west of the WCML as the tunnel headhouse and portal would be closer to these properties. The Sift baseline option would remove vegetation which would otherwise provide screening to these properties; • greater impacts on agricultural land due to the amount of land permanently required; • longer construction programme; and • higher construction cost.

Option	Outcome of analysis
Option 1 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer impacts on ecology avoids the loss of a small area of broadleaved woodland, pond and semi-improved natural grassland; • lower visual impacts during operation on residents of properties on Broughton Road, close to the junction with North Street and on Bradfield Road, west of the WCML as the tunnel portal and headhouse will be further from these properties. Retained vegetation will also help screen views. The tunnel portal and headhouse, however, will be closer to other properties along Broughton Road and the new development off Broughton Road, which is under construction, known as Broughton Gardens. However, there is greater potential for planting and screening of the tunnel portal, headhouse and auto-transformer station under this option, and therefore, for residents of these properties it is unlikely that visual impacts will be greater; • fewer impacts on agricultural land due to smaller area of land permanently required; • shorter construction programme; and • lower construction cost.

6.3 Wimboldsley to Lostock Gralam (MA02)

Cheshire plain lowering of alignment (south)

6.3.1 Consideration was given to a 7.4km section of the route where it will pass on embankments from Burnt Covert near Minshull Vernon, north of Crewe, through to just north of the Shropshire Union Canal. The opportunity to reduce the height of the embankment, and therefore, reduce the volume of earthworks and associated construction traffic and shorten the duration of construction impacts was considered, whilst retaining provision of a 1m clearance over existing ground level in response to existing geological conditions. Lowering the embankment heights would also provide an opportunity to realign the A530 Nantwich Road closer to its current alignment resulting in landscape and visual impacts on residents of fewer properties.

6.3.2 Two options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Sift baseline option: the route would be on embankment between 3m and 8m in height. The A530 Nantwich Road would be realigned 1.2km south of its current alignment, with this section of road alignment 2.3km in length. Clive Green Lane would be realigned 40m south of its current alignment; and
- Option A: the route would be on embankment, which would be between 1m and 7m in height. The A530 Nantwich Road would be realigned 50m south of its current alignment, with this section of road realignment 1km in length. Clive Green Lane would be realigned 40m north of its current alignment.

6.3.3 Option A was taken forward to the Proposed Scheme (refer to Volume 2, MA02 Map Book: map CT-06-308b to CT-06-310). On balance, Option A was taken forward as overall it will have fewer landscape and visual impacts and less impacts on the setting of the historic environment (listed buildings and a scheduled monument) during operation due to the

lower embankment, will result in less loss and severance of agricultural land, result in fewer community and socio-economic impacts, require less construction materials, and will be less complex, require less time and cost less to construct.

6.3.4 Table 4 provides a summary of the outcomes of the appraisal of the alternative option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative option considered.

Table 4: Consideration of local alternatives for Cheshire plain lowering of alignment (south)

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater landscape and visual impacts during operation than Option A. There would be greater landscape and visual impacts on residents of properties north of Coppenhall Moss, Wimboldsley and along the Shropshire Union Canal owing to the higher embankment. Similarly, there would be greater landscape and visual impacts on residents of properties around Minshull Vernon owing to both the higher embankment and presence of the A530 Nantwich Road realignment. Fewer impacts on Park Farm as the realignment of Clive Green Lane would be further from this property. The overall impacts on Wimboldsley would be to be similar to Option A as, although tall buildings and infrastructure within Crewe North rolling stock depot would be partially or even fully screened by the embankments the higher embankments would be visible in views from Wimboldsley; • greater impacts during operation on the historic environment due to the impact of higher embankments and the A530 Nantwich Road realignment on the setting of Grade II listed Park House Farm and Minshull Vernon Moated House Scheduled Monument. Fewer impacts on the setting of the Grade II listed Newfield Hall and Summerhouse as the A530 Nantwich Road would be realigned further to the south. Less impact on the setting of Grade II listed Park Farm from the Clive Green Lane realignment, which would be located further to the south and a greater distance from this receptor; • similar impacts on ecology as, although the Sift baseline option would avoid the loss of small areas of woodland near Clive Green Lane, it would have the potential for greater impacts from the loss of ponds and potential great crested newt habitat during construction from the larger footprint of the embankments and greater length of the A530 Nantwich Road realignment; • greater impact on noise and potentially air quality during construction due to increased construction traffic associated with larger embankments. There would be a number of changes to road traffic-related potential air quality and noise impacts during operation, but overall traffic-related impacts would be similar: • residents of properties that front the A530 Nantwich Road at Walley's Green would experience lower traffic-related impacts due to the realignment of the A530 Nantwich Road up to 700m further east; – Parkfield and Park Hall Farm residents would experience greater traffic-related impacts as they would be closer to the realigned A530 Nantwich Road; and – realignment of Clive Green Lane closer to residential properties at Stanthorne Park Mews and Leahead Cottages would result in greater road traffic-related noise and potential air quality impacts to these residents. • greater impacts on agricultural land through loss and severance due to the realignment and increased length of the A530 Nantwich Road; • greater community severance for those living in Walley's Green, as the realignment of the A530 Nantwich Road would result in a greater distance to travel to facilities to the east of the alignment. This would potentially lead to less business at The Verdin Arms public house during operation, which would result in greater socio-economic impacts;

Option	Outcome of analysis
	• longer construction programme; • more construction complexity due to the greater height of bridges and highway embankments that would be required to cross the A530 Nantwich Road and Clive Green Lane; and • greater construction costs due to substantially more imported fill and construction materials that would be required to construct higher embankments.
Option A (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • overall, fewer landscape and visual impacts during operation. There will be fewer landscape and visual impacts on residents of properties north of Coppenhall Moss and along the Shropshire Union Canal. This is due to lower embankment and because the realigned A530 Nantwich Road will be further from residential properties in and around Minshull Vernon and much closer to its current alignment. There will be greater impacts on residents of Park Farm from the realignment of Clive Green Lane due to loss of screening and the realignment being closer to Park Farm. Impacts on views from Wimboldsley will be less due to the lower embankment. However, the overall impacts on Wimboldsley are likely to be similar to the Sift baseline option as tall buildings and infrastructure within Crewe North rolling stock depot will be visible in views and the lower height of the embankment will provide less screening; • overall, less impacts on the setting of the historic environment due to lower embankment. There will be less impact on the setting of the Grade II listed Park House Farm and Minshull Vernon Moated House Scheduled Monument due to the lower embankment and the realignment of the A530 Nantwich Road much further north. However, there will be greater impacts on the setting of Grade II listed Park Farm from the realignment of Clive Green Lane. There will also be greater impacts on the setting of the Grade II listed Newfield Hall and Summerhouse due to the A530 Nantwich Road realignment being closer to its existing alignment but at a greater height; • overall impacts on ecology will be similar to the Sift baseline option. However, there will be less potential for impacts on ecology during construction of the embankments due to the smaller footprint and shorter realignment of the A530 Nantwich Road, resulting in less loss of habitat that could support protected and notable species such as great crested newt. There will be greater impacts on ecology from the realignment of Clive Green Lane as this will result in the loss of two areas of woodland; • less impacts from construction traffic, such as noise and potential air quality impacts to receptors close to construction routes, due to the smaller material volumes required for lower embankments. Overall, potential air quality and noise impacts from traffic will be similar to the Sift baseline option. There will be greater traffic-related potential air quality and noise impacts close to the A530 Nantwich Road in Walley's Green during operation, although potential air quality and noise impacts on Parkfield and Park Hall Farm will not occur. Less traffic-related potential air quality and noise impacts during operation on Stanthorne Park Mews and Leahead Cottages due to the greater distance to the realigned Clive Green Lane. However, the realigned Clive Green Lane will be closer to Park House Farm with potentially greater potential air quality and noise impacts; • the realignment of the A530 Nantwich Road will result in less loss and severance of agricultural land due to the much shorter alignment; • the realignment of the A530 Nantwich Road will result in less community severance for those living in Walley's Green as there will be a shorter distance to travel to facilities to the east of the alignment. There will be fewer socio-economic impacts on the Verdin Arms public house as the A530 Nantwich Road will not be aligned more than 1km to the south and therefore less impact on passing trade. There will be shorter journey times for road users during operation; • shorter construction programme;

Option	Outcome of analysis
	• less complex construction due to lower bridges and associated highway approach embankments; and • the smaller volume of construction materials required will result in lower construction cost.

Lowering alignment between Lostock Green and Lostock Gralam

6.3.5 Consideration was given to a 5km section of the route where it will pass on embankments from just south of the crossing of the A530 King Street, south-east of Rudheath on the eastern outskirts of Northwich, to the north of Smoker Brook and Leonard's Wood. The opportunity to reduce the height of the embankment and therefore reduce the volume of earthworks, associated construction traffic and shorten the duration of construction impacts such as traffic, noise and potential air quality impacts, were considered.

6.3.6 The following two options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: the route would pass on sections of embankment up to 17m in height and viaducts up to 24m in height. The A556 Chester Road would be realigned to the west of the route on a separate embankment 1m high; and
- Option A: the route would pass on embankments up to 14m in height and viaducts up to 23m in height. The A556 Chester Road would be realigned to the west of the route, on a separate embankment 4m high.

6.3.7 Option A was taken forward into the Proposed Scheme (refer to Volume 2, MA02 Map Book: map CT-06-314 to CT-06-316a). This is because the lower height of the viaducts and embankments will result in fewer landscape and visual impacts at Lostock Green and those to the west of the existing A556 Chester Road, lower impacts on the setting of listed buildings in Lostock Green and on non-designated heritage assets south of Lostock Green. In addition, Option A will have less geotechnical risk, noise, potential air quality and traffic impacts from construction traffic and activities. It will also require less materials and cost less to construct and have a shorter construction programme.

6.3.8 Table 5 provides a summary of the outcomes of the appraisal of the alternative option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative option considered.

Table 5: Consideration of local alternatives for route of the Proposed Scheme between Lostock Green and Lostock Gralam

Option	Outcome of analysis
Sift baseline option	Comparison of Sift baseline option against the Proposed Scheme: • greater impacts on the setting of Grade II listed Park Farmhouse, Shippon and former Barn at Park Farmhouse in Lostock Green, as well as non-designated heritage assets (Robin Hood Cottage, 43 Birches Lane, Poplar Grove, Grove Cottage in Lostock Green and Melvin Holme south of Lostock Green) due to the greater height of the embankment;

Option	Outcome of analysis
	• greater impacts on the landscape character and setting of Lostock Green as well as more visual impacts on the eastern edge of Lostock Gralam and western edge of Lostock Green. The higher embankment would be more prominent and harder to screen through landscape planting; • greater geotechnical risks as the Lostock Lime Beds to the west would be closer; • greater noise, potential air quality and traffic impacts during construction on local communities along construction routes due to the greater volume of construction traffic required to import embankment fill material; and • greater construction cost and longer construction programme.
Option A (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • lower impacts on the setting of Grade II listed Park Farmhouse, Shippon and former Barn at Park Farmhouse in Lostock Green, as well as non-designated heritage assets (Robin Hood Cottage, 43 Birches Lane, Poplar Grove, Grove Cottage in Lostock Green and Melvin Holme south of Lostock Green) due to the lower height of the embankment; • lower impacts on landscape character and setting of Lostock Green as well as lower visual impacts to residents of properties within Lostock Green and those to the west of the existing A556 Chester Road. A lower embankment height will be easier to screen through landscape planting in some places; • fewer geotechnical risks associated the Lostock Lime Beds as the lower embankment height and associated smaller footprint will result in a greater distance to the Lostock Lime Beds; • lower noise, potential air quality and traffic impacts on local communities along construction routes due to the smaller volume of construction traffic required to import embankment fill material; and • lower construction cost and shorter construction programme.

6.4 Pickmere to Agden and Hulseheath (MA03)

Highway alignment at the B5391 Pickmere Lane

6.4.1 Consideration has been given to the realignment of the B5391 Pickmere Lane, the diversion of Flittogate Lane, and also the re-connection of these highways with Budworth Road due to the HS2 WCML connection crossing through this area. Opportunities to reduce the extent of works required to these roads were also considered, including changes to the design and height of the HS2 WCML connection through the area.

6.4.2 Three options were taken forward to a detailed appraisal which considered environmental impacts, engineering and construction feasibility, and cost:

- Sift baseline option: the HS2 WCML connection would be on embankment with the realigned B5391 Pickmere Lane crossing above it. The HS2 WCML connection would cross Arley Brook on viaduct. The B5391 Pickmere Lane would be realigned 90m to the south-east of its existing alignment and would cross over the HS2 WCML connection on an embankment 2.5km long and up to 11m in height. New junctions would connect Flittogate Lane with the realigned B5391 Pickmere Lane and School Lane, which would be widened. No crossing would be provided for Budworth Road and traffic would be diverted via the B5391 Pickmere Lane and School Lane. Arley Brook viaduct, 102m in

length and up to 8m in height, would be located to the north of the realignment and would not be affected;

- Option A: the HS2 WCML connection would be on a viaduct and embankment up to 16m high to allow both Budworth Road and the B5391 Pickmere Lane to cross beneath via an underbridge. Budworth Road would be maintained on its existing alignment at ground level. The B5391 Pickmere Lane would be realigned 50m to the west of its existing alignment at ground level to reduce the skew of the crossing. Arley Brook viaduct would be extended to a length of over 200m to span over the B5391 Pickmere Lane realignment; and
- Option B: the same vertical alignment for the HS2 WCML connection as the Sift baseline option. Budworth Road and the B5391 Pickmere Lane realignment would cross under the HS2 WCML connection in a cutting 5m below ground level. Budworth Road would be maintained on its current alignment in cutting, whilst the B5391 Pickmere Lane would be realigned 50m to the west of its existing alignment to reduce the skew of the crossing in cutting. Arley Brook viaduct would be extended to a length of over 200m to span over the B5391 Pickmere Lane realignment.

6.4.3 Option B was taken forward into the Proposed Scheme (refer to Volume 2, MA02 Map Book: map CT-06-317 to map CT-06-318). This is because overall Option B will have fewer environmental impacts than Option A and the Sift baseline option. Option B will have fewer impacts on ecology compared to the Sift baseline option and similar impacts compared to Option A, will require smaller volumes of materials to construct thus requiring fewer vehicle trips, with fewer potential impacts on air quality and fewer impacts on traffic and transport. Option B will also have fewer landscape and visual impacts, fewer socio-economic impacts during operation, and be less complex to construct. Option B will, however, lead to greater impacts on water resources and flood risk during construction as it will require the construction of a cutting and larger foundations for the Arley Brook viaduct.

6.4.4 Table 6 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 6: Consideration of local alternatives for the highway realignment at the B5391 Pickmere Lane

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater potential impacts on air quality during construction due to transport of larger volumes of construction material; • greater impacts on ecology during construction due to greater habitat and pond loss; • fewer impacts on water resources and flood risk during construction as the impact on the groundwater in the underlying alluvium and the surface water in Waterless Brook would be lower. There would be no change to existing potential for flooding; • greater landscape and visual impacts on residents along the B5391 Pickmere Lane, School Lane, Budworth Road and Frog Lane and users of public rights of way (PRoW) in the area and the Heyrose Golf Club owing to the larger scale of the works, loss of vegetation and greater footprint;

Option	Outcome of analysis
	• greater socio-economic impacts during operation due to the closure of Budworth Road reducing access to Heyrose Golf Club; • greater impacts on traffic and transport resulting from the greater volumes of construction traffic and more extensive highway diversions and realignments as a result of the closure of Budworth Road; and • greater construction complexity due to larger volumes of fill material required for the embankments and highway works.
Option A	Comparison of Option A against the Proposed Scheme: • greater potential impacts on air quality during construction due to transport of larger volumes of construction materials; • similar impacts on ecology during construction due to a similar number of ponds lost; • fewer impacts on water resources and flood risk during construction as the impact on groundwater from the foundations of the Arley Brook viaduct crossing would be lower. There would be no change to existing potential for flooding and no modifications at Waterless Brook; • greater landscape and visual impacts during construction due to larger area of land required and an increase in the amount of vegetation removal. Greater visual impacts during operation owing to the HS2 WCML connection on a higher embankment; • similar socio-economic impacts during operation due to Budworth Road maintained on its current alignment, therefore having no impact on the access to Heyrose Golf Club; • greater impacts on traffic and transport during construction due to larger volumes of construction traffic. Impacts during operation would be similar, as Budworth Road would be maintained on its current alignment; and • greater construction complexity due to larger volumes of fill material required for the embankments and highway works.
Option B (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer potential impacts on air quality during construction due to transport of smaller volumes of construction material; • fewer impacts on ecology during construction when compared to the Sift baseline option due to fewer ponds being lost. Similar impact on ecology when compared to Option A; • greater impact on water resources and flood risk during construction as the cutting and larger foundations for the Arley Brook viaduct will result in greater interference with groundwater levels. There is potential for flooding of the B5391 Pickmere Lane and Budworth Road from Waterless Brook although the associated cutting will be located outside of the flood zone 2 and 3. There will be no new waterbody modifications at Waterless Brook; • fewer landscape and visual impacts due to the smaller area of land required during construction resulting in less vegetation removal, a smaller associated footprint and a lower HS2 WCML connection alignment than Option A making it less obtrusive in the landscape; • fewer socio-economic impacts during operation when compared to the Sift baseline option due to Budworth Road being maintained on its current alignment, therefore having no impact on access to Heyrose Golf Club. Similar socio-economic impacts when compared to Option A; • fewer impacts on traffic and transport during construction due to the lower volumes of construction traffic. Operational traffic and transport impacts will be lower than the Sift baseline option and similar to Option A due to Budworth Road being maintained

Option	Outcome of analysis
	on its current alignment and therefore will not require more extensive highway diversions; and • less complex to construct due to smaller volumes of fill material required.

6.4.5 As a result, of further design development following the detailed appraisal described above (and as shown in Volume 2, MA03 Map Book: map CT-06-317 to map CT-06-318), it was decided on balance that there was not enough justification at this stage to re-provide connectivity along Budworth Road given the relatively low traffic numbers using the road and the associated costs to undertake these works. It was therefore decided that Budworth Road will remain permanently closed during operation of the Proposed Scheme.

6.4.6 This permanent closure of Budworth Road is likely to result in minor operational socio-economic impacts on Heyrose Golf Club and on other businesses on Budworth Road. In addition, permanently diverting traffic from Budworth Road onto School Lane and Frog Lane would likely result in additional traffic, air quality and noise impacts along these roads.

6.4.7 These design updates do not change the outcome of the appraisal described above and the selection of the option taken forward into the Proposed Scheme.

Proposed auto-transformer feeder station near Hoo Green

6.4.8 Consideration has been given to the location of an auto-transformer feeder station in the vicinity of Hoo Green, which will supply electrical power from the National Grid network to the Proposed Scheme. The auto-transformer feeder station will include electrical connection, conversion and protection equipment to provide traction power. The auto-transformer feeder station will connect to the overhead line equipment at a neutral section[43] and receive power supplied from a National Grid supply point. The auto-transformer feeder station will be required at the start of a neutral section along the HS2 WCML connection at a location with a potential grid supply point to provide grid connection to existing electrical infrastructure.

6.4.9 In October 2017, the following four options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Option 1A: located immediately to the south of the A50, on the east side of the HS2 WCML connection, near Hoo Green. The auto-transformer feeder station would be adjacent to the Hoo Green cutting, at ground level, within an area of agricultural fields. The grid supply point would be located 200m south of the auto-transformer feeder

[43] A neutral section is a section of overhead line equipment that provides safe separation of two different electrical sections of the overhead line equipment while allowing the passage of train pantographs (the structure on top of the train carriage that collects electric current from the contact wire to provide power to the train).

station also on the east side of the HS2 WCML connection at ground level, 160m east of the HS2 WCML connection within agricultural fields;

- Option 1B (variant of Option 1A): located 500m south of the A50, and adjacent to the east side of the HS2 WCML connection, near Hoo Green. The auto-transformer feeder station would be located adjacent to the Hoo Green cutting, at ground level, within an area of agricultural fields. The grid supply point would be located 100m north-east of the auto-transformer feeder station, also on the east side of the HS2 WCML connection, at ground level, 170m east of the HS2 WCML connection within agricultural fields;
- Option 1D (variant of Option 1A): located 500m south of the A50, on the east side of the HS2 WCML connection, near Hoo Green. The auto-transformer feeder station would be adjacent to the Hoo Green cutting, at ground level, within an area of existing agricultural fields. The grid supply point would be located 100m east of the auto-transformer feeder station, also on the east side of HS2 WCML connection, at ground level, 200m east of the HS2 WCML connection, within agricultural fields.; and
- Option 4B: located to the west of the HS2 WCML connection, at the foot of the Heyrose embankment, in an area of land between the HS2 WCML connection, Arley Brook and Heyrose Golf Club. The grid supply point would be located 400m west of the auto-transformer feeder station, adjacent to the existing Budworth Road, 300m south-west of Arley Brook.

6.4.10 At this stage in the design development process, Option 1D was taken forward as the preferred option. This is because overall, this option will have fewer environmental impacts when compared to the alternative options. Option 1D will be further away from residents at Hoo Green, and will, therefore, have lower potential air quality, and landscape and noise impacts at this location during construction. The auto-transformer feeder station and grid supply point will be located further away from the nearest heritage assets (Grade II listed Mere Court Hotel and Legh Cottage and a scheduled monument at Hough Hall), and therefore, will have lower impacts during construction on the historic environment than the alternative options. Option 1D will have similar construction complexities to the alternative options.

6.4.11 However, since October 2017 further consideration was given to the location of the auto-transformer feeder station and grid supply point. This was based on a more detailed understanding of the traction power model, that is, how power is received from National Grid and converted to a form suitable for use. As a result, a traction power supply will be provided at south Crewe and the location of neutral sections amended. These neutral sections are further north: on the HS2 WCML connection between the crossing of the A50 near Yew Tree Farm to Peacock Lane; and on the HS2 Manchester spur, from the A50 to the area east of Ivy House Farm.

6.4.12 The following three options were taken forward in December 2018 to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: a revised version of the preferred Option 1D was taken forward from the previous appraisal. The auto-transformer feeder station would be at ground level and located 500m south of the A50 road (56m east of the preferred Option 1D) parallel to the existing National Grid 400kV overhead power line, on the east side of the HS2 WCML connection and adjacent to the Hoo Green cutting within agricultural fields. The grid supply point would be located 100m east of the auto-transformer feeder station, also on the east side of the HS2 WCML connection, at ground level, 100m east of the HS2 WCML connection, within agricultural fields. The grid supply point would therefore be 200m further to the north and 10m further to the east of the previously preferred Option 1D grid supply point to comply with National Grid technical requirements. This option would also incorporate a compound for a National Grid disconnector;
- Option 1: the auto-transformer feeder station would be located 1.2km east of Hulseheath, with the grid supply point and disconnector compounds adjacent. The three associated compounds (the grid supply point, auto-transformer feeder station and the disconnector) would be located within the section of land between the HS2 Manchester spur, the HS2 WCML connection and Peacock Lane; and
- Option 2: the auto-transformer feeder station would be located 1.2km east of Hulseheath on section of land between the HS2 Manchester spur, the HS2 WCML connection and Peacock Lane, with the disconnector compound immediately to the east of the auto-transformer feeder station. The existing National Grid 400kv overhead power line running parallel would need to be diverted to achieve clearance for the HS2 Manchester spur. In this option, the grid supply point would be separated from the auto-transformer feeder station and be located 100m further east on the south side of the HS2 Manchester spur. The high voltage electricity cable connection from the grid supply point to the disconnector compound would pass under HS2 Manchester spur.

6.4.13 Following engagement with National Grid, Option 1 was discounted as the size and shape of the land was unsuitable and is not considered further in this section. Option 2 was taken forward into the Proposed Scheme (refer to Volume 2, MA03 Map Book: map CT-06-321, B5 to C6). On balance, Option 2 was taken forward as it will locate the auto-transformer feeder station closer to the neutral section, will therefore require shorter cables, and will require less operational maintenance activities and will provide a simpler and more resilient traction electrical power solution. Option 2 will however, result in greater landscape and visual impacts due to the rural landscape character in the location of Option 2 and the new 6m wide maintenance access road. Option 2 will also have greater impacts on flood risk and will be located closer to areas of flood risk. Option 2 will also have greater noise impacts when compared with the Sift baseline option, although it will result in fewer impacts on ecology, as fewer ponds will be lost.

6.4.14 Table 7 provides a summary of the outcomes of the appraisal of the alternative options considered in December 2018 compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 7: Consideration of local alternatives for the auto-transformer feeder station relocation

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater impacts on ecology during construction due to the expected loss of four ponds (three more than Option 2) and the grid supply point being closer to Belt Wood Local Wildlife Site (LWS) and priority habitat; • fewer impacts on flood risk during construction as the auto-transformer feeder station and grid supply point would not be located in flood risk zones, so the risk of flooding would be lower; • fewer landscape and visual impacts along Peacock Lane, Chapel Lane, Hulseheath Lane, Back Lane, Agden Lane and Thowler Lane during construction, as the loss of trees would be less extensive. Fewer landscape and visual impacts during operation due to no maintenance access road and the general landscape character fairly open with larger fields and fewer hedgerows than is typical of the Cheshire plain and consequently the effect on the pattern of the landscape will be less adverse than for Option 2 in operation; • fewer noise impacts during construction as further away from receptors; • fewer construction complexities owing to shorter construction programme; and • greater operational complexity as the traction electrical power supply solution would have a less efficient design necessitating use of longer high voltage electricity cables.
Option 2 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer impacts on ecology during construction as only one pond will be lost; • greater impact on flood risk during construction due to location near flood risk zones associated with the tributary of Millington Clough 2 and Millington Clough 3, resulting in greater flood risk; • greater landscape and visual impact as there are more residents affected along Peacock Lane, Chapel Lane, Hulseheath Lane, Back Lane, Agden Lane and Thowler Lane. This is due to landscape alterations including a new or widened construction access from the A50 along Chapel Lane to the construction site and works to widen Peacock Lane and Back Lane. Greater landscape and visual impacts during operation due to a permanent change in the general landscape character including tree-lined roads, small fields surrounded by hedgerows and woodland belts which would be altered by the presence of the new access road and the widening of Peacock Lane and Back Lane; • greater noise impacts as closer to residential properties (seven properties at Hulseheath); • greater construction complexity which will require a longer construction programme; and • fewer operational complexities, requiring less operational maintenance as the solution will be a more efficient design with shorter high voltage electricity cables.

Highway alignment at Peacock Lane

6.4.15 Consideration has been given to realigning Peacock Lane between Bucklow Hill and High Legh, as the HS2 WCML connection and HS2 Manchester spur will cross through this area. Alternative options were considered to lessen the landscape and visual impacts associated with the height of the highway overbridge over the HS2 Manchester spur. For each of the

Peacock Lane realignment options the HS2 WCML connection and HS2 Manchester spur remain on the same horizontal alignment.

6.4.16 Three options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Sift baseline option: the HS2 WCML connection would be in cutting at this location. Peacock Lane would cross over the HS2 WCML connection at ground level on an overbridge. The HS2 Manchester spur would be on an embankment 3m in height. Peacock Lane would cross the HS2 Manchester spur on an overbridge 12m above ground level;
- Option A: the HS2 WCML connection would be in cutting at this location. Peacock Lane would cross over the HS2 WCML connection at ground level on an overbridge. The HS2 Manchester spur would be raised on an embankment 6m in height, allowing the realigned Peacock Lane to pass underneath via an underbridge in a cutting 3m below ground level; and
- Option B: the HS2 WCML connection would be in cutting at this location. Peacock Lane would cross over the HS2 WCML connection at ground level on an overbridge. The HS2 Manchester spur would be on an embankment 2m in height, allowing the realigned Peacock Lane to pass over via an overbridge 10m above ground level.

6.4.17 Option A was taken forward into the Proposed Scheme (refer to Volume 2, MA03 Map Book: map CT-06-321, B10 to E2). This is because it will have fewer landscape and visual impacts along with less impacts on the historic environment as the works will be located further from and avoid residential properties and heritage assets. Further, Option A will require less agricultural land, will have lower impacts on ecology as it will avoid the woodland at Back Lane and fewer ponds will be lost, will be less complex to construct and will have a lower construction cost. It is also the least disruptive of the three options to users of the existing highways as the majority of the works to divert Peacock Lane will be completed offline. However, like Option B, Option A will have greater potential impacts on air quality during construction due to the greater volume of earthworks and resulting greater number of construction traffic movements required.

6.4.18 Table 8 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 8: Consideration of local alternatives for the highway realignment at Peacock Lane

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater landscape and visual impacts during construction due to proximity of residents in the dwellings adjacent to local roads and users of PRoW. Greater impacts during operation due to the loss of vegetation and the introduction of a high overbridge; • greater impacts on historic environment during construction on the setting of Moss Brow Farm, Little Moss Farm and Thowlerlane Farm, assets of low local heritage value, due to the proximity of the construction works for the HS2 Manchester spur and Peacock Lane

Option	Outcome of analysis
	diversion. Gorse Cottage, an asset of low local heritage value, would be partially or wholly demolished; • greater impacts on ecology during construction due to severance of hedgerows, loss of a small section of woodland at Back Lane and the loss of at least two ponds; • greater impact on agricultural land during construction due to the greater footprint leading to more land required and soil being displaced; • fewer potential impacts on air quality during construction due to the lower volume of earthworks and less expected construction traffic; • greater impacts on traffic and transport during construction due to temporary road closures required to complete highway realignments; • greater construction complexity due to the greater area of land required and PRoW closures and diversions; and • greater construction cost.
Option A (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer landscape and visual impacts due to the works at a greater distance from residential premises on Peacock Lane, Chapel Lane, Moss Lane, Thowler Lane, Back Lane and Hulseheath Lane and users of PRoW. The underbridge will be less noticeable than the high overbridges proposed in the alternative options. This option will result in less vegetation removal; • fewer impacts on the historic environment during construction when compared to the alternative options on the setting of Moss Brow Farm, Little Moss Farm and Thowlerlane Farm, which are assets of low local heritage value, due to the earthworks for the Peacock Lane diversion further away from these assets. Gorse Cottage, an asset of low local heritage value, will not be demolished; • fewer impacts on ecology during construction as it will not cross the small section of woodland at Back Lane and fewer ponds will be lost; • fewer impacts on agricultural land during construction due to the smaller footprint, leading to less land required and soil being displaced; • greater potential impacts on air quality during construction when compared to the Sift baseline option due to the greater volume of earthworks and consequential greater number of construction traffic movements required. Similar impacts when compared to Option B; • fewer impacts on traffic and transport during construction due the proposed highway realignments being constructed offline with minimal disruption to the existing Peacock Lane; • fewer construction complexities when compared to the alternative options as the underbridge is a simpler solution than the overbridge and associated embankments. This option will require the smallest construction footprint; and • lower construction cost when compared to the alternative options.
Option B	Comparison of Option B against the Proposed Scheme: • greater landscape and visual impacts during construction due to proximity of residential premises along local roads and users of PRoW. Greater operational impacts due to loss of vegetation and the introduction of a high overbridge; • greater impacts on historic environment during construction due to impacts on the setting of Little Moss Farm and Thowlerlane Farm, assets of low local heritage value. Gorse Cottage would not be demolished for either option; • greater impacts on ecology during construction due to severance of hedgerows, loss of a small section of woodland at Back Lane and the loss of at least two ponds;

Option	Outcome of analysis
	• greater impacts on agricultural land during construction due to the greater footprint, leading to more land required and soil being displaced; • similar potential impacts on air quality during construction due to construction close to a number of receptors; • greater impacts on traffic and transport during construction due to temporary road closures required to complete highway realignments. Greater impacts from construction traffic due to the greater volume of earthworks and consequential greater number of construction traffic movements required within the construction areas or on the public highways; • greater construction complexity due to the greater area of land required and PRoW closures and diversions; and • greater construction cost.

Provision of future connection to Northern Powerhouse Rail London to Liverpool junction alignment

6.4.19 The NPR London to Liverpool junction will be a 3.1km long section of works that would include cuttings and embankments as well as structures to allow for the integration of the HS2 WCML connection, HS2 Manchester spur and future NPR lines as well as associated landscaping earthworks to provide for potential future NPR services. Consideration has been given to the horizontal and vertical arrangement for the junction between the HS2 WCML connection and the proposed NPR London to Liverpool junction alignment to London chord (previously referred to as the NPR south-west chord), which was not included in the preferred route announced in July 2017. It has been necessary to include provisions for future NPR services in order to avoid disruption to HS2 services due to both the construction and operation of potential future connecting NPR services. Options have been considered for the integration of the London to Liverpool junction with the arrangement for the HS2 WCML connection and the HS2 Manchester spur. Each option has considered a complex arrangement of the three components each comprising a northbound and southbound line.

6.4.20 Two options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Option 1: would include a box structure at High Legh and Hoo Green with the southbound HS2 Manchester spur crossing over the HS2 WCML connection where:
  - the southbound HS2 Manchester spur would pass over to the west of the HS2 WCML connection, north of the A50, within a box structure at High Legh which would be situated within a deep cutting (up to 13m below ground level);
  - the London to Liverpool junction (northbound) provision would pass over both the south and northbound sections of the HS2 WCML connection approximately 9m above ground level and the southbound HS2 Manchester spur (at existing ground level) within the Hoo Green box structure. At this point the HS2 WCML connection would be approximately 2m below existing ground level;

  - the London to Liverpool junction (southbound) provision would pass to the west of the Hoo Green box structure approximately 2m above existing ground level;
  - the London to Liverpool junction (southbound and northbound) provision would then converge to the west of the southbound HS2 Manchester spur so that they would all be at the same level when reaching the A50; and
  - the London to Liverpool junction would then continue north-west to tie into the Manchester to Liverpool junction to the north of the High Legh village.
- Option 2 includes a box structure at Hoo Green and the southbound HS2 Manchester spur passing under a raised HS2 WCML connection alignment, where:
  - the HS2 WCML connection will be raised to approximately 2m above existing ground level to allow the southbound HS2 Manchester spur to pass under the HS2 WCML connection within the Hoo Green Box structure;
  - the London to Liverpool junction (northbound) provision will pass over both the north and southbound HS2 WCML connections and over both the north and southbound HS2 Manchester spur lines within the Hoo Green Box structure at a height of approximately 14m above ground level. Within this box structure the HS2 Manchester spur southbound line would be approximately 7m below existing ground level and the HS2 Manchester spur northbound line will rise from around 1m below existing ground level to 2m above existing ground level;
  - the London to Liverpool junction (northbound) provision will then converge towards the London to Liverpool junction (southbound) provision and both of the HS2 Manchester spur lines such that they would all be at the same level at the A50; and
  - the London to Liverpool junction will then continue northwest to tie into the Manchester to Liverpool junction[44] to the north of the High Legh village.

6.4.21 Option 2 was taken forward into the Proposed Scheme (refer to Volume 2, MA03 Map Book: maps CT-06-319 to CT-06-320). While it would be similar in terms of construction complexity compared to Option 1, Option 2 was taken forward because on balance it will require less land and earthworks, cost less, require less time to construct and have fewer environmental impacts overall. Option 2, will however, give rise to greater noise impacts during operation as the cutting will be shallower near the community of Hoo Green and therefore will provide less noise screening.

6.4.22 Table 9 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

[44] The Proposed Scheme will make provision for future connections between HS2 and NPR between Manchester and Liverpool. This provision is referred to as the Manchester to Liverpool junction.

Table 9: Consideration of local alternatives for the provision of future connection to NPR London to Liverpool junction alignment

Option	Outcome of analysis
Option 1	Comparison of Option 1 against the Proposed Scheme: • greater impacts on the setting of historic environment as closer to the Grade II listed Hollowood Farmhouse, Winterbottom Farm and Mere Court Hotel; • greater area of land required to construct the deeper cutting; • greater potential impacts on air quality such as at Hollowood Farm, Winterbottom and Hoo Green Lane during construction associated with greater earthworks required and greater construction traffic; • greater noise impacts at Winterbottom and Hoo Green during construction due to greater construction traffic movements. Fewer noise impacts during operation as the HS2 WCML connection would be 8m lower in a deeper cutting, which would provide greater noise screening for Hoo Green; • greater impacts on water resources due to greater impacts on groundwater from the deeper cutting; • longer construction programme; and • greater construction cost because of greater earthworks required.
Option 2 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer impacts on the setting of historic environment due to being further from the Grade II listed Hollowood Farmhouse, Winterbottom Farm and Mere Court Hotel; • less land required to construct the shallower cutting; • lower potential impacts on air quality such as at Hollowood Farm, Winterbottom and Hoo Green Lane during construction due to less earthworks required resulting in fewer construction traffic movements; • fewer noise impacts at Winterbottom and Hoo Green during construction due to less construction traffic. Greater noise impacts during operation as the HS2 WCML connection will be 8m higher in cutting near Hoo Green. The shallower cutting near Hoo Green will provide less noise screening; • fewer impacts on water resources due to the shallower cutting having less of an impact on groundwater; • shorter construction programme; and • lower construction cost because of fewer earthworks required.

6.5 Broomedge to Glazebrook (MA04)

Route alignment over the Manchester Ship Canal

6.5.1 Consideration was given to the HS2 WCML connection where it will pass over the Manchester Ship Canal to the east of Hollins Green. For all options considered, the viaduct will be up to 29m in height at the point where it will cross the canal and 12m in height immediately adjacent to the Black Swan public house and Hollinfare Cemetery. Opportunities to lower the viaduct height are precluded by the operational requirements of the Manchester Ship Canal, although options to move the route eastwards were considered to lessen impacts on Hollinfare Cemetery, the Black Swan public house and residential properties within Hollins Green.

6.5.2 The following three options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: the HS2 WCML connection would pass to the east of Hollins Green on viaduct. The edge of the viaduct deck would be located 5m from the north-eastern boundary of the cemetery;
- Option A: the HS2 WCML connection would pass on viaduct 20m east of the north-eastern boundary of Hollinfare Cemetery; and
- Option B: the HS2 WCML connection would pass on viaduct 70m east of the north-eastern boundary of Hollinfare Cemetery.

6.5.3 Option B was taken forward into the Proposed Scheme (refer to Volume 2, MA04 Map Book: map CT-06-324, H7 to CT-06-325, I5). This option was taken forward because Option B will result in fewer landscape, visual and noise impacts for the residential properties at Hollins Green, Hollinfare Cemetery and the Black Swan public house, compared to the alternative options. Option B, similar to Option A, will also avoid land required from the Black Swan public house (a community facility) car park, which would be required for the Sift baseline option. Option B, similar to Option A, will be slightly less complex to construct compared to the Sift baseline option due to the larger construction working area on the west side of the Proposed Scheme, in particular in the vicinity of Hollinfare Cemetery. Option B will however, despite all options resulting in an identical area of ancient woodland loss, have a greater impact on Coroners Wood due to shading and disturbance further into the woodland compared to the alternative options.

6.5.4 Table 10 provides a summary of the outcomes of the appraisal of each of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 10: Consideration of local alternatives for route of the Proposed Scheme across the Manchester Ship Canal

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater impacts on the community during construction due to construction activity in proximity of Hollinfare Cemetery and the Black Swan public house. Land within the car park of the Black Swan public house would be required for construction; • greater visual impacts to users of Hollinfare Cemetery, the Black Swan public house and residential properties in Hollins Green due to the greater proximity of construction activity and the Manchester Ship Canal viaduct; • greater noise impacts on Hollinfare Cemetery, the Black Swan public house and residential properties in Hollins Green due to being closer to construction activity and the trains travelling on the viaduct; • less impact to the ancient woodland at Coroners Wood due to less disturbance and shading from the viaduct to better quality woodland by virtue of it being aligned closer to the western edge of the woodland area; and • greater construction complexity owing to the constrained construction working area between the viaduct and the boundary of Hollinfare Cemetery and the Black Swan public house.
Option A	Comparison of Option A against the Proposed Scheme:

Option	Outcome of analysis
	• greater impacts on the community during construction due to activity in proximity of Hollinfare Cemetery and the Black Swan public house. However, the requirement for land for construction from the car park of the Black Swan public house would be avoided; • greater visual impacts to users of Hollinfare Cemetery, the Black Swan public house and residential properties in Hollins Green due to the greater proximity of construction activity and the Manchester Ship Canal viaduct; • greater noise impacts on Hollinfare Cemetery, the Black Swan public house and residential properties in Hollins Green due to being closer to construction activity and trains travelling on the viaduct; • less impact to the ancient woodland at Coroners Wood due to reduced disturbance and shading from the viaduct to better quality woodland by virtue of it being aligned closer to the western edge of the woodland area; and • greater construction complexity owing to the constrained construction working area between the viaduct and the boundaries of Hollinfare Cemetery and the Black Swan public house.
Option B (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • less impact on the community due to less construction activity in the immediate vicinity of Hollinfare Cemetery and the Black Swan public house and there will be no requirement for land from the Black Swan public house car park; • fewer visual impacts due to a greater distance between the viaduct and the Black Swan public house, Hollinfare Cemetery and residential properties in Hollins Green; • less noise impacts on Hollinfare Cemetery, the Black Swan public house and residential properties in Hollins Green due to greater distance between the viaduct and Hollinfare Cemetery, the Black Swan public house and residential properties; • a greater impact to ancient woodland at Coroners Wood due to shading from the viaduct and disturbance further into the woodland area; and • less construction complexity due to a greater available construction working area, particularly in the vicinity of the Hollinfare Cemetery.

M62 West viaduct extension

6.5.5 Consideration has been given to the HS2 WCML connection adjacent to Holcroft Moss SSSI, which is part of the Manchester Mosses SAC. The site is designated due to the presence of a raised bog habitat, which is hydrologically sensitive and could be affected by local changes to groundwater flows related to the construction of the HS2 WCML connection through this area. Design options were considered to identify a solution that would have the least impact on local groundwater conditions and would also be suitable for construction through complex local ground conditions dominated by surface peat deposits.

6.5.6 The following two options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: the HS2 WCML connection would be located on an embankment 621m long and up to 7m high adjacent to and west of Holcroft Moss SSSI/Manchester Mosses SAC. The embankment would be supported by a series of piles 2.5m apart and up to 12m deep overlain by a layer of granular material to form a raft-like structure to support the embankment on top of the peat deposits; and

- Option A: the HS2 WCML connection would be located on a viaduct 830m long and up to 7m high adjacent to, and west of Holcroft Moss SSSI/Manchester Mosses SAC. The viaduct would extend to incorporate the crossing of the M62 located adjacent to, and north of Holcroft Moss SSSI/Manchester Mosses SAC. The viaduct would be founded on piers 40m apart, with piles up to 20m deep.

6.5.7 Option A was taken forward into the Proposed Scheme (refer to Volume 2, MA04 Map Book: map CT-06-326b, H5 to map CT-06-327, C7). Option A was taken forward because the design of the foundation works for Option A will have less impact on groundwater flows, and therefore, less potential to impact Holcroft Moss SSSI/Manchester Mosses SAC. It will also maintain greater ecological connectivity from east to west across the SSSI/SAC compared to the Sift baseline option. Option A will also require less agricultural land, fewer construction vehicle movements and associated excavated material handling, and thus less potential impact on air quality Option A will, however, have greater landscape and visual impacts on residents of properties to the west at Gorse Covert due to the difficulty in screening the viaduct compared to the Sift baseline option, which would be on embankment. Option A will also cost more to construct than the Sift baseline option.

6.5.8 Table 11 provides a summary of the outcomes of the appraisal of the alternative option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative option considered.

Table 11: Consideration of local alternatives for the M62 West viaduct extension

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater impact on groundwater flows and therefore greater potential impact to Holcroft Moss SSSI/Manchester Mosses SAC; • less ecological connectivity from east to west due to a fenced embankment restricting ecological movement; • greater temporary and permanent requirement for agricultural land; • greater potential impacts on air quality during construction due to potential dust generation associated with earthwork activity and a greater volume of construction traffic; • fewer landscape and visual impacts on residents of properties to the west at Gorse Covert due to greater integration of the embankment into the landscape; and • lower construction cost.
Option A (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • less groundwater flow impediment, and therefore, less potential impact to the integrity of Holcroft Moss SSSI/Manchester Mosses SAC; • greater ecological connectivity from east to west as the viaduct will allow movement for species beneath the structure; • less temporary and permanent requirement for agricultural land; • less potential impact on air quality during construction due to less excavated material, importation and handling. This will lead to fewer construction vehicle movements and less risk of dust generation; • greater landscape and visual impacts on residents of properties to the west at Gorse Covert due to the greater difficulty in screening a viaduct compared to an embankment; and • higher construction cost.

6.6 Risley to Bamfurlong (MA05)

A574 Warrington Road realignment

6.6.1 Consideration has been given to the realignment of the A574 Warrington Road where it will cross the HS2 WCML connection to the south of Culcheth. Consideration was given to avoiding environmental impacts associated with the realignment, which included the demolition of a residential property and the permanent requirement for land from playing fields used by Culcheth Athletic Junior Football Club.

6.6.2 The following two options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: realignment of the A574 Warrington Road 10m above the HS2 WCML connection, 50m to the west of the existing highway; and
- Option A: realignment of the A574 Warrington Road 9m above the HS2 WCML connection, 180m to the east of the existing highway.

6.6.3 Option A was taken forward into the Proposed Scheme (refer to Volume 2, MA05 Map Book: map CT-06-328, H2 to H9). This is because Option A will avoid the partial loss of playing fields associated with Culcheth Athletic Junior Football Club and will avoid the demolition of a residential property. Option A will also have fewer landscape and visual impacts and fewer impacts on the setting of the Grade II listed Newchurch Old Refectory (also known as Newchurch Old Rectory). Option A will have a shorter construction programme and cost less to construct compared to the Sift baseline option as it will avoid an area of surface deposits at risk of settlement that would have required substantial ground improvement works. Option A will however result in a severance impact to Bates Farm due to the realigned highway passing between the homestead and its associated agricultural land.

6.6.4 Table 12 provides a summary of the outcomes of the appraisal of the alternative option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative option considered.

Table 12: Consideration of local alternatives for route of the A574 Warrington Road

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater impacts on community facilities due to the partial loss of playing fields at the Culcheth Athletic Junior Football Club; • more residential demolitions will be required; • greater landscape and visual impacts and greater impacts on the setting of the Grade II listed Newchurch Old Refectory (also known as Newchurch Old Rectory) as the option is closer to the property; • no severance of the Bates Farm landholding; • greater geotechnical risk owing to a greater area of ground improvement works required as the option would pass over a larger area of surface deposits at risk of settlement; and • higher construction cost.

Option	Outcome of analysis
Option A (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • less impact on community facilities due to the avoidance of land associated with the Culcheth Athletic Junior Football Club; • no residential demolition; • lower landscape and visual impacts and lower impacts on the setting of the Grade II listed Newchurch Old Rectory (also known as Newchurch Old Rectory) due to greater distance of the realigned highway from the property; • greater impact on Bates Farm due to severance of the homestead and landholding by the realigned highway. Access between the homestead and landholding will be retained through access points provided on the realigned A574 Warrington Road; • smaller geotechnical risk owing to a smaller area of surface deposits prone to settlement crossed by the A574 Warrington Road and therefore less requirement for ground improvement; and • lower construction cost.

Wigshaw Lane

6.6.5 Consideration has been given to options for the closure, diversion or retention of Wigshaw Lane where the Culcheth cutting will cross in this location and in response to stakeholder consultation feedback and to reduce potential adverse impacts on local residents and users of highways in the area.

6.6.6 The following three options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: Wigshaw Lane would be permanently closed at the point where it would be crossed by the HS2 WCML connection and realigned via Glaziers Lane, the A574 Warrington Road and a new link road would be provided parallel to the Culcheth Linear Park;
- Option A: Wigshaw Lane would be permanently closed at the point where it would be crossed by the HS2 WCML connection and realigned via Glaziers Lane, the A574 Warrington Road and a new link road provided parallel to the Culcheth Linear Park. A non-motorised user overbridge over the HS2 WCML connection on the same alignment as Wigshaw Lane would be provided (57.9m long and 3.5m wide overbridge approximately 5m above existing ground level); and
- Option B: Wigshaw Lane would be kept open and realigned to the west of the existing highway alignment, over the HS2 WCML connection and would be tied back into the existing alignment of Wigshaw Lane to the south of the Culcheth Linear Park. Glaziers Lane would be permanently closed and would become an access only road for Partridge Lake Fishery. A new link road parallel to Culcheth Linear Park would be provided connecting Wigshaw Lane and the A574 Warrington Road.

6.6.7 Option B was taken forward into the Proposed Scheme (refer to Volume 2, MA05 Map Book: map CT-06-329, C2). Option B was chosen as it will not require the permanent closure of Wigshaw Lane and will have less impact on traffic during operation at the junction of the A574 Warrington Road and Common Lane in Culcheth, compared to the alternative options, which would give rise to traffic impacts at this junction. Option B will also have a shorter

journey length for pedestrians and cyclists relative to the Sift baseline option. However, Option B will have greater environmental impacts, including greater construction noise and landscape and visual impacts in Wigshaw, greater loss of priority woodland, and a greater construction cost, resulting from additional infrastructure and construction activity.

6.6.8 Table 13 provides a summary of the outcomes of the appraisal of each of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 13: Consideration of local alternatives for Wigshaw Lane

Option	Outcome of analysis
Sift baseline option	Comparison of Sift baseline against the Proposed Scheme: • greater vehicle traffic impact during operation at the junction of the A574 Warrington Road and Common Lane due to the permanent closure of Wigshaw Lane changing traffic flows in the area; • greater length of diversion for non-motorised users leading to longer journey time; • less area of priority woodland habitat loss; • less landscape and visual impacts upon residents of properties in Wigshaw due to less infrastructure (avoidance of an additional overbridge and new highway) and the greater retention of mature screening woodland; • less noise impacts upon residential properties in Wigshaw due to less construction in proximity to residential properties and the diversion of highway activity away from Wigshaw; and • lower construction cost.
Option A	Comparison of Option A against the Proposed Scheme: • greater vehicle traffic impacts during operation at the junction of the A574 Warrington Road and Common Lane due to the permanent closure of Wigshaw Lane changing traffic flow in the area; • shorter length of diversion for non-motorised users through the provision of a dedicated PRoW crossing, leading to a shorter travel time; • less area of priority woodland habitat loss; • less landscape and visual impacts upon residents of properties in Wigshaw due to less infrastructure (avoidance of an additional overbridge and new highway) and less mature screening woodland lost; • less noise impacts on residential properties in Wigshaw due to less construction in proximity to residential properties and the diversion of highway activity away from Wigshaw; and • lower construction cost.
Option B (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • impacts on vehicle traffic during operation at the junction of the A574 Warrington Road will be avoided as Wigshaw Lane would remain open and traffic will not be displaced on to the A574 Warrington Road, unlike the alterative options; • the length of non-motorised user diversion and therefore travel time will be less than in the Sift baseline option but greater than that for Option A; • greater area of priority woodland habitat lost; • greater landscape and visual impacts upon residents of properties in Wigshaw due to a new overbridge, an additional length of new highway for the Wigshaw Lane realignment and greater loss of mature woodland;

Option	Outcome of analysis
	• greater noise impacts upon Wigshaw residents due to greater construction activity and the retention of operational highway movements in the vicinity of residential properties; and • greater construction cost.

A573 Wigan Road realignment

6.6.9 Consideration has been given to the realignment of the A573 Wigan Road where it will be crossed by the HS2 WCML connection. Alternative options were considered to lessen agricultural land severance and landscape and visual impacts. Changes to the vertical alignment associated with the Lily Lane junction design (as described in the section below) facilitated alternative options for the realignment of the A573 Wigan Lane beneath the HS2 WCML connection that were not previously feasible.

6.6.10 The following three options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: the A573 Wigan Road would be realigned to the east by 200m to pass over the HS2 WCML connection on a bridge 10m in height. To cross over the HS2 WCML connection on a bridge, the highway would be elevated on embankment for 600m. Lightshaw Lane would be realigned at its westernmost extent northwards to meet the realigned A573 Wigan Road;
- Option A: the A573 Wigan Road would be realigned to the north-west to run parallel with the WCML. The realigned A573 Wigan Road would be at, or near ground level, along its entire length and would pass underneath the HS2 WCML connection. The realignment would connect back into the existing alignment of the A573 Wigan Road immediately adjacent to the highway crossing of the Leeds and Liverpool Canal. Lightshaw Lane would be diverted north parallel to the HS2 WCML connection to tie back into the existing alignment of the A573 Wigan Road, which would be retained for access; and
- Option B: the A573 Wigan Road would be realigned north-west to run parallel with the WCML. The realigned A573 Wigan Road would be at, or near ground level, along its entire length and would pass underneath the HS2 WCML connection. The realignment would connect into the existing A573 Wigan Road 200m south of the Leeds and Liverpool Canal crossing. Lightshaw Lane would be diverted south-west, from a point adjacent to the Grade II* listed Lightshaw Hall, under the HS2 WCML connection via an underbridge, and north-west to run parallel, and to the west of the HS2 WCML connection up to the existing Lightshaw Lane/A573 Wigan Road junction.

6.6.11 During the appraisal process for the above three options, it was decided that a hybrid option was potentially preferable. Following this, further work was done to develop the hybrid option, whereby the A573 Wigan Road would be realigned north-west to run parallel with the WCML (as for Option B above). The realigned A573 Wigan Road would be at, or near ground level, along its entire length and would pass underneath the HS2 WCML connection. The realignment would connect into the existing A573 Wigan Road 200m south of the Leeds and

Liverpool Canal crossing. Lightshaw Lane would be diverted north (as for Option A above), parallel to the HS2 WCML connection to tie back into the existing alignment of the A573 Wigan Road, which would be retained for access.

6.6.12 The A573 Wigan Road realignment design for the hybrid option was selected as it will be less complex to build than Option A, which would require a junction to be constructed adjacent to the existing Leeds and Liverpool Canal bridge.

6.6.13 The Lightshaw Lane realignment design in the hybrid option was selected as it will avoid impacts to the setting of the Grade II* listed Lightshaw Hall during construction and will avoid impacts to breeding birds present within the fields of Windy Bank Farm compared to the Sift baseline option and Option B. Overall, similar to Option A, the hybrid option will cost more to construct than the Sift baseline Option A and less than Option B.

6.6.14 The hybrid option was taken forward into the Proposed Scheme (refer to Volume 2, MA05 Map Book: map CT-06-332, H2 to map CT-06-333, E7). The hybrid option design was selected because overall it would have fewer environmental impacts and would be less complex to construct compared to the alternative options. Like Option A and B, it will have less landscape and visual impacts on recreational users of the Hey Brook corridor and the Leeds and Liverpool Canal than the Sift baseline option. Like Option A, the hybrid option will have less impact on the setting of the Grade II* listed Lightshaw Hall, compared to the Sift baseline option and Option B due to construction activity being further away. Similar to Options A and B, the hybrid option will have impacts on the setting of the Grade II* listed Lightshaw Hall during operation, but these will be less than the Sift baseline option. The hybrid option design for the A573 Wigan Road, similar to Option A and B, will also require less agricultural land, resulting in less severance of agricultural land and will have fewer construction related impacts associated with the delivery, handling and placement of fill material, including less construction traffic and potential air quality impacts than the Sift baseline option.

6.6.15 Table 14 provides a summary of the outcomes of the appraisal of each of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 14: Consideration of local alternatives for route of the A573 Wigan Road

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline against the Proposed Scheme: • greater landscape and visual impacts associated with the bridge and embankment approaches, particularly on recreational users of the Hey Brook corridor and the Leeds and Liverpool Canal due to their greater proximity to these receptors; • greater historic environment impact on the setting of the Grade II* listed Lightshaw Hall due to greater proximity of construction activity and the A573 Wigan Road alignment; • greater area of agricultural land required on both a temporary and permanent basis and greater severance of agricultural land; • greater impact on ecology due to disturbance to breeding birds as the A573 Wigan Road is realigned closer to Abram Flash SSSI; • greater volume of construction traffic associated with the import of embankment fill material;

Option	Outcome of analysis
	• greater potential impacts on air quality owing to a greater volume of construction traffic and increased fill material handling; • similar construction complexity, with no impact on the Leeds and Liverpool Canal bridge from the realignment of the A573 Wigan Road; • similar impact on Nan Hole Brook, Windy Bank Brook and Hey Brook; and • lower construction cost.
Option A	Comparison of Option A against the Proposed Scheme: • similar landscape and visual impacts on recreational users of the Hey Brook corridor, including users of the Leeds and Liverpool Canal; • similar impacts on the historic environment associated with the setting of the Grade II* listed Lightshaw Hall and the proximity of construction activity and the operational highway; • similar temporary and permanent agricultural land requirements and similar severance of agricultural land; • similar impacts on ecology relating to loss of priority woodland habitat; • similar volume of construction traffic associated with the import of fill material; • similar potential impact on air quality associated with construction traffic and fill material; • greater construction complexity associated with the junction adjacent to the Leeds and Liverpool Canal bridge due to the proximity of the realignment tie into the canal; • similar impact on Nan Hole Brook, Windy Bank Brook and Hey Brook; and • similar construction cost.
Option B	Comparison of Option B against the Proposed Scheme: • similar landscape and visual impacts on recreational users of the Hey Brook corridor, including users of the Leeds and Liverpool Canal; • greater impact on the historic environment associated with the setting of the Grade II* listed Lightshaw Hall due to the greater proximity of construction activity. Similar impacts during operation; • similar temporary and permanent agricultural land requirements and similar severance of agricultural land; • greater impact on the breeding bird habitat at Windy Bank Farm due to the Lightshaw Lane realignment; • similar volume of construction traffic associated with the import of fill material; • similar potential impact on air quality associated with construction traffic and fill material; • similar construction complexity, with no impact on the Leeds and Liverpool Canal bridge from the realignment of the A573 Wigan Road; • similar impact on Nan Hole Brook, Windy Bank Brook and Hey Brook; and • greater construction cost.
Hybrid option (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • landscape and visual impacts on recreational users of the Hey Brook corridor, including users of the Leeds and Liverpool Canal will be comparable to Options A and B, but less than the Sift baseline option because the realigned A573 Wigan Road will be at or around ground level and located adjacent to the WCML; • less construction impacts on the historic environment associated with the setting of the Grade II* listed Lightshaw Hall compared to the Sift baseline option and Option B due to construction activity being further away, although impacts will be similar to Option A. Operational impacts on the setting of the Grade II* listed Lightshaw Hall will be comparable to Options A and B but less than the Sift baseline option;

Option	Outcome of analysis
	• less temporary and permanent agricultural land required and less severance of agricultural land than the Sift baseline option due to realignment of the A573 Wigan Road being adjacent to the WCML, although similar to Options A and B; • less disturbance to breeding bird habitats at Abram Flash SSSI and Windy Bank Farm than the Sift baseline option and Option B, but similar impacts on ecology relating to loss of priority woodland to Option A; • less construction traffic compared to the Sift baseline option due to less fill material required with the highway alignment at or near ground level, although similar to Options A and B; • less potential impact on air quality compared to the Sift baseline option due to less construction traffic and fill material handling, although similar to Options A and B; • construction complexity similar to the Sift baseline option and Option B due to an avoidance of the existing Leeds and Liverpool Canal bridge but less than Option A; • similar impact on Nan Hole Brook, Windy Bank Brook and Hey Brook for all options; and • greater construction cost than the Sift baseline option, similar construction cost to Option A but less construction cost than Option B.

Lily Lane junction

6.6.16 Consideration has been given to the HS2 WCML connection and its connection to the WCML at Lily Lane junction. Options were considered to reduce the amount of land required and to reduce disruption to the operation of the WCML during construction.

6.6.17 The following five options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option (B1): both the northbound and southbound lines would pass over a single realigned WCML fast line on a concrete box structure. This option would require a combination of embankments and supporting retaining walls. The HS2 WCML connection in this option would be up to 16.3m in height;
- Option B2a: both the northbound and southbound lines would pass over a single realigned WCML fast line on a concrete box structure. The vertical and horizontal alignment would differ slightly to Option B1 with the line closer to the WCML. This option would require a combination of embankments and supporting retaining walls. The HS2 WCML connection would be up to 10.6m in height;
- Option B2b: both the northbound and southbound lines would pass over the realigned WCML southbound fast line on viaduct. The HS2 WCML connection in this option would be up to 11.1m in height;
- Option G2a: the northbound line would pass over the realigned WCML southbound fast line on a concrete box structure. The southbound HS2 line would remain adjacent, east of the WCML, prior to connecting to the WCML southbound fast line at ground level. This option would require a combination of embankments and supporting retaining walls. The HS2 WCML connection in this option would be up to 10.2m in height; and
- Option G2b: the northbound line would pass over the realigned WCML southbound fast line on viaduct. The southbound HS2 line would remain adjacent, east to the WCML prior,

to connecting to the WCML southbound fast line at ground level. The HS2 WCML connection in this option would be up to 10.2m in height.

6.6.18 Option G2a was taken forward into the Proposed Scheme (refer to Volume 2, MA05 Map Book: map CT-06-333, F3 to J4). Option G2a was selected because it will be the least complex, require the least time (with the exception of the shorter construction duration for Option B2b) and cost the least to construct Whilst the amount of land required for the alternative options would be similar, Option G2a will require less temporary and permanent agricultural land acquisition compared to the Sift baseline option (B1). Landscape and visual impacts associated with Option G2a will be similar to those alternatives that require construction of a viaduct (Option B2b and Option G2b), but it will have less impact than the other embankment options because of the greater integration of Option G2a into the landscape, which will be achieved from the lower height and smaller embankment footprint enabling greater retention of vegetation. Along with the viaduct options, Option G2a will require fewer earthworks than those alternatives with embankments. As a result, there will be less overall construction traffic than some of the alternatives.

6.6.19 Table 15 provides a summary of the outcomes of the appraisal of each of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 15: Consideration of local alternatives for the configuration of the Lily Lane junction

Option	Outcome of analysis
Sift baseline option (B1)	Comparison of the Sift baseline against the Proposed Scheme: • greater temporary and permanent agricultural land required and comparable standard of agricultural access; • greater landscape and visual impacts due to the greater scale and proximity of infrastructure to Aye Bridge Farm; • more extensive earthworks required and therefore a greater material import, resulting in more construction traffic and associated potential impacts on air quality during construction; • similar impact on ecological connectivity; • more complex to construct due to large embankments located on ground that is at risk of settlement; • longer construction programme; and • higher construction cost.
Option B2a	Comparison of Option B2a against the Proposed Scheme: • similar amount of permanent and temporary agricultural land acquisition required and comparable standard of agricultural access; • greater landscape and visual impacts on Aye Bridge Farm due to the greater scale of infrastructure; • more extensive earthworks required and therefore a greater material import, resulting in more construction traffic and associated potential impacts on air quality during construction; • similar impacts on ecological connectivity; • more complex to construct due to earthworks with varying alignments transitioning between different structures; • slightly longer construction programme; and • slightly higher construction cost.
Option B2b	Comparison of Option B2b against the Proposed Scheme:

Option	Outcome of analysis
	• similar area of temporary and permanent agricultural land acquisition required and restrictions to agricultural access may be reduced; • similar landscape and visual impacts on Aye Bridge Farm; • less extensive earthworks required to realign WCML from embankment onto viaduct, but greater use of construction materials for the viaduct, resulting in similar construction traffic during construction; • less impacts on ecology due to the viaduct providing greater connectivity for terrestrial mammals; • similar construction complexity; • shorter construction programme; and • higher construction cost.
Option G2a (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • less temporary and permanent agricultural land acquisition required compared to the Sift baseline option and similar amount of land required on a temporary and permanent basis compared to the other alternative options. Agricultural access may be constrained to dedicated access points (same as Options B1 and B2a) which provides less agricultural access connectivity than the viaduct options (Option B2b and G2b); • similar landscape and visual impacts on Aye Bridge Farm to Options B2b and G2b, but less than the Sift baseline option and Option B2a due to the smaller footprint and the retention of more trees and hedgerows that will result in greater integration into the landscape; • less earthworks than the other embankment options (Sift baseline option and Option B2a) that will result in less construction traffic. Similar construction traffic to the viaduct options (Option B2b and Option G2b); • similar impacts on ecology to the other embankment options (Sift baseline option and Option B2a) and greater impacts on ecology than the alternative viaduct options (Option B2b and Option G2b) owing to less ecological connectivity; • less complex to construct compared to the Sift baseline option, Options B2a and G2b due to the ability to phase the works that will facilitate easier construction access and less complex interactions between earthworks and structures. Similar complexity to Option B2b; • longer construction programme than Option B2b, although shorter construction programme compared to the other alternative options; and • lower construction cost.
Option G2b	Comparison of Option G2b against the Proposed Scheme: • similar area of temporary and permanent agricultural land acquisition required, although restrictions to agricultural access may be reduced; • similar landscape and visual impacts on Aye Bridge Farm; • less extensive earthworks required to realign WCML from embankment onto viaduct, but greater use of construction materials for the viaduct, resulting in similar construction traffic during construction; • less impact on ecology due to the viaduct providing greater connectivity for terrestrial mammals; • more complex to construct due to works very close to infrastructure associated with the WCML; • longer construction programme; and • higher construction cost.

6.7 Hulseheath to Manchester Airport (MA06)

Railhead at Ashley

6.7.1 Consideration has been given to alternative locations for the proposed railhead at Ashley. The railhead is required to be located at a strategic location along the route with a rail connection to both the HS2 Manchester spur and the existing conventional rail network. It will be temporarily used as the delivery location for bulk rail-borne materials such as ballast, slab track panels, rail and sleepers required for construction. The railhead will be decommissioned and the land reinstated following completion of construction.

6.7.2 Three options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Sift baseline option: the railhead would be located 200m south of Ashley, immediately east of Stock Farm, immediately to the north of the HS2 Manchester spur and immediately west of the Mid-Cheshire Line;
- Option 1: the railhead would be located 350m south of Ashley, 100m west of Lower House Farm, immediately to the south of the HS2 Manchester spur and immediately east of the Mid-Cheshire Line; and
- Option 2: the railhead would be located 400m south of the village of Ashley, 200m north of Arden House, immediately to the south of the HS2 Manchester spur and immediately west of the Mid-Cheshire Line.

6.7.3 Option 2 was taken forward into the Proposed Scheme (refer to Volume 2, MA06 Map Book, map CT-05-353, map CT-05-354, map CT-05-354-R1, map CT-05-355-R1 and map CT-05-355-R2). Option 2 was taken forward as it will result in fewer noise impacts and impacts on historic environment than the alternative options due to its location further from Ashley. Further, this option will have fewer potential air quality impacts during construction due to the lower volumes of construction materials and associated vehicle movements. It will require a lower volume of earthworks compared to the alternative options, and as a result, will have a shorter construction programme and lower construction costs.

6.7.4 Table 16 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 16: Consideration of local alternatives for the railhead at Ashley

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • greater potential impacts on air quality at Ashley during construction due to the transport of greater volumes of material; • greater noise impacts during construction and use of the railhead due to its location closer to Ashley;

Option	Outcome of analysis
	• fewer landscape and visual impacts during construction and use of the railhead because although this option is closer to Ashley, it is located in an area of existing low tranquillity, where the field pattern is less detailed; • less agricultural land required permanently and fewer impacts on the nearby holdings (Tatton Estates (Marsh Partnership), Tatton Estates (Arden Enterprises) and Sugar Brook Farm) with holdings continuing to operate; • fewer impacts on ecology due to less land required permanently, which would result in fewer direct impacts to habitats of importance and designated sites. Partial or complete loss of Ryecroft Covert LWS and site of biological importance (SBI), which is an area of deciduous woodland (considered a potential habitat of principal importance) at the time of sift but has been since identified as ancient woodland); • fewer impacts on water resources (Birkin Brook and Middle House Brook) during construction because the sidings would not directly interact with these watercourses. These are water bodies subject to the Water Framework Directive (WFD). There are three potential springs within 100m of the works which could be directly affected by the cuttings required for the railhead works; • greater impacts on historic environment during construction and use of the railhead on the setting of the Grade II Sycamore Cottage and the Church of St Elizabeth owing to works and structures close to these assets. Similar impacts on the views from Tatton Park; • greater construction complexities as this option would require more earthworks resulting in a longer construction programme; and • greater construction cost.
Option 1	Comparison of Option 1 against the Proposed Scheme: • greater potential impacts on air quality during construction owing to a longer construction duration and the transport of greater volumes of material; • fewer noise impacts overall to Ashley during construction, although this option will have a greater impact on Thorns Green as it is closer to this area. Fewer noise impacts to Ashley during operation but additional impacts to Thorns Green; • fewer landscape and visual impacts because the option would be located further from Ashley and visible to fewer visual receptors. The railhead would, however, be visible to residents of Lower House Farm, Tithebarn Farm, Breach Cottage, Ashley Cottage and Sugar Brook Farm; • larger area of agricultural land and greater number of farm holdings would be affected, including Higher Thorns Green Farm; Back Lane Farm; Lower House Farm; Blackshaw Heyes Farm and two farms (names unidentified). Permanent land required at Back Lane Farm and possibly Lower House Farm could result in the cessation of these holdings for this option; • fewer impacts during railhead use on ecology associated with disturbance from noise, light, and visual as there would be fewer receptors at a greater distance from the railhead. This option would likely require the partial loss of Ecclesfield Wood LWS and SBI, which may also qualify as habitat of principal importance; • similar impacts to water resources as this option would require ballast sidings to be located on top of tributaries of Sugar Brook within the Birkin Brook WFD water body. This would mean the channels would require realignment in advance of the construction of the sidings. The sidings would be in cut approximately 3m deeper than Option 2 which may restrict the groundwater flow into the Middle House Brook and its tributaries, as well as flows to the Round Covert and Brickhouse Wood LWS (which may be groundwater fed). The siding cuttings would also pass through the Ecclesfield Wood, which may be groundwater fed;

Option	Outcome of analysis
	• fewer impacts on the historic environment during construction with fewer impacts to the setting of Sycamore Cottage, Church of St Elizabeth and the historic settlement of Ashley. There would also be temporary impacts on the setting of Grade II Lower House Farm due to the proximity of the railhead and urbanisation of the rural landscape, and similar impacts to the views from Tatton Park; • greater construction complexity as this option would require more earthworks resulting in a longer construction programme; and • greater construction cost.
Option 2 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer potential impacts on air quality during construction due to the transport of smaller volumes of material and a shorter construction programme; • fewer noise impacts overall from construction due to its location further from Ashley and the community of Thorns Green but with greater impacts to residents of a small number of individual properties; • greater landscape and visual impacts due to its location in a more tranquil area, away from the M56 and where the pattern of the landscape is stronger with smaller fields and more hedgerows. The railhead will be further from Ashley, but it will be visible from Arden House, Sugar Brook Farm, Lower House Farm, Boundary Cottage, Tithebarn Farm, Breach Cottage, Ashley Cottage, Primrose Hill Farm and Ashley; • greater impacts on agriculture when compared to the Sift baseline option as a larger area of agricultural land will be required, with Tatton Estates (Marsh Partnership), Tatton Estates (Arden Enterprises) and Sugar Brook Farm affected. The latter being unlikely to continue operating. The Proposed Scheme will have fewer impacts on agriculture when compared to Option 1 which would affect a greater number of farm holdings including the likely cessation of Higher Thorns Green Farm, and the cessation of Back Lane Farm as a dairy farm. This option may also require the inclusion of an agricultural crossing. Impacts associated with the use of the railhead are comparable to the Sift baseline option; • greater impacts on ecology as the Proposed Scheme will likely result in the loss of potential habitat of principal importance woodland south of Birkin Farm, Erlam's Meadow LWS and SBI and potential lowland meadow Habitat of Priority Importance (HPI), semi-improved grassland habitats located to the south and west of Mobberley Road and potential woodland habitat of principal importance associated with Sugar Brook in the southern extent of the railhead boundary; • greater impacts on water resources when compared to the Sift baseline option, and similar impacts on water resource when compared to Option 1. Stabling sidings will be constructed over Middle House Brook and other tributaries of Birkin Brook WFD water body. This would mean the channels would require realignment in advance of the construction of the sidings. The siding cuttings that will be 3m deep may restrict the groundwater flow into the Middle House Brook, Birkin Brook and their tributaries, as well as to the wood near Arden House and Erlam's meadow LWS (which may be groundwater fed); • fewer impacts during operation on historic environment due to its location further from the Grade II Sycamore Cottage, the Church of St Elizabeth and historic village of Ashley, no impact on the Grade II Lower House Farm, and similar impacts to the views from Tatton Park when compared to the Sift baseline option and Option. Option 1 would result in greater impacts during operation with permanent impact on the setting of the Grade II Lower House Farm with the urbanisation of the rural landscape as well as vehicle and rail movement resulting in noise disturbance to the setting of Grade II Lower House Farm;

Option	Outcome of analysis
	• fewer construction complexities as the Proposed Scheme has the least earthworks and the shortest construction programme; and • lower construction cost.

Ashley infrastructure maintenance base-rail

6.7.5 Consideration has been given to alternative locations for the infrastructure maintenance base-rail (IMB-R) to be located at Ashley. The IMB-R will be required to be located at a strategic location along the HS2 Manchester spur. The Ashley IMB-R will provide support to the Crewe North rolling stock depot (RSD) and will enable railway maintenance vehicles to be temporarily stabled along the route and optimise maintenance operations.

6.7.6 Long-term stabling of railway maintenance vehicles is not envisaged at Ashley IMB-R. However, some maintenance/renewal activities will require vehicle stabling at Ashley for short periods and therefore the sidings will have suitable facilities to allow for vehicle preparation and inspection by the operators. Most maintenance works will be carried out away from the IMB-R and along the railway overnight.

6.7.7 Two options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Sift baseline option (Option 1): IMB-R would be located 400m south of Ashley, immediately to the south of the HS2 Manchester spur and immediately west of the Mid-Cheshire Line with a rail connection to the Mid-Cheshire Line. This location is maintained within the footprint of temporary railhead facility. This option would require a viaduct over Birkin Brook and Blackburn's Brook and approximately 1km of additional track embankment; and
- Option 2: IMB-R would be located 400m west of Ashley, immediately to the north of the HS2 Manchester spur and 500m west of the Mid-Cheshire Line with rail connections to both the HS2 Manchester spur and to the Mid-Cheshire Line. This option would not require a crossing of the Birkin Brook or Blackburn's Brook.

6.7.8 Option 2 was taken forward into the Proposed Scheme. Option 2 was selected as it will be less complex, take less time and be less costly to construct compared to the alternative option. It will result in fewer impacts on surface water and flood risk by avoiding Birkin Brook and Blackburn's Brook. The removal of the viaduct over Birkin and Blackburn's Brook will avoid the direct loss of brook habitat, part of Hancock's Bank Ancient Woodland, Hancock's Bank LWS, and will avoid severance and fragmentation of the wildlife corridor along both watercourses that connect to Rostherne Mere Ramsar site and Site of Special Scientific Interest (SSSI). Option 2 will however give rise to greater noise, potential air quality and landscape and visual impacts along with greater impacts on the historic environment as it will be closer to Ashley.

6.7.9 Table 17 provides a summary of the outcomes of the appraisal of the alternative option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative option considered.

Table 17: Consideration of local alternatives for the IMB-R

Option	Outcome of analysis
Sift baseline option (Option 1)	Comparison of the Sift baseline option against the Proposed Scheme: • greater impacts from construction on surface water and flood risk as this option would require a viaduct over Birkin Brook and Blackburn's Brook and therefore would impact on these water bodies; • greater impacts on groundwater flow from construction as this option would require cuttings (for the temporary and permanent sidings), which would be up to approximately 4m deep. The cutting may result in changes that may reduce the groundwater flow into tributaries of the Birkin Brook, a water body subject to the WFD, as well as to nearby habitats such as the wood near Arden House which may be groundwater fed; • greater impacts on ecology due to a viaduct over Birkin Brook and Blackburn's Brook resulting in greater habitat loss from the brooks and riparian habitat, Hancock's Bank Ancient Woodland, Hancock's Bank LWS and Ryecroft Covert LWS and Ancient Woodland Inventory Site (AWIS). This would result in greater severance and fragmentation of the wildlife corridor along both brooks that connect to Rostherne Mere Ramsar and SSSI. The location of the IMB-R (and temporary railhead) north of the wood near Arden House Ancient Woodland and LWS and north of the Birkin Brook corridor would also result in greater indirect impacts during construction. Once operational, there would be greater disturbance and displacement of species using the habitats; • fewer impacts on agricultural land due to less severance of land and holdings; • fewer potential impacts on air quality and noise due to construction activity being located further away from the residential area of Ashley, and from less construction traffic; • fewer impacts on the setting of the historic environment as the IMB-R would be further from the historic village of Ashley, Grade II listed Sycamore Cottage and Grade II listed Church of St Elizabeth; • fewer landscape and visual impacts on Ashley due to a smaller area of land required during construction and less visibility of infrastructure as the IMB-R would be located further from Ashley; • greater construction complexities and therefore a longer construction programme; and • greater construction cost.
Option 2 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer impacts on surface water and flood risk as this option will not require a viaduct over Birkin Brook and Blackburn's Brook; • fewer impacts on groundwater as this option will not require cuttings or viaduct piers and therefore will not impact groundwater flow into Birkin Brook, which is subject to WFD, or to the nearby ecological habitats such as the wood near Arden House which may be groundwater fed; • fewer impacts on ecology as this option will not require a viaduct over Birkin Brook and Blackburn's Brook and therefore will not result in habitat losses to these features or to Hancocks Bank Ancient Woodland, Hancocks Bank South LWS, Ryecroft Covert LWS. This option will avoid severance of the wildlife corridor along the corridor of both brooks; • greater impacts on agricultural land due to the greater severance of land and holdings from the construction of the Proposed Scheme; • greater potential impacts on air quality and noise impacts due to an increase in construction traffic during construction;

Option	Outcome of analysis
	• greater impact on the setting of historic environment due to its location closer to the historic village of Ashley, Grade II listed Sycamore Cottage and Grade II listed Church of St Elizabeth; • greater landscape and visual impacts due to a greater area of land required during construction affecting a larger area of open landscape and greater visibility of infrastructure in Ashley, from PRoW and from Birkin House, Birkinheath Cottage and Sycamore Cottage. Greater landscape and visual impacts during operation as a result of a larger footprint of the Network Rail link, greater loss of trees and changed views from Birkin House, Birkinheath Cottage and PRoW in the area; • fewer construction complexities and therefore has a shorter construction programme; and • lower construction cost.

6.7.10 As a result of further design development following the detailed appraisal described above (and as shown in Volume 2, MA06 Map Book, map CT-06-353, I5 to map CT-06-354, E5), the connection to the Network Rail Mid-Cheshire Line will be removed, although the proposed highway access will be retained. The auto-transformer station at Ashley will be relocated from the north to the south side of the HS2 Manchester spur. The IMB-R which forms part of the Proposed Scheme will remain 400m west of Ashley, immediately to the north of the HS2 Manchester spur and 500m west of the Mid-Cheshire Line with rail connections to the HS2 Manchester spur only.

6.7.11 The decision to remove the connection to the Mid-Cheshire Line was due to a better understanding of operational maintenance requirements. Removing the Network Rail connection will reduce the area of agricultural land required by the Proposed Scheme adjacent to and north of the HS2 Manchester spur, between Ashley Road and the Mid-Cheshire Line. It will result in fewer landscape and visual impacts within this area, to the south of Ashley. The Proposed Scheme will also be less complex to construct as works along the Mid-Cheshire Line to provide the connection will no longer be required.

6.7.12 These design updates do not change the outcome of the appraisal described above and the selection of the option taken forward into the Proposed Scheme.

Alignment at Ashley

6.7.13 Consideration has been given to the alignment of the HS2 Manchester spur between Ashley Road and Back Lane where it will pass to the south of the village of Ashley on embankments and a viaduct. A high level feasibility study was undertaken following local stakeholder feedback and concerns raised regarding the potential for noise, landscape and visual impacts on Ashley village from the HS2 Manchester spur and the associated road realignments in the area.

6.7.14 Two alignments were taken forward to a high-level appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Feasibility study baseline option: would be on embankments and viaduct ranging between 8m and 10m above ground level. Mobberley Road would be permanently realigned 142m to the east of its current alignment and would cross over the Mid-

Cheshire Line on an overbridge at 7m above ground level. The access to Back Lane Farm would be diverted over the HS2 Manchester spur on an overbridge. Several watercourses in the area would be permanently realigned to accommodate the realigned Mobberley Road.

- Feasibility study cutting option: would be in a deep cutting and would pass under the Mid Cheshire Line. Mobberley Road would require realignment and would cross over the HS2 Manchester spur on an overbridge at ground level. The access to Back Lane Farm would be diverted over the HS2 Manchester spur on an overbridge. The Tributary of Birkin Brook would cross the HS2 Manchester spur via an aqueduct.

6.7.15 The feasibility study baseline option was taken forward into the Proposed Scheme (refer to Volume 2, MA06 Map Book: map CT-06-354, E5 to J5). While it would likely have a greater landscape and visual impact due to the presence of the embankments, viaduct and overbridge, on balance it will likely result in fewer environmental impacts overall, and would take less time, be less complex and cost less to construct. The feasibility study baseline option will have fewer impacts on ecology due to less permanent loss of woodland habitat from Ecclesfield Wood LWS. In addition, it will have less impacts on groundwater flows through the area and will therefore have less impacts on Ecclesfield Wood, a groundwater dependant habitat, and less impacts on ponds within the LWS. There will also be fewer impacts on Arden House Wood Ancient Woodland Inventory (AWI) site and LWS due to fewer impacts on surface water flow throughout the area. In addition, the feasibility study baseline option will generate substantially less excavated material, requiring substantially fewer construction traffic movements throughout the area and will have less air quality impacts than the feasibility study cutting option.

6.7.16 Table 18 provides a summary of the outcomes of the appraisal of the cutting option compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the feasibility study baseline option considered.

Table 18: Consideration of feasibility study options for the alignment at Ashley

Option	Outcome of analysis
Feasibility study baseline (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • greater landscape and visual impacts during operation due to the presence of the HS2 Manchester spur embankments and viaduct, the presence of the prominent overbridge over Mobberley Road and the increased height of the Back Lane Farm accommodation road overbridge; • fewer impacts on groundwater and surface water flow throughout the area; • fewer impacts on ecology due less permanent loss of woodland habitat from Ecclesfield Wood. Fewer impacts on Ecclesfield Wood, a groundwater dependant habitat, as well as ponds within the LWS. Fewer impacts on Arden House Wood Ancient Woodland Inventory (AWI) site and LWS due to fewer impacts on surface water flow throughout the area; • lower volume of excavated material generated; • fewer traffic impacts during construction due to the lower volume of excavated requiring removal; • lower impact on air quality during construction due to fewer construction vehicle movements required; • similar noise impacts during construction;

Option	Outcome of analysis
	• less complex to construct; • shorter construction programme; and • lower construction cost.
Cutting option	Comparison of the cutting option against the Proposed Scheme: • fewer landscape and visual impacts as the cutting would not be as visible to surrounding receptors, the lower heights of the Mobberley Road viaduct and the Back-Lane Farm accommodation overbridge; • greater impacts on groundwater and surface water flow due to the presence of the cutting; • greater impact on ecology due to greater direct loss of woodland habitat within Ecclesfield Wood LWS as well as impacts on Ecclesfield Wood LWS and Arden House LWS and AWI due to the greater impacts on ground and surface water flow throughout the area caused by the cutting; • greater volume of excavated material generated due to the works required to construct the cutting; • greater traffic impacts during construction due to the greater amount of excavated material generated that would require removal; • greater impacts on air quality during construction due to the greater number of construction vehicle movements required to remove the excavated material; • similar noise impacts during construction; • more complex to construct; • longer construction programme; and • greater construction cost.

A538 Hale Road

6.7.17 Consideration has been given to the highway arrangements for the A538 Hale Road where it will cross the HS2 Manchester spur and connect to the M56 junction 6. This is to ensure that the design for Manchester Airport High Speed station takes into account any additional road traffic flows resulting from the users of the Proposed Scheme and, insofar as reasonably practicable, future NPR users.

6.7.18 Four options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost:

- Option 1: a traffic signal junction that would prevent traffic turning right from the A538 Hale Road and ahead from the M56 into Manchester Airport High Speed station. Access would be via a 'U-turn' movement at the adjacent roundabout junction on the A538 Hale Road, which could also act as the access and egress for potential future NPR car parks;
- Option 2: simple traffic signal junction forming a 'T-junction' with Hasty Lane, allowing all movements at the western side of the M56 junction 6. Secondary access into the Manchester Airport High Speed station and the potential future NPR car park locations sited on the A538 Hale Road to the west of the M56 junction 6. The secondary access could be fully signal controlled or a priority arrangement;
- Option 3: creation of two, three-arm signalised junctions, one at the western side of the M56 junction 6 and another internal to the Manchester Airport High Speed station. The

internal three-arm junction would connect back to a new roundabout on the A538 Hale Road; and

- Option 4: creation of three, three-arm signalised junctions, one at the western side of the M56 junction 6 and the other two internal to the Manchester Airport High Speed station, with one on the opposite side of the HS2 Manchester spur. The third junction would connect back to the A538 Hale Road.

6.7.19 Option 4 was taken forward into the Proposed Scheme. Option 4 will have fewer traffic and transport impacts, as the junction with Hasty Lane will be smaller and provide direct access to residents along the A538 Hale Road. Overall, Option 4 will have the fewest likely environment impacts compared to other options. Option 4 will have fewer potential air quality impacts and noise impacts compared to the alternative options, as the junction with Hasty Lane will be located further from the residential premises on the A538 Hale Road. Option 4 will have fewer landscape and visual impacts as the junction with Hasty Lane will be smaller and therefore less likely to change the character of the area to the same extent as the other options. While Option 4 will cost less to construct compared to Options 1 and 2, it will cost more than Option 3 to construct and will also have a longer construction programme than Options 2 and 3.

6.7.20 Table 19 provides a summary of the outcomes of the appraisal of the alternative options compared to the preferred option, as described above. A summary is also provided of the preferred option compared to the reasonable alternative options considered.

Table 19: Consideration of local alternatives for the A538 Hale Road

Option	Outcome of analysis
Option 1	Comparison of Option 1 against the Proposed Scheme: • greater traffic and transport impacts as the new road configuration, Hasty Lane roundabout and the junction connecting the eastern end of the A538 Hale Road, the M56 and the A538 Wilmslow Road would result in severance to the residents on either side of the A538 Hale Road. The wider road width would make it more difficult to cross than the direct access proposed in the Proposed Scheme; • greater potential air quality impacts and noise impacts during construction as the new road configuration at the eastern end of the A538 Hale Road would be increased in width to accommodate two lanes in either direction and a new junction connecting the M56 and the A538 Wilmslow Road which would be closer to the residential premises on the A538 Hale Road; • greater landscape and visual impacts during construction when residents of properties on the A538 Hale Road and Hasty Lane would have closer views of construction. Greater impacts during operation as the new road configuration and junction connecting the eastern end of the A538 Hale Road would change the character of the area; and • greater cost to construct and longer construction programme.
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater traffic and transport impacts as the 'T-junction' with Hasty Lane would introduce severance for the residents of properties on either side the A538 Hale Road, making it more difficult to cross than the direct access proposed in the Proposed Scheme;

Option	Outcome of analysis
	• greater potential air quality impacts and noise impacts during construction as the 'T-junction' with Hasty Lane would be located closer to the residential properties on the A538 Hale Road and Hasty Lane; • greater landscape and visual impacts as the 'T-junction' with Hasty Lane would be large-scale and would change the character of the area; and • greater cost to construct and longer construction programme.
Option 3	Comparison of Option 3 against the Proposed Scheme: • greater traffic and transport impacts as the roundabout on the A538 Hale Road would introduce severance for the residents of properties on either side of the A538 Hale Road, making it more difficult to cross than the direct access proposed in the Proposed Scheme; • greater potential air quality impacts and noise impacts during construction as the roundabout on the A538 Hale Road would be located closer to the residential properties on the A538 Hale Road; • greater landscape and visual impacts as the roundabout on the A538 Hale Road would be large-scale and would change the character of the area; and • lower cost to construct and shorter construction programme which reduces impact on local traffic whilst providing the opportunity to construct most of the works off-line.
Option 4 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer traffic and transport impacts as the junction with Hasty Lane will be smaller and provide direct access to the residents of the properties along the A538 Hale Road; • fewer potential air quality impacts and noise impacts during construction as the junction with Hasty Lane will be located further from the residential properties on the A538 Hale Road; • fewer landscape and visual impacts as the junction with Hasty Lane will be smaller and therefore less likely to change the character of the area to the same extent as the other options; and • lower cost to construct and shorter construction programme when compared to Options 1 and 2, but greater cost and longer programme when compared to Option 3.

6.7.21 Following further design development and the detailed appraisal described above (and as shown in Volume 2, MA06 Map Book, map CT-06-356), additional traffic forecast information became available. The revised forecast trebled the expected traffic volumes, which resulted in the need for capacity enhancements to the road network to accommodate the forecast increased traffic demands of both the Proposed Scheme and NPR, including change in the design at the A538 Hale Road.

6.7.22 The Proposed Scheme now includes traffic signal-controlled junctions at ground level on both slip roads of the M56. The existing M56 underpass (carrying the A538 Wilmslow Road) will be retained in its existing form, but the traffic direction priority will be altered, with all lanes accommodating westbound movement. A new M56 underpass to the north of the existing underpass will be constructed to accommodate eastbound traffic and it will also facilitate non-motorised users. New service roads will be provided on the A538 Hale Road between Hasty Lane and the connection of Hale Road to the connection with the signal-controlled junction. The slip roads on and off the M56 at junction 6 (south of the underpass)

will be maintained, largely in their current form, with appropriate widening to increase lane numbers on the approaches to the new junctions.

6.7.23 The design changes will result in a greater loss of land from the front gardens for the residents of the A358 Hale Road, compared to Option 4 selected within the appraisal above, as a result of construction of the service roads and potentially greater air quality, traffic and noise impacts due to increased traffic numbers.

6.7.24 These design updates do not change the outcome of the appraisal described above and the selection of the option taken forward into the Proposed Scheme.

Vertical alignment at Manchester Airport High Speed station

6.7.25 Further consideration has been given to the feasibility of raising the level of Manchester Airport High Speed station, with the alignment of the HS2 Manchester spur either over or under the M56. Opportunities were considered to reduce construction costs associated with excavation of large volumes of material to develop the station below ground level.

6.7.26 Three options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost, with all options having four platforms, access roads and car parks to the east and west of the HS2 Manchester spur:

- Sift baseline option (Option 1): deep cut with HS2 Manchester spur under the M56. The platforms would be 11.5m below ground level at the deepest point (track level at the station would be at 51.3m above ground level). Timperley Brook would cross under the station box in an inverted siphon. Temporary diversion of the M56 would be required during construction. Sunbank Lane, the A538 Hale Road and Thorley Lane would be required to be temporary realigned during construction and permanently realigned at operation to allow crossing of the HS2 Manchester spur;
- Option 2: shallow cut with HS2 Manchester spur under the M56. The platforms would be approximately 4.5m ground level at the deepest point (track level at station would be at 57.6m above ground level). Timperley Brook would cross under the station box in a culvert. Temporary diversion of the M56 will be required during construction. Sunbank Lane, the A538 Hale Road and Thorley Lane would require temporary realignment during construction and permanent realignment at operation to allow crossing of the HS2 Manchester spur; and
- Option 3: shallow cut with HS2 Manchester spur over the M56. The platforms would be 4.5m below ground at the deepest point (track level at station would be at 57.6m above ground level). Timperley Brook would cross under the station box in a culvert. Temporary lane closures of the M56 would be required (but these works are not likely to require diversion of the M56) during construction. The A538 Hale Road and Thorley Lane would require temporary realignment during construction and permanent realignment at operation to allow crossing of the HS2 Manchester spur. Sunbank Lane would not be affected by this option.

6.7.27 Option 2 was taken forward into the Proposed Scheme. Overall Option 2 was selected because it was considered the best balance between environmental impacts, engineering requirements and costs. Option 2 would cost substantially less to construct than Option 1 and slightly more than Option 3. Option 2 would likely result in less environmental impacts overall than Option 1 and less permanent impacts to landscape and visual and sound, noise and vibration than Option 3.

6.7.28 Similar to Option 3, Option 2 will result in fewer potential air quality impacts and noise impacts on the residential area of Hale Barns during construction when compared to Option 1 because a smaller volume of material will be generated from the excavations. Option 2 and Option 3 will result in greater noise impacts during operation compared to Option 1 on residents of properties along Brooks Drive and Davenport Green due to shallower cuttings but fewer noise impacts during operation compared to Option 3 as the viaduct over the M56 will not be required. Option 2 will have similar traffic and transport impacts when compared to Option 1, as both will require diversion of the M56 traffic and potentially longer local traffic diversions at the A538 Hale Road, and greater impacts compared to Option 3 as temporary diversion of the M56 and realignment of Sunbank Lane would not be required. Option 2 and 3 will similarly have a greater adverse impact on connectivity for non-motorised users moving across the station public realm when compared to Option 1.

6.7.29 Option 2 will have similar landscape and visual impacts during construction compared to both alternative options. During operation it will have greater landscape and visual impacts compared to Option 1 and fewer impacts than Option 3. Impacts during operation on the Hale Suburban Landscape Character Area (LCA) will be associated with raising the A538 Hale Road which may reduce connectivity between Hale Barns, Manchester Airport High Speed station and Manchester Airport itself. Other impacts during operation will be similar to Option 1 as the height and massing of Manchester Airport High Speed station and car parks would be similar. The station, Hale Road overbridge and Thorley Lane overbridge will also be partly screened by intervening vegetation along the M56 corridor and/or built development. There will be fewer landscape and visual impacts during operation compared to Option 3 as the viaduct over the M56 will not be required. Similar to Option 3, Option 2 will have fewer impacts on ecology and water resources when compared to Option 1 as Timperley Brook will cross the HS2 Manchester spur in a culvert rather than an inverted siphon, which will allow continuity of river grade and require less maintenance.

6.7.30 Table 20 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 20: Consideration of local alternatives for the vertical alignment at Manchester Airport High Speed station

Option	Outcome of analysis
Sift baseline option (Option 1)	Comparison of the Sift baseline option against the Proposed Scheme: • similar impacts on agricultural land as this option would require a similar area of land; • greater noise impacts at the residential areas of Hale Barns during construction due to more construction traffic. Fewer noise impacts during operation as the cuttings

Option	Outcome of analysis
	would screen some of the noise to adjacent residential properties on Brooks Drive and Davenport Green; • similar impacts on traffic and transport during construction diversion of M56 traffic around the construction site and local realignments of Sunbank Lane, the A538 Hale Road and Thorley Lane would be the same. Easier connectivity for pedestrians and cyclists across the station public realm; • greater impacts on ecology as Timperley Brook would cross the route in an inverted siphon, resulting in the loss of an open channel, possibly impeding fish migration and disrupting the hydrological flow regime. This option would result in similar impacts to the loss of priority habitat (deciduous woodland) and woodland habitat within Sunbank Wood and Ponds SBI where a viaduct would cross the River Bollin, the loss of priority habitat (deciduous woodland) within junction 6 of the M56 as a result of changes to the A538 Hale Road and, the loss of woodland habitat at Davenport Green Ancient Woodland (also designated as SBI and priority habitat (deciduous woodland); • greater impact on water resources and flood risk from construction as the Timperley Brook would cross the route in an inverted siphon resulting in a loss in river continuity and a potential increase in flood risk associated with the siphon; • similar landscape and visual impacts during construction for residents of properties in Thorns Green, South Hale (Burnside, Warburton Close and Drive, Bankside, Marlfield Road), Brooks Drive, the A538 Hale Road, Hasty Lane and Roaring Gate Lane, for recreational users of PRoW, along the River Bollin and on users of the Davenport Green Hall wedding venue. Fewer landscape and visual impacts during operation because this section of the route would largely be in cutting, which would screen views; • similar impacts on the historic environment as the Grade II listed Yewtree Farmhouse for which the historic setting would be affected by the construction of a large cutting; • greater potential impact on air quality on the residential area of Hale during construction due to greater volume of excavated material and greater construction traffic; • more complex to construct; and • substantially greater construction cost.
Option 2 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • similar impacts on agricultural land when compared to Option 1 as similar area of land required. Greater impacts on agricultural land when compared to Option 3 as a greater area of land required; • fewer noise impacts on the residential area of Hale Barns during construction when compared to Option 1 due to fewer construction traffic movements. Similar noise impacts during construction compared to Option 3 due to greater volume of material from the excavations and greater construction traffic movements. Greater noise impacts during operation compared to Option 1 due to shallower cuttings which will lower attenuation and result in greater noise impacts to residents of properties on Brooks Drive and Davenport Green. Fewer noise impacts to residents of properties during operation compared to Option 3 as the viaduct over the M56 will not be required; • similar impacts on traffic and transport during construction compared to Option 1 as the M56 will be diverted temporarily during construction and Sunbank Lane, the A538 Hale Road and Thorley Lane will be realigned. Greater traffic and transport impacts during construction compared to Option 3 as the M56 would not require temporary diversion as part of Option 3. Less connectivity for pedestrians and cyclists across the station public realm;

Option	Outcome of analysis
	• fewer impacts on ecology from the construction when compared to Option 1 as Timperley Brook will cross the route in a culvert rather than in an inverted siphon, which may allow fish migration and maintain the hydrological flow regime. Similar impacts on ecology from construction when compared to Option 3 as Timperley Brook will cross the route in a culvert. Similar loss from construction to priority habitat (deciduous woodland), woodland habitat within Sunbank Wood & Ponds SBI, priority habitat (deciduous woodland) within junction 6 of the M56 and woodland habitat at Davenport Green Ancient Woodland from construction when compared to Option1; • fewer impacts on water resources from construction of the Proposed Scheme compared to Option 1 as Timperley Brook will cross the route in a culvert rather than in an inverted siphon, which will allow continuity of river grade and require less maintenance. Greater impact on water resources when compared to Option 3 as Timperley Brook would cross the route in a culvert similarly to the Proposed Scheme, but the Ringway (previously Halebank cutting) of Option 3 may impact water dependant habitats of Sunbank Wood and Ponds SBI; • similar landscape and visual impacts from construction of the Proposed Scheme compared to Option 1 and 2 although the high viaduct within Option 2 will increase the zone of theoretical visibility (ZTV). Greater landscape and visual impacts compared to Option 1 during operation due to the raised station, which will be more visible in the landscape., Fewer landscape and visual impacts during operation compared to Option 3 as the viaduct over the M56 will not be required.; • similar impacts on the historic environment and setting of Grade II listed Yewtree Farmhouse when compared to Option 1, but fewer impacts on the historic environment when compared to Option 3 as there will be no impact on the setting of Grade II listed Yewtree Farmhouse during operation; • fewer potential air quality impacts on the residential area of Hale Barns during construction when compared to Option 1 due to a smaller volume of material from excavation and fewer construction traffic movements. Greater potential air quality impacts during construction compared to Option 3 due to greater volume of material from the excavations and greater construction traffic movements; • less complex to construct compared to Option 1, more complex to construct compared to Option 3; and • substantially lower construction cost when compared to Option 1, but slightly greater construction cost compared to Option 3.
Option 3	Comparison of Option 3 against the Proposed Scheme: • fewer impacts on agricultural land as the option would require less land; • similar noise impacts on the residential area of Hale during construction due to fewer construction traffic movements. Greater noise impacts during operation due to the shallower cuttings and a viaduct over the M56 resulting in greater noise impacts on properties on Castle Mill Lane, Back Lane, Sunbank Lane, Bankside, Warburton Drive, Warburton Close, Marfield Road, Brooks Drive and Davenport Green; • fewer impacts on traffic and transport as temporary diversion of the M56 and realignment of Sunbank Lane would not be required. Less connectivity for pedestrians and cyclists across the station public realm; • similar impacts on ecology as Timperley Brook would cross the route in a culvert rather than in an inverted siphon, which would not impede fish migration or alter the hydrological flow regime; • fewer impacts on water resources as the cutting south of Hale Barns would not be required, resulting in less of an impact on the water dependant habitats of Sunbank Wood and Ponds SBI. Similar to the Proposed Scheme, Timperley Brook would cross

Option	Outcome of analysis
	the route in a culvert rather than an inverted siphon, which would allow continuity of river grade and require less maintenance; • greater landscape and visual impacts as the viaduct over the M56 would be more visible in the landscape, affecting a wider area; • similar overall impacts to historic environment, but greater impacts to some assets such as Grade II listed Yewtree Farmhouse which would be impacted by the viaduct over the M56 which would affect the setting as well as the movement of trains on the viaduct over the M56; • fewer potential impacts on air quality on the residential area of Hale Barns during construction due to a smaller volume of material from the excavations and fewer construction traffic; • less complex to construct; and • slightly lower construction cost.

6.7.31 As a result of further design development following the detailed appraisal described above (and as shown in Volume 2, MA06 Map Book, map CT-06-356 to CT-06-357a), the design for the crossing of the Timperley Brook was changed to an inverted siphon under the station, re-joining the existing watercourse west of the station. The design of the crossing of Timperley Brook was revisited as a clearance of 2m between the top of the rail level and the top of the culvert was required, which was not met by the original design. Additionally, consultation was undertaken with Natural England and the Environment Agency who preferred an inverted siphon solution as it will limit the impact on adjacent ancient woodland and the existing watercourse. There would be no notable change in the environmental impacts identified in the detailed appraisal above, as a result of this design change.

6.8 Davenport Green to Ardwick (MA07)

Manchester tunnel vent shafts

6.8.1 Consideration has been given to several locations for each of the four intermediate vent shafts required along the 12.9km length of the Manchester tunnel. The 2017 preferred route identified indicative locations for four vent shafts along the Manchester tunnel. As these locations were indicative, they did not form a formal part of the design of the 2017 preferred route. Subsequently, through design development, options were identified and the appraisal process described below was carried out to select the preferred vent shaft at each location.

6.8.2 To provide power to the Proposed Scheme, the Palatine Road vent shaft and the Birchfields Road vent shaft (formerly known as the Lytham Road vent shaft) will each incorporate an auto-transformer station.

Altrincham Road vent shaft

6.8.3 In March 2018, two options for the Altrincham Road vent shaft, both including a headhouse building measuring 29m long, 28m wide and 15m high, were taken forward to a detailed

appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option (Option 1): would be located on a strip of land at the junction of the A560 Altrincham Road and junction 3a of the M56, bound by the existing Mid Cheshire Line to the north. Access would be from the A560 Altrincham Road through use of an existing vehicular access and egress point located on the eastern side of the site just off the A560 Altrincham Road and junction 3a of the M56; and
- Option 2: would be located on the site of a two-storey car park, which currently serves 'The Royals', a five-storey office building located adjacent to junction 3a of the M56, bound by the existing Mid Cheshire Line to the south. Access would be from the existing vehicular access point from the A560 Altrincham Road. There is also the possibility of extending the construction site to include the use of a second existing car park site that currently serves The Open University.

6.8.4 The Sift baseline option (Option 1) was taken forward into the Proposed Scheme (refer to Volume 2, MA07 Map Book: map CT-06-359, C7). Option 1 was selected as it would have slightly fewer socio-economic, community, noise, traffic and transport impacts and would avoid the demolition of the existing multi-story car park belonging to an office block on the adjacent site and loss of a cycleway.

6.8.5 Table 21 provides a summary of the outcomes of the appraisal of the alternative options considered in March 2018 compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative option considered.

Table 21: Consideration of local alternatives for the Altrincham Road vent shaft

Option	Outcome of analysis
Sift baseline option (Option 1) (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer community and noise impacts as no demolitions will be required and office workers and community uses will be further away; • slightly fewer socio-economic impacts as no demolitions or loss of existing business' car parking spaces will be required; • slightly lower construction costs, shorter programme duration, fewer safety considerations and fewer construction complexities as no demolition will be required; and • similar access to and from the highway network, although slightly fewer traffic and transport impacts as no impact to the cycleway network.
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater community and noise impacts as demolitions would be required and office workers and community uses would be closer to the site; • greater socio-economic impacts due to the demolition of a multi-storey car park, loss of the business car parking spaces and the proximity to an operational office building; • similar construction costs, programme risks, safety considerations and construction complexities; and

Option	Outcome of analysis
	• similar access to and from the highway network, although slightly greater traffic and transport impacts due to the loss of an existing cycleway located on the existing footway which would be situated to the rear of the existing office building.

Palatine Road vent shaft and auto-transformer station

6.8.6 In August 2017, the following four options for the Palatine Road vent shaft and auto-transformer station and extraction point for the four Manchester tunnel boring machines (TBM) extraction were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered. Because the TBMs will be extracted from the Palatine Road vent shaft and not the other vent shaft sites, the Palatine Road vent shaft will require a larger area of land during construction than the other Manchester tunnel vents shafts.

- Sift baseline option (Option 1): would be located on part of Withington Golf Club's golf course. Access to the vent shaft would be from the B5167 Palatine Road. Option 1 would be located within a flood zone and the Didsbury Flood Storage Basin. Option 1 would have a sufficient area of land necessary for TBM extraction;
- Option 2: would be located on the site of the former Tatton Arms public house, which has been vacant since 2007. The site is located within the Northenden Conservation Area and a flood zone but would be outside the Didsbury Flood Storage Basin. It would be accessed from Boat Lane. Construction of the vent shaft at this location would require the temporary use of an adjacent vacant area of land between the former Tatton Arms and the Ford Lane Riverside Residential Caravan Park. Option 2 could not accommodate infrastructure for tunnel boring machine extraction;
- Option 3: would be located on the northern bank of the River Mersey, to the north of the M60. The site is undeveloped land with no provision for direct access onto the highway network. Option 3 would be located within the flood zone but outside of the Didsbury Flood Storage Basin. Construction of the vent shaft at this location would require a new vehicular access and egress point via an underpass below the M60. Option 3 could not accommodate infrastructure for tunnel boring machine extraction; and
- Option 4: would be located within the grounds of the Grade II listed Nazarene Theological College, which is set within four acres of woodland approximately 100m to the east of Palatine Road. The highway access would be from Lancaster Road, off Spath Road. Option 4 would be located outside of the flood zone, the Didsbury Flood Storage Basin and Withington Golf Club's golf course. Option 4 is unlikely to be able to accommodate infrastructure for tunnel boring machine extraction within the grounds of the Nazarene College.

6.8.7 At this stage in the design development process, the Sift baseline option (Option 1) was taken forward as the preferred option. Option 1, unlike the alternative options, will provide an area of land sufficient for TBM extraction during construction and will not require temporary use of adjacent land. The Sift baseline option (Option 1) will have fewer landscape and visual impacts as it will be located in a less sensitive area than Option 3, which would be

adjacent to the River Mersey, and would cause landscape and visual impacts due to the openness of the area around the River Mersey. The Sift baseline option (Option 1), will have similar flood risk impacts to Options 2 and Option 3; but greater flood risks than Option 4.

6.8.8 Access to Option 3 will be more constrained than Option 1, due to its proximity to the River Mersey. The Sift baseline option (Option 1), will have less impact on the historic environment than Options 2 and 4 as they would not be located near to heritage assets. Option 4 would have greater impacts on built heritage as it would be located within the grounds of the Grade II listed Nazarene Theological College, whilst Option 2 would be located within a conservation area. Unlike the Sift baseline option (Option 1) Option 3 would require a new vehicular access and egress point to the public highway via an underpass below the M60, which would cost more to construct. On balance, the Sift baseline option (Option 1) was taken forward as the preferred option as it was the only site large enough to construct the vent shaft and extract the TBM.

6.8.9 However, since August 2017, engagement with the Environment Agency confirmed the Didsbury Flood Storage Basin was a statutory reservoir. Also, feedback from Manchester City Council and residents identified concerns about the proximity of the vent shaft, headhouse and construction compound to Ashfield Lodge, a residential apartment block. This resulted in consideration of further alternative locations for Palatine Road vent shaft and auto-transformer station to reduce flood risk impacts and the loss of capacity from the Didsbury Flood Storage Basin and impacts on Ashfield Lodge.

6.8.10 The following three options for the Palatine Road vent shaft and auto-transformer station, which would all have a 6m high headhouse, were taken forward in March 2018 to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered.

- Sift baseline option (Option 1): the preferred option previously identified in August 2017, would be located on part of Withington Golf Club's golf course, with access from the B5167 Palatine Road. Option 1 would be entirely within the Didsbury Flood Storage Basin and entirely within the flood zone. There would be sufficient space to provide the necessary infrastructure for construction;
- Option 5: would be located on part of the grounds of Withington Golf Club, on land currently occupied by the clubhouse and car park, and with access from Palatine Road. Option 5 would be partly within the Didsbury Flood Storage Basin and entirely within the flood zone; and
- Option 6: would be located on land which is currently occupied by trees and woodland to the south of the Withington Golf Club, clubhouse and car park. Option 6 would be located partly within the Didsbury Flood Storage Basin and entirely within flood zone. Option 6 would require the tunnel to move 150m to the west of the 2017 preferred alignment.

6.8.11 At this stage in the design development process, Option 5 was taken forward as the preferred option. Option 5 will require the demolition of Withington Golf Club's clubhouse, which would be avoided by the Sift baseline option and Option 6. Option 5 will have less

impacts on the Didsbury Flood Storage Basin compared to the other Options. Option 5 will, therefore, have less impact on the capacity of the Didsbury Flood Storage Basin and will require less flood zone and replacement floodplain storage compared to the other options. Option 5 will be located further from the residential Ashfield Lodge than the Sift baseline option, and will result in less construction noise, and landscape and visual impacts associated with the above ground vent shaft structures and access road.

6.8.12 Since March 2018, it was identified that Option 5 was located near to a high-pressure gas pipeline. Diverting the high-pressure gas pipeline within the Didsbury Flood Storage Basin would introduce greater complexity to the construction of the vent shaft, decrease flood storage capacity during construction and increase health and safety risks should the operation of the Didsbury Flood Storage Basin be required during the construction period. This resulted in consideration of further alternative locations for Palatine Road vent shaft and auto-transformer station.

6.8.13 The following three options for the Palatine Road vent shaft and auto-transformer station were taken forward in February 2019 to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered. All options would require two headhouses both measuring 34m long and 6m high, but with one 28m wide and the other 10m wide:

- Sift baseline option (Option 5): Palatine Road vent shaft and auto-transformer station, the preferred location in March 2018, would be on the site of Withington Golf Club. Option 5 would require the demolition of Withington Golf Club's clubhouse and would result in the loss of the whole car park and part of hole 18. It would be accessed from the B5167 Palatine Road. Option 5 would be located partly within the Didsbury Flood Storage Basin and entirely within the flood zone. Option 5 would require the diversion of an existing major gas pipeline;
- Option 6: Palatine Road vent shaft and auto-transformer station would be located on land currently occupied by trees and woodland to the south of the Withington Golf Club and car park, close to the clubhouse. It would be partly within the Didsbury Flood Storage Basin and entirely within the flood zone. It would be accessed from the B5167 Palatine Road. Option 6 would not require the diversion of an existing major gas pipeline and would not require the demolition of Withington Golf Club's clubhouse; and
- Option 7: Palatine Road vent shaft and auto-transformer station would be located on land partially in the car park of the Withington Golf Club and would be accessed from the B5167 Palatine Road. This option would require the demolition of Withington Golf Club's clubhouse, loss of the whole car park and part of hole 18. This would avoid the need for an existing major gas pipeline to be diverted. Option 7 would be located partly within the Didsbury Flood Storage Basin and entirely within the flood zone.

6.8.14 Option 7 was taken forward as the Proposed Scheme (refer to Volume 2, MA07 Map Book: map CT-06-360, E3). Option 7 was selected because it will require less land from, and therefore have less impact on, the capacity of the Didsbury Flood Storage Basin and the flood zone, compared to Option 6 and will avoid the need to divert the major gas pipeline.

Option 7 will therefore require a smaller area of replacement floodplain storage than Option 6. Compared to Option 5, Option 7 will have a slightly greater impact on the existing flood storage capacity due to the larger area of land required for the above ground structures but will have fewer impacts during construction as it will not require diversion of the gas pipeline like Option 5. Option 7 will have similar socio-economic impacts on Withington Golf Club to Option 5 as the clubhouse will be demolished, and the car park and approximately two golf holes will be lost during construction of the headhouse and associated features. Option 6 would have slightly less socio-economic impacts as the clubhouse could be retained in its current location. Option 7 will have fewer construction programme, safety considerations, access and construction complexities compared to Option 5 as a gas pipeline would not require diversion. Overall, Option 5 was considered to have similar impacts to Option 6.

6.8.15 Table 22 provides a summary of the outcomes of the appraisal of alternative options considered in February 2019 compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 22: Consideration of local alternatives for Palatine Road vent shaft in the Davenport Green to Ardwick area

Option	Outcome of analysis
Option 5	Comparison of Option 5 against the Proposed Scheme: • slightly less loss to the existing flood storage capacity due to smaller footprint of above ground structures, but greater impacts during construction associated with diversion of the gas pipeline; • similar socio-economic impacts during construction as the clubhouse of the Withington Golf Club would be demolished, and the car park and several holes from the green at Withington Golf Club would be lost; and • greater construction programme, safety considerations and construction complexities as a gas pipeline would be diverted within a flood storage basin.
Option 6	Comparison of Option 6 against the Proposed Scheme: • greater loss to the existing flood storage capacity and on the flood zone due to the location and larger footprint of above ground structure; • slightly fewer socio-economic impacts due to the retention of the clubhouse at Withington Golf Club, although the clubhouse would be adjacent to the construction compound. Similar area of golf course lost from the green at Withington Golf Club and car parking spaces would be lost; and • similar construction programme, safety considerations and construction complexities as a gas pipeline would not need to be diverted.
Option 7 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • slightly greater impacts on flood storage capacity during operation; • similar socio-economic impacts on Withington Golf Club to Option 5 as the clubhouse will be demolished, and the car park and approximately two holes will be lost from the golf green during construction of the headhouse and associated features. Slightly greater socio-economic impacts compared to Option 6 owing to the loss of the clubhouse, which will be retained as part of Option 6. All options would have a similar temporary loss of approximately three to four holes whilst the replacement floodplain storage areas are excavated; and

Option	Outcome of analysis
	• fewer construction programme, safety considerations, access and construction complexities compared to Option 5 as a gas pipeline will not be diverted. Similar impacts to Option 6.

Wilmslow Road vent shaft

6.8.16 In March 2018, the following two options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option (Option 1): Wilmslow Road vent shaft would be located on the site of an existing surface car park, one of several, that serves The Christie Hospital; and
- Option 3: Wilmslow Road vent shaft would be located on land currently occupied by an operational telephone exchange building.

6.8.17 Option 1 was taken forward into the Proposed Scheme (refer to Volume 2, MA07 Map Book: map CT-06-361, F6 to G6). Overall, environmental impacts for both Option 1 and Option 3 are likely to be similar. Option 1 will require the demolition of a building containing three ground floor retail units and three first floor apartments but overall would have slightly fewer socio-economic impacts than Option 3 which would require the demolition of the telephone exchange, the electricity sub-station, the diversion of associated utilities, the demolition of a car wash and potentially the demolition of a similar number of residential dwellings to Option 1. Option 1 will have slightly greater community impacts due to loss of existing car parking spaces for The Christie Hospital and the demolition of three residential apartments. Option 1 will be less complex and cost less to construct as it will avoid the works required to relocate the telephone exchange building and telecommunications infrastructure.

6.8.18 Table 23 provides a summary of the outcomes of the appraisal of the alternative option considered in March 2018 compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the alternative option.

Table 23: Consideration of local alternatives for Wilmslow Road vent shaft in the Davenport Green to Ardwick area

Option	Outcome of analysis
Option 1 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • slightly fewer socio-economic impacts as although demolition of three retail units will be required, Option 1 will avoid the demolition of a telephone exchange, sub-station and car wash and the diversion of existing telecommunications equipment required for Option 3; • greater impacts on the community due to the loss of The Christie Hospital's car parking spaces and demolition of three residential apartments to provide sufficient space for the construction compound; • similar impacts from noise during construction and from construction traffic on the residents, with the nearest at Lynway Drive; • similar traffic and transport impacts, however, the Proposed Scheme will use an existing road access so will not affect footways or cycleways;

Option	Outcome of analysis
	• lower construction complexities arising as demolition of an existing telephone exchange, sub-station and car wash and diversion of existing telecommunications equipment required by Option 3 will be avoided; and • shorter construction programme and less construction costs compared to Option 3, as will require fewer utility diversions and avoid the relocation of the telephone exchange facilities.
Option 3	Comparison of Option 3 against the Proposed Scheme: • slightly greater socio-economic impacts due to demolition of the existing telephone exchange, sub-station and car wash and requirement to divert existing telecommunications equipment; • slightly fewer community impacts due to avoiding The Christie Hospital's car park. The construction compound may require extending, which would potentially require residential demolitions; • similar noise during construction and construction traffic impacts, with the nearest residents at Wensley Drive and Oak Road; • similar traffic and transport impacts, however, Option 3 would require a new access road which could impact an existing cycleway and footway; • greater construction complexities arising from the need to demolish an existing telephone exchange, sub-station and car wash and divert of existing telecommunications equipment; and • a longer construction programme and more construction costs compared to Option 1, as Option 3 would require more utility diversions and relocation of the telephone exchange facilities.

Birchfields Road vent shaft (formerly Lytham Road vent shaft)

6.8.19 When the preferred route was announced in July 2017, the indicative vent shaft location was occupied by the Lytham Road Playing Fields. Since July 2017 a school, the Manchester Enterprise Academy (MEA) Central, has been constructed on the site and Lytham Road, which would be used by the Proposed Scheme for access, has been converted from a two way road into a one way road due to the access requirements of the MEA Central school. A sift was therefore carried out in March 2018 to appraise the July 2017 indicative safeguarded vent shaft location against alternative locations in order to reduce impacts on the new MEA Central school.

6.8.20 The following three options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option (Option 1, July 2017 indicative safeguarded location): would be located within the grounds of the MEA Central. The construction compound would result in the loss of a substantial part of the MEA Central car park and playing fields but would avoid the MEA Central building. Access would be off Lytham Road, a narrow one-way road. Option 1 would be located 3.1km from the Manchester tunnel north portal, within the maximum acceptable intervention distance;
- Option 2: would be located on the northern half of the car park of the Fallowfield Retail Park that currently accommodates three retail units. The southern part of the car park

includes a fast food restaurant, doctor's surgery and other retail units, one of which was vacant in March 2018. Due to the constrained nature of the site, potential expansion would be required onto adjacent areas of land to make the vent shaft construction site feasible. Access would be off the A34 Birchfields Road for construction traffic. Option 2 would be located 3.2km from the Manchester tunnel north portal, within the maximum acceptable intervention distance. The Fallowfield Retail Park carpark is used for drop off and pick up of pupils attending the adjacent Birchfields Primary School and Option 2 would provide opportunity for the provision of around 20 spaces for this purpose; and

- Option 3: would be located within the grounds of the University of Manchester's Armitage Sports Centre, with access off Moseley Road. Option 3 would be located approximately 3.6km from the Manchester tunnel north portal, and would exceed the maximum acceptable intervention distance. During the detailed appraisal process it was concluded that for engineering reasons Option 3 would not be viable given the distance to the Manchester tunnel north portal exceeded the 3.3km maximum desirable vent shaft spacing based on the Common Safety Method and HS2 Phase One precedent. As a consequence of exceeding this distance, Option 3 was removed from the detailed appraisal process.

6.8.21 Option 2 was taken forward as the preferred option. Option 2 was selected because it would avoid MEA Central. Option 2 would also have lower traffic, potential air quality and noise impacts during construction. This is because Option 2 would use an existing vehicular access and egress point on the A34 Birchfields Road instead of using Lytham Road, thereby avoiding impacts on residents along this a one-way residential street. Option 2 will have less of an impact on community compared to the Sift baseline option (Option 1), which would result in the loss of MEA Central's car park and sports fields.

6.8.22 However, since March 2019 additional design development was undertaken to further reduce impacts on the Fallowfield Retail Park.

6.8.23 Three options were taken forward to a detailed appraisal to consider environmental impacts, engineering and construction feasibility, and cost. All three options would be located within the northern part of the Fallowfield Retail Park, all require the demolition of the same three retail units and be accessed during construction from the A34 Birchfields Road:

- Sift baseline option (Option 2, March 2018): the vent shaft would be located on the north-western edge of the Fallowfield Retail Park fronting onto Birchfields Road;
- Option 4: the vent shaft would be located on the north-eastern edge of the Fallowfield Retail Park, adjacent to the Styal Line, an existing railway line; and
- Option 5: the vent shaft would be located within the northern part of Fallowfield Retail Park mid-way between Birchfields Road to the west and the Styal Line to the east.

6.8.24 Option 4 was taken forward into the Proposed Scheme (refer to Volume 2, MA07 Map Book: map CT-06-363, A6). The Option 4 vent shaft headhouse will be located at the rear of the Fallowfield Retail Park set back further from the A34 Birchfields Road and require less land than Options 2 and 5. As a result Option 4 will provide a greater area of land suitable for

redevelopment on the A34 Birchfields Road frontage, will have less landscape and visual impacts on residents on the A34 Birchfields Road and will provide space for potential landscape and visual mitigation screening.

6.8.25 Table 24 provides a summary of the outcomes of the appraisal of alternative options considered in March 2019 compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 24: Consideration of local alternatives for Birchfield Road vent shaft in the Davenport Green to Ardwick area

Option	Outcome of analysis
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater socio-economic impacts during operation as would occupy the whole of the northern half of the Fallowfield Retail Park, whereas the Proposed Scheme will require less retail park land during operation and create a new plot suitable for redevelopment fronting Birchfields Road; • greater landscape and visual impacts during operation on residents of properties on the A34 Birchfields Road as there would be less space available for landscape mitigation planting to provide screening to these properties; and • more land required for operation of the vent shaft.
Option 4 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer socio-economic impacts during operation as a site suitable for redevelopment fronting the A34 Birchfields Road will be created during operation; • fewer landscape and visual impacts during operation on residents of properties on the A34 Birchfields Road as there will be more opportunity for landscape planting mitigation to provide screening; and • less land required for operation of the vent shaft.
Option 5	Comparison of Option 5 against the Proposed Scheme: • greater socio-economic impacts during operation as Option 5 would occupy the entire northern part of the retail park during operation, including areas that the Proposed Scheme would not utilise; • greater landscape and visual impacts during operation on residents of properties on the A34 Birchfields Road as the less space would be available for landscape mitigation planting; and • more land required for operation of the vent shaft compared to the Proposed Scheme.

6.9 Manchester Piccadilly Station (MA07 and MA08)

Manchester Piccadilly High Speed station and Ardwick approach (with Northern Powerhouse Rail) (MA07 and MA08)

6.9.1 Consideration has been given to a requirement to increase the number of platforms at Manchester Piccadilly High Speed station from four to six in order to provide two additional platforms to accommodate NPR services. Consideration has also been given to the land required for the construction and operation of the Manchester Piccadilly High Speed station in order to avoid the site of the New Sheffield Street Boulevard as identified in the 2017

Manchester City Council HS2 Strategic Regeneration Framework and to maximise economic benefits of the Proposed Scheme in Manchester city centre.

6.9.2 The following two options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered. The alignment of both options would extend from Manchester Piccadilly High Speed station to the northern part of the Manchester tunnel including the Manchester tunnel north portal, and would be located to the north-west of the existing Ardwick Depot main building:

- Sift baseline option (Option 1): Manchester Piccadilly High Speed station would be configured to accommodate two side platforms and two island platforms, 70m in width; and
- Option 2: Manchester Piccadilly High Speed station would be configured to accommodate three-island platforms, 65m in width.

6.9.3 Option 2 was taken forward into the Proposed Scheme (refer to Volume 2, MA08 Map Book: map CT-06-365b, A5 to I5). Although several of the environmental impacts will be similar for both options, Option 2 will have a smaller station footprint, requiring less land from New Sheffield Street Boulevard, and as a result will have fewer socio-economic and landscape and visual impacts compared to Option 1. The narrower station footprint for Option 2 will enable Manchester City Council to better realise the aspirations of their HS2 Strategic Regeneration Framework. Option 2 will provide greater opportunities to utilise sustainable modes of transport such as walking and cycling due to a narrower Station Footprint and a wider New Sheffield Street boulevard. Option 2 will have fewer impacts on land quality and will allow the Chapeltown Apartments to be retained, which would be demolished as part of Option 1. Option 2 will also retain the car parks on St Andrews Square, avoiding the loss of up to three full-time equivalent jobs compared to the Option 1. Option 2 will also provide greater opportunities for HS2 and NPR trains to use all platforms, thereby providing greater resilience and reliability for these services, and will cost less to construct.

6.9.4 Table 25 provides a summary of the outcomes of the appraisal of the alternative option considered in February 2019 compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the alternative option.

Table 25: Consideration of local alternatives for the Manchester Piccadilly High Speed station and Ardwick approach

Option	Outcome of analysis
Sift baseline option (Option 1)	Comparison of the Sift baseline option against the Proposed Scheme: • greater socio-economic and landscape and visual impacts on the future users and occupiers of properties fronting the New Sheffield Street Boulevard due to the wider station footprint. The Sift baseline option would also require more commercial demolitions including demolition of car parking on St Andrews Square; • greater impact on community as there would be more residential demolitions; • greater impact on land quality due to larger construction compound, station footprint and greater number of demolitions; • fewer opportunities for walking and cycling due to requiring a much narrower New Sheffield Street boulevard; and

Option	Outcome of analysis
	• greater operational restrictions for HS2 and NPR trains to use all six platforms due to the track alignment and design restricting timetable flexibility.
Option 2 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer socio-economic and landscape and visual impacts due to the narrower station footprint that will allow a wider New Sheffield Street Boulevard. Fewer commercial demolitions will be required; • fewer impacts on community as there will be fewer residential demolitions; • fewer impacts on land quality due to the smaller construction compound, station footprint and fewer demolitions; • greater opportunities for walking and cycling due to providing a much wider New Sheffield Street boulevard; and • less operational restrictions for HS2 and NPR trains to use all six platforms due to the track alignment and design offering greater timetable flexibility.

6.9.5 As a result of further design development and decisions made by Transport for Greater Manchester (TfGM) following the detailed appraisal described above (and as shown in Volume 2, MA08 Map Book: map CT-06-365b), design amendments within and around Manchester Piccadilly High Speed station have been made to accommodate potential future Metrolink services. The design amendments include increases in the area of land required within the public highway and on Manchester City Council's land off Pollard Street to create a new Metrolink turnback facility. The majority of these changes do not result in any new or changed environmental impacts as the majority will fall within the public highway. However, the replacement Metrolink turnback facility will be located adjacent to a committed residential development, so there could be greater construction and operational noise, potential air quality and landscape and visual impacts on the future occupiers and residents of the development. These design updates do not change the outcome of appraisal described above and the selection of the option taken forward into the Proposed Scheme.

6.9.6 The Government has also undertaken a high level feasibility study and considered alternative options for providing some or all of the integrated HS2 and NPR station requirements as an underground station. However, the Proposed Scheme, for a 6-platform surface station, outperformed the other options considered. Locating all or part of the integrated station below ground could support the HS2 and NPR indicative TSS with some operational resilience and reduce the impact of the station on regeneration opportunities. However, it would come at a cost that could not justify the benefits, whilst the footprint and duration of construction would delay the delivery into service of HS2 and the local and national benefits that would bring. The analysis of options also indicated that overall the underground options would not perform better from an environmental perspective compared to locating the station at surface.

6.9.7 Although these underground options were not developed to the same level of detail as the Proposed Scheme, it was not considered viable that the design of these options could be optimised to overcome the major differentials compared to the proposed surface scheme, in particular with regard to cost. However, given the strong views in favour of an underground station expressed by some local stakeholders including the Mayor of Greater Manchester,

the Government has asked HS2 Ltd to continue to develop the design of underground options.

6.10 Utilities

High pressure gas mains diversions (MA03 and MA06)

6.10.1 Consideration has been given to the diversion of three high pressure gas main pipelines within the Hoo Green area (HP45, TX44 and TX43). These diversions will all broadly follow the same construction corridor and opportunities to reduce the extent of land required for the diversion works, construction complexity and costs have been considered.

High pressure gas main diversion P2B-HP45 route option

6.10.2 An existing 300mm diameter high pressure gas pipeline (P2B-HP45) and the Hoo Green Pressure Reducing Installation (PRI) are located between High Legh and the A556, with Hoo Green at its southern extent and bordering the M56 at its northern extent. This pipeline would be crossed by the HS2 WCML connection. A feasibility study undertaken by Cadent, the asset owner, concluded that a diversion of this pipeline and PRI would be required to facilitate construction and operation of the HS2 WCML connection and maintain the integrity of the pipeline

6.10.3 Four options, all which would be constructed using both open cut and trenchless crossing techniques, were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Option 1: a 3.7km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur;
- Option 2: a 5km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur and the M56;
- Option 3: a 2km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur; and
- Option 4: a 3.2km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur and the M56.

6.10.4 During the detailed appraisal process it was concluded that for engineering reasons Option 3 would not be viable as it would require substantial modifications to the HS2 alignment in the area. For these reasons, Option 3 was removed from the detailed appraisal process.

6.10.5 Option 1 was taken forward into the Proposed Scheme (refer to Volume 2, MA03 Map Book: map CT-06-320, CT-06-321 CT-06-322a and Volume 2, MA06 Map Book: map CT-06-351-R1) as it would be substantially less complex to build compared to Options 2 and 4, and would cost less to construct than Option 2. This is primarily because, unlike Options 2 and 4, Option 1 will not pass through a historic landfill, thereby having fewer impacts on land quality, and will be less complex to construct as it will not require a crossing of the M56. Option 1 will have fewer impacts on agricultural land than Option 2 due to the considerably shorter

length of diversion, but greater impacts than Option 4. Option 1, like Option 2, will have greater historic environment impacts as there is a scheduled monument within the construction zone. However, it is assumed that construction works will avoid direct impacts on this designation, but it is likely that the setting of the scheduled monument will be affected temporarily.

6.10.6 There are several areas of deciduous woodland on the Priority Habitats Inventory within the southern extent of the proposed pipeline diversion boundary. Option 1, like Option 2, would likely require the removal of a section of Belt Wood, designated as a LWS to accommodate the diversion. Option 1 however is likely to have less impact than Option 2 given the diversion is shorter and would require less land to construct. Option 4 would avoid Belt Wood LWS and due to being the shortest diversion route and smaller scale of works required would likely cause the least disturbance to habitats and species when compared to the alternative options.

6.10.7 Table 26 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 26: Consideration of local alternatives for P2B HP45 route options

Option	Outcome of analysis
Option 1 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • greater construction impacts on agricultural land than Option 4, but fewer temporary construction impacts on agricultural land than Option 2 due to the respective diversion route lengths; • greater impacts on the historic environment during construction than for Option 4 as there is a scheduled monument within the construction zone for Option 1. The setting of the scheduled monument will be affected temporarily by construction. Similar impacts as for Option 2; • greater ecological impacts during construction than for Option 4 as the construction works will require more land and cross a section of Belt Wood LWS, removing it from use. Comparative ecological impacts to Option 2. • fewer land quality impacts during construction than Options 2 and 4 as there will be no potential to pass through the historic landfill to the north of the M56; • fewer construction complexities as there will be no crossing of the M56; • longer construction programme; and • likely to cost less than Option 2, and more than Option 4.
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater construction impacts on agricultural land due to a longer diversion route; • historic environment impacts during construction would be the same as for the Proposed Scheme and would affect the setting of a scheduled monument. The setting of the scheduled monument will be affected temporarily during construction; • greater ecological impacts during construction than the Proposed Scheme as the construction works will require more land and would cross a section of Belt Wood LWS; • greater land quality impacts during construction as there would be potential to pass through the historic landfill to the north of the M56; • greater construction complexity owing to the crossing of the M56; • longer construction programme; and • likely to cost more to construct.

Option	Outcome of analysis
Option 4	Comparison of Option 4 against the Proposed Scheme: • fewer construction impacts on agricultural land due to a shorter diversion route; • fewer historic environment impacts during construction as the proposed pipeline diversion boundary would not affect the scheduled monument • fewer ecological impacts during construction than the Proposed Scheme as the construction works will require less land and would avoid Belt Wood LWS; • greater land quality impacts during construction as there would be the potential for the requirement to pass through the historic landfill to the north of the M56; • greater construction complexity owing to the crossing of the M56; • shorter construction programme; and • likely to cost less to construct.

6.10.8 As a result of further design development following the detailed appraisal described above (and as shown in Volume 2, MA03 Map Book: map CT-06-320, CT-06-321, 322a and MA06 Volume 2, Map Book: map CT-06-351-R1), HS2 Ltd, National Grid and Cadent identified additional land would be required, sufficient, for a tie in point for this diversion to the north of the M56 crossing. As a result, it was decided that Option 4 should be adopted for this diversion.

6.10.9 In addition, the alignment of Option 4 has been shifted approximately 20m south. This was due to design changes made by Cadent Gas in response to the relocation of the Peacock Lane Grid Supply Point sub-station and compound.

6.10.10 Overall, the environmental impacts of Option 4 would remain unchanged as a result of the design updates, and would be less than the environmental impacts identified for Option 1.

High pressure gas main diversion P2B-TX44 Route Option

6.10.11 An existing 900mm diameter high pressure gas pipeline (P2B-TX44) is located between High Legh and the A556, with Hoo Green at its southern extent and the M56 at its northern extent. This pipeline crosses the HS2 WCML connection. A feasibility study undertaken by National Grid, the asset owner, concluded that a diversion of this pipeline would be required.

6.10.12 Four options, which would all be constructed using both open cut and trenchless crossing techniques, were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline (Option 1): a diversion to the east of the HS2 WCML connection that would cross the HS2 Manchester spur and Chapel Lane. This diversion would be approximately 2.6km in length;
- Option 2: a 4.3km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur, along with the A50 Warrington Road and Chapel Lane;

- Option 3: a 5.1km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur, along with the A50 Warrington Road, Chapel Lane and the M56; and
- Option 4: a 3.6km long diversion located to the east of the HS2 WCML connection that would cross the HS2 Manchester spur, along with Chapel Lane and the M56.

6.10.13 Sift baseline (Option 1) was taken forward into the Proposed Scheme (refer to Volume 2, MA03 Map Book: map CT-06-320, and CT-06-321 and Volume 2, MA06 Map Book: map CT-06-351-R1). Sift baseline (Option 1) was selected as it will require less land during construction as it will be the shortest diversion and will therefore have fewer environmental impacts on agricultural land. This option will also have fewer noise, potential air quality and traffic impacts on local farms (Moss House Farm, Agden Brook Farm, Athill Farm and Booth Bank Farm) during construction than the alternative options.

6.10.14 There are several areas of deciduous woodland on the Priority Habitats Inventory which are located within the proposed pipeline diversion boundary. However, Sift baseline (Option 1) will also have fewer impacts on ecological designations compared with Options 2 and 3 as it will require less land and will avoid Belt Wood LWS and deciduous woodland on the Priority Habitats Inventory. In addition, sift baseline (Option 1) will have a shorter construction programme, will require less land and will therefore have fewer ecological impacts than all other options. Overall, Sift baseline (Option 1) has fewer construction complexities and cost less to construct than the alternative options as it will have a shorter diversion and fewer road crossings and is therefore expected to have fewer construction related impacts on nearby receptors.

6.10.15 Table 27 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 27: Consideration of local alternatives for P2B TX44 route options

Option	Outcome of analysis
Sift baseline option 1 (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer construction impacts on agricultural land due to a shorter diversion length; • fewer noise, potential air quality and traffic impacts on local farms (Moss House Farm, Agden Brook Farm, Athill Farm and Booth Bank Farm) during construction as the diversion will be shorter; • fewer impacts on ecology as Belt Wood LWS and deciduous woodland on the Priority Habitat Inventory, would be avoided; • fewer land quality impacts during construction as the gas pipeline will avoid the historic landfill to the north of the M56; and • fewer construction complexities than the alternative options as the Proposed Scheme will have the least numbers of road crossings and shortest diversion route; • shorter construction programme; and • likely to cost less to construct.
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater construction impacts on agricultural land due to a longer diversion route;

Option	Outcome of analysis
	• greater noise, potential air quality and traffic impacts on local farms (Moss House Farm, Agden Brook Farm, Athill Farm, Booth Bank Farm, Hulme Barns Farm and Hulse Heath Farm) as a longer diversion will be required; • greater impacts on ecology as the diversion would be routed through Belt Wood LWS and deciduous woodland on the Priority Habitat Inventory; • similar land quality impacts during construction it would not pass through the historic landfill to the north of the M56; and • greater construction complexities as due to two highways crossings (A50 Warrington Road and Chapel Lane) and a longer diversion route; • longer construction programme; and • likely to cost more to construct.
Option 3	Comparison of Option 3 against the Proposed Scheme: • greater construction impacts on agricultural land due to a longer diversion route; • greater noise, potential air quality and traffic impacts on local farms (Moss House Farm, Agden Brook Farm, Athill Farm, Booth Bank Farm, Hulme Barns Farm and Hulse Heath Farm) due to a longer diversion; • greater impacts on ecology as the diversion would be routed through Belt Wood and deciduous woodland on the Priority Habitat Inventory; • greater land quality impacts during construction as there is potential to pass through the historic landfill to the north of the M56; and • greater construction complexities due to three highways crossings (A50 Warrington Road, Chapel Lane and M56) and a longer diversion route; • longer construction programme; and • likely to cost more to construct.
Option 4	Comparison of Option 4 against the Proposed Scheme: • greater construction impacts on agricultural land due to a longer diversion route; • greater noise, potential air quality and traffic impacts on local farms (Moss House Farm, Agden Brook Farm, Athill Farm and Booth Bank Farm) due to a longer diversion; • similar impacts on ecology Belt Wood LWS and deciduous woodland on the Priority Habitat Inventory, would be avoided; • greater land quality impacts during construction as there is potential to pass through the historic landfill to the north of the M56; and • greater construction complexities due to two highway crossings (Chapel Lane and the M56) and a longer diversion route; • longer construction programme; and • likely to cost more to construct.

6.10.16 Design development continued following the detailed appraisal described above (and as shown in Volume 2, MA03 Map Book: map CT-06-320, and CT-06-321 and Volume 2, MA06 Map Book: map CT-06-351-R1). Design changes made by the asset owner (National Grid were in response to the relocation of the Peacock Lane grid supply point and associated compound. The amended alignment has been shifted approximately 100m south of the Option 1 alignment, but would not result in any changes to the environmental impacts identified within the appraisal above.

High pressure gas main diversion P2B-TX43 route option

6.10.17 An existing 900mm diameter high pressure gas pipeline (P2B-TX43) is located between High Legh and the A556, with Hoo Green to the south and the M56 to the north. This pipeline would be crossed by the route of the HS2 WCML connection. A feasibility study undertaken by National Grid, the asset owner, concluded that a diversion of this pipeline would be required.

6.10.18 The following two options, both which would be constructed using open cut and trenchless crossing techniques, were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline (Option 1): a 5.1km long diversion located to the east of and approximately parallel to the HS2 WCML connection. The diverted gas pipeline would cross the HS2 Manchester spur, the A50 Warrington Road and Chapel Lane; and
- Option 2: a 4km long diversion located to the west of and approximately parallel to the HS2 WCML connection. The diverted gas pipeline would cross the HS2 WCML connection (at its southern extent), the A50 Warrington Road and Peacock Lane.

6.10.19 Sift baseline (Option 1) was taken forward into the Proposed Scheme due to its location on the eastern side of the HS2 WCML connection (refer to Volume 2, MA03 Map Book: map CT-06-319 to CT-06-321 and Volume 2, MA06 Map Book: map CT-06-351-R1). Two further underground high pressure gas main diversions in the vicinity (Cadent's HP45 and National Grid's TX44) will also be routed to the east of the alignment (compared to Option 2 on the west), therefore allowing diversion routes to be combined with those of HP45 and TX44, which would be less complex to construct and require less land overall.

6.10.20 The Sift baseline (Option 1) will have fewer impacts on the community as there will be no impacts on footpaths and bridleways during construction and no work will be required within High Legh Park Golf Club. Furthermore, the diversion will be less complex to construct due to fewer road crossings, despite being a longer diversion than Option 2.

6.10.21 The Sift baseline (Option 1) will, however, have greater impacts on ecology during construction compared to Option 2. There are several areas of deciduous woodland on the Priority Habitats Inventory which are located within the proposed pipeline diversion boundary. In particular, a section of Belt Wood, which is also designated as a LWS, priority habitat is located within land required for the proposed pipeline diversion and would likely need to be removed to accommodate the diversion. It is acknowledged that post sift, a section of Belt Wood was identified as ancient woodland and will be subject to further design development to identify opportunities to avoid this site.

6.10.22 In addition, Sift baseline (Option 1) would also result in greater impacts on flood risk during construction as the boundary of the land required for the proposed pipeline diversion extends into Flood Zone 3 and a flood warning area that closely follows the course of the Millington Clough/Agden Brook.

6.10.23 Table 28 provides a summary of the outcomes of the appraisal of the alternative options compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 28: Consideration of local alternatives for P2B-TX43 route options

Option	Outcome of analysis
Sift baseline (Option 1) (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative option: • fewer impacts on the community during construction as there will be fewer road crossings and no work required within High Legh Park Golf Club; • greater impacts on ecology and biodiversity during construction as there are several areas of deciduous woodland within the proposed pipeline diversion boundary. In particular, the option will be routed through Belt Wood (a section of which is designated as a LWS, priority habitat); • additionally, Banks Wood ancient and semi-natural woodland, which forms part of a cluster of ancient and semi-natural woodland is located in the immediate vicinity; • greater risk to a Scheduled Monument (Hough Hall moated site, ancillary enclosure, and fishpond) which is adjacent to the proposed pipeline diversion boundary; • greater impacts on flood risk during construction as the northern extent of the pipeline diversion boundary is located within Flood Zone 3 and a warning area that closely follows Millington Clough and Agden Brooks; • lower construction complexity due to fewer road crossings and the construction zone will be combined with two further high-pressure gas main diversions construction zones (HP45 and TX44) reducing the overall impact and potential environmental effects; and • likely to cost more to construct.
Option 2	Comparison of Option 2 against the Proposed Scheme: • greater impacts on the community during construction due to disruption to the use of footpaths and bridleways and construction disturbance (dust, noise, traffic emissions) at High Legh Park Golf Club and the location of local community in the village of High Legh; • fewer impacts on ecology during construction as there are no LWS within the proposed pipeline diversion boundary; • fewer impacts on heritage; • fewer impacts on flood risk during construction as there are no areas known to be at risk of flooding within the proposed pipeline diversion boundary; • greater construction complexity due to the diversion needing to cross existing roads, increasing construction phase and construction footprint, although this option does have a slightly shorter diversion route; and • likely to cost less to construct.

6.10.24 As a result of further design development following the detailed appraisal described above (and as shown in Volume 2, MA03 Map Book: map CT-06-319 to CT-06-321 and Volume 2, MA06 Map Book: map CT-06-351-R1), the southern portion of the Sift baseline (Option 1) has been re-routed further west to avoid crossing through and therefore having a direct impact on Belt Wood, a section of which was classified as ancient woodland after the appraisal. This also led to similar design development changes for TX44 and HP45 discussed below.

6.11 Off Route Works

Depot (Western Leg)

6.11.1 Consideration has been given to the location of a depot to stable overnight HS2 trains that will serve stations in the north of England and Scotland. It would not be operationally or economically practical, or environmentally sustainable to run empty HS2 trains over long distances between stations and Crewe North Depot at end and start of service. The locations considered operationally practical were those near to stations where HS2 trains will finish service for the day (i.e. Glasgow, Edinburgh and Carlisle) and had potential to provide stabling for up to 28, approximately 200m long high speed trains.

6.11.2 An initial search for reasonable brownfield sites and existing depot sites between Carlisle, Glasgow and Edinburgh identified 35 potential locations. Identification of suitable sites took into account criteria including: the need to minimise long distance empty carriage movements from service termini locations, proximity to the existing railway, topography, whether the sites would provide sufficient space for the necessary operational layout and stabling of high speed trains, availability of a local supply of labour, whether it could accommodate light maintenance facilities and capacity to stable the number of trains determined by the train service specification.

6.11.3 Upon further consideration, many of the 35 brownfield sites were too small to accommodate a feasible track arrangement and would provide little, if any, space for light maintenance facilities. Only two brownfield options, at Kingmoor and at Craigneuk, could accommodate the required number of high speed trains and light maintenance requirements, both of which were later discounted. Kingmoor was discounted due to the existing yard being heavily utilised by Network Rail. It therefore would not provide sufficient space for the stabling sidings design, and access and egress roads without an extensive remodel of the existing stabling facilities. Craigneuk was discounted as the design would substantially affect the region's 'masterplan'[45]. Of the 35 identified brownfield and depot sites identified, none were considered feasible options based on minimum spatial requirements, constructability and current use. Consequently, the search for potential sites in the north of England and Scotland was extended to include greenfield sites.

6.11.4 The search of greenfield sites identified three possible sites for the depot. These sites were at Todhills, Annandale (an area located between Kirkpatrick Fleming and Gretna Green) and Ravenstruther. Each location was subject to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Option 1 Todhills: a new depot on a greenfield site located close to the WCML, east of Rockcliffe village. The proposed depot would require an area of land of approximately

[45] North Lanarkshire Council planning portal. Available online at: https://eplanning.northlanarkshire.gov.uk/online-applications/simpleSearchResults.do?action=firstPage.

45ha, bound by the WCML to the west, the M6 to the east and agricultural land to the south and north. The depot would be close to residential properties on Harker Road Ends, Chrysalis Cumbria (providing support to adults with learning disabilities), Heathlands Project (community disability farm) and Hadrian's Wall World Heritage Site. Construction of a depot at Todhills would require works within the impact risk zone (IRZ) identified for the Upper Solway Flats and Marshes SSSI. This SSSI is a component of the Upper Solway Flats and Marshes SPA and Ramsar and the Solway Firth SAC. It would also require works within the IRZ for the River Eden and Tributaries SSSI, a component of the River Eden SAC. Requirements for the depot would include stabling for up to 28 high speed trains 202m in length with a four-track maintenance shed for the servicing, cleaning and maintenance of passenger rolling stock and carriage washing machine plant and automatic vehicle inspection, each housed in separate buildings along the access road into the depot;

- Option 2 Annandale: a new depot on a greenfield site, of approximately 20ha, located east of Kirkpatrick Fleming, close to the WCML and the A76(M). The depot would be close to residential properties, The Mill Forge wedding venue and nearby listed buildings (one at Category B, which is Grahamshill Farmstead and Steading and the other at Category C, which is Williamsfield Farmhouse). Construction of a depot at Annandale would require works within 4km of the Upper Solway Flats and Marshes SSSI, part of the Upper Solway Flats and Marshes SPA and Ramsar and the Solway Firth SAC. The depot would have the same requirements as Option 1 and provide stabling for 28 high speed trains, maintenance and cleaning facilities as well as parking and welfare facilities; and
- Option A Ravenstruther: a new depot on a greenfield site, located west of Carstairs Junction close to the WCML. The depot would require an area of land of approximately 25ha, bound by the WCML to the north, agricultural land to the south, woodland to the east and Ravenstruther village to the west. The depot would be close to residential properties, including on Lanark Road, users of Silvermuir Road and community resources including Newmill Trout Fishery and Kames Golf Club, nearby listed buildings (one at Category B, which is Carstairs House Lodge) and two scheduled monuments. Construction of a depot at Ravenstruther would require works in proximity to Cranley Moss SSSI and SPA, Cleghorn Glen SSSI (part of Clyde Valley Woodlands SAC). The depot would have the same requirements as Option 1 and provide stabling for 28 high speed trains, maintenance and cleaning facilities as well as operational parking and welfare facilities.

6.11.5 At this stage in the design development process, Option 2 was taken forward as the preferred option. This is because Option 2 will, overall, have fewer environmental impacts than both Option 1 and Option A. Furthermore, Option 2 will be less complex from a construction, maintenance and operational perspective than the alternative options as Option 1 would be crossed by two High Voltage lines and Option A would require a major highway realignment.

6.11.6 Option 2 will have fewer impacts on ecology compared to Option 1 and Option A, as construction of Option 2 will result in loss of a less diverse range of habitats and nearby

designated areas, with the potential to be affected by hydrological and air quality changes, are located further from construction works. Option 2 will be located 4.5km away from the Upper Solway Flats and Marshes SSSI and within 1km of Raeburn Flow SSSI and SAC. However, Option 1 would be closer to the Upper Solway Flats and Marshes SSSI (1.2km) and would also be less than 1.5km from River Eden SAC; and, Option A would be 1.5km from Cranley Moss SSSI and SPA and 1.5km from Cleghorn Glen SSSI. Option 2 will also have fewer potential air quality impacts and noise impacts during construction compared to Option 1 and Option A due to the proximity of Option 2 to a motorway, resulting in absence of through traffic in rural areas, and fewer nearby residential receptors at Option 2. Option 2 will have fewer land quality impacts than Option A and Option 1, as construction of Option 2 will avoid construction on previously developed land and historic landfill. Option A is brownfield land (currently occupied by disused railway lines) and Option 1 is underlain with historic landfills, representing a contaminated land risk.

6.11.7 Like Option A, Option 2 will have fewer impacts on water resources and flood risk during construction compared to Option 1 which would cross Rockcliffe Beck and its Flood Zones (2 and 3) and require multiple culverts which could affect the hydromorphology of Rockcliffe Beck. Similar to Option 1, Option 2 will have greater impacts on agriculture compared to Option A.

6.11.8 Option 2 will have fewer historic environment impacts compared to Option A but will have greater historic environment impacts compared to Option 1, with the potential to impact the setting of Category B listed Grahamshill Farmstead and Steading and Category C listed Williamsfield Farmhouse, and the potential for Roman archaeological finds. Option 2 will have fewer landscape and visual impacts compared to Option A due to the construction of fewer elevated highway elements and fewer visual receptors, but will have greater landscape and visual impacts than Option 1 due to the introduction of infrastructure into a semi-urbanised area at Option 1.

6.11.9 Option 2 will have fewer socio-economic impacts compared to Option 1, but will have greater socio-economic impacts compared to Option A as reconfiguration of the depot access track could potentially impact the viability of the Mill Forge Wedding Venue, a scrapyard business located south of the WCML and cause disruption to surrounding farms, namely Cranberry Farm and Williamsfield Farm. Option 2 will also require larger volumes of construction materials compared to Option A, while less extensive excavation works at Option 2 compared to Option 1 mean there will be fewer impacts on construction traffic and less waste generation.

6.11.10 A Habitat Regulations Assessment (HRA) screening was undertaken for each of the three sites. This work comprised a desk-based assessment informed by publicly available data, and accordingly a precautionary approach was implemented. Each screening report concluded the same; that significant effects could not be ruled out and an appropriate assessment would be required to determine whether the Proposed Scheme would adversely affect the integrity of the European sites in question. As such, the potential for significant effects on these Natura 2000 sites was not a differentiator during the design development. Appropriate Assessment will be undertaken and an appropriate design will be developed

through an iterative process. Any studies to inform the required assessments will be completed and the outcomes agreed with Scottish Natural Heritage, prior to Royal Assent.

6.11.11 Since the consideration of the above three options for the location of a depot, consideration was given to whether there was a need for an additional smaller depot in combination with the main depot at Annandale. Whilst high speed trains would also be able to use the depot at Polmadie near Glasgow (part of Phase One), there would be a requirement for empty trains to travel long-distances when terminating at Edinburgh, either to Polmadie or Annandale. As such, the location of a second satellite depot near Edinburgh has been considered.

6.11.12 The following three options were taken forward to a detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered. The stabling numbers used for sifting were based on an initial engineering and spatial assessment. The use of Polmadie to stable eight high speed trains was common to all options and therefore this element of the options was not appraised:

- Option B: Annandale (28 high speed trains) and Polmadie (eight high speed trains). A depot on a greenfield site, of approximately 20ha, located east of Kirkpatrick village, close to the WCML and the A76(M). The depot would be close to residential properties, The Mill Forge wedding venue and listed buildings (one at Category B, which is Grahamshill Farmstead and Steading and the other at Category C, which is Williamsfield Farmhouse). Construction of a depot at Annandale would require works within 4km of the Upper Solway Flats and Marshes SSSI, part of the Upper Solway Flats and Marshes SPA and Ramsar, and the Solway Firth SAC. Requirements for the depot would include for up to 28 high speed trains 200m in length with a four-track maintenance shed for the servicing, cleaning and maintenance of passenger rolling stock and carriage washing machine plant and automatic vehicle inspection, each housed in separate buildings along the access road into the depot. This option would also involve the use of an existing satellite depot at Polmadie to stable up to eight high speed trains (four of the eight tracks would be used for stabling high speed trains under Phase One);
- Option B2: Annandale (28 high speed trains), Kingsknowe (four high speed trains) and Polmadie (eight high speed trains). A depot that would provide the same track layout as Option B at Annandale (28 high speed trains) and Polmadie. This option would involve the construction of a second new depot on a brownfield site, of approximately 1ha, located west of Kingsknowe train station. The purpose for keeping the same capacity layout at Annandale, despite the additional stabling at Kingsknowe, was to allow for operational flexibility, whilst the design could be rationalised at a later stage, if selected. Located in an urban setting, the depot at Kingsknowe would be close to residential properties, commercial properties and community facilities including Kingsknowe Golf Club; and
- Option B3: Annandale (18 high speed trains), East Calder (eight high speed trains) and Polmadie (eight high speed trains). A depot that would provide the same track layout as Option B at Polmadie depot. This option would provide stabling for fewer high speed trains at Annandale as East Calder would accommodate up to eight high speed trains.

This option would involve the construction of a new depot on a greenfield site, of approximately 2ha, located east of Kirkpatrick village, close to the WCML and the A76(M). A second new depot would be on a greenfield site, of approximately 17ha, located south of the A71 Bankton Road, south-east of Livingston. The depot would be close to a Calderwood SSSI (less than 1.2km) and two listed buildings (Category B Millrigg Farmhouse, Category C Bridge Gogar Burns).

6.11.13 Option B was taken forward in the Proposed Scheme (refer to Volume 4, Off-route effects Map Book: map CT-06-804 to CT-06-807). Option B was selected because, although operational costs will be greater than the alternative options, it will cost less to construct the stabling facilities at two sites compared to the alternative options that would require three sites. Furthermore, Option B will have fewer environmental impacts than Option B2 and Option B3. Option B will have fewer impacts on ecology compared to Option B2 and Option B3 and will have fewer landscape and visual impacts. Option B will have fewer impacts on noise, land quality, water resources, transport and socio-economics compared to Option B2, and similar to Option B3. Option B will have fewer impacts on agriculture and historic environment compared to Option B3, and similar to Option B2. Although Option B will have fewer potential air quality impacts during construction compared to Option B2.

6.11.14 Table 29 provides a summary of the outcomes of the appraisal of the alternative options considered compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 29: Consideration of local alternatives for a satellite depot (Western leg)

Option	Outcome of analysis
Option B (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer agricultural impacts when compared to Option B3 as fewer land holdings affected, and smaller area of agricultural land required. Similar agricultural impacts compared to Option B2; • fewer potential impacts on air quality and noise during construction, when compared to Option B2, due to there being fewer sensitive receptors close to construction works. Similar potential air quality and noise impacts during construction to Option B3. • fewer impacts on ecology during construction due to a smaller area of habitat loss, including arable, grassland, riparian and woodland included in the Scottish Semi-Natural Woodland Inventory, when compared to Option B2 and Option B3; • fewer historic environment impacts during construction, when compared to Option B3, associated with the setting of Category B listed Millrigg Farmhouse, Category C Ormiston Main Steading and Category B listed Ormiston House. Construction impacts on the scheduled monument of Whinnyrig and the setting of Category B listed Grahamshill Farmstead and Steading and Category C listed Williamsfield Farmhouse will be similar to Option B2 and Option B3; • fewer impacts on land quality and water resources when compared to Option B2 due to additional contaminated land risk associated with refuse tip at Option B2. Similar land quality impacts to Option B3; • fewer landscape and visual amenity impacts as new stabling facilities will be constructed at only one location, rather than two as with Option B2 and Option B3; • fewer socio-economic impacts compared to Option B2 due to presence of fewer nearby businesses. Similar socio-economic impacts to Option B3;

Option	Outcome of analysis
	• less extensive earthworks compared to Option B2 that will result in less construction traffic and generate less waste material. Similar impacts to Option B3; • less complex to construct as only requires construction at two sites, including of one new depot at Annandale, rather than at three sites, with two new stabling facilities, as for Option B2 and Option B3; and • lower construction costs associated with the construction of two sites rather than three (as with Option B2 and Option B3). However, greater operational costs than Option B2 and Option B3.
Option B2	Comparison of Option B2 against the Proposed Scheme: • similar agricultural impacts to the Proposed Scheme; • greater potential impact on air quality and noise due to a greater number of sensitive receptors associated with construction of an additional depot at Kingsknowe (residential properties at Hailesland Park and Walkers Wynd); • greater impact on ecology during construction due to an increase in area of semi-natural habitat loss, including woodland included in the Scottish Semi-natural Woodland Inventory and riparian habitat, in an urban setting which may disrupt habitat connectivity; • similar impacts on historic environment associated with construction impacts on the scheduled monument of Whyinnyrig and the setting of Category B listed Grahamshill Farmstead and Steading and Category C listed Williamsfield; • greater impact on land quality and water resources due to contaminated land risk associated with refuse tip at Kingsknowe; • greater landscape and visual impacts due to the introduction of new train infrastructure in two locations rather than one, as with the Proposed Scheme; • greater socio-economic impacts due to construction close to Kingsknowe Golf Club; • more extensive earthworks than the Proposed Scheme which will result in more construction traffic and generate more waste material; • more complex to construct as works will be undertaken at three sites, with two being new stabling sites, compared to the Proposed Scheme which will require construction at two sites, with one being a new stabling site; and, • greater cost of the construction of two sites when compared to one in the Proposed Scheme. However, reduced operational costs.
Option B3	Comparison of Option B3 against the Proposed Scheme: • greater impact on agriculture as more land holdings would be affected and a larger area of agricultural land required; • similar potential impact on air quality and noise during construction; • greater impact on ecology during construction due to a larger area of semi-natural habitat loss including arable, grassland and woodland included in the Scottish Semi-natural Woodland Inventory; • greater construction impact on historic environments associated with the setting of Category B listed Millrigg Farmhouse, Category C Ormiston Main Steading and Category B listed Ormiston House; • similar land quality and water resources impacts; • similar socio-economic impacts; • greater impact on landscape and visual amenity due to the introduction of new train infrastructure at two locations rather than one, as with the Proposed Scheme; • similar impacts on traffic and waste material; • more complex to construct as works will be undertaken at three sites, with two being new stabling sites, compared to the Proposed Scheme which will require construction at two sites, with one being a new stabling site; and

Option	Outcome of analysis
	• greater cost of the construction of the three sites when compared to the two sites in Option B. However, reduced operational costs.

Splitting and joining location in the North

6.11.15 Consideration has been given to the location of splitting and joining infrastructure (i.e. infrastructure to enable 400m long high speed trains to split into two constituent 200m high speed trains, and vice versa) on the northern portion of the WCML running between London and Scotland. There is a requirement to provide seating capacity between London and Scotland and increase capacity of the WCML, but there is no capability for 400m high speed trains working on the conventional rail network, particularly at Edinburgh and Glasgow, therefore the splitting and joining facility is required.

6.11.16 The following three options were taken forward to detailed appraisal where environmental impacts, engineering and construction feasibility, and cost were considered:

- Sift baseline option: Carstairs Station. The splitting and joining facilities would be located at Carstairs Station. Changes to the existing network would include extension of platforms to 415m, extensive remodelling to the track layout north and south of the station doubling the east junction and doubling of the Carstairs South Junction towards Edinburgh. The facilities would be close to residential properties around the station (on Station Road, Moss Road and Park Avenue at the western end and on Strawfrank Road and Pettinain Road) and Category B listed Carstairs House;
- Option A: Carstairs loops. The splitting and joining facilities would be located at Carstairs Junction. High speed trains would split and join in two loops, either side of the WCML. Changes to the existing network would include two 415m line sections for splitting and joining with platforms and doubling of Carstairs South Junction. The facilities would be located close to residential properties and the River Clyde; and
- Option B: Carlisle Station. This option would involve splitting and joining of high speed trains at Carlisle Station. Changes to the existing network would include extension of three platforms to 415m, additional through platform A, to replace platform 2 bay, minor changes to layout of southern throat and doubling of Carstairs South Junction to allow parallel movements between WCML and Edinburgh chord, via new track and new crossovers. This solution would improve capacity on the WCML. The required works for Option B would be contained within the existing conventional railway boundary and therefore requirement for additional land is not anticipated. The facilities would be close to residential properties, a scheduled monument (Roman and medieval town area bounded by Heads Lane West Wall and Blackfriars Street) approximately 225m to the north-west, two Grade I listed buildings (Crown Court and Nisi Prius Courthouse), River Eden and Tributaries SSSI and River Eden SPA. Carlisle Station itself is Grade II* listed.

6.11.17 Option B was taken forward into the Proposed Scheme (refer to Volume 4, Off-route effects Map Book: map CT-06-803). Option B was selected on the basis that during operation passengers and crew would be able to join services at Carlisle Station, and because it will

cost less to construct than the Sift baseline option. Similar to the Sift baseline option, Option B will have fewer impacts on agriculture and give rise to fewer landscape and visual impacts compared to Option A. It will have fewer socio-economic and community impacts compared to both the alternative options as there are fewer residential properties located within proximity to construction works and no residential or commercial demolitions will be required. Similar to the Sift baseline option, Option B will have fewer noise and flood risk impacts compared to Option A. Option B will also require less extensive earthworks than Option A which will result in less construction traffic and generate less waste material. However, Option B will require more extensive earthworks than the Sift baseline option and will have greater potential impacts on air quality and greater impacts on historic environment compared to both alternative options.

6.11.18 Table 30 provides a summary of the outcomes of the appraisal of the alternative options considered compared to the Proposed Scheme, as described above. A summary is also provided of the Proposed Scheme compared to the reasonable alternative options considered.

Table 30: Consideration of local alternatives for a splitting and joining location in the North

Option	Outcome of analysis
Sift baseline option	Comparison of the Sift baseline option against the Proposed Scheme: • impacts on agriculture similar to the Proposed Scheme; • fewer potential air quality impacts during construction as this option is not located within proximity to two AQMA, as with the Proposed Scheme; • greater impact on community during construction due to a number of residential receptors located within proximity to construction works (i.e. dwellings on Station Road, Moss Road, Park Avenue, Strawfrank Road and Pettinain Road); • fewer impacts on historic environments during construction as there is only one Category B listed building (Carstairs House) located within proximity, the setting of which would be unlikely to be affected; • landscape and visual impacts similar to the Proposed Scheme; • socio-economic impacts similar to the Proposed Scheme; • noise impacts similar to the Proposed Scheme; • impacts on water resources and flood risk similar to the Proposed Scheme; • less extensive earthworks than the Proposed Scheme which will result in less construction traffic and generate less waste material; • greater requirement for land beyond the existing conventional railway boundary compared to the Proposed Scheme; • limited operational opportunity for crew and passengers to access service at Carstairs as no alternative route available for train crew to access Carstairs in the existing access roads are closed; • more complex to construct and longer construction programme; and • greater construction costs.
Option A	Comparison of Option A against the Proposed Scheme: • greater impacts on agriculture during construction as Class 3 and 2 agricultural land would be lost, required for construction of new facilities; • fewer potential impacts on air quality during construction as this option is not located within proximity to two AQMA, as with the Proposed Scheme; • greater impact on community as a result of demolitions of residential and commercial properties adjacent to the railway corridor during construction;

Option	Outcome of analysis
	• fewer impacts on historic environments during construction as there are no heritage assets within proximity to the site; • greater impacts on landscape character resulting from a new large raised engineered structure within the open landscape; • greater socio-economic impacts during construction due to potential for impacts on businesses adjacent to the railway corridor; • greater noise impacts due to proximity of residential properties; • greater impacts on flood risk as there is potential for changes to floodplain function from widening embankments; • more extensive earthworks than the Proposed Scheme which will result in more construction traffic and generate more waste material; • greater requirement for land beyond the existing conventional railway boundary compared to the Proposed Scheme; • limited operational opportunity for crew and passengers to access service at Carstairs as no alternative route available for train crew to access Carstairs in the existing access roads are closed; • less complex to construct and similar construction programme duration; and • lower construction costs.
Option B (the Proposed Scheme)	Comparison of the Proposed Scheme with the alternative options: • fewer agriculture impacts than Option A as no agricultural land will be lost as a result of construction and operation at this location. Similar impacts on agriculture compared to Sift baseline option; • greater potential impacts on air quality compared to the alternative options due to proximity of two AQMA to construction works; • fewer community and health impacts when compared to alternative options as there are fewer residential properties located within proximity to construction works and no residential or commercial demolitions are anticipated; • greater historic environments impacts compared to alternative options due to construction within a Grade II* listed station structure (Carlisle Station); • fewer landscape and visual impacts compared to Option A as this option will involve construction of new rail infrastructure within an existing station. Similar impacts on landscape and visual compared to Sift baseline option; • fewer socio-economic impacts compare to Option A as disruption to operation of businesses is not anticipated. Similar impacts on socio-economics compared to Sift baseline option; • fewer noise impacts compared to Option A. Similar impacts on agriculture compared to Sift baseline option; • fewer impacts on flood risk compared to Option A as works not anticipated to impact floodplain function. Similar impacts on flood risk compared to Sift baseline option; • less extensive earthworks than Option A which will result in less construction traffic and generate less waste material. However, more extensive earthworks than sift baseline option which will result in more construction traffic and generate more waste material; • no requirement for land beyond the conventional railway boundary; • greater opportunity for crew and passengers to access services at Carlisle compared to alternative options; • less complex to construct and shorter construction programme compared to Sift baseline option, but more complex to construct and similar construction programme duration compared to Option A. Improved operational flexibility with future proofing for potential schemes in Scotland; and • lower construction costs than sift baseline option but greater construction costs than Option A.

hs2.org.uk

High Speed Two (HS2) Limited
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA
Freephone: 08081 434 434
Minicom: 08081 456 472
Email: HS2enquiries@hs2.org.uk