
HS2 Phase 2b: Crewe to Manchester and West Midlands to Leeds

Environmental Impact Assessment Scope and Methodology Report

Draft for consultation

July 2017



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.

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Contents

Executive summary	viii
Part A	1
1 Introduction	2
1.1 Purpose of this SMR	2
1.2 Structure of this SMR	3
1.3 Introduction to HS2	3
1.4 Description of the HS2 Phase 2b route	7
1.5 Interfaces with Phase One, Phase 2a and 2b	9
1.6 Previous environmental appraisal work on the Proposed Scheme	9
1.7 Monitoring of performance against sustainability and environmental goals	11
1.8 Hybrid Bill powers	13
1.9 EIA programme and other Phase 2b consultations	14
2 Changes between Phase One, Phase 2a and Phase 2b approach to EIA	15
2.1 The Phase One SMR	15
2.2 The Phase 2a SMR	15
2.3 The Phase 2b SMR	15
2.4 EIA Directive	16
2.5 Integrated assessment	17
2.6 Other changes	18
3 Stakeholder engagement and consultation	21
3.1 Introduction	21
3.2 General approach to stakeholder engagement	21
3.3 Key stages of engagement and consultation	22
3.4 Stakeholder groups	22
3.5 Using engagement to inform scheme design and assessment	24
4 Environmental Impact Assessment (EIA) methodology	25
4.1 Introduction	25
4.2 Scope of the assessment	32
4.3 Approach to mitigation	34
4.4 Cumulative effects	35
4.5 Defining significant effects	38
4.6 Assumptions and limitations	39
5 Reporting of alternatives	41
5.1 Introduction	41
5.2 The case	41
5.3 Reporting of alternatives	42
5.4 The alternatives	43
5.5 Strategic alternatives	43
5.6 Route wide rail alternatives	43

5.7	Route corridor, station and depot location alternatives	43
5.8	Local alternatives	44
5.9	Mitigation	44
Part B		45
6	Agriculture, forestry and soils	46
6.1	Introduction	46
6.2	Establishment of baseline and definition of survey	46
6.3	Consultation and engagement	49
6.4	Key aspects of the Proposed Scheme for the topic	50
6.5	Scope of assessment	51
6.6	Assessment methodology	52
6.7	Assumptions	62
7	Air quality	63
7.1	Introduction	63
7.2	Establishment of baseline and definition of survey	63
7.3	Consultation and engagement	63
7.4	Key aspects of the Proposed Scheme for the topic	64
7.5	Scope of assessment	64
7.6	Assessment methodology	66
7.7	Assumptions	69
8	Climate change	70
8.1	Introduction	70
8.2	Consultation and engagement	70
8.3	Greenhouse gases	71
8.4	Key aspects of the Proposed Scheme for the topic	73
8.5	In-combination climate change impacts	78
8.6	Climate change resilience	88
9	Community	95
9.1	Introduction	95
9.2	Establishment of baseline and definition of survey	95
9.3	Consultation and engagement	97
9.4	Key aspects of the Proposed Scheme for the topic	97
9.5	Scope of assessment	98
9.6	Assessment methodology	100
9.7	Assumptions	103
10	Ecology	104
10.1	Introduction	104
10.2	Establishment of baseline and definition of survey	104
10.3	Consultation and engagement	107
10.4	Key aspects of the Proposed Scheme for the topic	107
10.5	Scope of assessment	108
10.6	Assessment methodology	110

10.7	Assumptions	113
11	Electromagnetic interference	114
11.1	Introduction	114
11.2	Establishment of baseline and definition of survey	115
11.3	Consultation and engagement	116
11.4	Key aspects of the Proposed Scheme for the topic	116
11.5	Scope of assessment	116
11.6	Assessment methodology	117
11.7	Assumptions	120
12	Health	121
12.1	Introduction	121
12.2	Establishment of baseline	122
12.3	Consultation and engagement	122
12.4	Key aspects of the Proposed Scheme for the topic	123
12.5	Scope of assessment	124
12.6	Assessment methodology	126
12.7	Mitigation	132
12.8	Assumptions	133
13	Historic Environment	134
13.1	Introduction	134
13.2	Establishment of baseline	134
13.3	Consultation and engagement	137
13.4	Key aspects of the Proposed Scheme for the Historic Environment	139
13.5	Scope of assessment	139
13.6	Assessment methodology	141
13.7	Assumptions	147
14	Land quality	148
14.1	Introduction	148
14.2	Establishment of baseline and definition of survey	149
14.3	Consultation and engagement	151
14.4	Key aspects of the Proposed Scheme for the topic	152
14.5	Scope of assessment	152
14.6	Assessment methodology	153
14.7	Assumptions	158
15	Landscape and visual	159
15.1	Introduction	159
15.2	Establishment of baseline and definition of survey	161
15.3	Consultation and engagement	165
15.4	Scope of assessment	166
15.5	Assessment methodology	168
15.6	Assumptions	177
16	Major accidents and disasters	178

16.1	Introduction	178
16.2	Establishment of baseline and definition of assessment process	179
16.3	Consultation and engagement	180
16.4	Scope of assessment	180
16.5	Assessment methodology	183
16.6	Assumptions	192
17	Socio-economics	193
17.1	Introduction	193
17.2	Establishment of baseline and definition of survey	193
17.3	Consultation and engagement	194
17.4	Key aspects of the Proposed Scheme for the topic	194
17.5	Scope of assessment	194
17.6	Assessment methodology	196
17.7	Assumptions	200
18	Sound, noise and vibration	201
18.1	Introduction	201
18.2	Ground-borne noise and vibration	205
18.3	Airborne noise	213
19	Traffic and transport	224
19.1	Introduction	224
19.2	Establishment of baseline and definition of survey	224
19.3	Consultation and engagement	225
19.4	Key aspects of the Proposed Scheme for the topic	225
19.5	Scope of assessment	226
19.6	Assessment methodology	227
19.7	Assumptions	237
20	Waste and material resources	238
20.1	Introduction	238
20.2	Establishment of baseline and definition of survey	240
20.3	Consultation and engagement	241
20.4	Key aspects of the Proposed Scheme for the topic	242
20.5	Scope of assessment	242
20.6	Assessment methodology	244
20.7	Assumptions	250
21	Water resources and flood risk	251
21.1	Introduction	251
21.2	Establishment of baseline and definition of survey	251
21.3	Consultation and engagement	253
21.4	Key aspects of the Proposed Scheme for the topic	254
21.5	Scope of assessment	255
21.6	Assessment methodology	256
21.7	Assumptions	262

Part C	263
22 Structure of the Environmental Statement	264
References	265
Glossary of terms	279
Annex A – List of Technical notes	289
Annex B – List of consultees	292
Annex C – Route maps	313
Annex D – List of acronyms, initialism and units of measurement	325
Annex E – HS2 Ltd Sustainability Policy and Environment Policy	331
List of figures	
Figure 1 - The HS2 network	6
Figure 2 - The AoS process	10
Figure 3 - Proposed Environmental Impact Assessment process for Phase 2b	25
Figure 4 - Phase 2b community areas overview	29
Figure 5 - Phase 2b community areas western leg	30
Figure 6 - Phase 2b community areas eastern leg	31
Figure 7 - Hierarchy of alternatives considered	43
Figure 8 - Approach to the in-combination climate change impacts assessment	85
Figure 9 - Approach to the climate change resilience assessment	92
Figure 10 - Health pathways	125
Figure 11- Assessment process for the landscape and visual assessment	160
Figure 12 - Summary of risk events considered in the scope of the assessment for major accidents and/or disasters	183
Figure 13 - Screening process flow diagram	185
Figure 14 - The principles of managing risks both pre-and post-event	187
Figure 15 - The Government’s Waste Hierarchy	239
List of tables	
Table 1 - Changes in topic methodologies between Phase 2a SMR and Phase 2b SMR	19
Table 2 - Impact magnitude criteria for farm holdings	55
Table 3 - Agriculture receptor sensitivity criteria	56
Table 4 - Significance of effect criteria	57
Table 5 - Impact magnitude criteria for agricultural land	57
Table 6 - Agriculture resources sensitivity criteria	57
Table 7 - Impact magnitude criteria for forestry land	58
Table 8 - Forestry land sensitivity criteria	59
Table 9 - Impact magnitude criteria for soils	60
Table 10 - Soil sensitivity criteria	60
Table 11 - UK and EU air quality standards	67

Table 12 - Scope of GHG assessment broken down by life cycle stages, consistent with the principles set out in BS EN 15978:2011 and PAS 2080:2016	74
Table 13 - Temporal scope for the in-combination climate change impacts assessment	82
Table 14 - Temporal scope for the climate change resilience assessment	90
Table 15 - Impacts and effects on resources and receptors and spatial scope	98
Table 16 - Community impact magnitude criteria	101
Table 17 - Community receptor value/sensitivity criteria	101
Table 18 - Community - significance of effect criteria	102
Table 19 - Factors for assessing the significance/value of heritage assets	144
Table 20 - Factors influencing the assessment of magnitude of impacts	145
Table 21 - Matrix for establishing overall significance of effect	146
Table 22 - Criteria for assessing receptor sensitivity	154
Table 23 - Summary of temporary (construction) effects	155
Table 24 - Impact magnitude criteria	156
Table 25 - Significance of effects criteria	157
Table 26 - Landscape sensitivity	169
Table 27 - Landscape magnitude of change	171
Table 28 - Significance of effects for landscape assessment	172
Table 29 - Visual sensitivity	173
Table 30 - Visual magnitude of change	175
Table 31 - Significance of effects for visual assessment	176
Table 32 - Receptors to be excluded from assessment of major accidents and/or disasters	182
Table 33 - Legislation applicable to the Proposed Scheme of relevance to the assessment of Major Accidents and Disasters	187
Table 34 - Guidance relevant to the assessment	190
Table 35 - Socio-economic assessment: resources, receptors and spatial scope	195
Table 36 - Socio-economic impact magnitude criteria	197
Table 37 - Socio-economic receptor value/sensitivity criteria	198
Table 38 - Socio-economic - significance of effect criteria	199
Table 39 - Noise and vibration assessment approach for dwellings: interaction between Government policy and guidance, and EIA requirements (based on the noise hierarchy table presented in PPGN)	204
Table 40 - Ground-borne noise and vibration effect levels for permanent residential buildings	210
Table 41 - Vibration change criteria for the assessment of disturbance (annoyance) of occupants and building users	211
Table 42 - Ground-borne noise screening criteria for non-residential receptors	212
Table 43 - Ground-borne vibration screening criteria for non-residential buildings	213
Table 44 - Airborne noise from construction of the Proposed Scheme – adverse effect thresholds for environmental impact assessment stage for permanent residential buildings (façade levels)	218
Table 45 - Airborne noise from operation of the Proposed Scheme – adverse effect thresholds for permanent residential buildings (free-field levels)	219
Table 46 - Airborne noise from construction - criteria at residential receptors (construction noise only)	220
Table 47 - Airborne noise from operational train and road movements – classification of noise change permanent residential receptors.	220

Table 48 - Noise screening criteria for noise sensitive non-residential buildings and external amenity spaces	221
Table 49 - Environment: journey ambience	232
Table 50 - Effect levels for travellers affected by changes to amenity and ambience during construction	233
Table 51 - Inert landfill significance criteria	247
Table 52 - Non-hazardous landfill significance criteria	248
Table 53 - Hazardous landfill significance criteria	248
Table 54 - Baseline data and sources	253
Table 55 - Significance of effects	257
Table 56 - Magnitude of possible impacts	258
Table 57 - Examples of the value of possible water bodies or receptors	259

Executive summary

- High Speed Two (HS2) is the Government's planned new, high speed railway to link new high speed stations in London, Birmingham, the East Midlands, Leeds and Manchester. HS2 will not just connect the cities of Birmingham, Manchester, Leeds and London – it will run services to more than 25 stations across Britain and integrate with the rest of the rail and transport network, delivering faster, more frequent and more reliable services and connecting major cities in Britain.
- HS2 will provide train services which travel at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph)).
- HS2 will be built in phases. Phase One comprises the first section of the HS2 network of approximately 230km (143 miles) between London and the West Midlands that will commence operations in 2026. It was the subject of an Environmental Statement (ES) deposited with the High Speed Two (London – West Midlands) Bill in November 2013. Supplementary ES were deposited with Additional Provisions to that Bill in 2014 and 2015. The High Speed Two (London – West Midlands) Bill received Royal Assent in February 2017 and initial works on Phase One have commenced.
- Phase Two of HS2 will extend the route from Phase One in the West Midlands to the north-west to Manchester (approximately 143 km) (89 miles) with connections to the West Coast Main Line (WCML) at Crewe and Golborne, and to the north-east to Leeds with a connection to the Erewash Valley Line south-east of Chesterfield and the East Coast Main Line (ECML) approaching York (approximately 198 km (123 miles)), completing what is known as the 'Y network'.
- Phase Two of HS2 is being taken forward in two stages, referred to as Phase 2a and Phase 2b. Phase 2a of HS2 includes the section of the route between the West Midlands and Crewe. Phase 2a was taken forward in advance of the rest of Phase Two (Phase 2b) following reports by the Chairman of HS2 Ltd, Sir David Higgins (HS2 Plus¹ and Rebalancing Britain²) which recommended accelerating the delivery of the Phase Two section of the route between the West Midlands and Crewe to deliver some of the benefits that HS2 will bring to the North sooner. The West Midlands to Crewe Bill, together with an ES, was prepared for the Phase

¹ HS2 Ltd (2014), HS2 Plus A report by David Higgins. Available at:

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

² HS2 Ltd (2014), Rebalancing Britain – From HS2 towards a national transport strategy. Available at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/374709/Rebalancing_Britain_-_From_HS2_towards_a_national_transport_strategy.pdf

2a proposals which were deposited in Parliament in July 2017.

- In November 2016 the Government set out the majority of its preferred route for the remainder of Phase Two of HS2, Phase 2b³ and consulted on seven areas of substantial change. In July 2017, the Government confirmed the remaining sections of the Phase 2b route⁴. The powers for Phase 2b will be sought through a separate hybrid Bill, together with an ES, and that is expected to be laid before Parliament in 2019. Construction of Phase 2b is anticipated to commence in approximately 2023, with operation planned to start in 2033.
- This document is the Scope and Methodology Report (SMR). The SMR is a technical document which outlines the proposed methodological approach to the development of the Environmental Impact Assessment (EIA), and subsequent ES, for Phase 2b (the 'Proposed Scheme'). The ES will accompany the deposit of the hybrid Bill in Parliament and will be considered alongside the draft legislation in order to authorise the Proposed Scheme⁵.
- The EIA is required by a European Union (EU) Directive⁶ on the assessment of the effects of certain public and private projects on the environment (Directive 2014/52/EU). In addition, Parliament's Private Business Standing Order 27A (SO27A)^{7,8} requires the preparation of an ES to inform the decision-maker (Parliament) of the likely significant effects of the Proposed Scheme on the environment.
- The Directive has been transposed through the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017/571) (the EIA Regulations 2017).
- While the UK has notified its intention to withdraw from the EU, the UK remains a member until withdrawal, meaning that rights and obligations under EU law apply until the date of departure. The Government has announced its intention to convert all EU law into UK law, through the 'Great Repeal Bill'⁹, so that the same rules and laws will apply on the day after exit as on the day before. It will then be for democratically elected representatives in the UK to decide on any changes to that law, after full scrutiny and proper debate.

³ HS2 Ltd (2016), *From Crewe to Manchester, the West Midlands to Leeds and beyond*, 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

⁴ The Government launched a new public consultation on the location of the eastern leg rolling stock depot in July 2017.

⁵ It should be noted that the purpose of the SMR is to outline the approach that will be taken to the assessment in the EIA. The SMR does not include assessment findings. Findings will be contained within the ES.

⁶ *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014, amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*. Strasbourg, European Parliament and European Council.

⁷ House of Commons (2005), *Standing Orders of the House of Commons - Private Business*, London: The Stationery Office.

⁸ House of Lords (2005), *Standing Orders of the House of Lords - Private Business*, London: The Stationery Office.

⁹ Government has set out its position on the Great Repeal Bill in a White Paper: Department for Exiting the European Union (2017), *Legislating for the United Kingdom's withdrawal from the European Union*. London: The Stationery Office. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/604516/Great_repeal_bill_white_paper_accessible.pdf

- This SMR also sets out the methodology that is proposed for determining the likely environmental impacts and effects; and for assigning values of magnitude and significance to them. It also sets out the approach to the reporting of reasonable alternatives in the ES.
- In Summer 2017, HS2 Ltd will consult on this SMR (See Annex B for list of Consultees), to enable consultees to comment on the approach proposed. Following consultation, the SMR will be revised, taking into account the comments received where appropriate.
- This SMR sets out, in Part A, the general EIA methodology and scope of assessment, covering temporal, geographic and technical scope; approach to mitigation; cumulative effects; defining significant effects; and notes assumptions and limitations in undertaking the EIA. It provides a description of the approach to the study of reasonable alternatives.
- In Part B of this SMR, the scope and methodology for each environmental topic section is described. The environmental topics addressed are:
 - Agriculture, forestry and soils;
 - Air quality;
 - Climate change;
 - Community;
 - Ecology;
 - Electromagnetic interference;
 - Health;
 - Historic environment;
 - Land quality;
 - Landscape and visual;
 - Major accidents and disasters;
 - Socio-economics;
 - Sound, noise and vibration;
 - Traffic and transport;
 - Waste and material resources; and
 - Water resources and flood risk.
- An outline of the proposed structure of the ES is set out in Part C of this SMR.

Part A

1 Introduction

1.1 Purpose of this SMR

- 1.1.1 This Scope and Methodology Report (SMR) is a technical document that outlines the proposed scope and methodology for the Environmental Impact Assessment (EIA) and subsequent Environmental Statement (ES) for HS2 Phase 2b (Crewe to Manchester and West Midlands to Leeds) (the 'Proposed Scheme').¹⁰
- 1.1.2 This SMR provides an outline description of the Proposed Scheme and sets out the proposed scope of the environmental effects to be considered during the EIA. For each environmental topic in the SMR there is a description of the spatial and temporal scope. Consideration is given to effects that would arise during construction and operation of the Proposed Scheme including temporary, permanent, direct, indirect and cumulative effects.
- 1.1.3 This SMR also sets out the methodology that is proposed for determining the likely environmental impacts and effects, and for assigning values of magnitude and significance to them. It also sets out the approach to the reporting of reasonable alternatives in the ES.
- 1.1.4 Phase 2b is the proposed route from Crewe to Manchester (and connections into the West Coast Main Line (WCML)) (the western leg), and from the West Midlands to Leeds (and connections into the Midland Main Line (MML)) via the East Midlands and South Yorkshire (the eastern leg). Completing Phase 2b will unlock the full benefits of HS2. It will not only provide fast and reliable journeys to and from London, but also transforms connectivity and journey times between cities in the North and Midlands, helping to provide a truly national benefit.
- 1.1.5 In Summer 2017, HS2 Ltd will consult on this SMR (see Annex B for list of Consultees) to enable consultees to comment on the proposed approach. Following consultation, the SMR will be revised, taking into account the comments received where appropriate.
- 1.1.6 HS2 Ltd will also consult on a working draft of the ES ('the working draft ES'), currently expected in 2018. The final ES will accompany the deposit of the hybrid Bill in Parliament. At that point Parliament will consult and the public will have the opportunity to comment on the ES. Responses to that consultation will be subject to independent analysis to further inform Parliament as the decision maker.
- 1.1.7 The Proposed Scheme is not defined in detail at any location in this SMR, nor are the construction works or ancillary features associated with the Proposed Scheme. As the design of the Proposed Scheme is developed, HS2 Ltd will continue to engage with stakeholders to provide further information as it becomes available. The working draft ES will provide a snapshot of the emerging design and EIA and will be made available for public consultation.
- 1.1.8 This SMR provides the overarching methodology for conducting the EIA. In keeping with the approach adopted for previous phases of HS2, including Phase One (London

¹⁰ It should be noted that the purpose of the SMR is to outline the approach that will be taken to the assessment in the EIA. The SMR does not include assessment findings. Findings will be contained within the ES.

to West Midlands) and Phase 2a (West Midlands to Crewe), this SMR will be supplemented by a series of Technical notes to provide detailed methodologies for the assessment of each topic set out in Part B of this document. Technical notes for Phase 2b will be based on those prepared for Phase One and/or Phase 2a and updated to take into account any changes in proposed methodology ensuring relevance for Phase 2b as appropriate. The Technical notes are being developed in liaison with the Government's statutory authorities to provide a robust basis for the EIA and will be published alongside the ES. A list of the technical notes in preparation is set out in Annex A of this SMR.

1.2 Structure of this SMR

1.2.1 This SMR is divided into three main parts:

- Part A - an introduction to the Proposed Scheme, the background from the HS2 Phase Two Sustainability Statement^{11, 12}, an outline of the hybrid Bill process, an overview of changes between the EIA process for Phase One, Phase 2a and Phase 2b, a general description of the EIA assessment process (including the overall scope of the assessment) and a description of the approach to the reporting of reasonable alternatives;
- Part B - the environmental topic sections, describing the proposed scope and methodology for each environmental topic; and
- Part C - an outline of the proposed structure of the ES.

1.2.2 The annexes to this SMR include a list of consultee organisations and groups, a series of maps showing the Proposed Scheme and a list of Technical notes which will supplement this SMR alongside the ES.

1.3 Introduction to HS2

1.3.1 HS2 Ltd is a company wholly owned by the Department for Transport (DfT) and is charged with the design, construction and operation of high speed rail on behalf of the Government.

1.3.2 HS2 is planned to be a Y shaped high speed rail network with new stations in London, Birmingham, Manchester, East Midlands and Leeds. It will have a capacity to convey up to 18 trains per hour in each direction, at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph))¹³.

1.3.3 On some sections of the route, speeds would be lower than 360kph and speeds above 360kph would not be allowed unless the impacts of operation could be demonstrated to be no worse than assumed for operation at 360kph. Beyond the dedicated high speed route, high speed trains would also connect with the existing WCML and ECML

¹¹ HS2 Ltd (2013), *High Speed Rail: Consultation on the route from the West Midlands to Manchester, Leeds and beyond. Sustainability Statement*. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401154/pc205_vol_1_sustainability_statement_180713.pdf

¹² HS2 Ltd (2016), *High Speed Rail: Phase 2b Preferred Route Sustainability Statement including Post Consultation Update*. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568547/D25_WEB_C331_Sustainability_Statement_Including_Post_Consultation_Update_Volume_1_Main_Report_WEB_VERSION.pdf

¹³ Note that the alignment of the route has been designed to allow for train speeds of up to 400kph (250mph) in the future. In some places along the route this has not been possible to achieve for various reasons. Operation at up to 400kph will require demonstration that improved train design enables services to operate at that higher speed without giving rise to additional significant environmental effects.

to serve passengers beyond the HS2 network on these lines including to Glasgow, York, Newcastle, and Edinburgh. In South Yorkshire, high speed trains would connect onto the existing rail network to serve passengers in Chesterfield and Sheffield.

- 1.3.4 HS2 trains will be up to 400 metres (m) long with the capacity of around 1,100 seats. From 2033, HS2 could be used by two types of train. 'Captive' trains will only be able to run on newly built high speed lines. They will be built to European dimensions, so they will be slightly taller and wider than typical UK conventional trains. 'Conventional compatible' trains will be similar in performance to captive trains, but will be built to fit the existing UK infrastructure. They will not be as tall or as wide as the captive trains. This will allow them to serve existing UK stations and travel under existing bridges. They will be used to operate high speed services on HS2, and then continue on the existing UK network to locations such as Sheffield, Liverpool, Newcastle and Scotland. The Southeastern Javelin trains used on High Speed 1 (HS1) are examples of high speed trains that are adapted to fit UK railway infrastructure. Services using both the HS2 network and existing rail lines, will use conventional compatible trains. When running on the existing rail network, the HS2 conventional compatible trains (zoom long) will run at speeds achievable on this network.
- 1.3.5 HS2 will be built in phases. Phase One comprises the first section of the HS2 network of approximately 230km (143 miles) between London and the West Midlands that will commence operations by 2026. Stations will be developed at London Euston, London Old Oak Common, Birmingham Interchange and Birmingham Curzon Street. Some of the services will continue on the existing rail network to serve directly the North West and Scotland, through a connection with the WCML near Lichfield. Phase One was the subject of an ES deposited with the High Speed Two (London – West Midlands) Bill in 2013 and Supplementary ES deposited with Additional Provisions to that Bill in 2014 and 2015. The High Speed Two (London – West Midlands) Bill was granted Royal Assent in February 2017 and initial works on Phase One have commenced.
- 1.3.6 Phase Two of HS2 would extend the Phase One line to the North West and North East, to Manchester with connections to the WCML at Crewe and Golborne, and to Leeds with a connection to the ECML approaching York, completing what is known as the 'Y network'.
- 1.3.7 In January 2013, the Government announced its initial preferred route for Phase Two between the West Midlands, Leeds and Manchester. Following some minor amendments in July 2013, the proposed route was consulted on for seven months until January 2014.
- 1.3.8 In two reports, *Hs2 Plus* and *Rebalancing Britain*, Sir David Higgins recommended accelerating the section of the Phase Two route between the West Midlands and Crewe. By opening the section of Phase Two to Crewe by 2027 instead of 2033 the benefits of HS2 will be brought to the North sooner than originally planned. In the November 2015 Command Paper *High Speed Two: East and West, The Next Steps to Crewe and Beyond*, the Government announced its intention to bring forward the route between the West Midlands and Crewe, and set out the preferred line of route for the Proposed Scheme. Phase 2a will involve construction of the first approximately 58km of the western leg of Phase Two from the end of the Phase One route to Crewe, with a connection to the WCML at Crewe.

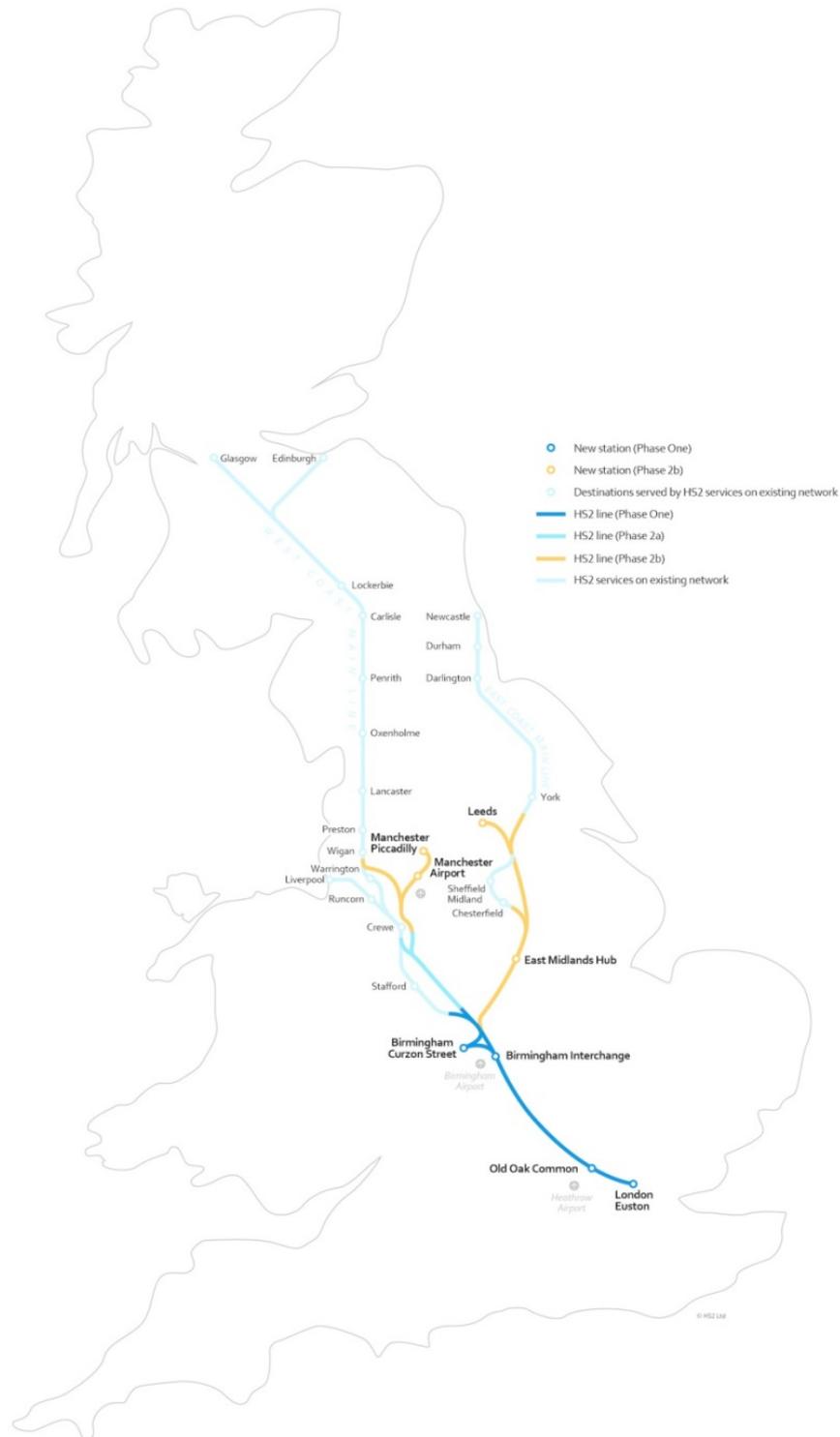
- 1.3.9 Phase 2a will connect with Phase One near Fradley, to the north-east of Lichfield, and connect to the WCML south of Crewe, to provide onward services beyond the HS2 network to the north-west of England and to Scotland. Construction of Phase 2a would commence in 2020 with operation planned to start in 2027. This is six years earlier than originally planned bringing some of the benefits of HS2 to the North sooner. The powers for Phase 2a are being sought through the West Midlands to Crewe Bill and an accompanying ES.
- 1.3.10 As noted in the Strategic Case for Phase 2a¹⁴, the Government's original programme for delivery of Phase One in 2026 (with a link to the conventional network at Handsacre) and of Phase Two in 2033 would have helped build a stronger, more balanced economy, capable of delivering growth and economic benefits. Accelerating the delivery of Phase 2a will:
- mean that the North West and Scotland will see more of the benefits of HS2 more quickly, and this will bring economic benefits sooner. Some of these economic benefits will come from businesses being more accessible to one another leading to greater interaction between them (agglomeration benefits) as well as offering improved accessibility to labour markets, and affecting the overall level of labour supply;
 - allow passengers travelling to or from a wide range of places to connect onto HS2 services given that Crewe is already a major hub on the rail network with regional and long distance connections to the wider North West, East Midlands, and North and South Wales;
 - relieve pressure on bottlenecks on the existing WCML at Colwich Junction and around Stafford, which should improve the reliability and performance on the existing main line; and
 - deliver faster journeys between London, Crewe, Manchester, Liverpool, Preston, Warrington, Wigan and Glasgow sooner, by allowing long distance trains to run further on high speed track to Crewe before re-joining the conventional network (as opposed to using the connection to the WCML at Handsacre).
- 1.3.11 Phase 2a will therefore deliver further journey time savings of up to 13 minutes in addition to the journey time savings already delivered by Phase One.
- 1.3.12 Given the added benefits of bringing the high speed route to Crewe much earlier than originally planned, the Government decided to pursue Phase 2a.
- 1.3.13 In relation to the rest of Phase Two, the Government set out the majority of its preferred route from Crewe to Manchester and from the West Midlands to Leeds, referred to as Phase 2b, on 15 November 2016. A public consultation was launched at that time, which sought feedback on proposals for seven remaining areas of the route where substantial changes had been made since the previous consultation. In July 2017, the Government confirmed the remaining areas of the Phase 2b route¹⁵. The

¹⁴ Department for Transport (Dft) (2015), *HS2 Phase 2a Strategic Outline Business Case: Strategic Case*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/570472/hs2-phase-2a-strategic-case.pdf

¹⁵ The Government launched a new public consultation on the location of the eastern leg rolling stock depot in July 2017.

powers for Phase 2b will be sought through a separate hybrid Bill and accompanying ES that is expected to be laid before Parliament in 2019. Construction of Phase 2b would commence in approximately 2023, with operation planned to start in 2033. This SMR relates to Phase 2b of the HS2 network. The proposed HS2 network is shown in Figure 1.

Figure 1 - The HS2 network



1.4 Description of the HS2 Phase 2b route

- 1.4.1 The following sections provide a summary description of the route of the Proposed Scheme based on the current stage of design. Annex C contains a series of Phase 2b route maps.

Western Leg

- 1.4.2 The Proposed Scheme from Crewe to Manchester forms the northern approximately 85km (approximately 53 miles) section of the western leg of Phase Two. This section commences approximately 600m to the south of the existing Crewe railway station and just north of the A500 to join the Phase 2a route.
- 1.4.3 The Proposed Scheme would continue under Crewe in twin tunnels. Emerging to the north of the town, the Proposed Scheme would run to the east of the WCML corridor before bearing north, away from the WCML. As the high speed route diverges from the WCML, a rolling stock depot would be provided in the area between HS2 and the existing WCML.
- 1.4.4 The Proposed Scheme would continue in a northerly direction passing between the towns of Winsford and Middlewich. It would run on a series of embankments and viaducts to the west of Lostock Green and east of Rudheath, Lostock Gralam and Higher Wincham, rising to cross over the M6. To the north of the M6, a junction would be provided, with a spur heading into Manchester and the alignment continuing north to the WCML near Golborne.
- 1.4.5 The Manchester spur would turn east and pass to the north of Rostherne Mere, running broadly parallel to the M56. It would then turn north and pass under the M56 at Warburton Green and into an interchange station near Manchester Airport. Just beyond the station, the route would enter twin tunnels under south Manchester, emerging in the Ardwick area, where it would rise onto a viaduct to enter the terminus station at Manchester Piccadilly.
- 1.4.6 The Proposed Scheme would continue north from the junction with the Manchester spur. It would cross mainly open countryside, under the M56 and over the Manchester Ship Canal on a viaduct to the east of Hollins Green. Passing over the M62, the route would curve to the south and west of Culcheth, before running between Lowton and Lowton Common. The route would then bear north-west before connecting into the WCML at Bamfurlong.

Eastern Leg

- 1.4.7 The Proposed Scheme of the eastern leg of Phase Two will run from the West Midlands to Leeds with a total route length of 198km (123 miles).
- 1.4.8 It will provide a connection to the Midland Main Line (MML) via the Erewash Valley Line south-east of Chesterfield and then connect to the conventional network at Church Fenton, south-west of York before joining the ECML.
- 1.4.9 The route begins north-east of Birmingham at the Phase One junction near Marston. The route would connect with the Phase One route, and follow the M42 and A42 corridor to Kegworth, near the East Midlands Airport. After Kegworth the route curves on viaduct in a northerly direction, passing over the flood plain of the river Soar and

river Trent. Following this the route passes through Long Eaton to the new East Midlands Hub (EMH) station at Toton. The route then follows the M1 corridor, to the east of the motorway.

- 1.4.10 Prior to Tibshelf, there is a spur to join the existing conventional network near Clay Cross. The spur is located near the A38 and Hilcote, passing under the M1 south of Newton before joining the existing Erewash Valley Line east of Stonebroom. The spur will enable HS2 services to connect to the MML to serve existing stations at Chesterfield and Sheffield city centre.
- 1.4.11 At Tibshelf, the route runs north until the spur towards Leeds City Centre Station. The route then continues north-east where it connects with the conventional network at Church Fenton before joining the ECML.
- 1.4.12 From Tibshelf the route travels north via Stainsby and Heath mainly following the M1 alignment in cutting and passing Hardwick Hall on a short embankment. At Bolsover the alignment is at grade or on embankment as it passes Sutton Scarsdale, Staveley and Shuttlewood.
- 1.4.13 At Staveley there is a grade separated junction which takes a spur to the Infrastructure maintenance depot (IMD) following an existing link along a disused former rail line. The IMD is located within a major development site and is reached via a combination of cuttings and embankments, some at grade.
- 1.4.14 North of the spur at Staveley, the route is mainly in cutting as it follows a narrow corridor aligned with the M1 passing close to several communities including Barlborough, Wales, and Aston.
- 1.4.15 At Thurcroft, the alignment crosses over a delta junction of the M1 and the M18 on two viaducts. It then runs in cutting and embankment between Bramley and Mexborough.
- 1.4.16 At Mexborough the route passes on viaduct over the valley before entering cuttings at Hickleton within a mostly rural setting. The line then travels north to north-west towards Hemsworth and Crofton through rolling countryside on a series of cuttings and embankments.
- 1.4.17 The route passes to the east of Barnburgh on embankment and Hickleton in deep cutting, before heading north-west to pass north of Thurnscoe and Clayton on a viaduct over the existing railway. This location has been identified as a potential connection point between HS2 and the existing railway, where trains travelling north from Sheffield could continue north on the HS2 mainline.
- 1.4.18 North of the village of Crofton the alignment traverses between Wakefield and Normanton and passes over a viaduct (the first of two) east of Methley Junction. At this location the line divides with the main line travelling north to Swillington and with a spur moving north-west towards Leeds Station.
- 1.4.19 The route alignment crosses a long viaduct (the second of two) and proceeds north-east to Swillington and then north towards Church Fenton where it joins the conventional rail network prior to joining the ECML. The approach to the conventional network at Ulleskelf is on a long viaduct.

1.4.20 The spur towards Leeds City centre starts at Methley and proceeds towards Woodlesford where it passes through a tunnel under the town. The route of the spur exits the tunnel into a cut and cover tunnel before travelling west within the existing Network Rail corridor at grade.

1.4.21 The line passes through the southern outskirts of Leeds City Centre prior to approaching the new station adjacent to the River Aire and with the new station connecting into the existing Network Rail station. To the east of Leeds city centre, there will be a new rolling stock depot.

1.5 Interfaces with Phase One, Phase 2a and 2b

1.5.1 The Phase One route terminates on a shallow embankment near Marston on a short spur off the Phase One route as it connects into the ECML. The Phase 2b route would continue from the end of this shallow embankment.

1.5.2 The Phase 2a route terminates at a headwall¹⁶, which would form the southern end of the tunnel that will continue underneath Crewe towards Manchester as part of the Phase 2b route. Provision has been made in the design for the HS2 route for this purpose.

1.6 Previous environmental appraisal work on the Proposed Scheme

1.6.1 HS2 Ltd has examined a substantial number of route-wide and more local alternatives to the Proposed Scheme. This work has been supported by an independent appraisal of sustainability (AoS).

1.6.2 The AoS process reflects the first stages of the early development/optionseering work that has been used to appraise and report on the sustainability performance of Phase One and Phase Two (Phase 2a and Phase 2b) proposals throughout their development up until the EIA process. The AoS covered a range of sustainability topics in a way that enabled appraisal and comparison of a large number of options.

1.6.3 Four underlying sustainable development priorities were used for the assessment:

- reducing greenhouse gas emissions and combating climate change;
- protecting natural and cultural resources and providing environmental enhancement;
- creating sustainable communities; and
- enabling sustainable consumption and production.

1.6.4 Beneath these priorities sat the 18 sustainability topics, covering matters such as noise and vibration, flood risk, greenhouse gases and resource use.

1.6.5 The AoS has formed a key part of the route sifting process, helping to:

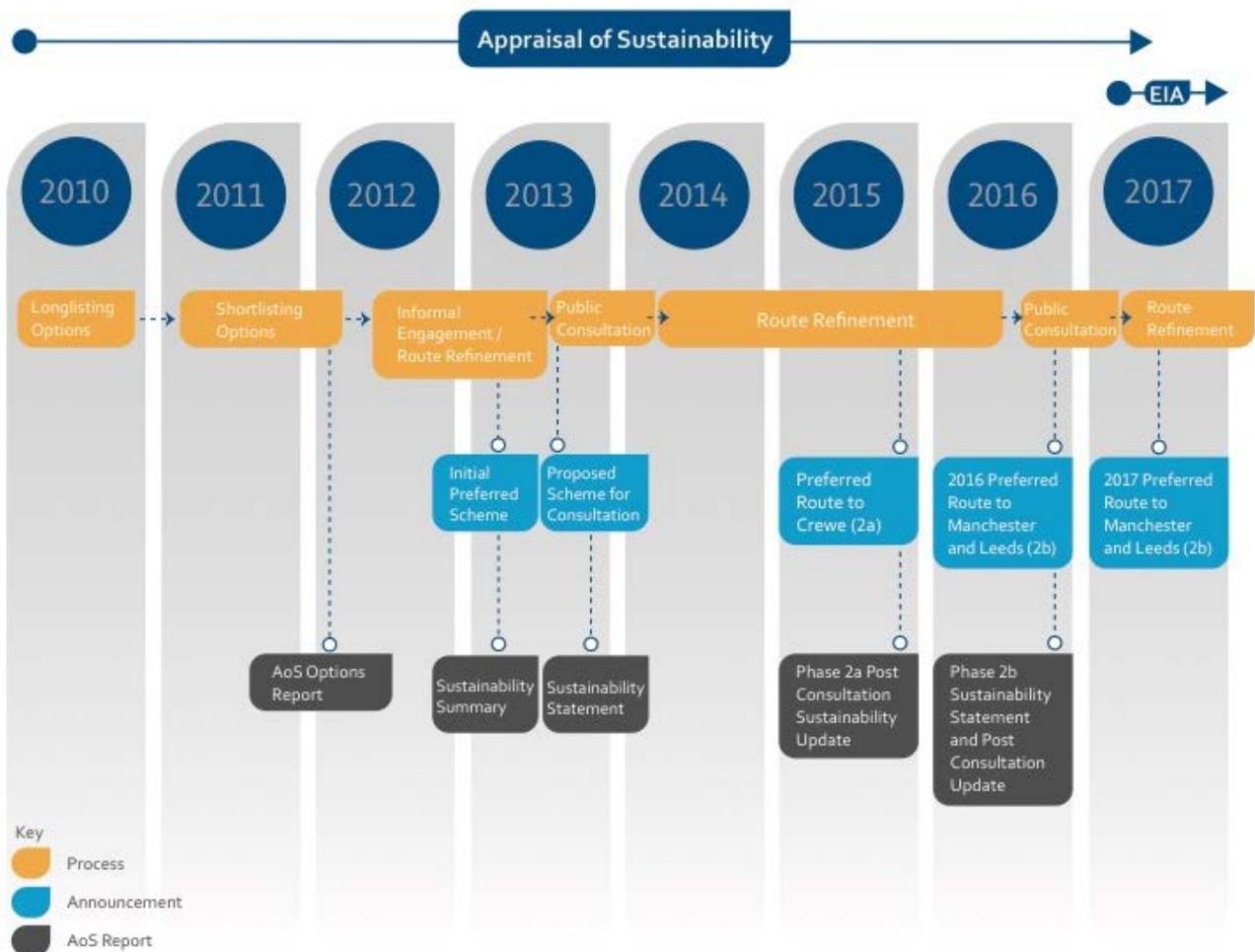
- advise engineers and HS2 Ltd during scheme design in relation to particular sustainability constraints and opportunities;

¹⁶ A supporting, protecting or retaining wall built at the front or top of a structure or area.

- inform the engineers in refining scheme proposals to avoid or lessen potential adverse effects;
- advise HS2 Ltd at key decision stages of the relative sustainability advantages and disadvantages of different options, and the consequence of potential impacts; and
- formally report the sustainability performance of the options at each stage.

1.6.6 The AoS process has enabled the independent reporting of sustainability performance throughout this time, with the latest report being the Sustainability Statement produced in November 2016. Two formal consultation exercises have also been conducted, providing access to environmental information including alternatives. These activities are shown on Figure 2 illustrating how the AoS process has underpinned the development of the Proposed Scheme in the period leading up to the start of the EIA stage. Issues raised during consultation on the Sustainability Statement (as part of the Phase 2b consultation) and its subsequent updates have helped to define the scope of the EIA topics, as described in the consultation section of each environmental topic (see Sections 6 to 21 of this SMR).

Figure 2 - The AoS process



1.6.7 The AoS process is described in full in the Sustainability Statement^{17, 18}. The proposed approach to reporting alternatives in the ES is provided in Section 5 of this document.

1.7 Monitoring of performance against sustainability and environmental goals

1.7.1 As described in Section 1.6, the AoS process has helped to report on the extent to which the Proposed Scheme, as it evolved, would satisfy sustainable development objectives and identified some potential positive and negative impacts. During the EIA process, likely significant effects will be reviewed and assessed in the context of the Proposed Scheme.

1.7.2 HS2 Ltd's Sustainability Policy (2017)¹⁹ sets out its priority for sustainable design, which will help to reduce adverse environmental effects. The Sustainability Policy sets out the following principles for sustainability in:

- spreading the benefits: Economic growth and community regeneration;
- opportunities for all: Skills, employment and education;
- safe at heart: Health, safety and wellbeing;
- respecting our surroundings: Environmental protection and management; and
- standing the test of time: Design that is future-proof.

1.7.3 Each of the Sustainability Policy principles is further described in the HS2 Sustainability Approach Document²⁰.

1.7.4 Beneath the Sustainability Policy, an Environmental Policy²¹ states HS2 Ltd's commitment to "developing an exemplar project, and to limiting negative impacts through design, mitigation and by challenging industry standards whilst seeking environmental enhancements and benefits". The policy also sets out HS2 Ltd's principles for environmental sustainability, covering the following environmental topics: Biodiversity; Landscape; Noise and vibration; Carbon; Climate change combined effects; Air quality; Water resources; Historic environment; Soils and agriculture; and Sustainable materials and waste. HS2 Ltd's Sustainability Policy and the Environmental Policy are appended to this SMR (see Annex E).

1.7.5 Practicable measures will be considered further to avoid or reduce the potential environmental effects of the Proposed Scheme as part of a continuing effort to improve the sustainability performance of the new railway during construction and

¹⁷ HS2 Ltd (2013), *High Speed Rail: Consultation on the route from the West Midlands to Manchester, Leeds and beyond. Sustainability Statement*. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401154/pc205_vol_1_sustainability_statement_180713.pdf

¹⁸ HS2 Ltd (2016), *High Speed Rail: Phase 2b Preferred Route Sustainability Statement including Post Consultation Update*. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568547/D25_WEB_C331_Sustainability_Statement_Including_Post_Consultation_Update_Volume_1_Main_Report_WEB_VERSION.pdf

¹⁹ HS2 Ltd (2017), *Sustainability Policy*. Available online at <https://www.gov.uk/government/publications/hs2-sustainability-policy>

²⁰ HS2 Ltd (2017), *Sustainability Approach*. Available online at

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/610225/Sustainability_Approach.pdf

²¹ HS2 Ltd (2017), *Environmental Policy*. Available online at: <https://www.gov.uk/government/publications/hs2-environmental-policy>

operation. The EIA will identify the likely significant environmental effects of the Proposed Scheme and determine options for further mitigation.

- 1.7.6 As described in Volume 1 (Introduction and methodology) of the Phase One ES and Phase 2a ES, in order to ensure that the environmental effects of the Proposed Scheme will not significantly exceed those identified in the ES, the Secretary of State for Transport is expected to establish a set of controls known as Environmental Minimum Requirements (EMRs) for the Proposed Scheme. The EMRs will be contained in a suite of documents that will sit alongside the provisions set out in the hybrid Bill itself. The nominated undertaker is the body to be appointed to take forward the detailed design and implementation of the Proposed Scheme after the hybrid Bill has been enacted. The nominated undertaker will be required to comply with the EMRs and the other hybrid Bill controls.
- 1.7.7 The EMRs, together with the controls in the Bill, will ensure that the impacts identified in the ES will not be exceeded, unless:
- this results from a change in circumstances that was not foreseeable at the time the ES was prepared;
 - any such changes will be unlikely to have significant adverse environmental effects;
 - the relevant works will be subject to a separate consent process and further EIA; or
 - any such change results from a change or extension to the project, where that change or extension does not itself require an EIA.
- 1.7.8 The EMRs will also impose requirements on the nominated undertaker to use reasonable endeavours to adopt measures to further reduce the adverse environmental effects reported in the ES, provided that this does not add unreasonable cost or delay to the construction or operation of the Proposed Scheme.
- 1.7.9 The EMRs will also detail any specific requirements on the nominated undertaker to monitor the impacts of construction; and the post-construction performance of mitigation measures implemented.
- 1.7.10 The EMRs are likely to include:
- general principles, in which the Secretary of State commits that the environmental effects reported in the ES are not exceeded by application of the environmental mitigation assessed in the ES;
 - a Code of Construction Practice (CoCP), which will set out measures to provide effective planning, management and control during construction;
 - an Environmental Memorandum, which provides a framework for HS2 Ltd and its contractors and stakeholders, such as the Environment Agency and Natural England, to work together to ensure that the design and construction of the Proposed Scheme is carried out with due regard for environmental considerations;

- a Planning Memorandum, which will set out the rules of conduct and administrative arrangements for HS2 Ltd and planning authorities related to the processing of detailed planning approvals under the provisions of the Bill including the design and appearance of bridges, noise barriers and earthworks;
- a Heritage Memorandum, which will set out a commitment to limit the impact on the historic environment and will address the elements of the design and construction works that will have a direct impact on heritage assets; and
- undertakings and assurances given during the passage of the hybrid Bill.

1.7.11 The revised EIA Directive 2014/52/EU (transposed into English legislation on 16 May 2017 as the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017/571) (the EIA Regulations 2017), makes provision for post-EIA monitoring of significant adverse effects on the environment in appropriate cases. HS2 Ltd will work with the relevant responsible authorities to develop the necessary monitoring in appropriate cases.

1.8 Hybrid Bill powers

1.8.1 The Government will deposit a hybrid Bill for consideration by Parliament in 2019. If passed, the Bill becomes an Act of Parliament conferring powers, including deemed planning permission, to build the railway line and thereafter to operate and maintain it. The powers would include:

- authority to nominate an undertaker to build, operate and maintain the railway line;
- a planning regime necessary for the nominated undertaker to make applications for approval of details for certain matters defined by the Act, to local planning authorities;
- giving the nominated undertaker the rights to construct, operate and maintain the railway and associated major works as described in the Act (and its accompanying plans and sections) and other ancillary works;
- powers of compulsory acquisition or temporary possession of land and properties required for the Proposed Scheme;
- powers to divert or protect gas, water, telecommunications and electricity infrastructure which might be affected by the Proposed Scheme; and
- powers over rights of way.

1.9 EIA programme and other Phase 2b consultations

- 1.9.1 HS2 Ltd will consult on a working draft of the ES for Phase 2b on HS2 Ltd's website²², expected in 2018. The working draft ES will present preliminary environmental information in the form of baseline data gathered to-date as well as details of:
- the emerging likely environmental impacts of the Proposed Scheme (and, where possible, the likely significant environmental effects); and
 - the emerging proposed mitigation measures that have been identified to address any significant adverse effects.
- 1.9.2 As the design and EIA develops alongside further engagement, it may be necessary to make further refinements to the Proposed Scheme. Consultation on a working draft of an Equality Impact Assessment (EQIA) Report for Phase 2b will also take place during 2018.
- 1.9.3 The formal ES will accompany the deposit of the Phase 2b hybrid Bill in Parliament. At that point Parliament will consult and the public will have the opportunity to comment on the ES. The consultation responses will be subject to independent analysis to further inform Parliament as per Standing Order 224a.
- 1.9.4 A separate consultation on the EQIA SMR for Phase 2b will be undertaken at the same time as the consultation on the draft Phase 2b EIA SMR.
- 1.9.5 The consultations will aim to bring relevant information forward to local people, local authorities and organisations to enable them to contribute their views on the Proposed Scheme and assist the development of the measures to avoid or reduce the environmental and equality effects. Details of all the consultations will be available on HS2 Ltd's website (www.gov.uk/hs2).

²² HM Government (2017), *Hs2*. Available online at: www.gov.uk/hs2

2 Changes between Phase One, Phase 2a and Phase 2b approach to EIA

2.1 The Phase One SMR

- 2.1.1 The Phase One EIA SMR was issued in draft for consultation in April 2012 and, following the consultation process, was amended and published in September 2012. An EIA for Phase One was carried out and an ES (the main ES) deposited alongside the hybrid Bill in November 2013.
- 2.1.2 For the Phase One main ES, an SMR addendum²³ was published in November 2013 and was supplemented by a series of Technical notes, specifying in more detail the assessment process for each environmental topic. Subsequently a series of amendments to the Phase One SMR and some of the Technical notes were prepared and published alongside the Phase One Supplementary Environmental Statements (SES) and Additional Provision (AP) ES documents, as follows:
- SMR addendum 2 (July 2015) – appended to the SES and AP₂ ES;
 - SMR addendum 3 (September 2015) – appended to the SES₂ and AP₃ ES; and
 - SMR addendum 4 (October 2015) – appended to the SES₃ and AP₄ ES.

2.2 The Phase 2a SMR

- 2.2.1 The Phase 2a SMR consolidated the Phase One SMR and addenda and introduced a number of updates in line with evolving legislation, guidance and best practice.
- 2.2.2 An addendum to the Phase 2a SMR was published as part of the ES alongside the hybrid Bill for Phase 2a in July 2017.
- 2.2.3 The Phase 2a SMR addendum includes a set of Technical notes, which contain more detailed assessment methodology for some topics. These were developed in liaison with the Government's statutory environmental advisors, where relevant, to provide a robust basis for the EIA.

2.3 The Phase 2b SMR

- 2.3.1 This Phase 2b SMR consolidates the Phase 2a SMR and addendum and introduces further updates, where relevant, in line with evolving legislation, guidance and best practice.
- 2.3.2 Changes made for Phase 2b will be accompanied by changes to the Technical notes. A list of the Technical notes for Phase 2b is set out in Annex A of this SMR.

²³ Hs2 Ltd (2013), Phase One ES, SMR Addendum, Volume 5, Technical Appendices (CT-001-000/2). Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260153/Vol5_Scope_and_methodology_report_addendum_CT-001-000.2.pdf

2.4 EIA Directive

- 2.4.1 The Phase One ES and subsequent SES and AP ES were prepared in accordance with Parliamentary Standing Orders, the codified EIA Directive 2011/92/EU and the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 (SI 1999/293) (the EIA Regulations).
- 2.4.2 Directive 2011/92/EU was amended in 2014 as the EIA Directive 2014/52/EU (EIA Directive 2014). This was transposed into English legislation on 16 May 2017 (through the EIA Regulations 2017).
- 2.4.3 In line with being an exemplar project and working to best practice, the Phase 2a ES was prepared in accordance with the amended 2014 Directive and the emerging UK regulations even though work on the Phase 2a ES commenced prior to May 2017.
- 2.4.4 The Proposed Scheme will be subject to authorisation through the hybrid Bill process. The objectives of EIA will, therefore, be pursued through the Parliamentary process. The ES will be prepared in accordance with the requirements of Standing Order 27A as well as the requirements of amended EIA Directive 2014 as transposed by the EIA Regulations 2017.
- 2.4.5 The EIA Directive 2014 recognises that environmental issues, such as resource efficiency, sustainability, biodiversity protection, climate change and the risks of major accidents and/or disasters should be included in assessment and decision making processes.
- 2.4.6 There are a number of changes contained in the EIA Directive 2014, which include the following:
- the sustainable use of soil and the need to address the 'land take' of projects (the term 'land' is introduced in Article 3 of the Directive which lists the factors to be addressed by EIA);
 - the need to address the significant effects of projects on biodiversity, to avoid or minimise such effects (Article 3 refers to 'Biodiversity with particular reference to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC');
 - the need to assess the impacts of projects on climate (for example greenhouse gas (GHG) emissions) and their vulnerability to climate change;
 - the need to consider the vulnerability of major infrastructure projects to major accidents and/or disasters and consequential significant adverse effects on the environment;
 - in relation to historical and cultural heritage and landscape - the need to address the visual impacts of projects, in relation to the built or natural landscape and urban areas;
 - a specific reference to assessment of human health is introduced (Article 3 uses the terms 'Population and human health' instead of 'human beings' as under the 2011 Directive);

- developers are required to provide a description of the 'reasonable alternatives' studied of relevance to the project (for example in terms of project design, technology, location, size and scale) and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects; previously the 2011 Directive referred to the 'main alternatives'; and
- provision for post-EIA monitoring of significant adverse effects on the environment in appropriate cases.

2.4.7 While the UK has notified its intention to withdraw from the European Union (EU), the UK remains a member until withdrawal, meaning that rights and obligations under EU law apply until the date of departure. The Government has announced its intention to convert all EU law into UK law, through the 'Great Repeal Bill'²⁴, so that the same rules and laws will apply on the day after exit as on the day before. It will then be for democratically elected representatives in the UK to decide on any changes to that law, after full scrutiny and proper debate.

2.4.8 The EIA Directive 2014 uses the term 'Environmental Impact Assessment Report' (rather than 'Environmental Statement') to describe the documentation that presents the findings of an EIA. The Directive has now been transposed through the EIA Regulations 2017. The updated Regulations have maintained the use of 'ES' rather than 'EIA Report' and therefore the term ES is used in this SMR.

2.5 Integrated assessment

2.5.1 To address the driver for further integration of human health and the environment within the EIA Directive 2014, and in consideration of the development of Health Impact Assessment practice, an integrated assessment is being proposed to support the Proposed Scheme. This will take the form of one assessment process which will consider relevant issues concerning environment, health and wellbeing together from the outset.

2.5.2 In addition to meeting the requirements of the EIA and health assessment processes, the integrated approach also addresses stakeholder expectations that the proposals are assessed collectively, to assist in understanding the interplay of environmental and human factors. Stakeholder engagement will be pivotal to this integrated assessment process (see Section 3 of this SMR for further details).

²⁴ Government has set out its position on the Great Repeal Bill in a White Paper: Department for Exiting the European Union (2017), Legislating for the United Kingdom's withdrawal from *the European Union*. London: The Stationery Office. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/604516/Great_repeal_bill_white_paper_accessible.pdf

2.6 Other changes

2.6.1 In addition, since the Phase One and Phase 2a EIAs have been conducted, guidance for some topic assessments has been revised and other changes have occurred which affect the technical scope of the assessment, including:

- changes in external policies and guidance (e.g. developments in reporting standards and policy documents related to the climate change assessment);
- updates to legislation such as the introduction of the Control of Electromagnetic Fields at Work Regulations 2016 (CEMFAW 2016) and an accompanying industry guidance note;
- changes in HS2 Ltd's Sustainability Policy and Environmental Policy;
- additional comments from stakeholders received since finalisation of the Phase 2a SMR which are also relevant to Phase 2b;
- new technical issues arising from the route and environment through which it passes, specific to the Proposed Scheme, for example, localised industries, old and existing landfill sites, chemical works, sewage farms, mine sites, spoil heaps, and other land uses along some sections of the route of the Proposed Scheme; and
- third party consultation undertaken by HS2 Ltd.

2.6.2 The technical scope has been refined and adapted in accordance with these additions and revisions, whilst also taking into account recent EIA practice for rail and other linear transport infrastructure projects, particularly the Phase One and Phase 2a EIAs.

2.6.3 The environmental topic areas proposed for inclusion in the Phase 2b EIA are as follows.

- Agriculture, forestry and soils;
- Air quality;
- Climate change;
- Community;
- Ecology;
- Electromagnetic interference;
- Health;
- Historic environment;
- Land quality;
- Landscape and visual;
- Major accidents and disasters;

- Socio-economics;
- Sound, noise and vibration;
- Traffic and transport;
- Waste and material resources; and
- Water resources and flood risk.

2.6.4 Table 1 provides an overview summary of the main changes that have been made in the Phase 2b SMR topic sections.

Table 1 - Changes in topic methodologies between Phase 2a SMR and Phase 2b SMR

Environmental topic to be included in the EIA	Changes in methodology for Phase 2b
Agriculture, forestry and soils	Minor technical updates to include: assessment of noise on agricultural livestock; and treatment of soils for planned restoration works
Air quality	Minor technical updates to: updated policy documents referenced; and inclusion of potential effects of mineral extraction for borrow pits
Climate change	Minor technical updates to reference the latest Institute of Environmental Management and Assessment (IEMA) guidance on addressing GHG emissions and significance in EIA; and reporting carbon emissions under a 'reasonable worst case' scenario. The assessment uses published UK climate change projections which are due to be updated in 2018. The new projections will be used within the assessment as they become available
Community	No change to the assessment methodology set out in the Phase 2a SMR
Ecology	Minor technical update to: criteria for data inclusion in the ES report; and reference to HS2 policy on no net loss of biodiversity
Electromagnetic interference	No change to the assessment methodology set out in the Phase 2a SMR
Health	No change to the assessment methodology set out in the Phase 2a SMR
Historic Environment	Minor technical updates to reflect: updated policy documents referenced; incorporation of comments from Historic England on tranquillity, setting and viability as well as the treatment of non-statutory heritage assets; the assessment methodology utilises the spatial scope set out in Phase One and Phase 2a SMR as the route passes through both urban and rural areas
Land quality	No change to the assessment methodology set out in the Phase 2a SMR. Some amendments to terms used to clarify the EIA process and the definition of contaminated land
Landscape and visual	Updating the visual assessment methodology to align more closely with Guidelines for Landscape and Visual Impact Assessment (3rd edition, 2013)
Major accidents and disasters	Some minor changes to terminology (i.e. disaster rather than natural disaster) reflecting the EIA Regulations 2017. This does not lead to any fundamental changes in the assessment methodology proposed compared to Phase 2a

Environmental topic to be included in the EIA	Changes in methodology for Phase 2b
Socio-economics	No change to the assessment methodology set out in the Phase 2a SMR
Sound, noise and vibration	The scope and methodology proposed for Phase 2b is the same as that applied to Phases One and 2a. The differences in the text of this SMR compared to that of Phases One and Phase 2a are mainly presentational in order to improve the accessibility of the section to the reader, to provide clear alignment with Phase One Information Papers and to bring forward into the SMR some detail that was included in the final environmental assessment stage for Phase One and Phase 2a rather than in the SMRs.
Traffic and transport	Restructuring and clarification of vulnerable road users section to include combined traffic-related severance (previously in 'Traffic flows and delays to vehicle occupants') and non-traffic related severance; removal of the change in journey time (delay) classification from the non-traffic related severance section to remove duplication with journey distance; minor changes to the 'Parking and loading' section; and reference to stations which were excluded from the Phase 2 a SMR.
Waste and material resources	No change to the assessment methodology set out in the Phase 2a SMR
Water resources and flood risk	The assessment methodology utilises the spatial scope set out in Phase One and Phase 2a SMR as the route passes through both urban and rural areas; and reference to new guidance on groundwater protection issued by the Environment Agency and Defra in March 2017

3 Stakeholder engagement and consultation

3.1 Introduction

3.1.1 Building upon activity undertaken to-date, stakeholder engagement will continue to inform the design and assessment of the Proposed Scheme. Engagement will be an ongoing process tailored around key design and assessment milestones.

3.1.2 During preparation of the EIA, ongoing engagement on the scope, methodology and assessment will occur with the expert, technical, specialist and local authority representative stakeholders relevant to those topics. A list of SMR consultees is provided in Annex B.

3.2 General approach to stakeholder engagement

3.2.1 HS2 Ltd will organise and facilitate stakeholder engagement activity, working closely with its consultant team. The general approach to stakeholder engagement for the Proposed Scheme will comprise:

- engagement and consultation scheduled to support the key development stages in the design, engineering, assessment and communication of the Proposed Scheme;
- a proactive approach to engaging stakeholders and the general public, in particular, within community areas along the route of the Proposed Scheme;
- the use of varied engagement techniques to suit the specific and often varied needs of specific stakeholders, including groups who may be hard to reach or engage; and
- a focus on the particular issues which are of greatest relevance or importance to each stakeholder group, to enhance the ability of the Proposed Scheme to address stakeholder concerns in a timely and effective manner.

3.2.2 Building on stakeholder engagement work already undertaken, it is important that engagement is used to provide a voice to those who may be affected by the Proposed Scheme generally, but also specifically to those who may be more vulnerable to impacts. Engagement will therefore be used to obtain local experience and knowledge that will allow for the identification of potential effects that might not otherwise have been considered.

3.2.3 Ultimately, engagement will focus on ensuring that local needs are taken into consideration when identifying appropriate mitigation and enhancement measures. This engagement will help to facilitate the early identification of such measures and their timely integration into the Proposed Scheme.

- 3.2.4 The engagement process will seek to be accessible and inclusive in its approach and is informed by HS2 Ltd's Equality, diversity and inclusion policy²⁵.

3.3 Key stages of engagement and consultation

- 3.3.1 The programme of ongoing stakeholder engagement and consultation will be structured around key milestones in the design development and assessment for the Proposed Scheme. This will provide the opportunity to update and consult stakeholders and the public on the evolving Proposed Scheme design and assessment process.
- 3.3.2 As set out in Section 2 of this SMR, HS2 Ltd will seek to consult on a working draft of the ES, early in the development of the Proposed Scheme. This is to allow for earlier engagement with those potentially affected by the Proposed Scheme and to help inform the scheme design and assessment.
- 3.3.3 Following consultation on the working draft ES, HS2 Ltd will continue to engage with the public and other stakeholders prior to the deposit of the Phase 2b hybrid Bill and supporting documents. In accordance with Parliamentary Standing Orders, Parliament will then consult on the formal ES after deposit of the hybrid Bill where the public will have the opportunity to comment on the final document. Parliamentary officials will appoint an independent assessor who will summarise responses and provide a report to Parliament before the Second Reading of the hybrid Bill.
- 3.3.4 Engagement, and specifically the formal period of consultation, will adopt a 'design-led' approach which will present the Proposed Scheme from a multi-disciplinary perspective. This will focus on the inter-relationships between environment and communities, and demonstrate how the Proposed Scheme design has sought to provide solutions for the benefit of both through the design development.
- 3.3.5 In doing so, it will enable stakeholders to be fully informed, understand what is proposed in their respective areas and identify predicted impacts arising from the Proposed Scheme. Through focus on the design, stakeholders will have the opportunity to assist in the identification of mitigation, where appropriate, as a result of a better understanding of the Proposed Scheme itself.

3.4 Stakeholder groups

- 3.4.1 HS2 Ltd has mapped stakeholders into four key groups, comprising communities; local authorities; expert, technical and specialist groups; and directly affected individuals and major asset owners. These are considered further in the following sections:
- 3.4.2 Building upon engagement undertaken to-date, future engagement and consultation will continue to be designed to meet the needs of these stakeholders, recognising that there will be different requirements and expectations for each group. This will allow for the Proposed Scheme to be developed in line with strategic and national aims as well as considering local issues and concerns.

²⁵ HS2 Ltd (June 2015), Information Paper G5: Equality, Diversity and Inclusion Policy, Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437449/G5_Equality__Diversity_and_Inclusion_Policy_v1.2.pdf

Communities

- 3.4.3 Communities which may be directly affected by the Proposed Scheme have been engaged in the development of the Phase 2b proposals to-date, and will continue to be a key focus of the engagement and consultation process.
- 3.4.4 During the design and assessment process, engagement with communities will continue to be carried out to fulfil regulatory and best practice guideline requirements. Consultation will be undertaken in a timely and appropriate manner to ensure communities have the opportunity, so far as possible, to input to and influence the development of the Proposed Scheme.
- 3.4.5 The role of ongoing community engagement will be to consider local issues and discuss potential ways to avoid and mitigate impacts of the Proposed Scheme, such as screening views of the railway, managing noise and reinstating highways, and identifying possible community benefits.
- 3.4.6 Reporting will be undertaken on a community area basis to assist engagement and understanding of the impacts of the Proposed Scheme within local communities across the route. The list of community areas is set out in Section 4.1.12 of this SMR.

Local authorities

- 3.4.7 The role of the local authorities for the areas through which the Proposed Scheme will pass is two-fold:
- as the holder of data and knowledge critical to informing the design and assessment; and
 - providing access to wider stakeholders and communities within the area through local knowledge.
- 3.4.8 Engagement will continue with local authorities throughout the design and assessment processes to maximise the opportunity for local authorities and parish councils to positively inform the development of the Proposed Scheme both in the context of technical input to the assessment and local knowledge and issues.

Expert, technical and specialist groups

- 3.4.9 This group comprises stakeholders with specific expert, technical or specialist knowledge or particular interest in the Proposed Scheme, many of whom will have a high level of influence on the design and assessment process, particularly in relation to technical feasibility and likely environmental and community impacts. This stakeholder group includes national representatives of environmental statutory authorities and government departments, as well as non-statutory technical/specialist organisations at the national, regional and local level. These stakeholders are likely to help influence project-wide mitigation strategies and principles.

Directly affected individuals and major asset owners

- 3.4.10 The engagement and consultation will have a strong focus on directly affected individuals, particularly landowners. These are recognised as priority stakeholders and there will be a programme of catered and direct engagement throughout the design and assessment development. This stakeholder group will also form a key part of the

baseline for the assessment of the Proposed Scheme, both in the consideration of agricultural land and as a component of the health baseline.

3.5 Using engagement to inform scheme design and assessment

- 3.5.1 The feedback and data received from stakeholders through both ongoing engagement and formal periods of consultation will be recorded and used to influence the design and assessment of the Proposed Scheme, where appropriate. Ongoing engagement will provide the opportunity to update stakeholders on the design evolution and assessment progress, identifying where feedback has helped inform both, up to hybrid Bill deposit.

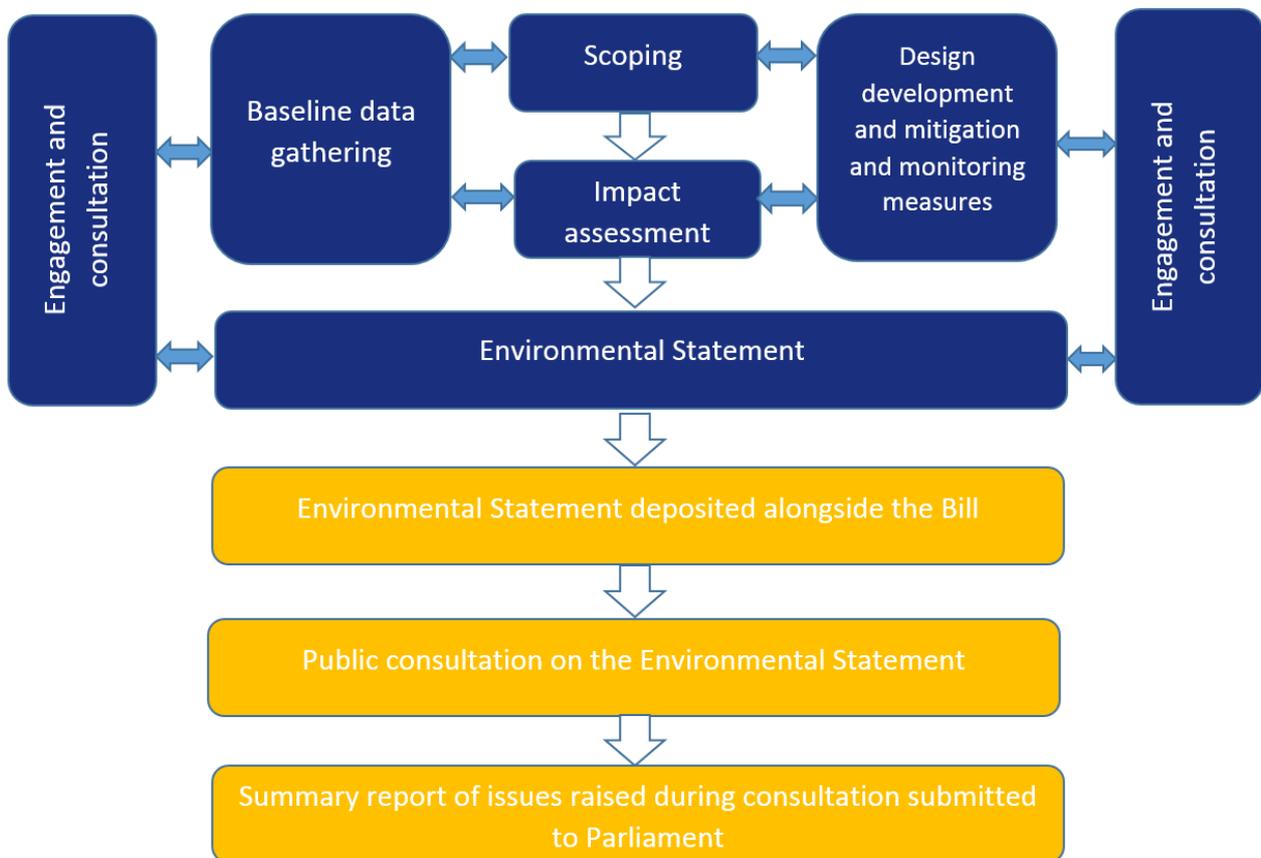
4 Environmental Impact Assessment (EIA) methodology

4.1 Introduction

4.1.1 The EIA is the process that will lead to the production of the ES which will be deposited alongside the Phase 2b hybrid Bill. It will be carried out in accordance with applicable legal requirements and current best practice. The Phase 2b EIA will seek to adopt the principles of the EIA Regulations 2017 and Standing Order 27A (as described in Section 2 of this SMR).

4.1.2 The EIA process will comprise a number of related and iterative activities, as illustrated in Figure 3.

Figure 3 - Proposed Environmental Impact Assessment process for Phase 2b



4.1.3 The main stages in the EIA process comprise:

- initial EIA scoping to establish the broad scope and methodology of environmental studies to be carried out for each environmental topic and engage and consult with stakeholders to take account of their views;
- establishing current baseline conditions (i.e. the environmental conditions that currently exist in the vicinity of the Proposed Scheme). These will be determined from desk-top studies, previous environmental studies, publicly available information, environmental surveys of the area and consultation with groups that have specialist local knowledge;

- projecting future baseline conditions (i.e. the future conditions without the Proposed Scheme in place). The current baseline will be extrapolated to take account of predicted or anticipated change factors including, but not limited to, changes caused by changing climatic conditions, policy, legislation, proposed development, advances in technology and by other planned infrastructure projects;
- establishing the likelihood of other developments being under construction before or during the construction of the Proposed Scheme;
- consideration of policies, guidelines and legislation and best practice relevant to EIA;
- assessment of the design of the Proposed Scheme in accordance with the methodology outlined for each environmental topic within the SMR, to identify the local extent of potential impacts and the practicable design measures to avoid, reduce or otherwise mitigate significant adverse environmental effects;
- ongoing engagement with environmental, planning and community stakeholders throughout the engineering design and assessment process;
- preparation of the working draft ES;
- public consultation on the working draft ES;
- further assessment in the light of consultation responses and ongoing design development and baseline surveys;
- preparation of the ES; and
- implementing mitigation and monitoring.

4.1.4 The ES will be deposited with Parliament alongside the hybrid Bill for the Proposed Scheme and will allow Parliament to make an informed decision on whether the Proposed Scheme should proceed. Following First Reading of the hybrid Bill and the deposit of supporting documents, Standing Order 224A requires a public consultation on the ES. This consultation will be held over a period of at least 56 days (eight weeks). A summary of comments on the ES will be provided by an independent assessor, appointed by Parliamentary officials, to inform the Second Reading of the hybrid Bill.

4.1.5 The provision of further information to Parliament and further consultation may be required during this legislative process.

4.1.6 In addition to describing the reasonable alternatives considered, the EIA will broadly consider the following two scenarios:

- the likely significant environmental effects of the construction, existence and operation of the Proposed Scheme at various times (see Temporal scope in Section 4.2 of this SMR); and
- the likely significant environmental effects of the Proposed Scheme in addition to other schemes that are either consented or under construction at that time (but are not included in the projected future baseline) and are

identified as having the potential to result in significant cumulative impacts and resultant effects (see Section 4.4 Cumulative effects of this SMR).

- 4.1.7 The EIA will consider both the beneficial and adverse environmental and community effects of the Proposed Scheme in the short, medium and long term. It will consider both temporary and permanent effects caused directly and indirectly by the Proposed Scheme. It will also address cumulative effects, as defined in Section 4.4 of this SMR.
- 4.1.8 A description of the mitigation measures envisaged in order to prevent, reduce and where possible offset any significant adverse effects will be provided in the ES.
- 4.1.9 The methodologies for the assessments provided in this SMR vary from topic to topic. In general however, all of the assessments will involve a process of interaction between engineering design, planning, environmental and community considerations with a view to avoiding or reducing significant adverse effects on the environment during construction and operation. Mitigation measures will be considered and incorporated within the Proposed Scheme wherever appropriate and practicable. The extent and scale of mitigation will be designed to control and minimise significant adverse environmental effects as well as identify opportunities to promote positive environmental effects.
- 4.1.10 There will inevitably be some uncertainties in predicting future impacts and effects, especially given that operation would not be due to commence until 2033.
- 4.1.11 Where it is not possible or appropriate to quantify impacts or their consequential effects, qualitative assessments will be carried out, based on professional experience and judgement. Where uncertainty exists, this, together with any assumptions relied upon, will be noted in the relevant assessment and any limitations to the EIA work will be reported in the ES.
- 4.1.12 Given the scale of the Proposed Scheme and to aid reporting and assist stakeholders find and digest information that is of relevance to them, the output from the EIA will be reported in relation to a series of geographical areas along the route, known as community areas. The community areas, as shown in Figure 4, Figure 5 and Figure 6, are:

Western Leg:

- Mo1 Hough to Walley's Green
- Mo2 Walley's Green to Lostock Gralam
- Mo3 Lostock Gralam to Hulseheath and Broomedge
- Mo4 Hulseheath and Broomedge to Glazebrook
- Mo5 Glazebrook to Bamfurlong
- Mo6 Bamfurlong to Davenport Green
- Mo7 Davenport Green to Ardwick
- Mo8 Manchester Piccadilly Station

Eastern Leg:

- L01 Marston to Birchmoor
- L02 Birchmoor to Appleby Parva
- L03 Appleby Parva to Ashby-De-La-Zouch
- L04 Ashby-De-La-Zouch to Kegworth
- L05 Kegworth to Stapleford (inclusive of EMH)
- L06 Stapleford to Nuthall
- L07 Nuthall to Pinxton
- L08 Pinxton to Newton and Tibshelf
- L09 Newton to Clay Cross
- L10 Tibshelf to Shuttlewood
- L11 Shuttlewood to Aston
- L12 Aston to Ravenfield
- L13 Ravenfield to South Kirkby
- L14 South Kirkby to Sharlston Common
- L15 Sharlston Common to Oulton and Swillington Common
- L16 Swillington Common to Ulleskelf
- L17 Oulton to Leeds Station
- L18 Leeds Station

Figure 4 - Phase 2b community areas overview

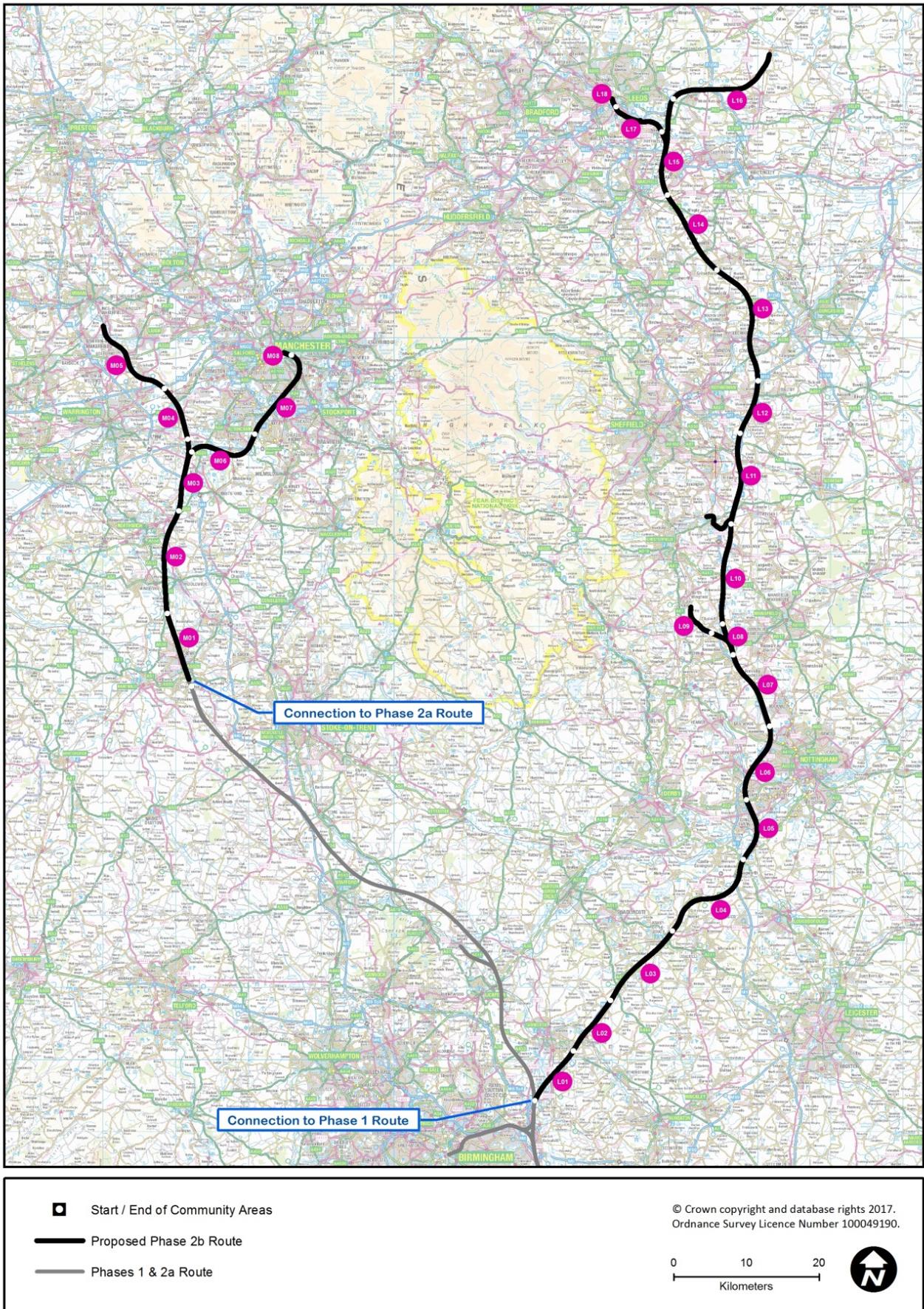


Figure 5 - Phase 2b community areas western leg

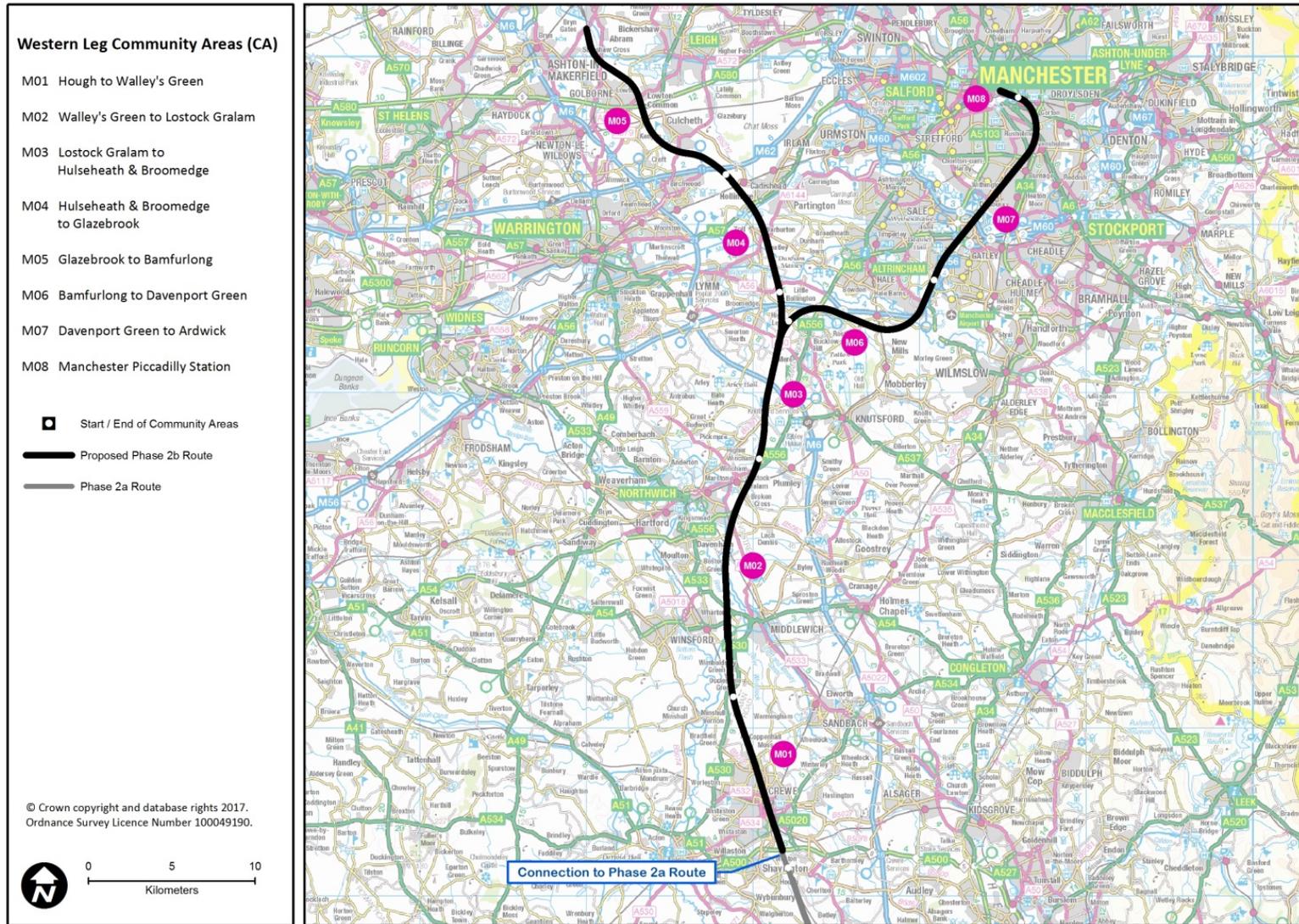
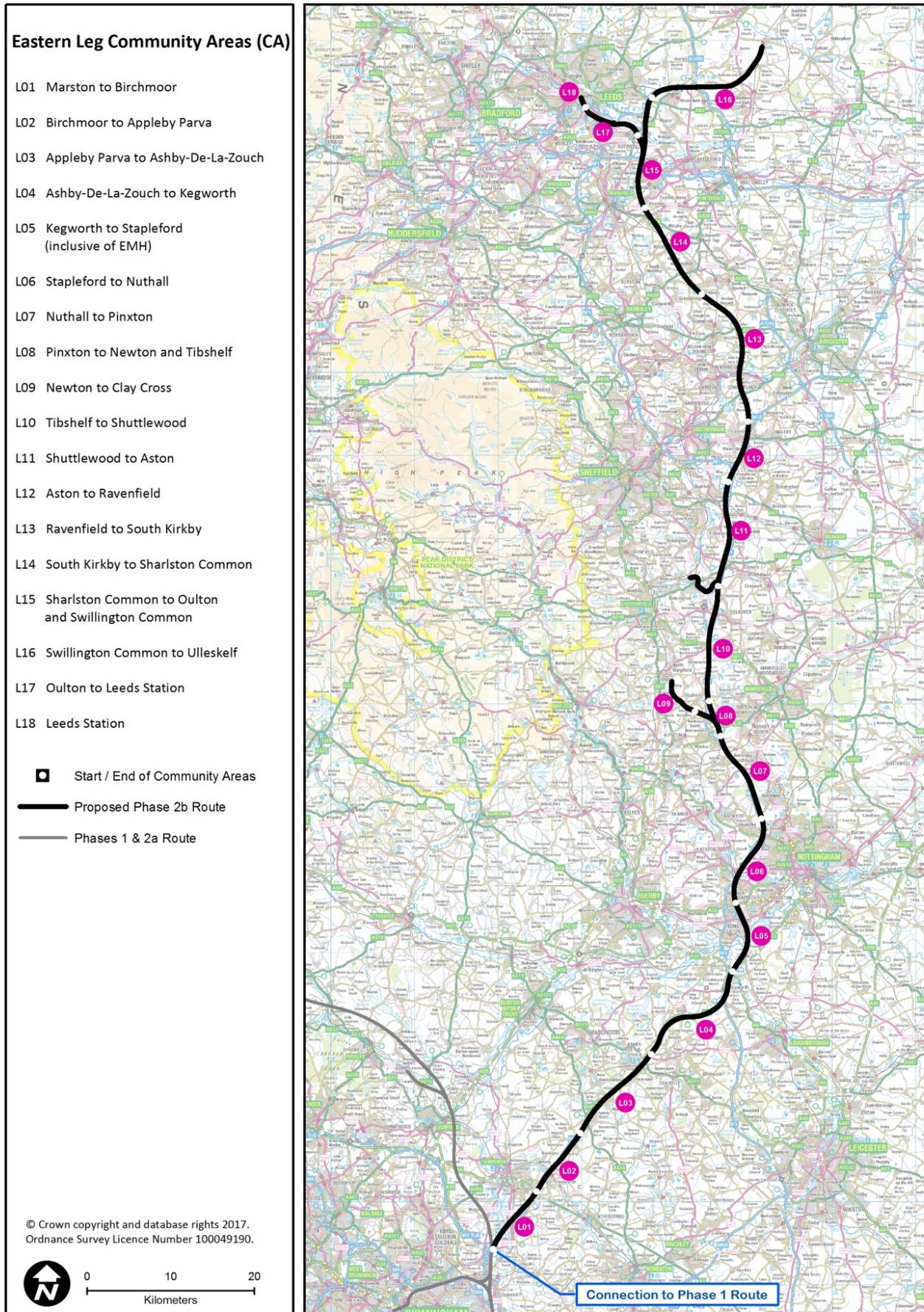


Figure 6 - Phase 2b community areas eastern leg



- 4.1.13 Environmental impacts and effects will be reported in the community area where they are experienced, whether they arise from inside that area, or from an adjoining area. If effects arise on a receptor (for example an ancient woodland) which straddles the boundary between two areas, the effects will be reported in both community areas. Any environmental impacts and effects that are experienced outside of the community areas will be reported in an 'Off-route' volume to the ES.

4.2 Scope of the assessment

- 4.2.1 The following section defines the temporal, geographic and technical scope of the assessment of the Proposed Scheme.

Temporal scope

- 4.2.2 The main construction works for the Proposed Scheme are expected to take place between 2023 and 2033 (including a period of testing and commissioning), although the duration, intensity and scale of construction along the route varying over this period. The ES will set out the proposed construction programme in order to establish the likely duration of works in each location. The assessment of construction effects will then relate to the programme described.
- 4.2.3 Trains are currently expected to start operating on the Proposed Scheme in 2033, six years after the opening of Phase 2a. The ES will describe the predicted frequency, speed and length of trains and how that is estimated to change after 2033 when Phase 2b becomes operational.
- 4.2.4 Effects arising from longer term considerations after the opening of Phase One, Phase 2a and Phase 2b, the progressive growth in background road traffic or the maturing of mitigation (e.g. growth of planting or habitat creation) will be considered. Where this applies, the environmental topic sections in Part B of this SMR identify the appropriate temporal scope that would be adopted, taking account of these factors.
- 4.2.5 The EIA will establish the baseline environment as it exists at present, and then take account of likely changes to the baseline for the future scenarios defined within this section.

Geographic scope

- 4.2.6 The term geographic scope (also called spatial scope) means the area over which the EIA will consider effects. In general, this will take into account the distance from the Proposed Scheme over which changes to the environment are likely to occur as a result of the construction or operation of the Proposed Scheme. In addition to the land required permanently it will also address land required for construction (both for short and long term periods) and then returned to an agreed condition afterwards. In addition to the physical extent of the works, the geographic scope is influenced by two principal factors:

- the nature of the baseline environment; and
- the manner in which the effects are likely to be propagated.

4.2.7 In addition, the EIA will consider any significant effects caused by activities such as:

- HS2 services on the 'conventional network' north of Crewe and north of Golborne on the WCML, on the Erewash Valley Line and MML running in to Sheffield and north of Church Fenton where trains will run onto the ECML;
- changes to HS2 passenger levels on Phase One and Phase 2a as a result of Phase 2b and consequential effects; and
- consequential changes to rail traffic on the 'conventional network', especially on the WCML between Crewe and the north, the Erewash Valley Line and MML running into Sheffield and the ECML approaching York.

4.2.8 Transboundary effects are significant environmental effects caused in other countries (i.e. other than the UK). There are no direct connections between HS2 and other countries. Therefore, it is considered unlikely that the Proposed Scheme will result in any significant effects on the environment of another country and thus transboundary effects are not proposed to be considered further.

Technical scope

4.2.9 The environmental topic areas to be considered and the extent of the assessment work proposed for each is referred to as the technical scope. The technical scope of the EIA for the Proposed Scheme will seek to meet the requirements of EIA Directive 2014 (which has been transposed through the EIA Regulations 2017) as described in Section 2 of this SMR. The EIA will assess the likely significant effects of the Proposed Scheme on the following environmental topics:

- agriculture, forestry and soils;
- air quality;
- climate change;
- community;
- ecology;
- electromagnetic interference;
- health;
- historic environment;
- land quality;
- landscape and visual;
- major accidents and disasters;
- socio-economics;
- sound, noise and vibration;

- traffic and transport;
- waste and material resources; and
- water resources and flood risk.

4.2.10 These environmental topics have been evaluated as part of this scoping exercise in order to determine the extent to which they should be included in the EIA, having regard to whether there are likely to be significant effects that relate to them. Part B of this SMR provides further details for each environmental topic regarding the assessment approach to be applied during the EIA.

4.2.11 This SMR sets the overarching framework for the scope of the EIA for the Proposed Scheme and the methodology to be applied. Detailed methodologies for the environmental topics will also be developed in conjunction with environmental statutory authorities and government departments and presented in Technical notes for each environmental topic to be assessed. These Technical notes will be published alongside the ES. The Technical notes will take into account updates from the Phase 2a EIA methodology which included detailed approaches to the new topics required by application of the EIA Directive 2014 and as transposed through the EIA Regulations 2017. Any further updates required since the Phase 2a EIA have also been considered.

4.3 Approach to mitigation

4.3.1 The ES will set out mitigation measures that would help to avoid, reduce, repair or, where appropriate, offset significant adverse effects. The EIA Regulations 2017 require an ES to include “a description of any features of the proposed development, or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment”. Such measures will be described generally in the ES as mitigation measures. Priority has been given to avoiding or preventing effects; and then (if this is not possible), to reducing or abating them; and then, if necessary, to offsetting them through restoration or compensation.

4.3.2 The mitigation measures and policies to be considered in the assessment can be divided into three types:

- mitigation that is provided through the planning and design of the Proposed Scheme, which is not shown explicitly as such on the scheme drawings;
- mitigation that requires additional physical features, which is shown on the scheme drawings; and
- mitigation to be delivered through further measures in accordance with HS2 Ltd policies.

4.3.3 Mitigation opportunities will continue to be identified during development of the Proposed Scheme prior to the submission of the hybrid Bill. The EIA process is iterative, which is likely to enable further refinement of the Proposed Scheme, with the objective of avoiding or reducing significant adverse environmental effects. Mitigation measures will be identified by regularly reviewing the likely significant adverse environmental effects identified during the ongoing assessment process and

considering these at design workshops within the HS2 project teams. Design modifications will be considered to avoid or reduce significant adverse effects.

4.3.4 During the EIA process, HS2 Ltd intends to develop the mitigation incorporated into the Proposed Scheme through:

- the HS2 Sustainability Policy - to set environmental standards which the Proposed Scheme should aim to achieve, thereby structuring and guiding the design;
- collaborative working between environmental assessment, engineering design teams and engagement teams - to achieve improved and integrated design outcomes;
- community engagement and consultation - to allow local people, environmental organisations and responsible authorities to raise issues and propose design and mitigation changes to be considered within the Proposed Scheme;
- recording proposed mitigation along the route to gauge the consistency of approach applied along the route; and
- CoCP - an HS2 Ltd document to describe the approach to be taken during construction to reduce adverse effects on communities and the environment, including through the use of Local Environmental Management Plans.

4.3.5 The proposed mitigation measures will be described in the ES, together with the significant effects remaining after mitigation (termed the residual effects). Where the Proposed Scheme is likely to improve environmental conditions (over and above the baseline), these effects will be identified as enhancements.

4.4 Cumulative effects

4.4.1 Cumulative effects are broadly defined as incremental effects that result from the accumulation of a number of individual effects. They may result either from:

- a combination of effects arising from the Proposed Scheme (intra-project effects). For example, intra-project effects may arise during construction in cases where the occupiers of a group of neighbouring residential properties experience noise, visual and traffic effects, resulting from construction activities and the passage of construction vehicles on the local road network; or
- from an interaction between the effects of the Proposed Scheme with the effects of other developments that are likely to be under construction or to have been completed during construction or operation of the Proposed Scheme (inter-project effects). For example, construction of the Proposed Scheme and Phase One may give rise to inter-project effects at the interface between the two schemes.

- 4.4.2 Cumulative effects can be either temporary or permanent and can broadly arise from:
- intra-project effects – i.e. where works may give rise to 'in-combination' effects on a particular receptor (e.g. through noise, visual and transport impacts);
 - 'cumulative effects' of HS2 Phase 2b with other developments in the area which either have planning permission or are subject to site allocation in a statutory development plan, by including those other developments within the future baseline against which Phase 2b is assessed; and
 - 'cumulative effects' of HS2 Phase 2b (the Proposed Scheme) by including HS2 Phase One and Hs2 Phase 2a as part of the future baseline. Consideration will also be given to the potential combined effects of all phases of HS2 against a no-HS2 baseline for relevant topics, where possible.
- 4.4.3 Other proposed schemes that should be considered in the assessment of cumulative effects in combination with HS2 will be considered during the EIA, including Crewe Hub and Northern Powerhouse Rail (NPR). As an example, it is expected that the EIA would consider carefully the effects of the overlapping construction of Phase One, Phase 2a and Phase 2b in the vicinity of receptors of impacts from the Proposed Scheme, particularly at the interface around Crewe (for Phase 2a) and around Marston (for Phase One).
- 4.4.4 The Command paper High Speed Two: East and West (November 2015)²⁶ can be taken as national policy support for the development of a Crewe Hub. It set out, in paragraphs 6.14 and 6.15, the emerging options for a Crewe Hub station, noting that options work being undertaken by Network Rail and HS2 Ltd, with Cheshire East Council was focused on two locations (the existing Crewe station and Basford sidings). Network Rail has since considered those options, the outcome of which is that if a Crewe Hub scheme is to be taken forward, it should be located at the site of the existing station. In a further Command paper (High Speed Two: From Crewe to Manchester, the West Midlands to Leeds and beyond (November 2016))²⁷, the Government, in paragraphs 23 and 24, endorsed this conclusion and confirmed that it 'continues to support the vision for a Crewe hub'.
- 4.4.5 In July 2017, the Government launched a consultation on Crewe Hub. These emerging proposals are not currently part of HS2 and it will be confirmed, in due course, how any necessary development consent is to be secured for these emerging proposals, which would include an assessment of the effects arising from Crewe Hub.
- 4.4.6 Given that Government has yet to decide on the detail of the Crewe Hub station, it is not considered appropriate to undertake appraisal of the cumulative effects of constructing and operating the Proposed Scheme and Crewe Hub together at this stage. However, as part of the Phase 2a assessment, an analysis was undertaken to consider the potential combined effects of construction traffic for both schemes,

²⁶ Department for Transport (DfT) (2015), *High Speed Two: East and West: The next steps to Crewe and beyond November 2015*. Cm 9157, November 2015. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480712/hs2-east-and-west.pdf

²⁷ Department for Transport (DfT) (2016), *High Speed Two: From Crewe to Manchester, the West Midlands to Leeds and beyond*. Cm9355, 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

including the consideration of any potential off-route traffic impacts, insofar as is possible with the information available at the time of the assessment.

- 4.4.7 The report 'Rebalancing Britain', which was published in October 2014, focused on transport connectivity across the north of England, and called for the establishment of a new body to manage transport issues at a strategic level across the north of England. The Government subsequently established Transport for the North (TfN) as the body responsible for taking this work forward. TfN have in turn established the NPR project to look at new and upgraded rail links across the North of England, focussed on a number of conditional outputs for journey times and frequency of train services between some of the major cities of the north of England.
- 4.4.8 HS2 will serve northern cities including Manchester, Liverpool, Leeds, Newcastle and Sheffield. There is, therefore, a clear link between the Proposed Scheme and the aspirations of TfN, and HS2 Ltd has played an integral role in working with TfN to develop its NPR project.
- 4.4.9 HS2 Ltd continues to work with TfN and Network Rail to look at options for rail investment in the north of England that might help to deliver these aspirations, whether through new rail lines, rail bypasses, or upgrades to the current network.
- 4.4.10 At the same time, HS2 Ltd has also reviewed the Proposed Scheme to make sure that plans are co-ordinated and make the most of the opportunities presented by the NPR project. With this in mind, HS2 Ltd has reviewed the Proposed Scheme to consider whether it should change to accommodate potential future growth or connections. For example, proposals for stations in South and West Yorkshire have been influenced by the wider debate on improving transport connectivity in the north of England.
- 4.4.11 Similarly, HS2 Ltd is continuing to work with TfN to understand how the Proposed Scheme can facilitate connectivity between key cities in the North West. For example, an additional junction could be provided to deliver a new connection between Liverpool and Manchester. Work continues with TfN to understand whether this is the best way of delivering stakeholders' aspirations for improved connectivity.
- 4.4.12 It is expected that the core route of the Proposed Scheme will not have to change significantly to accommodate NPR aspirations. This work will continue during the hybrid Bill design and assessment process to consider whether, for example, it would be appropriate to future-proof the Proposed Scheme by including passive provision for possible future connections, including a possible northern connection in South Yorkshire.
- 4.4.13 As part of the assessment of cumulative effects for Phase 2b, consideration will be given to impacts arising from train movements associated with NPR on the HS2 network, insofar as possible with the information available at the time of the assessment.
- 4.4.14 The geographical scope of other schemes to be included in the cumulative assessment depends on the context (e.g. rural or urban) and on the characteristics of the topic concerned. This will be defined for each scheme and for each environmental topic in the course of the EIA process in engagement with appropriate stakeholders.

- 4.4.15 Where relevant, potential cumulative effects arising will be identified in each environmental topic assessment, which will include details of the cumulative assessment methodology and results.

4.5 Defining significant effects

- 4.5.1 This SMR refers to both environmental impacts and environmental effects. The general approach taken is that the Proposed Scheme has the potential to cause an impact on the receiving environment or its neighbours either through physical change (such as the land used for the project, or change in land form) or through changes in sound or noise levels, air quality, or socio-economic factors. The extent to which an impact causes a significant environmental, socio-economic or community (including health) effect to occur will depend on a number of factors. In the main, it is significant effects that are reported in the ES, but in the EIA process much of the attention is on assessing the level of impacts that give rise to the effects and determining how to avoid or reduce them (in line with the mitigation hierarchy).
- 4.5.2 The predicted effects will be classified according to whether they are considered to be major, moderate or minor; and beneficial or adverse. This will provide a consistent approach to expressing the results of the assessments undertaken as part of the EIA. The terms used are defined as follows:
- beneficial - advantageous or positive change to an environmental resource or receptor;
 - adverse - detrimental or negative change to an environmental resource or receptor;
 - minor - slight, very short term or highly localised impact;
 - moderate - limited impact (by extent, duration or magnitude); and
 - major - considerable impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation.
- 4.5.3 The duration of impacts will be categorised as short, medium or long term, where they are not permanent. There is no definition of these terms in EIA practice and it is recognised that the use of the terms would depend on the viewpoint of the user, especially where the user is subjected to the impact or effect. It is therefore important that in addition to using these descriptors, the EIA also gives an indication of the duration. In general, and given the length of the construction programme, the EIA will consider those impacts that last a matter of months to be 'short term' and those that continue through to the commencement of operations as 'long term'.
- 4.5.4 Some impacts would arise directly from construction or operation of the Proposed Scheme and others would arise more indirectly from activities associated with the Proposed Scheme or resulting as a consequence of it. Whether an impact arises directly or indirectly does not affect whether the resulting effects are considered to be significant or not.
- 4.5.5 Potential variants to the foregoing approach are described as appropriate in the environmental topic sections in Part B of this SMR.

- 4.5.6 Where it is not possible or appropriate to quantify impacts or their consequential effects, qualitative assessments will be carried out, based on professional experience and judgement. Where uncertainty exists this, together with any assumptions relied upon, will be noted in the relevant assessment and any limitations to the EIA work will be reported in the ES.
- 4.5.7 The significance of effects will be evaluated with reference to recognised standards and accepted criteria for each assessment topic, where these are available. Where no recognised standards or criteria exist, professional judgement will be used to develop an appropriate approach to undertake a robust and appropriate assessment, as explained below. Each environmental topic section in this SMR describes the approach to be taken. In determining whether a resulting effect is significant due consideration will be given to:
- spatial extent (e.g. local, district, regional, national or international);
 - magnitude;
 - duration (whether short, medium or long term);
 - frequency of occurrence;
 - nature of the effect (whether direct or indirect, permanent or reversible);
 - whether it occurs in isolation, is cumulative or interactive;
 - sensitivity and number of receptors affected;
 - value of a resource affected;
 - performance against environmental quality standards; and
 - compatibility with environmental policies.
- 4.5.8 Where effects are considered to be significant, the ES will show the geographic (or spatial) level at which they are viewed as significant (for example, at a community level or a regional or national level).
- 4.5.9 The EIA is being undertaken by independent qualified and competent experts from a number of consultancies with sufficient expertise to ensure the completeness and quality of the assessment. The leads for each environmental topic, from the appointed consultancies, meet regularly to discuss the methodology being applied, the issues, impacts and effects arising, and the solutions available. National representatives of environmental statutory authorities and government departments are also involved in these discussions. This approach enables experienced EIA practitioners to apply expert professional judgement where appropriate on a consistent basis.

4.6 Assumptions and limitations

- 4.6.1 Each environmental topic section of the ES will include a section to explain assumptions and limitations made in undertaking the assessments.
- 4.6.2 During the preparation of the EIA there could be some circumstances that result in factors that may limit the information available to inform the assessment process.

Any limitations, and the consequences on the completeness or potential accuracy of conclusions, will be described in the relevant environmental topic section of the ES.

4.6.3 Broadly, EIA assumptions and limitations can be divided into three categories;

- general assumptions and limitations that apply to several, many or all topics (key general assumptions and limitations are listed below);
- topic specific assumptions that apply to all locations (key topic specific assumptions are described in the topic sections of this report); and
- location specific assumptions and limitations (location specific assumptions and limitations will be described in the ES).

4.6.4 Key general assumptions are:

- all existing land uses along the route of the Proposed Scheme will remain unchanged should the Proposed Scheme not proceed;
- assessment of effects will take account of incorporated mitigation such as noise barriers, landscaping and planting. Incorporated mitigation includes measures set out in the draft CoCP; and
- where available information and field survey data is limited, the assessment and development of mitigation will take a precautionary approach employing a reasonable worst case for the assessment.

4.6.5 If there are reasons why these general assumptions do not apply to a particular assessment, then this will be explained in the ES.

4.6.6 It is likely that there will be topic specific limitations due to gaps in data sets and lack of survey data where access to land has not been obtained. Such limitations will be set out in the ES. Assessments may employ professional judgement, where the definition of baselines is constrained by lack of data; use of professional judgement will be made explicit in the ES.

5 Reporting of alternatives

5.1 Introduction

5.1.1 This section provides an overview of the case for HS2 and sets out the approach that will be taken in relation to the consideration and reporting of alternatives in the ES.

5.2 The case

5.2.1 The case for HS2 revolves around four key elements: extra capacity, improved connectivity, local growth and direct opportunities for people and businesses.

5.2.2 The Government considers that a continuing increase in demand will create a need over the next 20 to 30 years for additional capacity to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. It does not, however, believe transferring rail investment to road or domestic aviation to be an appropriate solution. Rather, 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.

5.2.3 The Government does not consider that future enhancement packages or upgrades to existing rail lines will be sufficient to meet long-term capacity needs for passengers or freight. Upgrades to existing rail lines would cause substantial disruption to train services for the duration of upgrade and enhancement works and would only delay rather than eliminate the need for new lines in the future. In addition, the strategic, economic and connectivity benefits that high speed rail would be capable of delivering, would be foregone.

5.2.4 Previous studies undertaken by HS2 Ltd have identified that building new conventional rail lines would not be significantly cheaper, nor would their impacts on the environment and communities be significantly less than those of new high speed rail lines. Moreover, new conventional rail lines would deliver fewer benefits in terms of enhanced connectivity and support for long-term economic growth. These matters are described in more detail within the report High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed Y network²⁸.

5.2.5 The total benefits provided specifically by Phase 2b would be greater than those provided by strategic alternatives involving upgrades or alterations to existing rail lines. The Proposed Scheme would generate more rail demand, provide greater capacity and shorter journey times and benefit more passengers. These matters are described in more detail within the report Strategic Alternatives to HS2 Phase 2b (November 2016)²⁹. Furthermore, delivering Phase 2b enhances the overall economic case for HS2 as a whole. The Strategic Outline Business Case published in November 2016 sets out the incremental benefits accrued from delivery of the Proposed Scheme.

²⁸ Atkins (February 2011), *High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed 'Y' Network*

²⁹ Atkins (November 2016), *Strategic Alternatives to HS2 Phase 2b*

5.3 Reporting of alternatives

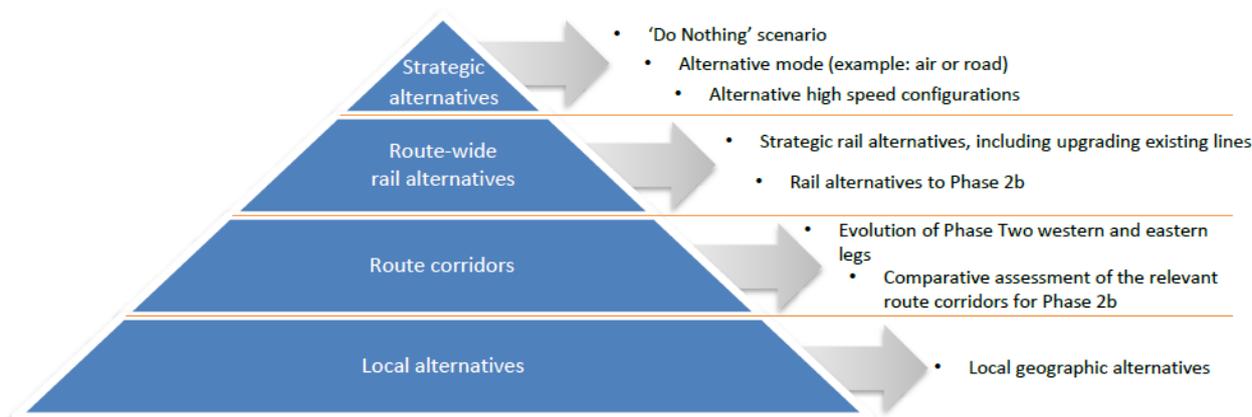
- 5.3.1 The Proposed Scheme reflects work by HS2 Ltd undertaken since 2010 to examine a substantial number of possible strategic, route-wide and local alternatives to the proposed route alignment. The main alternatives that have been considered for Phase Two and the Proposed Scheme are set out in a number of reports³⁰. The information contained within these reports will inform the main alternatives reported in the ES.
- 5.3.2 The case for a high speed rail network has already been accepted in the High Speed Rail (London-West Midlands) Act 2017. The alternatives to the proposed Y network will not be revisited in detail in the Phase 2b ES, as these have been presented in the Alternatives report for the Phase One ES published in November 2013.
- 5.3.3 These reports describe route alternatives considered up to the route announcement made in July 2017. The information within these reports will inform the description of strategic alternatives, route-wide rail alternatives, route corridor, station and depot location alternatives (see Sections 5.6 and 5.7 of this SMR). Thereafter, the ongoing design and EIA work will provide the basis for more local alternatives to the Proposed Scheme (see Section 5.8 of this SMR).
- 5.3.4 The reporting of alternatives will:
- summarise the reasons for choosing the Proposed Scheme, in the light of the other reasonable alternatives identified; and
 - outline the reasons for selecting the alternatives identified, including a description of how the assessment was undertaken including any difficulties encountered in compiling the required information.
- 5.3.5 The reporting of alternatives will also:
- describe the reasonable alternatives in terms of design, technology, location, size and scale;
 - include a comparison of the environmental effects of the relevant alternatives; and
 - outline the likely evolution of the current state of the environment without implementation of the Proposed Scheme (baseline scenario) (refer to individual environmental topics under Part B of this SMR).
- 5.3.6 In addition to environmental appraisal, a supporting narrative will be provided, where appropriate, on how the relevant alternatives considered have been evaluated, including from an engineering and operational perspective, with a clear justification for those options taken forward.

³⁰ *Options for Phase Two of the high speed rail network*, a report to Government by HS2 Ltd (March 2012); *Options for Phase Two of the high speed rail network appraisal of sustainability* (March 2012); *High Speed Rail: Consultation on the route from the West Midlands to Manchester, Leeds and beyond - Sustainability Statement, Volume 1: main report of the Appraisal of Sustainability* (July 2013); *Rebalancing Britain: From HS2 towards a national transport strategy* (October 2014); *The Strategic Case for HS2 Phase 2a* (November 2015); *High Speed Two: East and West, The next steps to Crewe and beyond* (November 2015); *The Economic case for HS2 Phase 2a, House of Commons Briefing Paper* (December 2015); *High Speed Rail: Phase 2b Preferred Route Sustainability Statement including Post Consultation Update* (November 2016)

5.4 The alternatives

- 5.4.1 The reasonable alternatives to be described will be set out in accordance with the hierarchy in Figure 7. The geographic scope and level of detail provided for the alternatives will vary depending on which level of the hierarchy they form a part. For example, the strategic alternatives will consider the scope of the whole Y network inclusive of both Phase 2a and 2b, and environmental factors will be considered at a high level. The route corridor alternatives, station and depot location alternatives will be confined to the geographic scope of Phase 2b and will be described in greater detail in the ES.

Figure 7 - Hierarchy of alternatives considered



- 5.4.2 Strategic alternatives and route wide rail alternatives will be reported in Volume 1. Local alternatives will be reported within the Volume 2 community area reports of the ES.

5.5 Strategic alternatives

- 5.5.1 The reporting of strategic alternatives will describe, in outline, alternatives to Phase Two, including:
- a 'do nothing' scenario;
 - alternative modes (air or road); and
 - alternative high speed configurations to the Y network.

5.6 Route wide rail alternatives

- 5.6.1 The reporting of route wide rail alternatives will describe, in outline, alternatives to Phase Two, including rail alternatives to Phase 2b.

5.7 Route corridor, station and depot location alternatives

- 5.7.1 A comparison of the environmental effects of different route corridor, station and depot location alternatives, and the reasons for the subsequent selection of the Preferred Scheme as announced in July 2017 and taken forward for EIA will be reported in the ES. This will concentrate on the relevant route corridor alternatives along the western leg between Crewe and Manchester Piccadilly via Manchester Airport (including a connection to the WCML), and along the eastern leg between the

West Midlands and Leeds (including connections to the Erewash Valley Line /MML and the ECML). It will also concentrate on the depot and stations along the route and at the terminus points of the route.

5.8 Local alternatives

- 5.8.1 This section will be split into two parts. The first part will report on those reasonable local alternatives considered in the development of the Preferred Scheme (as announced in July 2017). The second part will report on the reasonable local alternatives considered for the Proposed Scheme as the EIA progresses. In both cases the ES will report local, geographically specific reasonable route alternatives considered in the development of the Proposed Scheme. The reporting of local alternatives will take into account factors such as construction feasibility and programme, cost and environment in determining the preferred option to be taken forward into the Proposed Scheme.
- 5.8.2 There will continue to be refinement to the design in response to environmental assessment and the stakeholder engagement planned by HS2 Ltd, to address local environmental sensitivities and local issues raised through consultations and other factors such as engineering feasibility and cost. These would include, for example, the location of construction site compounds, the access routes to and from construction sites, and the location of environmental mitigation. Where appropriate and feasible, localised alternatives for these types of features will be considered in the ES in order to determine their most suitable location.
- 5.8.3 The outcomes of the appraisal for local alternatives, with a clear justification of options taken forward, will be reported in the ES.

5.9 Mitigation

- 5.9.1 The process by which environmental considerations have informed and been integrated into the design of the reasonable alternatives and the Proposed Scheme, including environmental mitigation measures, will be reported. This will include those measures or features which were considered to avoid, prevent or reduce any likely significant effects on the environment.

Part B

6 Agriculture, forestry and soils

6.1 Introduction

- 6.1.1 This section of the SMR covers agriculture, forestry and soils which includes the environmental topic areas of soil, agricultural and forestry land, and farm and farm-based enterprises. In particular, it considers the potential impacts of the requirements for land in terms of agricultural land quality, soil resources, local rural businesses and on-farm enterprises, and agri-environment schemes. The potential impacts on forestry, in the context of this topic, only relate to commercial forestry as a receptor.
- 6.1.2 The approach that will be adopted to assess agricultural impacts is derived from national planning policy and the revised EIA Directive 2014.
- 6.1.3 The principal feature of national policies regarding agricultural land use is the emphasis on safeguarding scarce natural resources in the long-term national interest. Consequently, policies for development in the countryside give a measure of protection to the best and most versatile agricultural land (defined as Grades 1, 2 and 3a in the Agricultural Land Classification (ALC) system).
- 6.1.4 National policy advises that the economic and other benefits of the best and most versatile agricultural land should be taken into account in decisions on development. Where substantial development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be used in preference to higher quality land.
- 6.1.5 ALC is not the sole consideration in assessing how development proposals affect agriculture. Other factors to be considered include the conservation of displaced soil resources and the impacts on farm holdings.
- 6.1.6 There have been no changes to legislation, guidance or best practice specific to agriculture, forestry and soils which has changed the scope or methodology for assessment since the Phase 2a SMR.

6.2 Establishment of baseline and definition of survey

- 6.2.1 A high-level description of the baseline environment is contained in paragraph 5.13.1 and 7.13.1 of the Phase 2b post-consultation Sustainability Report³¹. This indicates that the appraisal of sustainability process has sought to limit the loss of the highest quality, Grades 1 and 2, agricultural land, according to the five-grade ALC system described below.
- 6.2.2 High level agricultural land classification maps of the Proposed Scheme for the western leg show that Grade 1 agricultural land is limited to the drained peat of Chat Moss between Manchester and Liverpool. Approximately 900m of land shown as Grade 1 would be crossed by the route in the vicinity of Holcroft Moss. In addition, an estimated 19.8km of the western route would be through land classified as Grade 2, notably in the Mersey Valley around Lymm and Warrington. High level agricultural

³¹ HS2 Ltd (2016), *High Speed Rail: Phase 2b Preferred Route Sustainability Statement including Post Consultation Update*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568547/D25_WEB_C331_Sustainability_Statement_Including_Post_Consultation_Update_Volume_1_Main_Report_WEB_VERSION.pdf

land classification maps of the Proposed Scheme for the eastern leg show that no Grade 1 agricultural land would be directly affected. An estimated 28km of the eastern route would cross Grade 2 agricultural land, notably in the Tame Valley, in the low hills between the Anker and the Mease valleys, in the hills between Strelley and Greasley, and in the undulating plateau between Garforth and Church Fenton.

- 6.2.3 There is a well-established methodology for classifying the quality of agricultural land, contained within guidance issued by the then Ministry of Agriculture, Fisheries and Food (MAFF) in 1988³².
- 6.2.4 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. Grade 1 land is 'excellent quality' agricultural land with very minor or no limitations to agricultural use, and Grade 5 is 'very poor quality' land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a ('good quality' land) and Subgrade 3b ('moderate quality' land).
- 6.2.5 MAFF produced a Provisional ALC of England and Wales in the late 1960s/early 1970s at a scale of 1:63,360 (1 inch to 1 mile). This information is now shown on magic.gov.uk (at a scale of 1:250,000) and was used to inform the Phase Two Sustainability Statement. This ALC information was based on reconnaissance field surveys and was intended to provide general strategic guidance on agricultural land quality. It is not, however, sufficiently accurate for use in the assessment of individual developments and should not be used other than as general guidance. In addition to limitations of scale, this classification was undertaken using a system that has since undergone two fundamental revisions and does not distinguish between the subgrades of Grade 3, which has important policy implications.
- 6.2.6 Since the publication of the Provisional ALC, certain areas of the country (usually those proposed for non-agricultural development) have been surveyed in greater detail. Those surveys carried out by MAFF and its successors are available from Natural England, and are also shown on magic.gov.uk.
- 6.2.7 The approach to the ALC survey of all land to be acquired or used for the Proposed Scheme will be undertaken in two parts. Firstly, an interpretation of published geological, topographical, soil and agro-climatic information will be undertaken in the light of the ALC guidelines to provide a prediction of the likely grades of agricultural land that will be affected. Then the predictive ALC will be augmented with the results of detailed ALC surveys undertaken by MAFF or Department for Environment, Food and Rural Affairs (Defra) and by other recognised sources within or adjacent to the route corridor of the Proposed Scheme. The predictive ALC survey will also be augmented with the findings of detailed field survey along the route of the Proposed Scheme to validate its findings, where required and where practicable.
- 6.2.8 The soil surveys for ALC and soil resource plans will involve the examination of soil profiles using hand-held augers and spades. Samples will be taken for laboratory analysis. The soil characteristics will then be described and analysed in terms of the MAFF guidelines to verify the grade of agricultural land. The specification for ALC and

³² Ministry of Agriculture, Fisheries and Food (1988), *Agricultural Land Classification of England and Wales: Revised guidelines and criteria for grading the quality of agricultural land*, MAFF

soil surveys is set out in Technical note Agricultural Land Classification and Soils Surveys.

- 6.2.9 The soil surveys will inform this topic and will collect data on soil physical properties within woodlands and other open land, where practicable, in order to inform the potential selection of compensation areas for woodland affected by the Proposed Scheme, particularly ancient woodland. The surveys will collect nutrient, pH and organic matter samples within all open areas in order to inform proposals for landscape mitigation planting, habitat creation and translocation.
- 6.2.10 The soils data collected will provide detailed baseline information on the pre-construction ALC grade and will provide a target soil profile specification for restoration of agricultural land. It will provide the necessary information to delineate, quantify and characterise the topsoils and subsoils available prior to these materials being stripped, inform the designing in of climate change resilience for soils and provide the necessary detail to assess the suitability of the different soil materials for agricultural and other restored land uses. The survey data will also inform recommendations on appropriate methods for handling and storing soils in order to protect their main functions during construction to be set out in Information Paper, Soil handling for land restoration.
- 6.2.11 A risk assessment will be prepared to ensure that health and safety hazards relating to the ALC and soil surveys are taken into account. Defra guidance on biosecurity for visits to premises with farm animals will be followed³³. Biosecurity guidance for visits to woodland habitat will also be followed³⁴.
- 6.2.12 The term 'farm holding' is used in a wide sense and is taken to include land associated with arable cropping, livestock rearing, field-scale and glasshouse horticulture (of edible and non-edible crops), farm woodland enterprises such as wood fuel production, and private and commercial equestrian enterprises. Non-agricultural, land-based enterprises will be those within the control of the main occupier of the farm holding.
- 6.2.13 Information on the existing use of land to be acquired or used will be obtained primarily from the owners and occupiers of the land. Where land is within a written tenancy, this information will be obtained mostly from the tenant as it is the effects of the Proposed Scheme on occupiers of land and/or owners of the businesses affected that will be assessed for the EIA. This will involve face-to-face interviews based on a standard set of questions which will cover:
- a description of the existing size, location and use of farm holdings;
 - a description of the existing scale and nature of agricultural and non-agricultural enterprises based on farm holdings and their associated capital and labour inputs;
 - a discussion of the physical impacts on the structure and operation of the farm holding;

³³ Department for Environment, Food and Rural Affairs (Defra) (2008), *Biosecurity Guidance to Prevent the Spread of Animal Diseases*, Defra

³⁴ Forestry Commission England (2016), *Biosecurity – Keep it Clean*. Available online at: <https://www.forestry.gov.uk/england-keepitclean>

- a discussion about potential options to mitigate such impacts; and
- a discussion about potential options for mitigating significant environmental effects identified on an individual farm holding.

6.2.14 Where practicable, a representative of the HS2 Ltd stakeholder engagement team will attend the interviews alongside the agricultural surveyor. In order to minimise the number of visits to individual farm holdings, questions relating to other environmental matters may be raised within the interview as appropriate.

6.2.15 Information on the presence of any agri-environment schemes (such as Environmental Stewardship, the Woodland Grant Scheme and Countryside Stewardship) will be obtained from magic.gov.uk, the Natural England website³⁵ and from individual landowners and occupiers, who will also be asked for details of the nature, requirements and duration of such schemes on the whole farm.

6.2.16 In addition to data collected from landowners and occupiers, information on woodlands affected by the Proposed Scheme will be obtained from the National Forest Inventory³⁶.

6.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

6.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for agriculture, forestry and soils for the Proposed Scheme.

Engagement as part of the EIA process

6.3.2 It is intended to continue engagement with representatives from (but not exclusively):

- Natural England;
- Forestry Commission;
- the National Farmers' Union;
- the Country Land and Business Association;
- the Central Association of Agricultural Valuers; and
- the Confederation of Forest Industries.

6.3.3 The owners and occupiers of land to be acquired or used for the construction and operation of the Proposed Scheme would be consulted as part of the EIA process. The specification for farm impact assessment surveys is set out in Technical note Farm Impact Assessment Surveys.

³⁵ Natural England (2016), *Our Work; Farming and Land Stewardship; Funding for Land Management*; Available online at: <http://www.naturalengland.org.uk/ourwork/farming/funding/default.aspx>

³⁶ The National Forest Inventory (2016). Available online at: <http://www.forestry.gov.uk/inventory>

6.3.4 Consultation with owners and occupiers will be used to develop detailed design of the scheme to avoid or reduce impacts on farm holdings and rural business.

6.3.5 A farmer pack will be developed for the Proposed Scheme which will build on that established for Phase One and Phase 2a³⁷. The pack will provide a bespoke Farmers Record, the scope and content of which will reflect the individual circumstances of each landowner or occupier. It will include maps of the construction works and the permanent works on each holding, and will set out assurances and commitments made by HS2 Ltd, together with agreements reached between HS2 Ltd and the landowner or occupier. The pack will also set out a broad timeline of HS2 activities, including the estimated date of entry to the land for the commencement of construction, the construction programme and the opening of the railway. The third part of the pack will comprise a Guide for Farmers and Growers, which sets out HS2 policies and guidance in relation to agricultural matters, including acquisition, compensation, land management during construction, land restoration and other matters.

6.4 Key aspects of the Proposed Scheme for the topic

6.4.1 The key aspects of the Proposed Scheme that will affect agricultural land, forestry and soil interests will involve:

- permanent and temporary requirements for all grades of agricultural land; permanent land requirements will affect the nation's stock of agricultural land, which may include areas of high quality land;
- permanent and temporary displacement of soils in other land uses (e.g. woodland and land in agri-environment schemes); permanent loss of such soils will reduce the ability to support particular habitats. The ecology and climate change assessments consider the effects and impacts on biodiversity and carbon storage properties; see Sections 8 (Climate change) and 10 (Ecology);
- permanent requirement of commercial forestry land as a land use and management feature; permanent forestry land requirements will affect the nation's stock of forestry resource. The impacts on the ecological, historic environment and landscape and visual receptors relating to woodland are covered in Sections 10 (Ecology), 13 (Historic environment) and 15 (Landscape and visual);
- the sustainable re-use of soils displaced by the Proposed Scheme; soil is a finite resource which fulfils a number of functions and services. These include: food and fibre production; environmental interaction with air and water, particularly marked with peats and highly organic soils; support of ecological habitats and biodiversity; support for the landscape; protection of the historic environment; and provision of raw materials. The temporary displacement of soils introduces the risk of downgrading the quality of land during soil handling. Where agricultural uses are to be resumed on land disturbed during the construction of the Proposed

³⁷ HS2 (2016), *Guide for Farmers and Growers*. Available online at <https://www.gov.uk/government/publications/hs2-guide-for-farmers-and-growers>

Scheme, the design objective is to avoid any reduction in long term capability, which would downgrade the quality of the disturbed land, through the adoption of good practice techniques in handling, storing and reinstating soils on that land;

- permanent and temporary severance of agricultural land and loss of agricultural access; the severance of land may affect the continued ability to farm or otherwise use the land to its potential;
- permanent and temporary severance of commercially-managed woodlands affecting access for management and the continued viability of woodland management;
- loss of farm dwellings, farm buildings and other on-farm infrastructure; farm capital may support substantial areas of land and the loss of this capital may affect the continued ability to farm or otherwise use this land to its potential;
- permanent and temporary disruption or loss to drainage, irrigation and water supplies; such disruption or loss will affect land quality if permanent, and hence land use; or lead to short-term land use change; and;
- construction impacts, e.g. dust and pollution, on adjacent agricultural land which may affect the ability of that land to continue in its present land use; the likelihood of such impacts will be assessed, in the first instance, under the relevant topics. For example the air quality assessment considers the effects and impacts of dust; see Section 7 (Air quality).

6.5 Scope of assessment

Spatial scope

- 6.5.1 The study area will need to be defined for the agriculture, forestry and soils prior to assessment. For most of the key issues identified, the study area is likely to be restricted to the limits of the land to be acquired or used for the construction and operation of the Proposed Scheme, although there may be the potential for effects on neighbouring farmland during the construction and operational phases.
- 6.5.2 Baseline agricultural land quality and farm holding data will initially be collected for a zoom-wide corridor centred on the Proposed Scheme alignment, as the full extent of the study area (which equates to all agricultural land required for the construction of the Proposed Scheme) will be uncertain at the time of baseline work, although there will be a need for flexibility in the study area where off-site works are anticipated to extend beyond this limit.

Temporal scope

- 6.5.1 The temporal scope for this topic is outlined in Section 4.2 (Scope of the assessment) of this SMR. Agriculture forestry and soil effects will be assessed for the construction period (2023 – 2033) and the year of opening in 2033. The temporal scope will be extended for areas of re-instated agricultural land; typically, agricultural aftercare on

restored land lasts for five years following soil placement in order to ensure that soil structure has stabilised satisfactorily.

- 6.5.2 The methodology and timeframes for assessing climate change impacts on sensitive receptors and significant effects assessed by the agriculture, forestry and soils topic are set out in Section 8 (Climate change).

Technical scope

- 6.5.3 The EIA Directive 2014, the EIA Regulations 2017 and national planning policy will form the basis of the assessment of effects of the Proposed Scheme on agriculture, forestry and soils, and will define the scope of the assessment, namely:
- the quantity and quality of agricultural and forestry land that would be affected, both temporarily and permanently;
 - the quantity of forestry land that would be affected, both temporarily and permanently; the nature and use of the agricultural and non-agricultural soil resource that would be affected (and displaced) by the Proposed Scheme; and
 - the physical impact of land loss and severance and other impacts on agricultural enterprises and farm-based non-agricultural enterprises.

6.6 Assessment methodology

Legislation

- 6.6.1 In 2006, the European Commission adopted a comprehensive Thematic Strategy for Soil Protection³⁸ specifically dedicated to soil protection which included a proposal for a 'Soil Framework Directive'³⁹ to promote the sustainable use of soil and protect soil as a natural and non-renewable resource. However, the proposed Directive was withdrawn in April 2014 as it could not be agreed by a qualified majority. In taking its decision, the European Commission stated that it remains committed to the objective of the protection of soil and will examine options on how best to achieve this.
- 6.6.2 No direct replacement proposals have yet come forward from the Commission, although Directive 2014/52/EU emphasises that public and private projects should consider and limit their impact on land, particularly as regards land required, and on soil, including as regards organic matter, erosion, compaction and sealing (i.e. covering undisturbed natural soils with urban development and infrastructure construction).
- 6.6.3 Although there remains no specific UK legislation for the protection of soil and agricultural land, Defra issued the Soil Strategy for England – Safeguarding our Soils⁴⁰ in 2009. The aims of the Strategy have been incorporated into the Natural Environment White Paper, *The natural choice: securing the value of nature*⁴¹ and set out Defra's vision that by 2030 all England's soils will be managed sustainably and

³⁸ European Commission (EC) (2006), *Soil Thematic Strategy (COM (2006) 231*, EC

³⁹ European Commission (EC) (2006), *Proposal for a Soil Framework Directive (COM (2006) 232*, EC

⁴⁰ Department for Environment, Food and Rural Affairs (Defra) (2009), *Safeguarding our Soils: A Strategy for England*, Defra

⁴¹ Department for Environment, Food and Rural Affairs (Defra) (2011) *The Natural Environment White Paper, The natural choice: securing the value of nature*. London: The Stationery Office

degradation threats tackled successfully in order to improve the quality of England's soils and safeguard their ability to provide essential services for future generations.

6.6.4 The Strategy sets out priorities for action in respect of:

- better protection of agricultural soils;
- protecting and enhancing stores of soil carbon;
- building the resilience of soils to a changing climate;
- preventing soil pollution;
- effective soil protection during construction and development; and
- dealing with the legacy of contaminated land.

Planning policy

6.6.5 The National Planning Policy Framework⁴² (NPPF) advises at paragraph 109 that the planning system should contribute to and enhance the natural and local environment by, amongst other matters, protecting and enhancing soils.

6.6.6 Paragraph 112 of the NPPF indicates that the economic and other benefits of the best and most versatile agricultural land should be taken into account in development decisions. Where significant development of agricultural land is demonstrated to be necessary, poorer quality land should be used in preference to higher quality land.

6.6.7 There is no guidance in policy with regard to the effects of development proposals on farm holdings although paragraph 28 of the NPPF emphasises the need to support economic growth in rural areas to create jobs and prosperity by, amongst other means, promoting the development and diversification of agricultural and other land-based rural businesses.

6.6.8 Although Natural England's Technical Information Note (TIN) 049 (2012)⁴³ indicates that land quality is not the sole consideration in how development proposals affect agricultural land in the planning system, it no longer refers to other relevant factors such as the impact on farm size and structure, the use of buildings and other fixed equipment, or any stimulus a development might give to rural economic activity. TIN 049 indicates that planning authorities are guided by the NPPF to protect and enhance soils more widely, including for example conserving soil resources during construction and preventing soil from being adversely affected by pollution.

Guidance

6.6.9 The Planning Practice Guidance (PPG)⁴⁴ was issued in March 2014 and repeats policy in paragraph 112 of the NPPF in respect of the quality of agricultural land.

6.6.10 The guidance indicates that the ALC provides a method for assessing the quality of farmland to enable informed choices to be made about its future use within the

⁴² Department for Communities and Local Government (DCLG) (2012), *National Planning Policy Framework*. London: The Stationery Office

⁴³ Natural England (2012), *Agricultural Land Classification: protecting the best and most versatile agricultural land*. Technical Information Note TIN049, Second edition, www.naturalengland.org.uk

⁴⁴ Department for Communities and Local Government (2016). *Planning Practice Guidance*. Available online at: <http://planningguidance.communities.gov.uk/>

planning system, with direction given to Natural England for further information on ALC. The guidance also confirms that Natural England has a statutory role in advising local planning authorities about agricultural land quality issues.

- 6.6.11 The guidance also repeats policy in the NPPF in respect of soils and states that the planning system should protect and enhance valued soils because they are an essential finite resource that provides important ecosystem services, such as a growing medium for food, timber and other crops, a store for carbon and water, a reservoir of biodiversity and a buffer against pollution.
- 6.6.12 Guidance on classifying agricultural land is contained in 'Agricultural Land Classification of England and Wales, Revised guidelines and criteria for grading the quality of agricultural land', prepared by MAFF in 1988 and summarised in Natural England's TIN 049.
- 6.6.13 Good practice guidance on soil handling and management during the construction phase, to minimise potential adverse impacts on the soil resource, is found in MAFF's 'Good Practice Guide for Handling Soils'⁴⁵, Defra's 'Construction Code of Practice for the Sustainable Use of Soils on Construction Sites'⁴⁶ and Defra's 'Guidance for Successful Reclamation of Mineral and Waste Sites'⁴⁷.
- 6.6.14 Guidance on the assessment of effects on farm holdings, such as severance and fragmentation which could affect viability, is provided in the Design Manual for Roads and Bridges (DMRB)⁴⁸. Although developed for highways projects, the DMRB has developed methodologies that are also useful for other linear developments.
- 6.6.15 Guidance on the sustainable management of forestry soils is provided in the United Kingdom Forestry Standard (UKFS) guidelines on Forests and Soil⁴⁹.

Significance criteria

- 6.6.16 In order to assess the effects of the Proposed Scheme on agricultural resources, significance criteria are adopted which relate to the effects on agricultural land and soils, on farming and other farm-based enterprises, and on commercially-managed forestry land.
- 6.6.17 The significance level attributed to each effect will be assessed based on the magnitude of change due to the Proposed Scheme, the sensitivity of the affected receptor/receiving environment to change, and the relative scarcity or abundance of the resource/receptor in the locality, as well as in a wider context, given that some receptors or features may group or converge in a particular locality.
- 6.6.18 The significance criteria are based on available guidance and have been developed following consultation with Defra, Natural England, and the Forestry Commission.
- 6.6.19 The ALC survey will provide a statement of the amount and quality of agricultural land within the land to be acquired or used for the construction and operation of the Proposed Scheme. The magnitude of change will be reflected in the land required

⁴⁵ Ministry of Agriculture, Fisheries and Food (MAFF)(2000), *Good Practice Guide for Handling Soils*, MAFF

⁴⁶ Defra (2009), *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*, Defra

⁴⁷ Defra (2004), *Guidance for Successful Reclamation of Mineral and Waste Sites*, Defra

⁴⁸ Highways Agency et al. (2001), *Design Manual for Roads and Bridges*, Volume 11, Section 3, Part 6 Land Use

⁴⁹ Forestry Commission (2011), *Forests and soil, UK Forestry Standard Guidelines*. Available online at: <http://www.forestry.gov.uk/forestry/infd-8bvduk>

permanently and temporarily for the Proposed Scheme and the sensitivity of the agricultural land resource will be reflected in its grading relative to the abundance of best and most versatile land within a 4km corridor in each community area.

- 6.6.20 This topic will consider the conservation and reinstatement of displaced soil resources. Natural and undisturbed soils on agricultural land, forestry/woodland and ecologically valuable areas that is disturbed by the Proposed Scheme are a distinct and important subset of excavated materials. Their separate handling (where required for agricultural/forestry/ecological re-use) will be subject to different and higher standards of management than other excavated material in order to reflect and retain their greater environmental value and potential. As such, they will be handled differently from other excavated materials.
- 6.6.21 It is common practice for EIA significance criteria to set an absolute threshold for the loss of a certain area of best and most versatile agricultural land (typically 20 or 50 hectares). However, such an approach will be inappropriate for a project of this scale; instead the local significance of loss of best and most versatile land will be related to the abundance or special value of such land in the relevant community area.
- 6.6.22 The assessment will set out the predicted physical impacts on individual farm holdings, including the land required in each holding during the construction phase, the area of land severed, the area to be restored to agriculture and the resulting permanent requirement for land from each holding, including the permanent requirement for land for landscape planting and habitat creation. The effects will be expressed primarily in physical terms and will reflect the degree of operational change required following construction of the Proposed Scheme.

Agricultural receptors (farms and other rural land-based businesses)

- 6.6.23 The nature of impacts will comprise primarily the requirement of land from the farm holding (permanent and temporary), the severance of parcels of agricultural land (permanent and temporary), the loss of key farm infrastructure (dwellings, buildings and other structures such as irrigation reservoirs and slurry pits) and the imposition of disruptive effects, such as noise and dust, on land uses and the holding's operations.
- 6.6.24 Guideline criteria for assessing the magnitude of impacts are presented in Table 2. Where a farm holding experiences different levels of impact for different types of impact, the higher level will be assigned. Thus, for example, a farm holding that will lose 15% of its land (medium impact) but will retain access to severed land via a private means of access (low impact) will be assessed as incurring a medium impact.

Table 2 - Impact magnitude criteria for farm holdings

Impact magnitude	Definitions			
	Land required	Severance	Infrastructure	Disruptive effects
High	>20% of all land farmed	No access available to severed land	Direct loss of farm dwelling, building or structure substantially affecting the flexibility of farm management	Disruption discontinues land use or enterprise

Impact magnitude	Definitions			
Medium	>10% - 20% of all land farmed	Access available to severed land via the public highway	Loss of or damage to infrastructure affecting the flexibility of farm management	Disruption necessitates substantial change to scale or nature of land use or enterprise
Low	> 5% - 10% of all land farmed	Access available to severed land via private way	Infrastructure loss/damage does not affect the flexibility of farm management	Disruption necessitates some changes to scale or nature of land use or enterprise
Negligible	5% or less of all land farmed	No new severance	No permanent impact on farm infrastructure	Disruption does not affect land use or enterprise

6.6.25 The sensitivity of receptors will be determined by the extent to which they have the capacity to absorb or adapt to impacts, which will be determined primarily by their nature and scale.

6.6.26 In general terms, larger farm holdings will have a greater capacity to absorb impacts and will be less sensitive. However, the scale of the land holding is reflected in the magnitude of impact and the percentage of land required from the farm. For example, the loss of 100 hectares from a 400 hectare (1,000 acre) farm would be a high impact (25%) whereas the same area of land required from a 1,000 hectare farm would be low (10%). The sensitivity criteria therefore concentrate on the nature of the receptor in order to avoid giving undue weight to the scale of operations. They are presented in Table 3.

Table 3 - Agriculture receptor sensitivity criteria

Receptor sensitivity	Definition
High	<p>Farm types in which the operation of the enterprise is dependent on the spatial relationship of land to key infrastructure, and where there is a requirement for frequent and regular access between the two, or dependent on the existence of the infrastructure itself, e.g.:</p> <ul style="list-style-type: none"> • dairying, in which milking cows travel between fields and the parlour at least twice a day; • irrigated arable cropping and field-scale horticulture, which are dependent on irrigation water supplies; and • intensive livestock or horticultural production which is undertaken primarily within buildings, often in controlled environments.
Medium	<p>Farm types in which there is a degree of flexibility in the normal course of operations, e.g.:</p> <ul style="list-style-type: none"> • combinable arable farms; and • grazing livestock farms (other than dairying).
Low	Farm types and land uses undertaken on a non-commercial basis.

6.6.27 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table 4.

Table 4 - Significance of effect criteria

Significance		Impact magnitude			
		High	Medium	Low	Negligible
Sensitivity of receptor	High	Major – significant	Major/Moderate – significant	Moderate– significant	Minor – not significant
	Medium	Major/Moderate – significant	Moderate – significant	Minor – not significant	Negligible – not significant
	Low	Moderate - significant	Minor – not significant	Negligible – not significant	Negligible – not significant

Agricultural land

6.6.28 Guideline criteria for assessing the magnitude of impacts are presented in Table 5. The magnitude of impact is assessed according to the proportion of best and most versatile agricultural land required by the Proposed Scheme within each community area.

Table 5 - Impact magnitude criteria for agricultural land

Impact magnitude	Definitions
High	More than 60% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land
Medium	20% - 60% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land
Low	Less than 20% or less than 10ha of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile land
Negligible	Less than 2% of agricultural land required for the construction or operation of the Proposed Scheme is best and most versatile agricultural land

6.6.29 The sensitivity of resources affected will be determined by their inherent value, as reflected in the proportion of best and most versatile land within each community area, within the context of the abundance of best and most versatile agricultural land in the locality, defined as a 4km corridor centred on the Proposed Scheme, as shown in Table 6.

Table 6 - Agriculture resources sensitivity criteria

Resources sensitivity	Definition
High	Best and most versatile agricultural land where 'Low Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps
Medium	Best and most versatile agricultural land where 'Moderate Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps

Resources sensitivity	Definition
Low	Best and most versatile agricultural land where 'High Likelihood of best and most versatile agricultural land' is the most extensive category in a 4km-wide corridor according to the Defra Likelihood maps

6.6.30 The Defra database and maps, 'Likelihood of Best and Most Versatile Agricultural Land' show:

- areas of High Likelihood, where more than 60% of the land is likely to be Best and Most Versatile;
- areas of Moderate Likelihood, where 20% to 60% of the land is likely to be Best and Most Versatile; and
- areas of Low Likelihood, where less than 20% of the land is likely to be Best and Most Versatile.

6.6.31 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table 4. At the route-wide level, the proportion of each grade of agricultural land that would be required for the Proposed Scheme will be compared to national estimates of each grade of land as a measure of the significance of effect on the national resource of agricultural land. At the local level, the quality of land required for the Proposed Scheme will be related to the abundance of Best and Most Versatile Land within a 4km corridor in each community area.

Forestry land

6.6.32 Woodlands are an important natural resource as they offer soil protection, water regulation and carbon storage, provide wood products and support forest industries.

6.6.33 This assessment will consider the quantitative impact on commercial forestry land as a land use and management feature. It will not assess the other impacts related to woodland, for which reference needs to be made principally to the ecology, historic environment and landscape and visual assessments; see Sections 10 (Ecology), 13 (Historic environment) and 15 (Landscape and visual) respectively.

6.6.34 The nature of the impact will comprise the direct requirement for forestry land. The areas of forestry land that will be affected by the Proposed Scheme will be measured and also expressed as a percentage of the total land requirements within the community area, as shown in Table 7.

Table 7 - Impact magnitude criteria for forestry land

Impact magnitude	Definitions
High	More than 10% of land required for the construction or operation of the Proposed Scheme is forestry land
Medium	6% - 10% of land required for the construction or operation of the Proposed Scheme is forestry land
Low	Less than 6% of land required for the construction or operation of the Proposed Scheme is forestry land

Impact magnitude	Definitions
Negligible	Less than 1% of land required for the construction or operation of the Proposed Scheme is forestry land

6.6.35 The sensitivity of commercial forestry, as a land use, will be determined within the context of the abundance of forestry land in the locality, as measured within a 4km-wide corridor, following the approach taken with agricultural land. The abundance will be related to the average woodland coverage in England of 10%, as shown in Table 8.

Table 8 - Forestry land sensitivity criteria

Resources sensitivity	Definition
High	Forestry land where there is less than the national average forestry cover (<6%) within a 4km wide corridor within the community area
Medium	Forestry land where there is the national average forestry cover (6-10%) within a 4km wide corridor within the community area
Low	Forestry land where there is above the national average forestry cover (>10%) within a 4km wide corridor within the community area

6.6.36 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table 4.

Soil resources

6.6.37 The impact on the soil resource will reflect the degree to which disturbed soil resources are reused on and, if necessary, off the Proposed Scheme in a manner that enables the resource to continue to fulfil one or more of the primary soil functions of:

- the production of food and biomass, and the provision of raw materials;
- the storage, filtration and cycling of water, carbon and nitrogen in the biosphere;
- the support of ecological habitats and biodiversity;
- the support for the landscape;
- the protection of the historic environment; and
- the provision of a platform for human activities, particularly construction and recreation.

6.6.38 Peat has a higher organic matter content than other soils and represents a large reservoir of organic carbon. It is recognised that substantial peat deposits to the west of Manchester will be disturbed by the construction of the Proposed Scheme. Particular care will be taken to ensure that peat and peaty soils are handled under appropriate soil moisture conditions to reduce damage to their physical characteristics and reduce CO₂ emissions.

- 6.6.39 The assessment will consider the key functions identified for soil in a particular location and use the criteria for assessing the magnitude of impact as shown in Table 9.

Table 9 - Impact magnitude criteria for soils

Impact magnitude	Definitions
High	The soil displaced from the Proposed Scheme is unable to fulfil one or more of the primary soil functions
Medium	The soil displaced from the Proposed Scheme mostly fulfils the primary soil functions off-site or has a reduced capacity to fulfil the primary functions on site
Low	The soil displaced from the Proposed Scheme mostly fulfils the primary soil functions on-site
Negligible	The soil retains its pre-existing functions on-site

- 6.6.40 The sensitivity of displaced soil will reflect its textural characteristics, in the light of local rainfall conditions, and its susceptibility to the effects of handling during construction and the re-instatement of land, as shown in Table 10.

Table 10 - Soil sensitivity criteria

Resources sensitivity	Definition
High	Soils with high clay and silt fractions (clays, silty clays, sandy clays, heavy silty clay loams and heavy clay loams) and organic and peaty soils where Field Capacity Days (FCD) are 150 or greater Medium textured soils (silt loam, medium silty clay loam, medium clay loam and sandy clay loam) where FCDs are 225 or greater
Medium	Soils with a high clay and silt fraction (clay, silty clay, sandy clay, heavy silty clay loam and heavy clay loam) and organic and peaty soils where FCDs are fewer than 150 Medium textured soils (silt loam, medium silty clay loam, medium clay loam, sandy clay loam) where FCDs are fewer than 225 Soils with a high sand fraction (sands, loamy sands, sandy loams and sandy silt loams) where FCDs are 225 or greater
Low	Soils with a high sand fraction (sands, loamy sands, sandy loams and sandy silt loams) where the FCD is fewer than 225

- 6.6.41 The significance of an effect will be a product of the magnitude of the impact and the sensitivity of the receptor, as summarised in Table 4.

Construction effects

- 6.6.42 Construction effects on agricultural and forestry land and farm and land-based enterprises will include: land requirements; severance of agricultural and forestry land and farm holdings; the loss of, or disruption to, buildings and operational infrastructure such as drainage; and the use of the soil resource displaced by the construction of the Proposed Scheme.

- 6.6.43 Other construction effects will include: the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; unintentional pollution of soil and water courses or bodies, used for crop irrigation or livestock drinking water supplies; spread of injurious weeds to adjacent agricultural land from soil and material stockpiles; and construction noise on farm and farm-based enterprises.
- 6.6.44 Construction effects will be distinguished between temporary and permanent effects. Temporary construction effects will comprise the land required to construct the Proposed Scheme which will include: the land returned to agricultural or forestry use after construction; the temporary severance of land during the construction period; and the effects of disruption, principally from construction noise and dust, on land uses and enterprises.
- 6.6.45 Permanent construction effects will comprise: the net area of agricultural and forestry land required to operate the Proposed Scheme, following the construction period and the restoration of land required temporarily to agricultural and forestry uses; the permanent severance of land; and the permanent loss of or effect on farm infrastructure such as property, buildings and structures, and the consequential effects on land uses and enterprises.

Operational effects

- 6.6.46 Operational effects on agricultural and forestry land and farm and farm-based enterprises may include sound emanating from moving trains and the propensity of operational land to harbour noxious weeds.
- 6.6.47 The sound, noise and vibration assessment considers the effects on agricultural livestock receptors; see Section 18 (Sound, noise and vibration).
- 6.6.48 The following screening criteria for the predicted operational airborne sound levels will be used to identify potential adverse effects upon agricultural livestock:
- Daytime 70 dB $L_{pAeq, 16hour}$;
 - Night-time 60 dB $L_{pAeq, 8hour}$; and
 - During a train pass-by 90 dB L_{pAFmax}^{50} .
- 6.6.49 Since grazing livestock is able to move freely away from the sound source, the assessment will concentrate on identifying and assessing effects on fixed livestock buildings or other enclosures within 40m of the nearest track.

Cumulative effects

- 6.6.50 The construction of the Proposed Scheme, combined with the construction of Phase One and Phase 2a of HS2 and developments that are already taking place or anticipated along the route of the Proposed Scheme, may result in increased pressure on agricultural and forestry land and farm businesses. Cumulative effects will be assessed in relation to other substantial projects that have received consent at the time of the assessment.

⁵⁰ Where the animal is habituated to the source then this screening criterion is not applicable.

6.7 Assumptions

- 6.7.1 The assessment within this topic area considers soils as a medium for food and fibre production, and excludes an assessment of soil quality from the perspective of contamination, which is detailed in Section 14 (Land quality) of this SMR. Soil also fulfils a number of functions, such as environmental interaction with air and water; support for ecological habitats and biodiversity; support for the landscape; and protection of the historic environment. These aspects will be assessed under the relevant environmental topics within the ES.
- 6.7.2 This assessment also considers the effects on all farms (including horticulture), equestrian units, farm woodland and forestry enterprises, farm-based recreational and tourist uses and farm diversification projects that are either ancillary to the main agricultural use or within the control of the farm business. Other rural enterprises are assessed in Sections 9 (Community) and 17 (Socio-economics) of this SMR.

7 Air quality

7.1 Introduction

7.1.1 This section of the SMR covers air quality which includes the environmental topic area of local air quality and air pollution. It describes the methodologies that will be used to identify the potential for impacts and effects upon sensitive human and ecological receptors.

7.1.2 Air quality changes would occur during construction as a result of the construction activities, associated traffic movements and highway interventions. During operation, the main changes in air quality would arise as a result of changes to road layouts and traffic flows.

7.1.3 The assessment will focus on air pollutants that are likely to arise from the construction and operation of the Proposed Scheme. These pollutants are oxides of nitrogen (NO_x), nitrogen dioxide (NO₂), particulate matter (PM₁₀, PM_{2.5}) and dust.

7.2 Establishment of baseline and definition of survey

7.2.1 The Proposed Scheme runs through both rural and urban areas. In rural areas air quality is generally good but elevated pollutant concentrations exist in urban areas mainly related to vehicle emissions from heavily trafficked roads. Where concentrations are elevated, local authorities have declared Air Quality Management Areas (AQMAs).

7.2.2 The air quality assessment will include a review of existing AQMAs and potential Clean Air Zones (CAZ) that may exist within the study area.

7.2.3 Baseline air quality information will be obtained from background maps published by Defra, air quality monitoring data from local authority and national networks and local authority air quality reports. Where required, further monitoring will be undertaken including for model verification purposes and/or to gather more information on existing air quality.

7.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

7.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for air quality for the Proposed Scheme.

Engagement as part of the EIA process

7.3.2 The key stakeholders to be engaged with in relation to air quality assessment methodology are environmental health departments at local authorities where:

- the Proposed Scheme would pass through;
- the Proposed Scheme maintenance depots would be located;
- the Proposed Scheme stations would be located;

- significant changes in operational or construction traffic would occur; and
- there are construction activities in general.

7.4 Key aspects of the Proposed Scheme for the topic

7.4.1 The main air quality effects from the Proposed Scheme during its construction would arise from:

- emissions associated with site plant and vehicles;
- emissions from construction traffic;
- changes in traffic emissions arising from local diversions and road realignments; and
- dust arising from activities such as use of haul roads, wind erosion of temporary stockpiles, earth moving operations, and demolition activities.

7.4.2 The above aspects would have the potential to cause changes in NO₂ and PM₁₀/PM_{2.5} concentrations and may cause dust deposition at sensitive human receptor locations. In addition, some have the potential to cause changes in NO_x concentrations at ecologically sensitive habitats. Ozone will not be considered in this assessment as it is formed at a regional level and the expected changes in pollutant emissions are unlikely to have a significant effect on its formation in the atmosphere.

7.4.3 Air quality effects from the operation of the Proposed Scheme can be categorised into direct and indirect effects. Direct effects would arise from the changes in traffic flows on the highway network, as well as emissions from buildings. Indirect effects would arise from changes in emissions brought about by a modal shift from car to rail services, which may have a beneficial effect on air quality.

7.5 Scope of assessment

Spatial scope

7.5.1 Assessment of the effects of emissions arising from local traffic diversions and construction traffic around worksites and stations would be limited to receptors located along roads that meet any of the criteria specified in the Design Manual for Roads and Bridges (DMRB)⁵¹. These criteria will be applied along the length of the route of the Proposed Scheme to identify where further assessment is required, and comprise:

- road alignment change by 5m or more;
- daily traffic flows change by 1,000 annual average daily traffic (AADT) or more;
- heavy duty vehicle (HDV) flows change by 200 AADT or more;

⁵¹ Highways Agency (2007), *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, HA207/07*, The Stationery Office

- daily average traffic speed change by 10kph or more; or
- peak hour traffic speed change by 20kph or more.

- 7.5.2 The assessment of dust emissions arising from construction sites associated with the Proposed Scheme will be carried out in accordance with the Institute of Air Quality Management (IAQM) Guidance⁵². These include areas around worksites where there are sensitive receptors within 350m from the construction site boundary and/or within 50m of the routes used by construction vehicles on the public highway and up to 500m from construction site entrances.
- 7.5.3 The assessment of dust emissions associated with any mineral extraction during construction undertaken as part of the Proposed Scheme will be carried out in accordance with the IAQM mineral dust guidance⁵³.
- 7.5.4 Assessment of nitrogen deposition will be required if there are significant changes in traffic flows within 200m of ecologically sensitive sites. The assessment will follow the methodology set out in the DMRB guidance. Ecological resources and other ecological issues are described in Section 10 (Ecology), of this SMR.
- 7.5.5 Assessment of health effects from air pollution will be undertaken for NO₂ and PM_{2.5} concentrations for the population within 200m of the affected road network. The health effects in relation to air quality are also described in Section 12 (Health) of the SMR.

Temporal scope

- 7.5.6 The assessment of air quality effects due to changes in traffic during construction of the Proposed Scheme will be undertaken for the following scenarios:
- future 'without the scheme' traffic emissions for the peak years during the construction period; and
 - future 'with the scheme' traffic emissions for the peak year during the construction period.
- 7.5.7 The assessment of air quality effects due to changes in traffic during operation of the Proposed Scheme will be undertaken for the following scenarios:
- future 'without the scheme' traffic emissions during the opening year of operation; and
 - future 'with the scheme' traffic emissions during the opening year of operation.

Technical scope

- 7.5.8 The assessment will not include the transboundary effects of the Proposed Scheme on air quality, as the likely changes in atmospheric emissions would be negligible in this context.

⁵² Institute of Air Quality Management (IAQM) (2014), *Guidance on the assessment of dust from demolition and construction*, IAQM

⁵³ IAQM (2016), *Guidance on the assessment of mineral dust impacts for planning*. Available online at: http://www.iaqm.co.uk/text/guidance/mineralsguidance_2016.pdf

7.6 Assessment methodology

Legislation

7.6.1 The assessment will take into account the following legislation, and any subsequent changes to this legislation:

- Part 4 of the Environment Act 1995;
- The Air Quality (England) (Amendment) Regulations 2002⁵⁴ and the Air Quality Standards Regulations 2010⁵⁵ and the Air Quality Standards (Amendment) Regulations 2016⁵⁶;
- Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe⁵⁷; and
- National Planning Policy Framework (NPPF) 2012⁵⁸ and National Planning Practice Guidance (NPPG) 2014⁵⁹.

Guidance

7.6.2 The assessment will take into account the following guidance:

- Local Air Quality Management (LAQM) Technical Guidance (2016)⁶⁰;
- DMRB Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, HA207/07;
- IAQM and Environmental Protection UK (EPUK) guidance on land-use planning and development control 2017⁶¹;
- Greater London Authority (GLA) Supplementary Planning Guidance, Control of Dust and Emissions during Construction and Demolition⁶²;
- IAQM guidance on the assessment of dust from demolition and construction; and
- IAQM guidance on the assessment of mineral dust impacts.

Air quality standards

7.6.3 Air quality limit values and objectives are quality standards for clean air and to protect human health or harm to vegetation. These limit values and objectives will be used as assessment criteria for determining the significance of any potential changes in local air quality resulting from the Proposed Scheme. Some pollutants have standards expressed as annual average concentrations and others have standards expressed as

⁵⁴ *The Air Quality (England) (Amendment) Regulations 2002* (SI 2002 No. 3043). London: The Stationery Office

⁵⁵ *The Air Quality Standards Regulations 2010* (SI 2010 No. 1001). London: The Stationery Office

⁵⁶ *The Air Quality Standards (Amendment) Regulations 2016* (SI 2016 No. 1184). London: The Stationery Office

⁵⁷ Official Journal of the European Union (2008), *Directive 2008/50/EC of the European Parliament and of the Council of the 21 May 2008 on ambient air quality and cleaner air for Europe*, EU

⁵⁸ Department for Communities and Local Government (2012), *National Planning Policy Framework*

⁵⁹ Department for Communities and Local Government (2014), *National Planning Practice Guidance - Air Quality*

⁶⁰ Department for Environment, Food and Rural Affairs (2016), *Local Air Quality Management Technical Guidance*.

⁶¹ Moorcroft and Barrowcliffe et al, (2015), *Land-Use Planning & Development Control: Planning for Air Quality*, London: Institute of Air Quality Management.

⁶² Greater London Authority (GLA) (2014), *Supplementary Planning Guidance, Control of Dust and Emissions during Construction and Demolition*.

24-hour, 1-hour or 15-minute average concentrations. Some pollutants have standards expressed in terms of both long-term and short-term concentrations.

- 7.6.4 Table 11 sets out the EU air quality limit values and UK national air quality objectives for the pollutants relevant to this study (NO_x, NO₂, PM₁₀ and PM_{2.5}). In the ES, the term 'air quality standards' will be used to refer to both the English air quality objectives and the air quality limit values introduced in the UK based on EU Directives.

Table 11 - UK and EU air quality standards

Pollutant	Averaging period	Limit value / Objective
NO _x (for protection of vegetation)	Annual mean	30µg/m ³
NO ₂	Annual mean	40µg/m ³
NO ₂	1 hour mean	200µg/m ³ not to be exceeded more than 18 times a year (99.8th percentile)
PM ₁₀	Annual mean	40µg/m ³
PM ₁₀	24 hour mean	50µg/m ³ not to be exceeded more than 35 times a year (90.4th percentile)
PM _{2.5}	Annual mean	25µg/m ³

Construction effects

Dust emissions

- 7.6.5 The construction effects will be assessed through an investigation of potential sources of air pollutant emissions from construction activities and through the formulation of appropriate mitigation and control measures. An environmental risk assessment of construction effects will be carried out using the risk-based approach from the IAQM guidance, as described in the Air Quality Technical note Guidance on assessment methodology (Annex A).
- 7.6.6 An assessment of dust emissions associated with any mineral extraction activities will be carried out using the risk-based approach from the IAQM mineral dust guidance as described in the Air Quality Technical note Guidance on assessment methodology.
- 7.6.7 The assessment will identify where particular mitigation measures are required to address local issues. These mitigation measures will be detailed in the Local Environmental Management Plans being developed for each local authority area.

Traffic emissions

- 7.6.8 With regard to assessment of the effects of emissions arising from changes in traffic flows during construction, traffic data will be screened using the DMRB criteria described in paragraph 7.5.1. Following this screening exercise, roads meeting any of these criteria would be subject to a detailed assessment using the atmospheric dispersion model ADMS-Roads to investigate the effects of changes in traffic flows. Dispersion modelling would use the latest vehicle emission data from Defra and take

into account information in the National Atmospheric Emissions Inventory (NAEI), as appropriate. Comparison of the results with and without the construction traffic and local diversions in the future years would allow the effect to be determined.

- 7.6.9 This assessment would comply with the requirements of LAQM Technical Guidance and would address the issues related to model verification and sensitivity analysis. This will only be considered in relation to areas where detailed air dispersion modelling is required and it will not be necessary elsewhere on the route of the Proposed Scheme. The approach for assessing traffic emissions is further described in the Air Quality Technical note - Guidance on the assessment methodology.
- 7.6.10 Defra has published technical guidance for local authorities on when and how emissions from moving and stationary diesel trains should be considered in relation to LAQM duties⁶³. In the absence of any other specific guidance, this will be used to inform the assessment of potential air quality impacts from construction related train operations. Defra's guidance addresses locations with relevant exposure where there is risk of exceedance of the annual mean air quality standard for NO₂. Such locations are within 30m of railway tracks but only where the background annual mean NO₂ concentration is above 25µg/ m³. In the context of the Proposed Scheme these locations may occur in the vicinity of temporary railheads where diesel locomotives are used for construction related activities.

Operational effects

- 7.6.11 Operational effects due to changes in traffic flows and diversion of traffic along the route of the Proposed Scheme and at off-route locations would be assessed using the methodology described in paragraph 7.6.8. The assessment of emissions from other sources, such as emissions from buildings, will be assessed using the ADMS dispersion model if a significant impact is expected. This is further described in the Air Quality Technical note Guidance on assessment methodology. An initial appraisal will be undertaken that will examine the magnitude and location of the emissions to determine the need for dispersion modelling.

Nitrogen Deposition

- 7.6.12 Where there is a need to carry out an assessment of nitrogen deposition near to sensitive sites, for both the construction and operational assessments, this will follow the methodology detailed in Volume 11 of the DMRB. Any changes in nitrogen deposition will also be reported in terms of the percentage change relative to the critical load and level for ecosystem protection. Any potential impacts on ecological systems relating to air quality changes will be addressed in the ecological assessment, Section 10 (Ecology).

Cumulative effects

- 7.6.13 Cumulative effects will be largely taken into account in the traffic data used for the assessment which will incorporate likely changes brought about by other proposed and committed developments both during and following construction. Where there is planned development that includes significant emissions to the atmosphere then

⁶³Defra (2016), Local Air Quality Management Technical Guidance (TG16). Available online at: <https://laqm.defra.gov.uk/documents/LAQM-TG16-April-16-v1.pdf>

these emissions would be included within the air quality modelling undertaken for the Proposed Scheme if these are likely to result in cumulative effects.

- 7.6.14 Where there is the potential for more than one site to contribute to construction dust impacts, the cumulative effects will be considered in the assessment.

7.7 Assumptions

- 7.7.1 The air quality assessment assumes that details of construction activities would be available for the construction sites.
- 7.7.2 The air quality assessment will take into account HS2 Ltd's policies on vehicles emissions, i.e. the use of Euro VI HGVs and Euro 4/6 petrol/diesel cars and LGVs during construction of the Proposed Scheme.

8 Climate change

8.1 Introduction

8.1.1 This section of the SMR addresses the scope and methodology for the three route-wide assessments to be undertaken within the climate change topic:

- the greenhouse gas (GHG) assessment;
- the in-combination climate change impacts assessment; and
- the climate change resilience assessment.

8.1.2 The GHG assessment relates to the effects of the Proposed Scheme on GHG emissions contributing to climate change. The in-combination climate change impacts assessment relates to the combined effect of the impacts of the Proposed Scheme and potential climate change impacts on the receiving environment. In line with IEMA guidance⁶⁴, the combined effect of the impacts of the Proposed Scheme and potential climate change impacts on the receiving environment are referred to as 'in-combination impacts' and 'in-combination effects'. This is distinct from uses of the terms 'combined effects' and 'cumulative effects' used elsewhere in the SMR. The climate change resilience assessment relates to the resilience of the Proposed Scheme to climate change impacts.

8.1.3 For purposes of clarity, this section addresses the three climate change topic assessments separately, except for the sub-section on stakeholder engagement and consultation processes.

8.1.4 As stated in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) Synthesis Report⁶⁵, mitigation (i.e. reducing GHG emissions) and adaptation (i.e. responding to climate change impacts) are complementary approaches to reducing risks of climate change impacts over different timescales. Mitigation, in the short-term and medium-term, can substantially reduce climate change impacts in the latter decades of the 21st century. Benefits from adaptation can be realised now to address current risks, and can be realised in the future to address emerging risks. Innovation and investments in environmentally sound infrastructure and technologies can both reduce GHG emissions and enhance resilience to climate change.

8.2 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

8.2.1 Consultation responses to the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for climate change for the Proposed Scheme.

⁶⁴ Institute of Environmental Management and Assessment (IEMA) (2015), IEMA Environmental Impact Assessment Guide To Climate Change Resilience And Adaptation. Available at:

http://www.iema.net/system/files/iema_guidance_documents_eia_climate_change_resilience_and_adaptation.pdf

⁶⁵ IPCC (2014), Climate Change 2014: *Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; http://ar5-syr.ipcc.ch/topic_summary.php

Engagement as part of the EIA process

8.2.2 Key stakeholder groups are to be included during the engagement and consultation process for the GHG assessment, the in-combination climate change impacts assessment and the climate change resilience assessment. The consultees will be identified according to the geographic scope and nature of the issues. The key stakeholder groups include:

- central government departments and agencies;
- non-governmental organisations;
- construction industry stakeholders; and
- rail industry stakeholders.

8.3 Greenhouse gases

Introduction

8.3.1 This section of the SMR covers greenhouse gases which includes the environmental topic area of greenhouse gas emissions reported in the form of the 'carbon footprint'. A carbon footprint is the total GHG emissions associated with a particular scheme, policy or development. The GHG emissions are converted into tonnes of carbon dioxide equivalent (tCO₂e) which standardises the global warming potential of the main GHG⁶⁶ into one index based on the global warming potential of carbon dioxide (CO₂). Hereafter the term carbon is used to refer to the combined GHG emissions.

8.3.2 The Proposed Scheme will be assessed within the context of the UK's evolving carbon agenda. The Climate Change Act 2008 committed the UK to its first statutory carbon-reduction target to reduce carbon emissions by at least 80% from 1990 levels by 2050⁶⁷. To ensure that regular progress is made towards the target the Climate Change Act established a system of carbon budgets. The first five carbon budgets, leading to 2032, have been set in law. Meeting the fourth (2023-27) and fifth (2028-2032) carbon budgets will require that carbon emissions are reduced by 50% (by 2025) and 57% (by 2030) respectively relative to 1990 levels. It is expected that the Government will publish a plan for meeting the legislated carbon budgets in the second half of 2017.

8.3.3 In December 2015, a global climate agreement – the Paris Agreement⁶⁸ – was adopted at the 21st Conference of the Parties (COP21). A central aim of the Paris Agreement is to strengthen the global response to climate change by limiting the global temperature increase this century to below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5

⁶⁶ The seven main GHGs are: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃) according to the National Atmospheric Emissions Inventory, Overview of greenhouse gases. Available online at: <http://naei.defra.gov.uk/overview/ghg-overview>

⁶⁷ Department of Energy & Climate Change (2011), *The Carbon Plan – reducing greenhouse gas emissions*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47613/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf

⁶⁸ United Nations (2015), Paris Agreement, (2015), Available online at: https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

degrees Celsius. To achieve this aim, the Paris Agreement additionally sets a target for net zero⁶⁹ global carbon emissions in the second half of this century. The Paris Agreement was ratified and entered into force in November 2016. In line with the Paris Agreement, the Government has indicated it intends at some point to set a UK target for reducing domestic emissions to net zero.

- 8.3.4 The Government's Construction Industry Strategy⁷⁰ presents the UK's low carbon construction aspirations. It includes the aspiration to decrease construction GHG emissions by 50% by 2025 based on 1990 levels, as reported in the Green Construction Board's Low Carbon Routemap for the Built Environment⁷¹.
- 8.3.5 The GHG assessment will quantify and report – in the form of a 'carbon footprint' – the reasonable worst case scenario carbon emissions associated with the construction and operation of the Proposed Scheme. The carbon footprint will be reported in tonnes of carbon dioxide equivalent (tCO₂e). The Proposed Scheme's carbon footprint will be compared to UK national and transport sector GHG emissions in order to provide context for the scale of the carbon footprint.

Establishment of baseline and definition of survey

- 8.3.6 Scenarios of current and future baselines will be built on the work of the Sustainability Statement. The baseline GHG assessment will cover the following aspects:
- changing travel patterns and modal shift; and
 - projected UK grid power carbon emissions.
- 8.3.7 Baseline transport data will be based on the latest PLANET Framework Model (PFM). The PFM transport model reports on travel patterns by mode (road and rail) on the route of the Proposed Scheme, and will also consider air travel. Transport efficiency improvements over time will also be considered. The impact that the Proposed Scheme has on freight will be assessed separately.

⁶⁹ Net-zero means "a balance between anthropogenic emissions by sources and removals by sinks of carbon emissions in the second half of this century". United Nations (2015), *Paris Agreement*. Article 4 Paragraph 1. Available online at: https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

⁷⁰ HM Government (2013), *Industrial Strategy: government and industry in partnership*. HM Government, London

⁷¹ The Green Construction Board (2013), *Low Carbon Routemap for the UK Built Environment*, Available online at: <http://www.greenconstructionboard.org/otherdocs/Routemap%20ofinal%20report%2005032013.pdf>

8.4 Key aspects of the Proposed Scheme for the topic

8.4.1 Key aspects of the Proposed Scheme for this topic include:

- earthworks – includes all excavated material, backfill volumes and any soil treated throughout the construction process. Carbon emissions will arise from the energy used by plant equipment in the extraction of material, as well as from logistical operations transporting material along the route of the Proposed Scheme;
- land use, land use change and forestry (LULUCF) – includes carbon emissions that are either captured or released, resulting from direct human-induced changes in land use during construction and operation;
- demolition – to accommodate the Proposed Scheme, demolition and re-development of sites (e.g. local businesses and residential properties) will be required. Carbon emissions associated with the transport of demolition waste will be included in the GHG assessment;
- construction – covers the embedded carbon of construction materials used in structures such as tunnels, bridges, viaducts, rail lines and supporting infrastructure. This will include the logistical impact of delivering materials to site and removal of waste from site. Depending on data availability, fuel used by plant equipment during construction (such as tunnel boring machines) will also be included;
- operation – covers energy consumption of infrastructure such as stations, depots, signalling, lighting and tunnel fans;
- rolling stock – energy use, and consequential GHG emissions, from the running of the trains will depend on, but not be limited to, the following factors: train weight, acceleration, traction efficiency, braking performance, regenerative braking, train resistance, tunnel resistance aerodynamic factors, passenger loads and speed. The embedded impact of the rolling stock will also be included in the GHG assessment;
- maintenance – covers the day-to-day upkeep of the railway (track, bridges, tunnels etc.) as well as the trains. Maintenance activities, similar to construction, involve plant equipment, materials and transport;
- energy supply – the construction and operational assessment will take account of grid decarbonisation; and
- modal shift – this assessment will consider road, rail and air efficiency improvements likely to have occurred by the time the Proposed Scheme is in operation, as well as the likely impact on road, conventional rail and domestic air travel carbon emissions.

Scope of GHG assessment

- 8.4.2 The scope of the GHG assessment is summarised in Table 12. Best practice criteria for the exclusion of inputs and outputs (cut-off rules) will be applied. Any application of the criteria for the exclusion of inputs and outputs will be documented.

Table 12 - Scope of GHG assessment broken down by life cycle stages, consistent with the principles set out in BS EN 15978:2011 and PAS 2080:2016

Life cycle assessment boundary stages	Description
Pre-construction stage (module A0)	<p>Represents preliminary studies and works such as strategy and brief development, architecture, design efforts, EIA and cost planning. Most if not all these functions will be largely office based</p> <p>For example, GHG emissions associated with office energy use and consultants travel</p>
Product stage (modules A1 – A3)	<p>Represents the embedded GHG emissions associated with the extraction, processing and manufacturing of the Proposed Scheme's construction material for permanent assets. This includes all energy and GHG emissions from manufacturing plants, primary and secondary manufacturing stages as well as any transport emission between these stages</p> <p>For example, concrete manufacturing includes energy and GHG emissions linked to all key stages: quarrying, aggregate crushing, transport of aggregates to ready-mix concrete plants and asphalt plants. This final stage includes emissions associated with the adding of water and cement mixes</p>
Construction process - transport stage (module A4)	<p>Represents transport related GHG emissions associated with the delivery of construction material, such as concrete and steel, and construction equipment to construction sites along the Proposed Scheme from the point of production (or point of storage in the case of plant and machinery)</p>
Construction process –on-site stage (module A5)	<p>Represents GHG emissions from construction site works activities including:</p> <ol style="list-style-type: none"> 1. temporary works, ground works, and landscaping; 2. materials storage and any energy or otherwise need to maintain necessary environmental conditions; 3. transport of materials and equipment on site; 4. installation of materials and products into the infrastructure asset; 5. emissions associated with site water demand; 6. waste management activities (transport, processing, final disposal) associated with waste arising from the construction site; 7. production, transportation, and waste management of materials/products lost during works; and 8. GHG implications associated with land use change.
Use stage – installed products and materials (module B1)	<p>Represents the GHG emitted directly from the fabric of products and materials once they have been installed as part of the Proposed Scheme. Includes carbon sequestration from tree planting</p>

Use stage (modules B2 – B5)	Represents the GHG emissions resulting from activities of works and new materials for the maintenance, repair, replacement and refurbishment of the Proposed Scheme during the use stage/operation
Use stage - operational energy (modules B6)	Represents the GHG emissions resulting from the energy used by the Proposed Scheme's infrastructure and building-integrated systems (e.g. fans, pumps, lights), minus any electricity generated through on-site low carbon energy sources not exported to the grid
Use stage - operational water (modules B7)	Represents the GHG emissions resulting from the provision of water required by the Proposed Scheme to enable it to operate and deliver its service. It will include all water used and its treatment (pre- and post-use) during the normal operation of the Proposed Scheme. For example this includes water used in the maintenance and cleaning of the rolling stock.
Use stage - other operational processes (module B8)	Represents other process GHG emissions arising from the Proposed Scheme to enable it to operate and deliver its service including management of operational waste
Use stage – users utilisation (module B9)	Represents the GHG emissions associated with the operation of the rolling stock and un-regulated energy consumption not required for the technical and functional performance of the infrastructure (e.g. plug-in appliances, such as computers, refrigerators, audio, TV and production or process-related energy use).
End of life stage (module C1)	Represents the GHG emissions resulting from activities of deconstructing, demolishing and decommissioning the Proposed Scheme. Essentially these are on-site GHG emissions from plant equipment.
End of life stage (modules C2 – C4)	Represents the activities associated with transport, waste management and final disposal of materials associated with the site and materials of the Proposed Scheme
Benefits and loads beyond the infrastructure life cycle (module D)	Includes: <ol style="list-style-type: none"> 1. avoided GHG emission impacts associated with the Proposed Scheme including potential for re-use, recovery and recycling of materials and/or energy beyond the system boundary; 2. savings in GHG emissions from modal shift of passenger and freight journeys associated with the Proposed Scheme; and 3. electricity and fuel use for surface access journeys to the Proposed Scheme.

Assessment methodology

8.4.3 Although there is no specific standard for reporting infrastructure GHG emissions in EIA, a variety of existing standards will be used to guide this assessment:

- the European Commission (EC) guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment⁷²;

⁷² European Commission (2013), *Integrating Climate Change and Biodiversity into Environmental Impact Assessment*. Available online at: <http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf>; <http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf>

- the Publically Available Specification (PAS) 2080⁷³ on carbon management in infrastructure;
- BS EN 15804⁷⁴ which outlines the requirement for quantifying and reporting emissions at a product level;
- BS EN 15978⁷⁵ which outlines the calculation method to assess performance at the buildings level, based on life cycle assessment (LCA); and
- IEMA's guide to assessing GHG emissions and evaluating their significance in EIA⁷⁶.

- 8.4.4 The GHG assessment will use the guiding principles of existing standards and guidance. This will be supported by a combination of carbon modelling tools, lifecycle software, publicly available information including the University of Bath's Inventory of Carbon and Energy⁷⁷ on construction materials, and specific figures from environmental product declarations (EPDs).
- 8.4.5 Depending on data availability the reporting unit will be in tonnes of carbon dioxide equivalents (tCO₂e) covering the seven main GHGs⁷⁸ listed by the Greenhouse Gas Protocol accounting standard⁷⁹.
- 8.4.6 The approach used will be to:
- define carbon emission sources;
 - gather information and appropriate GHG coefficients; and
 - calculate carbon emissions.
- 8.4.7 The GHG assessment will report the carbon footprint from construction and 120 years of operation to align with the assumed design life. In addition, assessments will be carried out for the following time periods:
- 2023 – start of construction;
 - 2033 – Proposed Scheme opening;
 - 2041 – full technical capacity and operation of HS2 as a whole; and
 - 2093 – 60 years of operation after opening.

⁷³ British Standard Institute (2016), PAS 2080:2016, *Carbon management in infrastructure*, PAS 2080:2016.

⁷⁴ British Standard Institute (2013), BS EN 15804+A1:2013. *Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products*, BS EN 15804+A1:2013.

⁷⁵ British Standard Institute (2011), BS EN 15978:2011. *Sustainability of construction works – assessment of environmental performance of buildings – Calculation method*, BS EN 15978:2011.

⁷⁶ IEMA (2017), *Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance*.

⁷⁷ Hammond, G.P. and Jones, C.I (2008), *Inventory of Carbon & Energy (ICE) Version 1.6a*, University of Bath, UK

⁷⁸ Direct GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃)

⁷⁹ Greenhouse Gas Protocol (2013), *Required Greenhouse Gases in Inventories – Accounting and reporting standard amendment. WRI and WBCSD, USA*. Available online at: http://www.ghgprotocol.org/files/ghgp/NF3-Amendment_052213.pdf

- 8.4.8 Construction related emissions will be based on the construction and logistics information for the Proposed Scheme. This includes information relating to specific design elements (such as viaducts or bridges) across the entire route in terms of:
- volume (m³) of construction materials;
 - type of construction material (e.g. concrete, imported fill, steel, gravel);
 - transport distances (km) of construction material; and
 - volume (m³) of waste generated (both construction and demolition).
- 8.4.9 The excavation and movement of excavated materials along the Proposed Scheme will be modelled separately. This assessment will provide volumes of materials along with distances travelled and modes of transport.
- 8.4.10 Data collection will capture the following information for design elements such as a viaduct or bridge:
- volume of materials;
 - life span of design element and replacement/ maintenance strategy where applicable;
 - GHG coefficients;
 - overall carbon emissions of each design element; and
 - functional units (e.g. tonnes of carbon dioxide CO₂e per metre and year of design element) if available.
- 8.4.11 Construction site carbon emissions relating to fuel and energy use by plant equipment will be calculated using appropriate assumptions. These assumptions will consider carbon emissions associated with machinery and plant used.
- 8.4.12 Transport related carbon emissions will be based on the latest PFM transport model, and will include:
- conventional rail network: change in train movements on the conventional network as a result of uptake of services on the Proposed Scheme;
 - modal shift: transfers from domestic air trips to the Proposed Scheme; and
 - modal shift: transfer from road onto the Proposed Scheme.
- 8.4.13 The carbon benefits associated with the released capacity on the conventional network for freight transport will also be assessed.

Assumptions

- 8.4.14 The GHG assessment will be based on a number of assumptions. A series of alternative future scenarios will be assessed in order to illustrate the sensitivity of the Proposed Scheme's carbon footprint to key assumptions; this assessment will be set out in the ES.

8.5 In-combination climate change impacts

Introduction

- 8.5.1 These sections address the in-combination climate change impacts assessment, which assesses the combined effects of the impacts of the Proposed Scheme and potential climate change impacts on the receiving environment.
- 8.5.2 As part of the assessment a review will be undertaken of the most recent climate change legislation, policy, best practice guidance, publicly available research and previous climate change impact and risk assessments for high-speed rail and major infrastructure projects. For example, infrastructure and other asset specific guidance including that published by Rail Safety Standards Board⁸⁰, Network Rail⁸¹ and the Cabinet Office⁸² will be considered. This review will be relevant to both the in-combination and resilience assessments.
- 8.5.3 At present, no international legislation or policy framework exists that specifies the scope and methodology to be used as part of the in-combination climate change impacts assessment within the EIA process. However, there are several guidance reports that provide relevant background (see for example guidance by the Food and Agriculture Organisation^{83,84} and the World Health Organisation⁸⁵).
- 8.5.4 At the European level, the EIA Directive 2011/92/EU⁸⁶ places a requirement upon projects anticipated to have significant effects on the surrounding environment and communities to make a formal assessment of these effects. The amended EIA Directive 2014 identifies the important role that the EIA process can play in assessing climate change impacts. It states that EIAs shall identify, describe and assess the direct and indirect significant effects of climate, and the risk of major accidents and/or disasters that are relevant to the project, including those caused by climate change. The methodology for identifying and assessing the likely significant environmental effects that would arise from the Proposed Scheme if it were to be affected by a major accident or disaster is detailed in Section 16 of the SMR. The Directive 2014/52/EU entered into force on 15 May 2015 and contains the amendments to the 2011 Directive in full. The regulations implementing this directive were transposed into UK legislation in May 2017.

⁸⁰ RSSB (2016), Tomorrow's Railway and Climate Change Adaptation: Phase 1 Summary Report (T1009). Available online at: <https://www.rssb.co.uk/research-development-and-innovation/research-and-development/research-project-catalogue/t1009>

⁸¹ Network Rail (2017), Climate change and weather resilience. Available online at:

<https://www.networkrail.co.uk/communities/environment/climate-change-weather-resilience/>

⁸² Cabinet Office (2011), Keeping the country running: natural hazards and infrastructure. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/61342/natural-hazards-infrastructure.pdf

⁸³ Food and Agriculture Organization of the United Nations (2013), Climate-smart agriculture sourcebook. Available at:

<http://www.fao.org/docrep/018/i3325e/i3325e.pdf>

⁸⁴ Food and Agriculture Organization of the United Nations (2013), *Climate change guidelines for forest managers*. Available at:

<http://www.fao.org/3/i3383e.pdf>

⁸⁵ The World Health Organisation (2016), *Climate change and health*. Available online at: <http://www.who.int/mediacentre/factsheets/fs266/en/>

⁸⁶ *Directive 2011/92/EU 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.

- 8.5.5 The EC guidance on Integrating Climate Change and Biodiversity into EIAs⁸⁷ carried out under the amended EIA Directive 2014⁸⁸, includes climate change and biodiversity related guidance for screening and scoping, analysing evolving baseline trends, identifying alternative and baseline measures, monitoring and adaptive management. There are also several publications by the EC addressing climate change impacts for EIA topics, such as agriculture, ecology, health, landscape and water. The publications provide background information on climate change impacts in Europe and suggest potential mitigation measures^{89,90,91,92}. The EC is currently undertaking an evaluation of the EU Adaptation Strategy, which will be completed by mid-2018⁹³.
- 8.5.6 At a national level, the Climate Change Act 2008 requires the UK Government to undertake a national Climate Change Risk Assessment (CCRA) every five years. The second CCRA was published in 2017⁹⁴ and provides assessments of climate change risks for different sectors of society, including infrastructure, people and the built environment, natural environment and natural assets, business and industry as well as international dimensions and cross-cutting issues. The assessment builds upon the CCRA 2012⁹⁵ and aims to assess the urgency of further action to tackle different climate change risks for the UK, as well as realise potential opportunities. The most urgent climate change risks for the UK include flooding and coastal change risks; risks to health, well-being and productivity from high temperatures; risks of shortages in the public water supply and for agriculture, energy generation and industry, risks to natural capital, including terrestrial, coastal marine and freshwater ecosystems, soils and biodiversity; risks to domestic and international food production and trade; and new and emerging pests and diseases and invasive non-native species, affecting people, plants and animals.
- 8.5.7 Following the CCRA 2012, the first National Adaptation Programme (NAP)⁹⁶ was published, detailing the Government's long term strategy to address the main climate change risks and opportunities for the UK. The NAP is published every 5 years and is due to be updated in 2018. The Committee on Climate Change (CCC) and its Adaptation Sub-Committee conduct an independent assessment of progress by the NAP every two years⁹⁷. These progress reports contribute towards the wider

⁸⁷ European Commission (2013), Integrating Climate Change and Biodiversity into Environmental Impact Assessment. Available online at: <http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf>

⁸⁸ Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. Strasbourg, European Parliament and European Council

⁸⁹ European Commission (2009), *Human, Animal and Plant Health Impacts of Climate Change*. Available online at: http://ec.europa.eu/health/climate_change/policy/index_en.htm;

⁹⁰ European Commission (2015), *EU Agriculture and Climate Change*. Available online at: http://ec.europa.eu/agriculture/climate-change/factsheet_en.pdf

⁹¹ European Commission (2016), *Adapting the management of Water and Environmental Resources in response to Global Change*. Available online at: http://ec.europa.eu/environment/water/adaptation/index_en.htm

⁹² VOS, C. et al. (2008) *Adapting landscapes to climate change: examples of climate-proof ecosystem networks and priority adaptation zones*. Journal of Applied Ecology. 45: 1722-1731

⁹³ European Commission (2017) *Climate Action: EU Adaptation Strategy*. Available online at: https://ec.europa.eu/clima/policies/adaptation/what_en

⁹⁴ Committee on Climate Change (2017), *Progress in preparing for climate change*. Available online at: <https://www.theccc.org.uk/uk-climate-change-risk-assessment-2017/>

⁹⁵ DEFRA (2012) *CCRA - UK Climate Change Risk Assessment 2012 - GA0204*. Available online at: <http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747>

⁹⁶ DEFRA (2013), *The National Adaptation Programme: Making the country resilient to a changing climate*. HM Government, London: The Stationery Office

⁹⁷ Committee on Climate Change (2015), *Reducing emissions and preparing for climate change: 2015 Progress Report to Parliament*. Available at <https://www.theccc.org.uk/publication/reducing-emissions-and-preparing-for-climate-change-2015-progress-report-to-parliament/>

understanding of national climate change risks, including risks specific to the transport sector and rail infrastructure. Further national-level research specific to climate change and rail includes the RSSB project *Tomorrow's Railway and Climate Change Adaptation (TRaCCA)*, which explores rail specific climate change impacts and discusses a range of adaptation approaches. Further understanding of UK climate change impacts can be obtained through the reports submitted under the UK Adaptation Reporting Power (ARP) in the first and second rounds of reporting⁹⁸. Reports are produced by organisations with functions of a public nature and statutory undertakers and include the identification and examination of climate change impacts and risks relevant to water, agriculture and forestry, health and wellbeing, and the natural environment.

- 8.5.8 IEMA has published guidance on climate change resilience and adaptation⁶⁴ in response to the requirements specified in the amended EIA Directive 2014. This guidance provides an approach to undertaking assessments of in-combination climate change impacts and climate change resilience within the EIA process in the UK.
- 8.5.9 The Environment Agency provides guidance on climate change allowances to be used in flood risk assessments as set out in the NPPF⁹⁹. This advice includes climate change allowances for peak river flow and peak rainfall intensity for flood risk assessments for different UK river basin districts, flood zones and land use sensitivities. The assessments made of the implications of climate change for future flood risks associated with the Proposed Scheme will take account of the content of this guidance. Furthermore, the Environment Agency provides additional guidance¹⁰⁰ for the management of uncertainty in flood risk assessments and flood defence design, aiming to update the Environment Agency's Fluvial Freeboard Guidance Note (report W187)¹⁰¹ published in 2000. Although this document has not formally replaced the 2000 document, it is considered important for HS2 Phase 2b, as it is based on best practice cases and effective approaches to uncertainty. The assessments made of the implications of uncertainty associated with the Proposed Scheme, including climate change, will take account of the content of this guidance. These assessments will be reported in the ES within the water resources and flood risk sections of the community area reports with separate stand-alone flood risk assessments prepared for each community area. A route-wide assessment demonstrating alignment with NPPF policies will also be included in the water resources and flood risk section of the ES. These assessments will inform the assessments undertaken by the climate change topic.
- 8.5.10 The approach and findings of the HS2 Phase 2a ES are a relevant starting point for the Proposed Scheme in-combination climate change impacts assessment. Volume 3, Section 4 and Volume 5 Appendix CL-002-000, published as part of the Phase 2a ES, include potential in-combination climate change impacts and existing mitigation measures which contribute to climate change resilience.

⁹⁸ Department for Environment, Food and Rural Affairs (Defra) (2017), Climate change adaptation reporting: second round reports. Available at: (<https://www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports>)

⁹⁹ Environment Agency (2017), *Flood risk assessments: climate change allowances*. Available online at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

¹⁰⁰ Environment Agency (2017), *Accounting for residual uncertainty – updating the freeboard guide*. Environment Agency, Horizon House, Deanery Road, Bristol

¹⁰¹ Kirby, A.M; Ash. J.R.V; (2000), *Fluvial Freeboard Guidance Note: R&D Technical Report W187*. Environment Agency, Bristol

Establishment of baseline

- 8.5.11 The term 'baseline' in this section refers to the description of current and future climate conditions that will inform the assessments of in-combination climate change impacts and climate change resilience. The term 'future climate baseline' is not to be confused with the EIA term 'future predicted baseline'. Future climate baseline refers to the description of the climate in a future time period using climate change projections for climatic variables.
- 8.5.12 Based on experience from Phase One and Phase 2a, climate change impacts on different receptors, in-combination with the impacts of the Proposed Scheme, are not expected to vary notably for the individual community areas, which comprise the proposed route. As such, the in-combination climate change impacts assessment will be route-wide and current climate data and climate change projection data will be sourced for locations along the western and eastern legs of the route – namely Crewe at the southern end and Manchester at the northern end of the western leg; Birmingham at the southern end of the eastern leg, the East Midlands on the eastern leg, and Leeds at the northern end of the eastern leg. These locations are considered generally representative of the climate, within which the Proposed Scheme would be located.
- 8.5.13 The current and future climate baselines for the Proposed Scheme will be established in two stages. The initial stage of the assessment, and related content for inclusion in the draft ES, will be informed by interim baseline data obtained from the UK Climate Projections 2009 (UKCP09). UKCP09 is currently the official set of projections for the UK but is in the process of being updated and a new set of projections, the UK Climate Projections 2018 (UKCP18), is scheduled for publication in March 2018. Therefore, the final assessment, and related results for inclusion in the final ES, will be based on baseline data obtained from UKCP18.
- 8.5.14 The following paragraphs relate to the description of the first set of climate baseline data using UKCP09. Following the publication of UKCP18 a second set of climate baseline data (current and future) will be established and described.
- 8.5.15 The emissions scenarios in UKCP09 are plausible representations of the future development of emissions of substances (e.g. GHGs and aerosols) that can influence global climate. The medium and high emissions scenarios available from UKCP09 will be included in the description of climate change projections. The low emissions scenario will not be explored as it is not considered to be realistic, given historical GHG emissions¹⁰².
- 8.5.16 UKCP09 is based on probabilistic projections that assign a likelihood to different possible climate change outcomes. Different assumptions within climate models as well as the choice of emission scenarios can lead to these differences in possible climate change outcomes.

¹⁰² Climate Change Research Centre (CCRC) (2009), *The Copenhagen Diagnosis; Updating the World on the Latest Climate Science*. Available online at: http://www.ccrcc.unsw.edu.au/sites/default/files/Copenhagen_Diagnosis_HIGH.pdf

- 8.5.17 The probability levels of 10%, 50% and 90% for the medium and high emissions scenarios will be used for the initial assessment of the likelihood of changes in climate variables and to describe climate change trends. The terminology used to define likelihood of changes in climate variables is based on the terminology adopted in UKCP09¹⁰³, which is based on the terminology used by the IPCC Fourth Assessment Report¹⁰⁴.
- 8.5.18 The 50% probability level for the medium emissions scenario will be used for the initial assessment of in-combination climate change impacts with additional sensitivity testing for the full range of probability levels and emissions scenarios. This consideration of probability levels is in agreement with the recommendations in UKCP09¹⁰⁵ and IEMA¹⁰⁶ guidance, i.e. the use of the 10% and 90% probability levels are used to represent low and high changes in climate¹⁰⁷. It is also in agreement with the climate change projections used in HS2 Phase One, Phase 2a and in line with reports submitted under the NAP¹⁰⁸.
- 8.5.19 The assessment of in-combination climate change impacts relating to flood risk will be based upon current Environment Agency guidance, as described in Paragraph 8.5.9.
- 8.5.20 The initial assessment of potential climate change impacts on the effects associated with the Proposed Scheme will be undertaken in accordance with timeframes outlined in the methodologies for each topic. Table 13 provides a comparison of these timeframes and the corresponding timeframes for UK climate change projections.

Table 13 - Temporal scope for the in-combination climate change impacts assessment

	Design	Construction (including testing and commissioning)	Operation (start)	Operation of Proposed Scheme
In-combination climate change impacts assessment	n/a	2023-2033	2033	2033 onwards
Topic assessment timeframes				
UKCP09 time period ¹⁰⁹	2020s (2010-2039)	2020s (2010-2039)	2030s (2020-2049)	2080s (2070-2099) ¹¹⁰

¹⁰³ UK Climate Projections; Definition of unlikely (2016), Available online at: <http://ukclimateprojections.metoffice.gov.uk/23192>

¹⁰⁴ IPCC Fourth Assessment Report; Climate Change (2007), Working Group I: The Physical Science Basis; The IPCC Assessments of Climate Change and Uncertainties. Available online at: https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch1s1-6.html

¹⁰⁵ UK Climate Projections (2010), *Briefing report*. Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87867&>

¹⁰⁶ Institute of Environmental Management and Assessment (IEMA), 2015, IEMA Environmental Impact Assessment Guide To Climate Change Resilience And Adaptation. Available at:

http://www.iema.net/system/files/iema_guidance_documents_eia_climate_change_resilience_and_adaptation.pdf

¹⁰⁷ UK Climate Projections; Before you start using UKCP09. Available online at: <http://ukclimateprojections.metoffice.gov.uk/21679>

¹⁰⁸ DEFRA (2017), *Climate change adaptation reporting; Second round reports*. Available online at:

¹⁰⁹ UKCP09 uses 30-year time periods for both the baseline climate and for all future climate projections. The projections are reported for seven overlapping 30-year time periods from 2010 - 2099. Each future time period is named based on the decade upon which it is centred. The 2020s, 2050s and the 2080s are most commonly used time periods

¹¹⁰ For timescales outside the standard UKCP09 time periods the Climate change topic will engage with relevant government agencies (e.g. the Met Office and Environment Agency) for additional advice and guidance. In the case of flood risk only, climate change allowances up to and beyond 2115 will be used as indicated in Guidance - Flood risk assessments: climate change allowances (NPPF). This is because the NPPF defines

- 8.5.21 According to UKCP09, during the construction phase of the Proposed Scheme (2023 – 2033) projected climate trends in the UK suggest the following changes to long-term, seasonal averages:
- warmer, drier summers and milder, wetter winters¹¹¹; and
 - an increase in annual average temperature¹¹² and fewer days with snow and frost¹¹³.
- 8.5.22 Extreme weather during the construction phase will:
- very likely¹¹⁴ include more very hot days¹¹⁵;
 - likely include more intense downpours of rain¹¹⁶ (particularly in summer); and
 - very likely include an increase in dry spells¹¹⁷.
- 8.5.23 In addition, it is likely, although with a higher level of uncertainty, that the probability of the following extreme weather events will increase as a consequence of climate change:
- short periods of intense cold weather (still expected as a result of natural variability¹¹⁸); and
 - an increase in the frequency and intensity of storms and high winds (widely accepted as difficult to predict with any certainty¹¹⁹).
- 8.5.24 During the operation of the Proposed Scheme (2033 onwards) these changes in climatic averages and extreme weather events are projected to become more pronounced.
- 8.5.25 Climate change projections for extreme weather events will initially be obtained using the Weather Generator (WG)¹²⁰ in UKCP09. However, it should be noted that the WG is subject to a number of limitations which are described on the UKCP09 website¹²¹. The main limitations of the WG relate to the representation of extreme weather events, especially in the representation of short duration (hourly) extreme rainfall and long-term events such as droughts. The WG will not be available within the UKCP18

the 2080s as covering the period 2070-2115 for the purposes of flood risk assessment, and HS2 can be considered as a development with a lifespan of at least 120 years

¹¹¹ UK Climate Projections; Climate Change Projections Table 4.1, 4.2, 4.4 and 4.5 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf>

¹¹² UK Climate Projections; Climate Change Projections Section 4.3.5 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf>

¹¹³ UK Climate Projections; Climate Change Projections Table 3 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf>

¹¹⁴ UK Climate Projections; Definition of unlikely (2016). Available online at: <http://ukclimateprojections.metoffice.gov.uk/23192>

¹¹⁵ UK Climate Projections; Climate Change Briefing Report Table 3 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87868&filetype=pdf>

¹¹⁶ UK Climate Projections; Climate Change Projections, Table 4.2 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf>

¹¹⁷ UK Climate Projections; Climate Change Briefing Report Table 4 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87868&filetype=pdf>

¹¹⁸ UK Climate Projections; Climate Change Briefing Report Table 3 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87868&filetype=pdf>

¹¹⁹ UK Climate Projections; Climate Change Projections Section 1.4 (2009). Available online at: <http://ukclimateprojections.metoffice.gov.uk/media.jsp?mediaid=87894&filetype=pdf>

¹²⁰ UK Climate Projections (2009), About the Weather Generator. Available online at: <http://ukclimateprojections.metoffice.gov.uk/22540>

¹²¹ UK Climate Projections (2009), Limitations of Weather Generator 2.0. Available online at: <http://ukclimateprojections.metoffice.gov.uk/22653>

therefore new methods will be used to obtain extreme weather events to inform the final climate baselines and final assessment.

- 8.5.26 Once UKCP18 are published, a thorough review and update of the methods described in this section for obtaining projections for changes in both climatic averages and extreme weather events will be undertaken.

Scope of in-combination climate change impacts assessment

Technical scope

- 8.5.27 An initial assessment of potential climate change impacts during construction and operation will be undertaken for all environmental topics in collaboration with topic specialists. This process will determine the requirement for undertaking a more detailed assessment of significant in-combination climate change impacts and effects for relevant topics or community areas.
- 8.5.28 Potential climate change impacts may be greater or more numerous for some topics than others, due to the varying sensitivity of topic receptors and resources to projected changes and trends in the characteristics of climate variables. Topics sensitive to climate change will remain scoped in for a more detailed assessment of in-combination climate change impacts for topic specific effects. This more detailed assessment will determine whether there are any significant in-combination effects to report.
- 8.5.29 In addition to this section of the SMR, climate change may also be discussed within other individual topic sections of the SMR where relevant.

Spatial scope

- 8.5.30 Potential climate change impacts will initially be assessed route-wide, with any significant in-combination climate change effects reported on a route leg basis as appropriate for relevant topics.
- 8.5.31 The assessment will take into account the distances either side of the Proposed Scheme, within which other topics are undertaking their own assessment of effects. For example, the landscape topic is considering landscape character effects beyond the route corridor to the extent of the defined character area boundaries. The width of the survey corridor for the ecology topic will be defined by the potential area of ecological impact. This will vary depending on a number of factors, including the engineering of the route, the topography and ecological connectivity of the landscape, and the ecological receptor. In rural sections, the survey corridor for some species could extend up to 500m either side of the land required for construction; in urban sections, the survey corridor will, in general, be much narrower as the zone of impact will be more restricted.

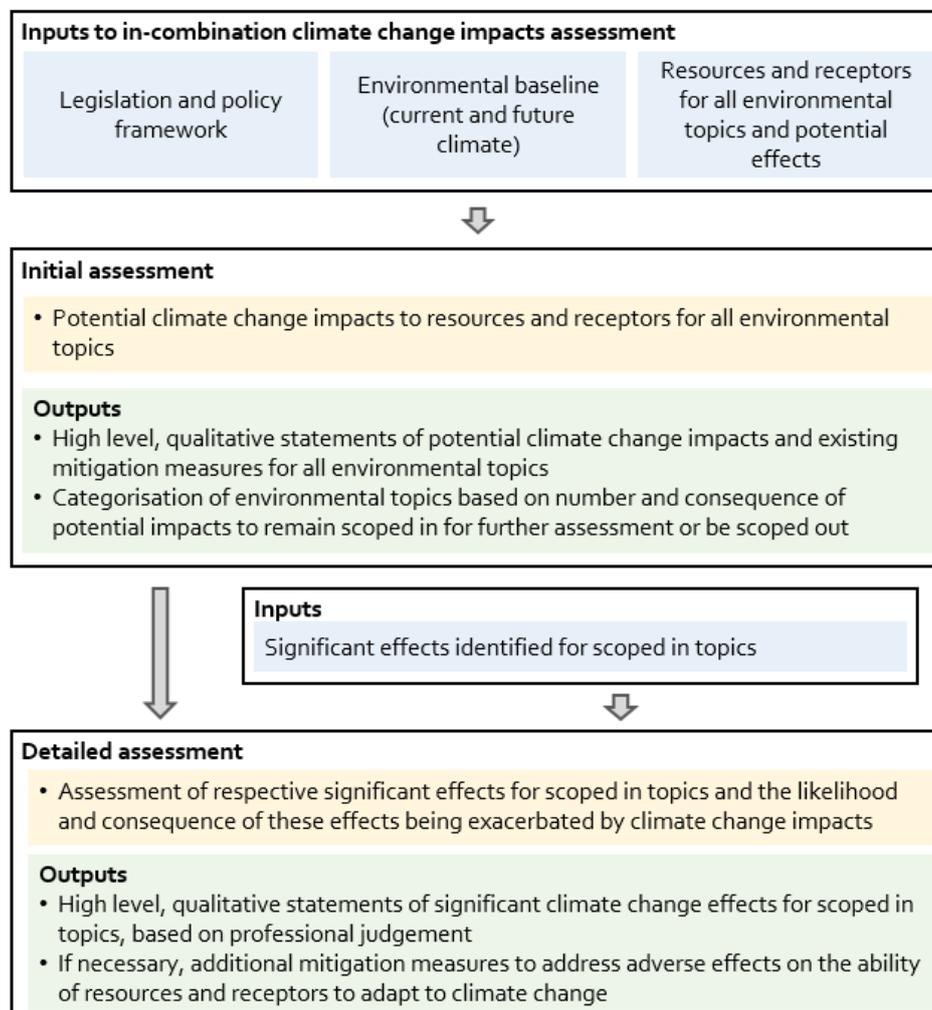
Temporal scope

- 8.5.32 Potential climate change impacts will be assessed for all topics for the 2020s (to cover the effects of construction which is estimated to commence in 2023 until 2033 including commissioning). Potential climate change impacts relevant to the effects of operation (which commences in 2033) will be assessed for the 2080s (to cover as much of the operational life of the Proposed Scheme as possible).

Assessment methodology

- 8.5.33 Potential climate change impacts relevant to the Proposed Scheme will be considered at the route-wide level for all topics, across all legs and community areas of the Proposed Scheme. This will form the basis for an initial in-combination climate change impacts assessment, the scope of which will include all environmental topics, and will be carried out by the climate change topic with input from topic specialists. This will be informed by climate change projections for the Proposed Scheme, recent and relevant science, policy and guidance for each topic, and the initial assessment results from all topics' community area (Volume 2) and route wide (Volume 3) assessments. The initial in-combination climate change impacts assessment will identify environmental topics to remain scoped in for a more detailed assessment. See Figure 8 for an illustration of this approach.

Figure 8 - Approach to the in-combination climate change impacts assessment



- 8.5.34 In addition to the review of documents included in the introduction to Section 8.4, a review will be undertaken as part of the initial assessment of the most recent, publicly available research, evidence and technical knowledge as well as existing legislation and guidance. Relevant European, national and local policies and guidance on climate change impacts, adaptation and resilience will be identified and referenced for each environmental topic, where applicable. For example, topic specific guidance published

by the Food and Agriculture Organisation¹²², the Woodland Trust¹²³, the Forestry Commission¹²⁴, the Landscape Institute¹²⁵, Public Health England¹²⁶ and Defra¹²⁷ will be considered.

- 8.5.35 Climate change science is an evolving field of enquiry, and the integration of potential climate change impacts into the EIA process is still a relatively new approach. For many environmental topics, the evidence base is growing but not definitive, or there is insufficiently detailed evidence available at the local level. Conversely, for some environmental topics such as water resources and flood risk there is a relative abundance of evidence and guidance. Thus, it may be difficult to achieve a consistent level of detail in the in-combination climate change impacts assessment for all topics in line with the established EIA methodologies.
- 8.5.36 Following consideration of potential climate change impacts, informed professional judgement will be used by topic experts to produce high level, qualitative statements about potential topic specific impacts resulting from projected climate change (i.e. changes and trends in climate averages and extreme weather events) for receptors and resources in the area surrounding the Proposed Scheme.
- 8.5.37 These high level, qualitative statements will include recommendations of any mitigation measures necessary to increase the ability of resources and receptors to adapt to climate change beyond those already suggested by each environmental topic. Additionally, allowances for future measures and monitoring to ensure the continued resilience of receptors and resources will also be considered.
- 8.5.38 Example criteria that will be used to complete the initial in-combination climate change impacts assessment are set out in the bullet points below. The assessment will also include any topic specific references identified in addition to those listed in the legal and policy framework section above. These will be considered together with the climate change projections and informed professional judgement for each topic to complete the assessment. The results of the initial in-combination climate change impacts assessment will be presented in a summary table for each EIA topic in the route-wide assessment with the following general headings:
- resources/receptors potentially impacted by the Proposed Scheme;
 - effects of Proposed Scheme on receptors/resources identified by topic;
 - existing or embedded mitigation measures for these effects;

¹²² Food and Agriculture Organization of the United Nations (2017). *Strengthening Sector Policies for Better Food Security and Nutrition Results*. Available online at: <http://www.fao.org/3/a-i7217e.pdf>

¹²³ Woodland Trust (2015), *Climate change - the Woodland Trust's position*. Available online at: <https://www.woodlandtrust.org.uk/publications/2015/06/climate-change>

¹²⁴ Forestry Commission (2016), *Forests and climate change*. Available online at: <http://www.forestry.gov.uk/climatechange> .

¹²⁵ Landscape Institute (2008), *Landscape architecture and the challenge of climate change*. Available online at: <http://www.landscapeinstitute.org/PDF/Contribute/LIClimateChangePositionStatement.pdf>

¹²⁶ Health Protection Agency (2012), *Health Effects of Climate Change in the UK*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/371103/Health_Effects_of_Climate_Change_in_the_UK_2012_V1_3_with_cover_accessible.pdf

¹²⁷ Defra (2011), *The England Biodiversity Strategy*. Available online at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69446/pb13583-biodiversity-strategy-2020-111111.pdf

- potential climate change impacts on resources/receptors and identified effects;
- likelihood¹²⁸ and consequence of in-combination climate change impacts given existing or embedded mitigation measures;
- mitigation measures to address adverse effects on the ability of resources/receptors to adapt to climate change; and
- allowances for future measures and monitoring.

8.5.39 Following the initial assessment, topics will then be categorised into one of the following four categories, based on the number and consequence of potential in-combination impacts as part of the initial assessment:

- many potential climate change impacts with high consequences (to remain scoped in for more detailed assessment);
- some or few potential climate change impacts with high consequences (to remain scoped in for more detailed assessment);
- few potential climate change impacts with low consequences (to be scoped out); and
- no potential climate change impacts (to be scoped out).

8.5.40 The scoping decision will be reviewed by the environmental topic specialists in collaboration with the climate change topic specialists.

8.5.41 A more detailed assessment will then be undertaken for the topics that remain scoped in. This will include an assessment of each topic's respective significant effects and a determination of whether they could potentially be exacerbated or ameliorated by climate change impacts. The assessment will determine whether there are any significant in-combination climate change effects to report.

8.5.42 The potential significance of in-combination climate change impacts and effects identified will then be assessed qualitatively, based upon the professional judgement of relevant environmental topic specialists working closely with the climate change topic specialists.

8.5.43 An exception to the approach outlined above is the assessment of water resources, flood risk and drainage design, which will be quantitative and take into account current Environment Agency climate change allowances for increases in peak river flow and rainfall intensity¹²⁹.

Construction effects

8.5.44 The effects of the Proposed Scheme will be assessed for the construction phase, including an assessment of potential in-combination climate change impacts.

¹²⁸ N.B. The assessment of likelihood of in-combination climate change impacts will be based on professional judgement and is distinct from the definitions of likelihood used to describe probability levels in the UKCP09 climate change projection data and the levels of likelihood used in the climate change resilience assessment.

¹²⁹ Environment Agency (2017), Flood risk assessments: climate change allowances. Available online at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Operational effects

- 8.5.45 The effects of the Proposed Scheme will be assessed for the operational phase, including an assessment of potential in-combination climate change impacts.

Mitigation measures

- 8.5.46 If existing mitigation measures¹³⁰ are considered insufficient to address the ability of resources and receptors to adapt, then additional mitigation measures will be developed by the climate change topic specialists in collaboration with the environmental topic specialists.

Monitoring

- 8.5.47 Allowances for future measures and monitoring to ensure the continued resilience of receptors and resources will also be identified.

8.6 Climate change resilience

Introduction

- 8.6.1 These sections address the climate change resilience assessment of the Proposed Scheme.
- 8.6.2 As for the in-combination climate change impact assessment, a review will be undertaken of the most recent climate legislation, policy, best practice guidance, publicly available research and previous climate change impact and risk assessments for high speed rail and major infrastructure projects.
- 8.6.3 Currently no international legislation or policy framework exists that specifies the approach to be used for the climate change resilience assessment. Several guidance reports provide relevant background information, for example the UN and the United States have explored the impact of climate change on transport infrastructure and railways^{131,132}.
- 8.6.4 Similarly, at European and national level most legislation and policy framework relevant for the in-combination climate change impacts assessment is also relevant for the climate change resilience assessment.
- 8.6.5 The amended EIA Directive 2014 states that the vulnerability of projects to climate change needs to be assessed within the EIA process. The EC guidance on Integrating Climate Change and Biodiversity into EIA¹³³ recommends that alternatives and measures are considered at the planning stage to ensure, amongst other things, that projects are resilient to the impacts of climate change. It highlights a shift in thinking to account for possible long term risks within environmental assessments, and the

¹³⁰ Existing mitigation measures refers to embedded design mitigation measures and environmental mitigation measures identified by topics as part of their assessments.

¹³¹ National Climate Assessment (2014), *Climate Change Impacts in the United States*- Chapter 5: Transportation

¹³² United Nations Economic Commission for Europe (2013), *Climate Change Impacts and Adaptation for International Transport Networks*

¹³³ European Commission (2013), *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*. European Union Publications Office <http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf>

role of resilience in this shift. The EIA process is well placed to aid this progression, showing how a changing baseline can affect a project over time.

- 8.6.6 The EC has also released sector specific guidance¹³⁴ on the interface between climate change and infrastructure, including projected impacts and resilience levels. This document accompanies the Communication An EU strategy for adaptation to climate change¹³⁵ and provides further background material supportive of the narrative and arguments put forward in the Communication. This working document also presents, for some areas, an outline of actions that the Commission will be undertaking, as announced in the Communication.
- 8.6.7 As for the in-combination climate change impacts assessment, the following sources provide relevant background information and context at the national level:
- the IEMA guidance on climate change resilience and adaptation⁶⁴ provides an approach to incorporating climate change resilience assessments into the EIA process in the UK;
 - relevant reports submitted under the UK ARP in the first and second rounds of reporting¹³⁶ (for example, Network Rail, National Grid, and Highways England; and
 - the guidance on climate change allowances published by the Environment Agency¹³⁷, which will be used in the flood risk assessment for the Proposed Scheme.
- 8.6.8 The approach and findings of the HS2 Phase 2a ES are a relevant starting point for the Proposed Scheme climate change resilience assessment. Volume 5 Appendix CL-002-000, published as part of the Phase 2a ES, includes potential climate change risks and existing mitigation measures which contribute to climate change resilience. Further work on the design of HS2 Phase 2a also provides useful additional information for the Proposed Scheme climate change resilience assessment.

Establishment of baseline

- 8.6.9 The environmental baseline for the climate change resilience assessment will be the same as the baseline defined for the in-combination climate change impact assessment. It will be based upon current and future climate data available for locations along the western and eastern legs of the route – namely Crewe at the southern end and Manchester at the northern end of the western leg, Birmingham at the southern end of the eastern leg, the East Midlands on the eastern leg, and Leeds at the northern end of the eastern leg.
- 8.6.10 The resilience of the Proposed Scheme will be based on the potential risks during the timeframes for the interim preliminary design stage, and the future design,

¹³⁴ European Commission (2013), *Adapting Infrastructure to Climate Change- Communication from the commission to the European Parliament, the council, the European economic and social committee and the committee of the regions: An EU Strategy on Adaptation to Climate Change*. Available online at: https://ec.europa.eu/clima/sites/clima/files/adaptation/what/docs/swd_2013_137_en.pdf;

¹³⁵ European Commission (2013), *An EU strategy for adaptation to climate change*. Available online at: https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf;

¹³⁶ Department for Environment, Food and Rural Affairs (Defra) (2017) Climate change adaptation reporting: second round reports. Available at: (<https://www.gov.uk/government/collections/climate-change-adaptation-reporting-second-round-reports>)

¹³⁷ Environment Agency (2017), Flood Risk Assessments: climate change allowances. Available at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

construction, operation and maintenance stages over the 120 year design life of the Proposed Scheme. Table 14 provides a comparison of these timeframes and the corresponding timeframes for UK climate change projections. It should be noted that design lives vary for different assets and infrastructure associated with the Proposed Scheme.

Table 14 - Temporal scope for the climate change resilience assessment

	Design	Construction (including testing and commissioning)	Operation (start)	Operation of Proposed Scheme
Climate change resilience assessment Proposed Scheme activities / stages	2016-2020	2023-2033	2033	2033 onwards
UKCP09 time period ¹³⁸	2020s (2010-2039)	2020s (2010-2039)	2030s (2020-2049)	2080s (2070-2099) ¹³⁹

8.6.11 Paragraphs 8.5.21– 8.5.23 summarise the UKCP09 climate change projections for mean climatic conditions and extreme weather events for the construction and operation phases of the Proposed Scheme.

8.6.12 As explained in paragraph 8.5.13, once UKCP18 are published, new current and future climate baselines will be established.

Scope of climate change resilience assessment

Technical scope

8.6.13 The technical scope of the climate change resilience assessment comprises an assessment of all potential climate hazards for all infrastructure and assets associated with the Proposed Scheme to the end of their design life and the assessment of any potential climate change risks.

Spatial scope

8.6.14 The spatial scope of the climate change resilience assessment comprises the western and eastern legs of the Proposed Scheme.

Temporal scope

8.6.15 The temporal scope of the climate change resilience assessment will include consideration of risks relevant to the design and construction stages and operation of the Proposed Scheme as described in Table 14. It is anticipated that the review of

¹³⁸ UKCP09 uses 30-year time periods for both the baseline climate and for all future climate projections. The projections are reported for seven overlapping 30-year time periods from 2010 - 2099. Each future time period is named based on the decade upon which it is centred. The 2020s, 2050s and the 2080s are most commonly used time periods

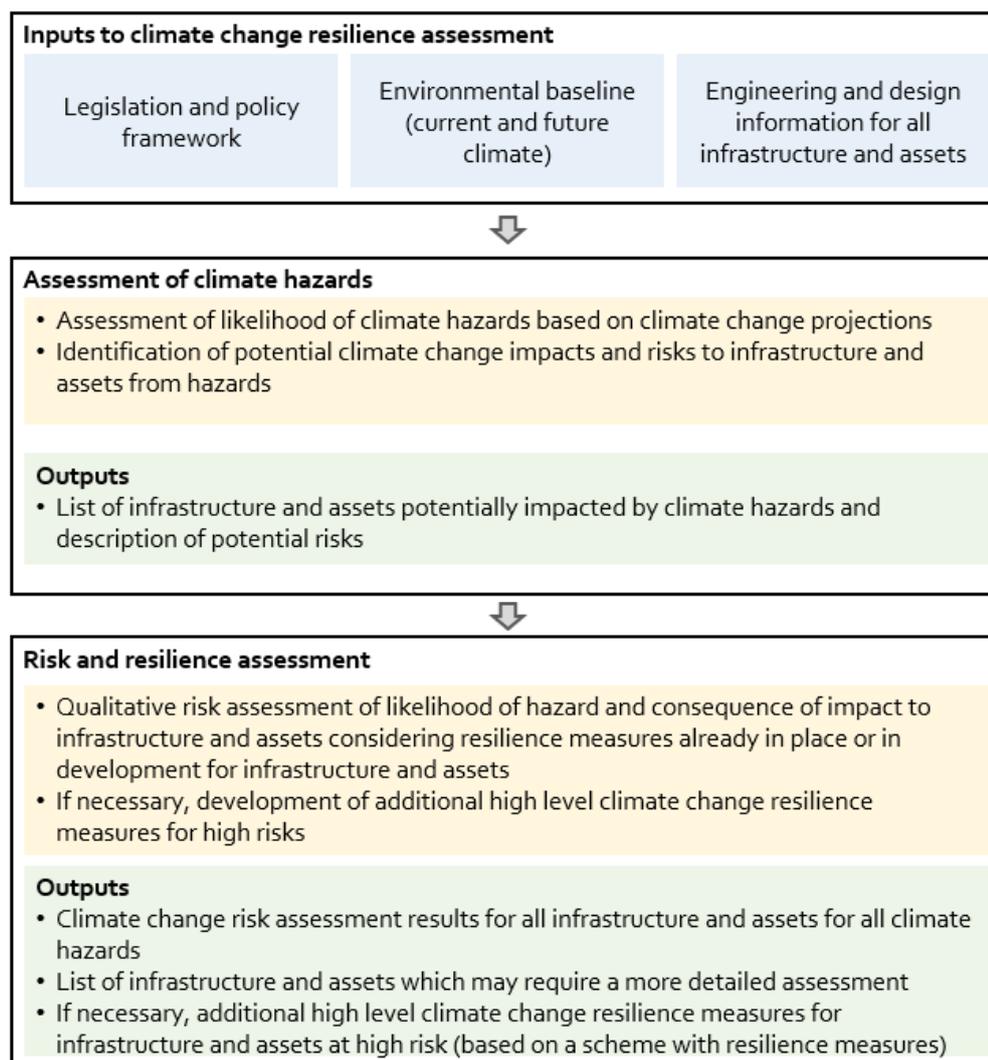
¹³⁹ For timescales outside the standard UKCP09 time periods the Climate change topic will engage with relevant government agencies (e.g. the Met Office and Environment Agency) for additional advice and guidance. In the case of flood risk only, climate change allowances up to and beyond 2115 will be used as indicated in Guidance - Flood risk assessments: climate change allowances (NPPF). This is because the NPPF defines the 2080s as covering the period 2070-2115 for the purposes of flood risk assessment, and HS2 can be considered as a development with a lifespan of at least 120 years

these potential climate change related risks will be an on-going process as the design progresses, and that related resilience measures will also be reviewed accordingly.

Assessment methodology

- 8.6.16 The climate change resilience assessment will be considered at a route-wide level. Following the establishment of environmental baselines and a review of relevant engineering and design information for all assets, an assessment of the potential climate hazards associated with the Proposed Scheme will be undertaken. This will be followed by the climate change risk and resilience assessment. See Figure 9 for an illustration of this approach.
- 8.6.17 As for the in-combination climate change impacts assessments, the integration of the climate change resilience assessment into the EIA process is still a relatively new approach. For transport infrastructure and assets, the evidence base is growing but not definitive, or there is insufficiently detailed evidence available for specific assets. Conversely, for some engineering and design disciplines, such as flood risk engineering, there is a relative abundance of evidence and guidance.
- 8.6.18 The route-wide climate change resilience assessment will initially be informed by the descriptions of changes in climate averages and extreme weather events provided in UKCP09 to qualitatively assess the impacts of climate change on the Proposed Scheme using professional expertise and judgement. It will take into account current weather events and climatic conditions, and consider how these might change during construction and the operational life of the infrastructure and assets associated with the Proposed Scheme. UKCP18 will be used to inform the final climate change resilience assessment. A more detailed and quantitative assessment may then be carried out during future design stages.
- 8.6.19 In the case of flood risk, more detailed planning requirements and design guidance relating to climate change exists. Therefore, an assessment of climate change impacts on flood risk will be carried out within the water resources and flood risk topic assessment at the route-wide and site-specific levels taking into account current Environment Agency climate change allowances for increases in peak river flow and rainfall intensity.
- 8.6.20 In order to develop a baseline understanding of the embedded resilience of the Proposed Scheme, the assessment will consider all relevant technical documentation and design codes and standards. In addition, any existing resilience measures for each risk, either already in place or in development, for infrastructure and assets will be explored and included in the assessment.
- 8.6.21 The climate change resilience assessment will be composed of two main parts: the assessment of climate hazards and the risk and resilience assessment, see Figure 9.

Figure 9 - Approach to the climate change resilience assessment



8.6.22 The risk and resilience assessment will be based on the likelihood of a hazard having an impact on the Proposed Scheme and the consequence of the impact. The definitions of these terms can be summarised as follows:

- a hazard is an effect of a changing climate, which has the potential to do harm to the infrastructure and assets associated with the Proposed Scheme;
- an impact can be any damage to the infrastructure or assets or an interference with their ability to operate - an impact can be direct, for example flooding of the infrastructure or assets, or indirect, for example heat exhaustion of workers;
- consequence is considered to be a degree of disruption to services; and
- risk is the combination of likelihood of a hazard having an impact on infrastructure assets, taking into account mitigation measures, and the potential consequence resulting from this impact.

Hazards assessment

8.6.23 The following climate hazards will be considered in this risk assessment¹⁴⁰:

- high and low temperatures;
- diurnal temperature range;
- high precipitation;
- soil moisture deficit;
- drought;
- humidity;
- ice and snow/cold;
- insolation (solar irradiation);
- river, surface water and groundwater flooding;
- storms/lightning strikes; and
- wind.

8.6.24 The degree to which the frequency and intensity of these potential hazards may change as a result of climate change is explained in the UKCP09 climate change projections. The level of uncertainty in these projections is also described in the UKCP09 reports and the Tomorrow's Railway and Climate Change Adaptation (T1009) reports. For example, there are large uncertainties on the direction of change in storms and high winds. It should be noted that the route-wide and site-specific flood risk assessments cover all relevant sources of potential flooding hazards (river, surface water and groundwater flooding).

Risk assessment

8.6.25 The risk assessment will consider the likelihood of a hazard occurring and the consequences of the respective impact on the infrastructure and assets of the Proposed Scheme (major accidents and disasters are considered further in Section 16).

8.6.26 The potential likelihood and consequence of impacts to the infrastructure and assets associated with the Proposed Scheme will be scored using a qualitative five point scale.

- likelihood – very likely, likely, as likely as not, unlikely, very unlikely; and
- consequence of impact – very high, high, medium, low, very low.

8.6.27 The resulting risk level will be scored as either:

- very high, high, medium, low, very low.

¹⁴⁰ Source: Adapted from UKCP09, T1009, 2011, 2015 and Phase One.

Mitigation measures

- 8.6.28 The assessment of likelihood and consequence of impact will consider mitigation and resilience measures already in place or in development for infrastructure and assets. Following consideration of potential climate change impacts, informed professional judgement will be used by engineering and design experts to produce high level, qualitative statements about potential infrastructure and asset specific climate change impacts and risks.
- 8.6.29 The risk assessment will identify the need for any additional resilience measures to protect against the effects of climate change, based on those risks assessed as scoring 'high' or 'very high'. High level resilience measures will be designed as part of workshops and focus groups with key engineering and design experts.
- 8.6.30 This level of risk assessment is considered appropriate for the interim preliminary design stage, and may be developed further during future design, construction and operation stages. The assessment will identify where this is the case and will include details in the assessment results.

Monitoring

- 8.6.31 Appropriate weather and climate change resilience monitoring measures will be identified.

9 Community

9.1 Introduction

9.1.1 This section of the SMR covers community which includes the assessment of impacts and effects on residential property and community infrastructure/organisations.

9.1.2 Impacts relevant to the community assessment fall broadly within the following categories:

- demolition/construction, direct land required and impacts on property; and
- intrusion/disturbance to communities and community facilities caused by other environmental impacts.

9.1.3 Community resources and receptors are set out in the following sections against the themes of residential property and community infrastructure.

Residential property

9.1.4 This will include private, rented and shared ownership residential dwellings and their surrounding grounds/gardens, student accommodation, extra care/retirement housing, mobile homes (where there are established and recognised locations) and homes used in conjunction with a business or other function.

9.1.5 Receptors include the residents or tenants of properties. They also include employees who permanently reside in a residential property, for example, care givers and janitors.

9.1.6 Impacts on commercial and industrial property will be addressed as part of the socio-economic assessment within the ES. Impacts on farms and farm-based enterprises will be addressed as part of the agriculture, forestry and soils assessment within the ES.

Community infrastructure/organisations

9.1.7 This will include community facilities and infrastructure such as education, health, emergency services, places of worship, sports and recreational facilities, publicly accessible open spaces and recreational public rights of way (PRoW).

9.1.8 Receptors include users and beneficiaries of resources which can include local residents, organised (community) groups, pupils, patients, congregations and employees who use community infrastructure. Receptors also include owners and organisations running the resources.

9.2 Establishment of baseline and definition of survey

Characteristics of communities

9.2.1 The potential for adverse impacts on communities has influenced the development of the Proposed Scheme.

9.2.2 Nevertheless, the proposed route alignment passes through, and potentially affects, a diverse range of communities and people. The main centres of population include

Crewe, Greater Manchester and Greater Nottingham and Leeds, but the route will pass close to a variety of settlements, including towns, villages, hamlets and isolated farmsteads in the countryside. The route will also include a spur to Sheffield passing through Chesterfield.

9.2.3 The key community characteristics of relevance include:

- their physical layout, accessibility and scale (e.g. in relation to land required, demolitions and severance);
- the location, type and importance of community facilities; and
- their demographic profile (including the incidence of deprivation).

Baseline data and methods

9.2.4 The baseline will include data collected on both resources and receptors.

9.2.5 Potential resources include:

- community infrastructure, including education, health, emergency services, community halls and places of worship;
- recreation infrastructure, including entertainment facilities, sports facilities, and other leisure activities;
- publicly accessible open space;
- residential properties (in terms of their occupation and amenity); and
- recreational PRoW.

9.2.6 Receptors include:

- individuals using community resources;
- residents;
- community groups;
- owners and organisations with interests in the community resources; and
- local communities as a whole.

9.2.7 Information on resources and receptors to inform the assessment will be drawn from a variety of sources that include:

- data collected during the preparation of the Sustainability Statement, supplemented and updated as appropriate;
- relevant national datasets such as: Index of Multiple Deprivation Access Domain; Census data; Office of National Statistics Neighbourhood Statistics; Sport England's participation dataset; Land Registry information; Valuation Office Agency information; and Yellow Pages and/or similar data sets on local facilities;

- existing local studies and information such as: open space surveys; land-use surveys; housing needs surveys; user surveys; membership lists; registered users;
- analysis and data from relevant topics such as: air quality (Section 7); health (Section 12); landscape and visual (Section 15); socio-economics (Section 17); sound, noise and vibration (Section 18); and traffic and transport (Section 19); and
- new field surveys where appropriate, for example, relating to publicly accessible open spaces and recreational PRoW.

9.2.8 The information collected on community resources and receptors, drawing on the above sources, will be limited by the extent of publicly available data and data obtained through consultation and engagement with communities.

9.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

9.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for the community assessment for the Proposed Scheme.

Engagement as part of the EIA process

9.3.2 In accordance with the consultation and engagement process set out in Section 3, further engagement with relevant organisations and communities will be carried out as part of the assessment. Engagement will be appropriate to each organisation.

9.3.3 Relevant organisations include:

- national government departments and statutory organisations;
- local government including local authorities, combined authorities and parish councils on the line of route of the Proposed Scheme; and
- non-governmental organisations including relevant voluntary and community sector organisations and other special interest groups.

9.3.4 Stakeholders will also be able to respond to consultation as part of a coordinated EIA approach.

9.4 Key aspects of the Proposed Scheme for the topic

9.4.1 The assessment of community effects will consider impacts and effects during both construction and operation of the Proposed Scheme. Impacts can generate the following broadly defined effects on receptors and resources:

- loss or gain: A loss or gain to a resource or receptor. For example, a decrease in housing stock as a result of demolitions;

- displacement: The re-location of receptors and resources from one location to another within the study area. For example, people moved from their homes to replacement homes permanently or temporarily;
- in-combination effects: Amenity value relates to the enjoyment of a resource by a receptor. The amenity value that resources offer receptors may be affected by a combination of factors including: noise and vibration; HGV traffic; air quality; and visual impacts. The assessment of in-combination effects on community receptors will draw on the conclusions from other assessment topics taking into account professional judgement about the sensitivity of the individual resource or receptors to the predicted effects; and
- isolation: In the context of this assessment isolation is to be measured by the barriers local communities face in making their usual journeys. This includes physical, psychological and social barriers (i.e. non-economic) and the effects of this on local communities. Isolation of commercial and industrial buildings and land, and severance of agricultural property and land, are addressed within the scope of assessments presented in Section 6 (Agriculture, forestry and soils) and Section 17 (Socio-economics).

9.4.2 Integrated working between the EIA community, socio-economic and health assessments and the Equality Impact Assessment (EQIA) will ensure that the assessment methodologies are aligned through:

- establishment of a consistent baseline for the community areas that will meet the requirements for these disciplines; and
- ensuring relevant significant community effects are taken into account as part of the health assessment and the EQIA.

9.5 Scope of assessment

9.5.1 The scope for the community assessment draws on the experience and good practice from similar infrastructure projects elsewhere (including Phase One and Phase 2a) and professional judgment of a suitably qualified EIA practitioner.

Spatial and technical scope

9.5.2 The proposed spatial scope is summarised in Table 15. This scope will be refined as the assessment proceeds (e.g. to ensure consistency with other environmental topics).

Table 15 - Impacts and effects on resources and receptors and spatial scope

Resource	Impacts	Effects:		Spatial scope
		Resources	Receptors	
Residential property	Residential property (including gardens) lost to land requirement	Reduction in housing stock available for people	Displacement of home owners/tenants, inconvenience and loss of their assets	Direct land required by HS2 either for the Proposed Scheme itself or for construction

	In-combination effects of noise and vibration, HGV traffic, air quality and visual impacting on residents ¹⁴¹	Character or quality of residential properties change as a result, for example due to noise and vibration; HGV traffic; reduction in air quality; visual impacts	Receptors' enjoyment of resource is changed	Relevant impact area from the edge of the route of the Proposed Scheme is a minimum of 250m in both urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Isolation of residential properties from other residential properties and community resources	Visual or physical e.g. islanding or isolation of resource	Reduction in social interaction and/or reduced access to neighbours or community facilities	Anticipated to cover some households up to 1km from the route and construction sites and depending upon specific context and proposals ¹⁴²
Community organisations, recreation infrastructure and open/play space	Community resources lost to land requirement	Decline in facilities available for community use or temporary impairment of use	Loss of facilities and benefits for users, workers owners, and groups/organisations	Direct land required by the Proposed Scheme
	Presence of construction workers with consequent requirements for use of community resources or services	Increased demand from construction workers on local community facilities or services	Reduced availability of local resources or services for existing users	Distance to relevant community resources and services likely to be used by construction workers
	In-combination effects of noise and vibration, HGV traffic, air quality and visual impacting on community infrastructure operations ¹⁴³	Character or quality of cities/towns/ neighbourhoods changes as a result of noise and vibration; HGV traffic; reduction in air quality; visual impacts	Receptors' enjoyment of resource is changed	Relevant impact area from the edge of the route of the Proposed Scheme is a minimum of 250m in urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Isolation of community resources from users	Visual or physical e.g. islanding or isolation of resource	Reduced access to community resources or effect on use of resources	Catchment area of affected resource where it is subject to isolation ¹⁴⁴

¹⁴¹ Noise and vibration; HGV traffic, vibration, pollution, air quality and visuals significant effects have been identified for the in-combination assessment as it is those effects which are most likely to potentially contribute to a change of amenity value of residential property and community infrastructure operations

¹⁴² The distance of the diversion and duration are factors in determining whether or not there is an impact

¹⁴³ Noise and vibration, HGV traffic, air quality and visuals significant effects have been identified for the in-combination assessment as it is those effects which are most likely to potentially contribute to a change of amenity value of residential property and community infrastructure operations

¹⁴⁴ The distance of the diversion and duration are factors in determining whether or not there is an impact

Temporal scope

- 9.5.3 The temporal scope for this topic is outlined in Section 4.2 (Scope of the assessment). Community effects will be assessed for the construction period (including a period of commissioning) (2023 - 2033) and for the year of opening in 2033. However, the assessment will also need to reflect the temporal scope of other topic assessments such as Air quality (Section 7); Landscape and visual (Section 15); Sound, noise and vibration (Section 18) and Traffic and transport (Section 19).

9.6 Assessment methodology

- 9.6.1 There are no industry-wide accepted methods for assessing community effects for projects of this nature. Methods have been developed for predicting and assessing effects which draw on existing guidance, analysis and methods established for other railway and large infrastructure projects including Phase One and Phase 2a of HS2.

Legislation and guidance

- 9.6.2 Relevant guidance includes:
- Highways Agency (2009) Design Manual for Bridges and Roads: Volume 11 Environmental Assessment¹⁴⁵ and Highways England Interim Advice Notes¹⁴⁶; and
 - industry accepted practice from other major infrastructure project EIAs, for example Phase One and Phase 2a, Crossrail and Thames Tideway Tunnel.

Significance criteria

- 9.6.3 The significance of a community effect will be determined by assessing both the:
- magnitude of the impact; and
 - the sensitivity of the community resources or receptors.

Determining magnitude of impacts

- 9.6.4 To determine the magnitude of impact, the nature of the impact (beneficial or adverse) and characteristics (i.e. whether direct or indirect, secondary, cumulative, short or long-term, permanent or temporary, reversible or irreversible) will be assessed and classified as high, medium, low or negligible.
- 9.6.5 The magnitude of an impact is its severity or scale. The magnitude of an impact on a resource or receptor reflects consideration of information and analysis relating to the spatial extent (localised/isolated versus widespread with potential secondary effects); the extent (number of groups and/or people or households affected); and the duration (short, medium and long-term).

¹⁴⁵ Highways Agency (2009), *Design Manual for Roads and Bridges: Volume 11*. London: the Stationery Office. Available at: <http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/index.htm>

¹⁴⁶ Department for Transport (DfT) and Highways England (2016), Standards for Highways online resources . Available online at: <http://www.dft.gov.uk/ha/standards/ians/index.htm>

- 9.6.6 Guideline criteria have been established based on professional judgment and are presented in Table 16. Specific magnitude criteria are included in the Technical note Community – further assessment guidance (referenced in Annex A).

Table 16 - Community impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very adverse/beneficial, and very likely to affect large numbers of groups and/or people (with number depending on the local context and nature of the impact), and that will usually continue and effectively constitute long-term impact on the baseline conditions
Medium	An impact that is likely to affect a moderate number of groups and/or people (with the number depending on the local context and nature of the impact)
Low	An impact that is likely to affect a small number of groups and/or people (with number depending on the local context and nature of the impact) and/or the base case is not affected beyond a short or medium-term duration
Negligible	An impact that is temporary in nature and/or is anticipated to have a slight or no effect on the well-being of groups and/or people

Determining receptor sensitivity

- 9.6.7 The sensitivity of receptors (people) will be determined by the extent to which individuals have the capacity to experience the effect without a significant loss or gain. This will, in part, be related to the sensitivity of the community resource(s) affected in terms of their importance, scarcity and size. Sensitivity will be classified as high, medium or low.
- 9.6.8 Guideline criteria have been established using professional judgment to determine the sensitivity of the receptors. These are presented in Table 17. Specific sensitivity criteria are included in the Technical note Community – Further assessment guidance, referenced in Annex A.

Table 17 - Community receptor value/sensitivity criteria

Receptor value and/or sensitivity	Definition
High	Individuals or groups that have little or no capacity to experience the impact without incurring a significant effect
Medium	Individuals or groups that have a limited or average capacity to experience the impact without incurring a significant effect
Low	Individuals or groups that generally have adequate capacity to experience impacts without incurring a significant effect

Determining the significance of effects

- 9.6.9 The significance of a community effect is a product of the magnitude of the impact and the sensitivity of the receptor and will be determined based on professional judgement.
- 9.6.10 The approach to determining the significance of community effects is summarised in Table 18.

Table 18 - Community - significance of effect criteria

Significance		Impact magnitude			
		High	Medium	Low	Negligible
Sensitivity of receptor	High	Major adverse /beneficial - significant	Major adverse /beneficial - significant	Moderate adverse /beneficial – significant	Minor adverse /beneficial - not significant
	Medium	Major adverse /beneficial - significant	Moderate adverse /beneficial - significant	Minor adverse /beneficial - not significant	Negligible - not significant
	Low	Moderate adverse/ beneficial - significant	Minor adverse/ beneficial - not significant	Negligible - not significant	Negligible - not significant

- 9.6.11 Effects are considered to be major and significant if both impact magnitude and receptor sensitivity are high or medium. Effects are considered to be moderate and significant if impact magnitude is high and receptor sensitivity is low, or alternatively if receptor sensitivity is high and impact magnitude is low.
- 9.6.12 Other effects, equating to minor adverse/beneficial and negligible effects, are not considered to be significant.

Construction effects

- 9.6.13 Construction effects will be assessed following the general EIA assessment process including:
- establishment of the baseline with definition and collection of relevant data and information as outlined in Section 9.2 (establishment of baseline and definition of survey);
 - consultations including those outlined in Section 9.3 (consultation and engagement); and
 - assessment of impacts and effects against key aspects of the Proposed Scheme as outlined in Section 9.4 (key aspects of the Proposed Scheme for the topic), covering the scope outlined in Section 9.5 (scope of assessment) and using the significance criteria outlined in this section.

Operational effects

- 9.6.14 The same process will be used for the assessment of operational effects as outlined for construction effects above.

Cumulative effects

9.6.15 The community assessment will report three types of cumulative effect as outlined in Section 4.4 (cumulative effects) of this SMR:

- inter-project effects – the EIA will consider the interaction between the Proposed Scheme, Phase One, Phase 2a and other existing and/or approved projects in the vicinity of the Proposed Scheme which are under construction or have been consented which may give rise to significant cumulative effects;
- intra-project (in-combination) effects – where two or more residual significant effects from other EIA topics (air quality, noise and vibration, HGV traffic or visual impact) coincide on a community resource / receptors (as outlined in Section 9.4.1); and
- synergistic – termed 'community-wide effects' these occur where a combination of effects on individual resources have a wider impact on a community, such that they change the experience of a significant proportion of people within that community in terms of their day to day functions (live, work, leisure, travel).

9.7 Assumptions

9.7.1 For assessment purposes it will be necessary to assume that the baseline characteristics established during the EIA process will remain largely unchanged. However, where it is possible to predict change, or to identify planned community facilities, these will be incorporated into the future baseline.

10 Ecology

10.1 Introduction

10.1.1 This section of the SMR covers ecology which includes the environmental topic areas of habitats, species and sites recognised or designated for nature conservation and biodiversity.

10.1.2 It describes the methodologies that will be used to identify the potential for impacts and effects upon species and habitats, including sites recognised or designated for their significance for nature conservation that are found along the route of the Proposed Scheme.

10.2 Establishment of baseline and definition of survey

10.2.1 The baseline conditions for the ES will be established through a combination of desk study, field survey and consultation.

10.2.2 Existing biological data for the route of the Proposed Scheme will be obtained from relevant Biological Records Centres and from national and local specialist data sources, such as bat groups. The data to be collated will include:

- statutory designated sites within 10km of the route¹⁴⁷;
- non-statutory designated sites and ancient woodlands within 5km of the route of the Proposed Scheme;
- records of protected, priority or otherwise notable species within 5km of the route of the Proposed Scheme (in some locations and for some species including bats, the corridor of search will be extended up to 10km from the route to ensure that a complete baseline for the assessment is gathered); and
- priority, or otherwise notable habitats, or features within 500m of the route of the Proposed Scheme.

10.2.3 Other relevant sources of ecological data such as local Biodiversity Action Plans, priority habitats and species lists, existing Phase 1 habitat surveys and Habitat Biodiversity Audits, Ancient Woodland Inventories, Biodiversity Opportunity Mapping and Green Infrastructure studies will be consulted.

10.2.4 In addition, existing ecological data available from other sources, such as ESs associated with other relevant developments or nature reserve monitoring records, will be consulted where available. A desk study will also be undertaken to identify any additional woodlands within the land required for construction of the Proposed Scheme and a 500m radius around it that have the potential to be ancient woodland. This will be based on a review of historical mapping, and may merit inclusion on the Ancient Woodland Inventory, subject to consultation with Natural England and further ecological survey and assessment.

¹⁴⁷ Desk study searches encompass corridors either side of the centreline of the proposed route

- 10.2.5 The width of the survey corridor will be defined by the potential area of ecological impact. This will vary depending on a number of factors, including the engineering of the route, the topography and ecological connectivity of the landscape, and the ecological receptor. In rural sections, the survey corridor for some species, such as great crested newt, could extend up to 500m either side of the land required for construction; in urban sections, the survey corridor will, in general, be much narrower as the zone of impact will be more restricted.
- 10.2.6 Phase 1 habitat surveys will be carried out and will include the identification of woodland and veteran trees. On the basis of the habitats present, and on the basis of professional judgement by an ecologist as to the potential for the presence of protected or otherwise notable species, further detailed specialist surveys will be undertaken where possible.
- 10.2.7 Specialist surveys will include:
- detailed botanical surveys (including Phase 1, National Vegetation Classification and woodland condition);
 - surveys of invasive non-native species;
 - river and watercourse surveys (including River Habitat Surveys and River Corridor Surveys);
 - hedgerow surveys;
 - Veteran tree survey;
 - ditch surveys;
 - pond surveys;
 - Great Crested Newt Habitat Suitability Index (HSI) surveys of water bodies and eDNA surveys;
 - amphibian surveys;
 - reptile surveys;
 - breeding bird surveys;
 - wintering and passage bird surveys;
 - badger surveys;
 - hazel dormouse surveys;
 - bat surveys of suitable features and bat emergence and activity surveys;
 - otter surveys;
 - water vole surveys;
 - terrestrial invertebrate surveys;

- aquatic macro-invertebrate surveys including white-clawed crayfish surveys; and
- fish surveys.

- 10.2.8 Further details on the survey methodologies will be set out in the Field Surveys Methods and Standards (FSMS) Technical note (referenced in Annex A). The methods set out in this SMR follow recognised methodologies (deviating only where considered appropriate); and have been determined in consultation with Natural England.
- 10.2.9 The desk study and field surveys, aided by consultation, will support the identification of sites and features of value. In addition, the assessment will identify landscape-scale ecological features, such as linear features (e.g. hedgerows, watercourses, and disused railway lines) that have additional value in providing habitat connectivity and potential migration corridors. This will include identification of landscape scale initiatives such as green infrastructure strategies and living landscape initiatives.
- 10.2.10 As a general rule desk study records will be considered as historic if they are more than 15 years old and therefore unlikely to provide relevant information to inform the baseline for the assessment. Different cut-off dates will be applied for the following receptors:
- habitats and higher/lower plant records - all records prior to 1 October 1990 considered as historic (a longer period than the standard due to their less mobile nature); and
 - white-clawed crayfish - all records prior to 1 October 2007 considered as historic (a shorter period than the standard due to the on-going rapid decline in numbers resulting from the spread of non-native crayfish).
- 10.2.11 Data from prior to the above dates will only be included as historic data in the ES where no more recent survey data are available, or where the data are of contextual value in relation to considering evidence of longer term species declines/advances and/or to identifying potential targets for habitat creation or species re-introductions.
- 10.2.12 The methodologies and proposed extents for ecological surveys likely to be required on a widespread basis across the route are provided in the FSMS Technical note.
- 10.2.13 The FSMS Technical note is not intended to cover all survey methodologies utilised. Additional survey methods or deviations from the methodologies identified in the FSMS will be reported in the relevant community area reports within the ES, if they are required at specific locations.

10.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

10.3.1 A number of organisations raised ecology matters in their consultation response to the Sustainability Statement. These included:

- Natural England;
- Environment Agency;
- Woodland Trust;
- Forestry Commission;
- Royal Society for the Protection of Birds;
- The Wildlife Trusts;
- National Trust; and
- Local authorities.

10.3.2 Relevant consultation responses on the Phase Two Sustainability Statement were taken into account in the development of the scope and methodology for ecology.

Engagement as part of the EIA process

10.3.3 During the EIA, the above organisations will remain key consultees for ecology and other national bodies will be consulted as appropriate.

10.3.4 In addition, at a local level, other organisations and individuals will be consulted as appropriate to provide existing data and contribute context to the assessment. These may include local authorities, landowners and local species interest groups (for example, bat, bird and reptile).

10.4 Key aspects of the Proposed Scheme for the topic

10.4.1 Adverse effects on nature conservation could arise most obviously through direct land-take, resulting in habitat loss, fragmentation and creation of barriers, and affecting the ability of habitats and populations of species to maintain favourable conservation status. This may result in the loss or degradation of ecological corridors and networks and a decline in connectivity between habitats. At least in the short to medium-term, temporary land-take may give rise to similar effects to those arising from permanent land-take, due to the slow recovery of species, populations and habitats. Some habitats, such as ancient woodland, are recognised as being irreplaceable and where such habitats are unavoidably affected, loss should be reduced as far as is reasonably possible.

10.4.2 Disturbance as a result of sound, noise, vibration, movement and/or light during site clearance, construction and operation could give rise to indirect effects on some species. Ecological effects can also result from edge effects, air and water pollution, arising once again during site clearance and construction, and from changes in water levels or flows.

- 10.4.3 In addition, there is the potential for the Proposed Scheme to have beneficial effects, for example as a consequence of habitat creation designed to extend and link fragments of semi-natural habitat.
- 10.4.4 Key potential ecological impacts are listed in Section 10.6 (Assessment methodology).

10.5 Scope of assessment

Temporal scope

- 10.5.1 The main construction works for the Proposed Scheme are anticipated to take place between 2023 and 2033 (including commissioning). The assessment of construction effects will relate to the construction programme set out in the ES. Effects arising from the operation of the Proposed Scheme will be assessed taking account of the services that are expected when HS2 reaches maximum capacity.
- 10.5.2 The baseline for the assessment will be taken as conditions at the time of the 2017-2018 surveys. Where the baseline is considered likely to change between the date of the surveys and the future scenarios this will be made clear in the ES¹⁴⁸. The predicted ecology baseline(s) in the relevant year(s) will be based on projection methods described in Section 8 (Climate change).

Spatial scope

- 10.5.3 The spatial scope of the ecological assessment will be defined by the potential area of ecological impact. More details are provided in Section 10.2 (Establishment of baseline and definition of survey). In summary, the area of search for existing information will extend up to 10km from the route of the Proposed Scheme. The extent of field surveys will vary according to the species and/ or habitat under study and the potential area of impact as explained in paragraph 10.2.5.
- 10.5.4 The spatial scope will include not only the physical extent of the works, including land-take associated with construction sites, road improvements and off-site works, but also indirect or secondary effects such as temporary and permanent changes in road traffic.
- 10.5.5 Due to the large scale of the Proposed Scheme and the large volumes of information to be collected in support of the assessment, the ES will report on only those resources/receptors identified as potentially relevant to the assessment. For Natura 2000 sites this is identified through Habitats Regulations Assessment to determine the potential for likely significant effects. For other receptors, it has been defined as follows:
- all statutory designated sites within Natural England's Site of Special Scientific Interest (SSSI) Impact Risk Zones, and any others considered potentially subject to significant effects;

¹⁴⁸ There will be a need for a programme of repeating and updating ecological surveys to continue beyond the deposit of the hybrid Bill, up to the point of site clearance, with monitoring beyond that time

- non-statutory designated sites (and ancient woodlands) located within a 500m radius of the land required for the construction of the Proposed Scheme, and any others considered potentially subject to significant effects; and
- protected and/or notable habitats and species¹⁴⁹ within or adjacent to land required for the construction of the Proposed Scheme, and any others considered potentially subject to significant effects.

Technical scope

- 10.5.6 The assessment will consider all ecological receptors with the potential to be directly or indirectly affected by the Proposed Scheme, including sites designated for their nature conservation value, legally protected or otherwise, notable species / habitats, all species and habitats of nature conservation importance i.e. not only those listed in Section 10.2, plus any other relevant information gathered. As well as assessing effects on individual sites or receptors, the cumulative effects of the works on the ecology along the length of the Proposed Scheme will also be assessed, see Section 10.6 (Assessment methodology). It will also consider the effects on landscape-scale ecological features and habitat connectivity.
- 10.5.7 In order to ensure that all likely significant effects of the Proposed Scheme will be identified, where baseline information is incomplete a precautionary approach of assuming a reasonable worst-case evaluation is to be adopted. This approach will be utilised to assign precautionary values to both known receptors and potential receptors based on the best available information. Further details are provided in the Ecological assessment method Technical note (referenced in Annex A).
- 10.5.8 In keeping with the aims set out in The Natural Environment White Paper¹⁵⁰ mitigation will be developed at both a strategic and local level, see Technical note Ecological principles of mitigation (referenced in Annex A).
- 10.5.9 The potential impacts and effects of climate change on ecological receptors, alongside the effects of the Proposed Scheme on the ability of habitats and species in the wider landscape to respond to climate change, will be considered as part of the route-wide assessments for ecology and climate in the ES. The climate change assessment is set out in Section 8 (Climate change) of this SMR.
- 10.5.10 Impacts on relevant European designated sites will be described within the ES, against the requirements of both the EIA and the Habitats Regulations. Supporting technical studies may be presented in a separate, standalone document(s).
- 10.5.11 A separate assessment will be made of the implications of the relevant aspects of the proposals covered by the Water Framework Directive¹⁵¹ (WFD). This is discussed in Section 21, Water resources and flood risk. The WFD assessment will inform the assessment of effects related to water quantity and quality, as well as

¹⁴⁹ *Natural Environment and Rural Communities Act 2006*. London, The Stationery Office

¹⁵⁰ Department for Environment, Food & Rural Affairs, (2011), *The Natural Choice: securing the value of nature*. London, The Stationery Office

¹⁵¹ European Commission (EC) (2000), *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*. Official Journal of the European Communities. **327**, p 1-72.

hydromorphology. The respective biological effects will be reported in the ecology section of the ES.

- 10.5.12 In addition to the overlap with the water resources assessment in regard to the WFD, there are overlaps between the ecology assessment and a number of other assessments being undertaken as part of the EIA. Section 7 should be referred to regarding the air quality assessment; Section 13 should be referred to regarding the historic environment aspects of veteran trees affected by the Proposed Scheme; Section 15 should be referred to with regard to the landscape and visual impacts and effects from loss of habitat; Section 18 with regard to the sound, noise and vibration assessment and Section 21 with regard to the water resources and flood risk assessment.
- 10.5.13 The Government and HS2 Ltd are also seeking to achieve no net loss of biodiversity for the Proposed Scheme. The methodology used for this no net loss assessment has been adapted from the approach used for Phase One and Phase 2a, taking account of the review undertaken by Natural England during 2016. It will be used to compare the habitats present pre and post-construction, see Technical note Methodology for demonstrating no net loss in biodiversity (referenced in Annex A). The outputs from the no net loss calculation will be reported separately at www.gov.uk/hs2.

10.6 Assessment methodology

- 10.6.1 The assessment is to be guided by the methodology advocated by the Chartered Institute of Ecology and Environmental Management (CIEEM) as published in the Second Edition in January 2016¹⁵². Full details of the assessment methodology are provided in the Ecological assessment method Technical note (referenced in Annex A).

Legislation

- 10.6.2 The assessment will take into account relevant national and international legislation including:
- The Wildlife and Countryside Act 1981 (as amended)¹⁵³;
 - The Conservation of Habitats and Species Regulations 2010 (as amended 2012)¹⁵⁴;
 - Protection of Badgers Act 1992¹⁵⁵;
 - The Hedgerows Regulations 1997¹⁵⁶;
 - Countryside and Rights of Way Act 2000¹⁵⁷;

¹⁵² Chartered Institute of Ecology and Environmental Management (2016), *Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater and Coastal*. CIEEM

¹⁵³ *The Wildlife and Countryside Act 1981* (as amended). London, The Stationery Office

¹⁵⁴ *The Conservation of Habitats and Species (Amendment) Regulations 2012* (SI 2012 No. 1927). London, Her Majesty's Stationery Office.

¹⁵⁵ *The Protection of Badgers Act*. London, The Stationery Office

¹⁵⁶ *The Hedgerows Regulations 1997* (SI 1997 No. 1160). London, The Stationery Office

¹⁵⁷ *Countryside and Rights of Way Act 2000*. London, The Stationery Office

- Natural Environment and Rural Communities Act 2006;¹⁵⁸
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003¹⁵⁹;
- Salmon and Freshwater Fisheries Act, 1975 (as amended)¹⁶⁰; and
- Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.

Guidance

10.6.3 The assessment also takes into account relevant guidance set out in national, regional and local planning policy and other guidance, including, but not limited to:

- NPPF (2012)¹⁶¹;
- Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system¹⁶²;
- Natural Environment White Paper - The Natural Choice: securing the value of nature (2011);¹⁶³
- Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network (2010; the 'Lawton Report')¹⁶⁴;
- Biodiversity 2020: A strategy for England's wildlife and ecosystem services (2015)¹⁶⁵;
- Natural England and Forestry Commission Standing Advice for Ancient Woodland and Veteran Trees (2014)¹⁶⁶;
- Natural England Standing Advice for Protected Species (2014 / 2015)¹⁶⁷; and
- DfT's DMRB Volume 11 (Ecology and Nature Conservation) and Interim Advice Note 130/10 (Ecology and Nature Conservation: Criteria for Impact Assessment).

10.6.4 As well as taking account of nature conservation policies in Local Development Frameworks, the assessment will consider other relevant local plans for biodiversity

¹⁵⁸ *Natural Environment and Rural Communities Act 2006*. London, The Stationery Office

¹⁵⁹ The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (*SI 2003 No. 3242*). London, Her Majesty's Stationery Office.

¹⁶⁰ *Salmon and Freshwater Fisheries Act 1975* (C 51). London: The Stationery Office.

¹⁶¹ DCLG (2012), National Planning Policy Framework. DCLGC. Bressenden Place, London

¹⁶² Office of the Deputy Prime Minister (ODPM) and Defra (2005), *ODPM Circular 06/2005 and Defra Circular 01/05, Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system*, ODPM

¹⁶³ Department for Environment, Food and Rural Affairs (Defra) 2011, *The Natural Environment White Paper, The natural choice: securing the value of nature*. London: The Stationery Office

¹⁶⁴ Defra (2010), *Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network*, Defra.

¹⁶⁵ Defra (2015), *Biodiversity 2020: A strategy for England's wildlife and ecosystem services*, Defra.

¹⁶⁶ Forestry Commission England (2014). *Standing advice for ancient woodland and veteran trees*. Natural England Available online at: [http://www.forestry.gov.uk/pdf/AncientWoodsSA_v7FINALPUBLISHED14Apr3.pdf/\\$FILE/AncientWoodsSA_v7FINALPUBLISHED14Apr3.pdf](http://www.forestry.gov.uk/pdf/AncientWoodsSA_v7FINALPUBLISHED14Apr3.pdf/$FILE/AncientWoodsSA_v7FINALPUBLISHED14Apr3.pdf)

¹⁶⁷ Natural England and Defra 2014/2015, *Protected Species and sites: how to review planning proposals*. Accessed online at: <https://www.gov.uk/guidance/protected-species-and-sites-how-to-review-planning-proposals>

protection and enhancement such as local biodiversity action plans, green infrastructure plans and Nature Improvement Areas.

Significance criteria

- 10.6.5 Further details of the significance criteria used for the assessment are provided within the Ecological assessment method Technical note (referenced in Annex A).
- 10.6.6 Each potential ecological receptor will be evaluated against the following geographical frames of reference: international; national; regional; county/metropolitan; district/borough; local/parish; and negligible. The standard geographical frames of reference of 'site' and 'within zone of influence' will not be used as they are not considered appropriate for a linear scheme of this scale.
- 10.6.7 It is important that there is a consistent approach to the definition of significance across the different environmental topics reported in the ES. Significant ecological effects on receptors at different geographical scales will therefore be related to the overall significance categories used by other environmental topic areas. This process will also ensure that the overall assessment focuses on the key significant ecological issues.

Construction effects

- 10.6.8 Potential impacts resulting from construction activities include:
- temporary and permanent land required;
 - severance of ecological corridors and networks;
 - fragmentation of habitats and sites;
 - barrier effects (to movement of fauna);
 - noise and visual disturbance;
 - disturbance from lighting;
 - dust deposition;
 - air pollutants emitted from construction vehicles and plant;
 - risk of water quality changes from surface water runoff;
 - hydrological effects, from changes in water levels and/or flows;
 - effects on groundwater and any habitats reliant on them;
 - changes in management, resulting in habitat degradation; and
 - introduction and spread of invasive non-native species.
- 10.6.9 The Proposed Scheme also offers opportunities for creation and enhancement of habitats. There are opportunities to restore, reconnect and to 're-naturalise' terrestrial and aquatic habitat, the value of which is limited by existing modification. Both the landscape and drainage designs of the Proposed Scheme will be influenced by ecological opportunities, for example, through creation of more natural watercourses.

Ensuring that the landscaping and habitat creation associated with the Proposed Scheme has a nature conservation legacy is reflected in the Environmental Design Aims.

Operational effects

10.6.10 Potential operational activities that could give rise to ecological effects include:

- barrier effects (to movement of fauna);
- mortality of wildlife from collision;
- noise and visual disturbance;
- disturbance from lighting;
- accidental pollution; and
- introduction and spread of invasive non-native species.

Cumulative effects

10.6.11 Cumulative effects are those that result from a combination of a number of individual effects. In the context of the ecological assessment of the Proposed Scheme, these will include:

- the combined ecological effect on a single receptor of a number of individual environmental impacts, e.g. area of land required and noise and airborne dust, arising from the Proposed Scheme;
- the cumulative effects of localised ecological impacts along the length of the railway, for example the potential of cumulative loss of certain habitat types; and
- interaction between ecological effects arising from the Proposed Scheme and those from other relevant projects (including Phase One and Phase 2a) and plans (both on single receptors and along the length of the route of the Proposed Scheme).

Significance of effects and monitoring

10.6.12 Details of the process for determining significance of effects are provided within the Ecological assessment method Technical note (referenced in Annex A).

10.6.13 In the event that any significant residual impacts remain, procedures for monitoring those significant effects will be developed, as appropriate, as part of the overall monitoring approach.

10.7 Assumptions

10.7.1 The ecology section of the ES will include a section to explain any assumptions made in undertaking the ecological assessment.

11 Electromagnetic interference

11.1 Introduction

- 11.1.1 This section of the SMR covers electromagnetic interference which includes the environmental topic areas of Electromagnetic Fields (EMF), and Electromagnetic Interference (EMI), including Electromagnetic Compatibility (EMC). EMF is produced whenever electricity is present.
- 11.1.2 EMI is disturbance that affects an electrical system due to magnetic and electric fields, electromagnetic induction, conduction or electromagnetic radiation emitted from an external source.
- 11.1.3 EMC is the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to other equipment in that environment.
- 11.1.4 The principal source of EMF from the Proposed Scheme that may have an effect on third parties will be the traction power supply system. Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system. In addition, equipment located within the infrastructure maintenance depot do not produce levels of EMF that will have an effect outside the operational railway. The Electromagnetic Compatibility Regulations 2016 ensures that equipment shall be so designed and manufactured to ensure that the electromagnetic disturbance generated does not exceed the level above which radio and telecommunications equipment or other equipment can operate as intended.
- 11.1.5 The Proposed Scheme (and particularly its nature as an electrified railway) is not unique, hence, there exists data from HS1 and HS2 Phase One¹⁶⁸ for example that can be used to illustrate the minimal effects of EMI to the environment.
- 11.1.6 EMI is an issue that can normally be mitigated through the application of EMC industry accepted practice during design and installation.
- 11.1.7 EMF limits are specified in the EU Directive 2013/35/EU Electromagnetic Fields (EMF) limits, published in 2013 and enforced in the UK by the Control of Electromagnetic Fields at Work Regulations 2016 (CEMFAW 2016). An industry guidance note has been produced by the RSSB GLGN1620 : Guidance on the Application of the Control of Electromagnetic Fields at Work Regulations, to support the CEMFAW Regulations.
- 11.1.8 EMF exposure to workers and the general public will be addressed as part of this assessment.
- 11.1.9 Many of the effects caused by EMI will be eliminated or reduced to acceptable standards during the design and installation period of the Proposed Scheme. Designs for the Proposed Scheme are covered by British and European Standards and industry accepted practice.

¹⁶⁸ HS2 Ltd (2013). *London-West Midlands Environmental Statement Volume 5: Technical Appendices*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/259623/Route-Wide_HS2_EMC_Management_Plan_EM-002-000.pdf

11.2 Establishment of baseline and definition of survey

- 11.2.1 In constructing and operating the Proposed Scheme, there will be key interface issues that require evaluation and management. A definitive list of interfaces will be established as part of the initial survey scope. The new infrastructure will have an impact on and be impacted upon by its surroundings, which will differ throughout the length of the route of the Proposed Scheme.
- 11.2.2 Where the Proposed Scheme is adjacent to an existing railway corridor, there will be a significant interface with the existing railway networks. Although the existing infrastructure may have systems and procedures to mitigate the effects of EMI, it is possible that the introduction of the Proposed Scheme's infrastructure may have an adverse effect on the existing railway infrastructure. Similarly, the existing railway infrastructure may have an effect on the Proposed Scheme (both infrastructure and rolling stock).
- 11.2.3 British and European Standards exist to mitigate the effects of EMI on neighbouring railways. These standards will be adopted through design, installation, operation and maintenance best practice. HS2 Ltd will consult with other infrastructure owners during the design period.
- 11.2.4 For areas not adjacent to an existing railway, the Proposed Scheme's infrastructure is likely to have a greater impact on its surroundings. It is therefore important to identify any key areas along the route where EMI could be an issue for the sensitive receptors identified.
- 11.2.5 A desk top assessment will be undertaken to identify potential receptors at risk which are external to the operational railway. Examples of potentially sensitive sites that may be at risk and are to be considered are:
- universities;
 - schools;
 - hospitals;
 - military establishments;
 - airports;
 - emergency and commercial radio stations;
 - residential properties; and
 - industrial properties.
- 11.2.6 The above sites have been chosen in relation to their potential to host/operate electrical equipment and the likely sensitivity of this equipment, as described in BS EN61000-6-2:2005, BS EN61000-6-1:2007, Ministry of Defence Standard 59-411:2007, BS EN60601-1-2:2015 and BS EN50121: series.

11.3 Consultation and engagement

11.3.1 During the preparation of the ES, consultation will be undertaken as appropriate, with the following organisations:

- Network Rail;
- Sheffield SuperTram,
- Nottingham Express Transit (Nottingham Tram),
- Manchester Metrolink,
- electricity supply authorities;
- electricity distribution companies;
- data and telecommunication companies;
- local authorities;
- hospitals; and
- airports.

11.4 Key aspects of the Proposed Scheme for the topic

11.4.1 The following are potential sources of EMI:

- temporary sources: direct effects could be caused by construction from significant activities such as tunnelling, as a result of the use of electrical machinery, such as pumps, generators and compressors. Tunnel boring machines utilise high voltage electricity supplies. These activities will be supported from local work compounds close to the structure/tunnel being constructed, local worksites, or larger construction compounds where equipment may be used; and
- permanent sources: direct effects could be caused by the operational railway and its supporting systems (e.g. overhead line equipment (OLE) and traction distribution, infrastructure maintenance depot, ventilation shafts and other line side equipment, traction sub stations, rolling stock depots and rolling stock, both existing and proposed).

11.4.2 The main source of EMF will be the traction power system, as electromagnetic emissions are caused by the current flowing in an electrical system.

11.4.3 The higher currents found in high voltage power lines have the potential to create larger EMF, the strength of which diminish rapidly with distance from the source.

11.5 Scope of assessment

11.5.1 A desk study will be undertaken to identify potential sources of EMF and EMI that may be produced during both the construction and operational phases of the Proposed Scheme. This will identify the potential risk and the potential impact and effect. The desk-based study will also identify establishments where people are potentially at risk

from the EMF produced by the Proposed Scheme's 25 kilovolts (kV) electrification traction power.

- 11.5.2 The study will identify potentially sensitive receptor sites within a 50m corridor either side of the centreline of the nearest track within the Proposed Scheme, or from proposed power equipment (e.g. OLE and traction substations).
- 11.5.3 Once each receptor site has been identified, a risk assessment will be undertaken to categorise the perceived level of risk and to identify the potential mitigation for each receptor site.
- 11.5.4 A risk assessment will be undertaken to assess the impact of EMF effects on nearby equipment, installations and people.
- 11.5.5 The assessment will use data from the preliminary traction power modelling completed by HS2 Ltd, in undertaking the evaluation.

11.6 Assessment methodology

Legislation and guidance

- 11.6.1 The following standards are relevant:
 - ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (1Hz to 100kHz): 2010;
 - EU Directive 2013/35/EU Electromagnetic Fields (EMF) limits;
 - The Electromagnetic Compatibility Directive 2014/30/EU;
 - BS EN 61000-6-1:2007. Electromagnetic compatibility Part 6.1: Generic standards- immunity for residential, commercial and light industrial environments;
 - BS EN 61000-6-2:2005. Electromagnetic compatibility Part 6.2: Generic standards- immunity for industrial environments;
 - BS EN 61000-6-3:2007. Electromagnetic Compatibility Part 6.3: Generic standards— Emissions for residential, commercial and light-industrial environments;
 - BS EN 61000-6-4:2007. Electromagnetic Compatibility Part 6-4: Generic standards— Emissions for industrial environments;
 - BS EN 50499:2008. Procedure for the assessment of the exposure of workers to electromagnetic fields;
 - EC Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300GHz);
 - EU Directive 2006/42/EC on machinery;

- BS EN 50121 series of standards, Railway Applications, Electromagnetic Compatibility, which contains the following parts:
 - BS EN 50121-1:2017 Part 1: General;
 - BS EN 50121-2:2017 Part 2: Emissions of the whole railway system to the outside world;
 - BS EN 50121-3-1:2017 Part 3-1: Rolling stock - train and complete vehicle;
 - BS EN 50121-3-2:2015 Part 3-2: Rolling stock – apparatus;
 - BS EN 50121-4:2016 Part 4: Emissions and immunity of the signalling and telecommunications apparatus; and
 - BS EN 50121-5:2017 Part 5: Emissions and immunity of fixed power supply installations and apparatus.
- BS EN 50122 series of standards, Railway Applications - Fixed installations - Electrical safety, earthing and the return circuit, which consists of:
 - BS EN 50122-1:2017 Part 1: Protective provisions against electric shock;
 - BS EN 50122-2:2010 Part 2: Provisions against the effects of stray currents caused by d.c. traction systems; and
 - BS EN 50122-3:2010 Part 3: Mutual Interaction of a.c. and d.c. traction systems.

Significance criteria

EMC Zones

- 11.6.2 Using the estimated levels of generated EMF from the preliminary traction power modelling results, the levels of predicted EMF will be assessed against the maximum levels mandated by British and European Standards.
- 11.6.3 For the effects of EMF on human health, any level above 1,000 microTesla (μT) as stated within EU Directive 2013/35/EU will be considered as significant.
- 11.6.4 For the effects of EMI on susceptible electrical or electronic equipment, where the level exceeds 3 Amperes per metre (A/m) for residential and 30A/m for industrial equipment, this will be regarded as significant. These levels are the current limits identified in BS EN 61000-6-1:2007 and BS EN 61000-6-2:2005 respectively.
- 11.6.5 EM Zone 1: For equipment less than 10m from the centreline of the nearest track rails or from non-traction power equipment (i.e. cables transformers or switchgear). BS EN 50121-4:2016 (Signalling and Telecommunication Apparatus) and BS EN 50121-5:2017 (Fixed Power Supply Installations) will be applied in this zone. The emission and immunity levels are provided in the BS. BS EN 50121-4:2016 (Signalling and Telecommunication Apparatus) applies to any safety critical equipment located in this zone.

- 11.6.6 EM Zone 2: For equipment greater than 10m, but less than 20m from the centreline of the nearest track rails or from non-traction power equipment (i.e. cables, transformers or switchgear). BS EN 61000-6-2: 2005 (Generic standards - Immunity for industrial environments) and BS EN 61000-6-4 (Generic standard - Emissions for Industrial Environments), will be applied in this zone. The emission and immunity levels are given in the BSs. Any safety critical equipment located in this zone would also apply to these BSs.
- 11.6.7 EM Zone 3: For equipment greater than 20m from the centreline of the nearest track rails or non-traction power equipment (i.e. cables transformers or switchgear). BS EN 61000-6-1: 2007 (Generic standard - Immunity for residential, commercial and light industrial environments) and BS EN 61000-6-3: 2007 (Generic standards - Emissions for residential, commercial and light industrial environments), will be applied in this zone. The emission and immunity levels are given in these BSs.
- 11.6.8 For emissions affecting people outside the 20m zone, EU Directive 2013/35/EU EMF limits will be followed.
- 11.6.9 Where risk is identified, proposals for mitigation will be recommended.
- 11.6.10 In creating the hazard log, the impact and risk levels will be established thereby identifying key areas for assessment. At some point before energisation, baseline measurements will be taken to confirm the EMI background levels of the existing environment.

Construction effects

- 11.6.11 The effects of construction will be evaluated and appropriate mitigation measures will be recommended to address any potentially significant adverse effects identified. Ongoing measurements and monitoring will be considered during construction, where significant adverse effects are identified.

Operational effects

- 11.6.12 The effects of operation will be evaluated and appropriate mitigation measures will be recommended to address any potentially significant adverse effects.

Cumulative effects

- 11.6.13 Any cumulative effect due to the Proposed Scheme running close to an existing electrified railway, for example, will be included in the assessment.
- 11.6.14 The traction power modelling, the results from which the assessment will be made, will be developed using the worst case traction loads for the proposed timetable. Any effects of EMF and EMI will therefore be considered using the worst case loads.

11.7 Assumptions

11.7.1 The following assumptions are made:

- no site visits will be conducted, rather a desk-based study will be undertaken;
- no EMI modelling or detailed calculations will be undertaken;
- where information is not available, professional judgement will be used to reach a conclusion. It may be possible, subject to review, to use information from other recent and similar railway construction projects;
- the compilation of information from which to assess the baseline measurements will be dependent on the availability of recorded information; and
- in accordance with good safety management principles, it is assumed that risks due to EMI will be reduced using the 'as low as reasonably practicable' (ALARP) principle.

12 Health

12.1 Introduction

12.1.1 This section of the SMR covers health which includes the environmental topic areas of health assessment, community profiling, stakeholder engagement, and assessment.

12.1.2 When considering the health effects of development projects, health is viewed in a broad sense, encompassing both physical and mental wellbeing, as influenced by a wide range of environmental, social and economic determinants. This broader understanding of health is captured in the World Health Organization (WHO) definition: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"¹⁶⁹. Health effects will be assessed at the population level, through the consideration of exposure to the environmental and socio-economic impacts of the Proposed Scheme and evaluation of the potential for these impacts to affect health. In addition, the assessment will highlight potential impacts on specific groups of receptors such as users of facilities that may be impacted by the Proposed Scheme, or vulnerable groups within the community.

12.1.3 Health assessment is a multi-disciplinary activity that cuts across the boundaries of health, public health, social sciences and environmental sciences. The potential health effects of the Proposed Scheme will be assessed alongside environmental effects through an integrated process. The impacts and effects on human health and populations directly arising from the Proposed Scheme in the event of it being affected by a major accident or disaster are considered in Section 16, major accidents and disasters.

12.1.4 The objectives of the assessment are to:

- describe how the Proposed Scheme has the potential to impact (directly and indirectly) on the factors that influence health and wellbeing (termed 'health determinants')¹⁷⁰;
- identify the likely extent and intensity of exposure to impacts on health determinants;
- qualitatively or quantitatively assess the potential health effects arising from these impacts;
- identify those sections of the population likely to be most affected, either positively or negatively, by impacts on health determinants; and
- identify measures to enhance the positive and mitigate the negative effects on community health and wellbeing.

¹⁶⁹ World Health Organization (1948), *Constitution of the World Health Organization Basic Documents, 45th edition supplement*. Available online at: www.who.int/governance/eb/who_constitution_en.pdf

¹⁷⁰ The health of an individual is determined primarily by gender, genetics and lifestyle. For a population, a significant contribution to its health status is governed by external factors such as socio-economics and the physical environment. These factors are referred to as health determinants and the assessment of health relies on the fact that impacts on these determinants will have corresponding health effects, based on the evidence from scientific literature.

12.2 Establishment of baseline

Baseline data and community profiling

- 12.2.1 Baseline data will be collected from a variety of sources and will be used to construct a community health profile, providing an overview of the prevailing socio-economic status of the existing population and giving an indication of levels of health and wellbeing. The analysis of data will focus on identifying vulnerable sub-groups that may be particularly sensitive to health and wellbeing effects. Reference will also be made to environmental baseline information collated by other topics, including environmental characteristics (e.g. noise, air quality and landscape character), and the presence of key features and resources used by the community.
- 12.2.2 The process of gathering baseline data will be undertaken in collaboration with related assessment topics including community and socio-economics. The principal sources of data will include:
- national datasets such as those from the Office of National Statistics, Local Authorities, Public Health Observatories, Public Health England (PHE), Sport England (Active People Survey), Joint Strategic Needs Assessment, and other sources;
 - local public health reports;
 - information from local strategies and policies relating to health and wellbeing;
 - data obtained through consultation with public health authorities;
 - feedback received through joint public consultations; and
 - outputs from the EIA baseline assessment (e.g. sound noise and vibration, air quality and landscape and visual baselines).
- 12.2.3 Over the timescale of the Proposed Scheme's delivery, the profile and situation of affected communities will change, influenced by wider economic and policy change as well as demographic trends. Where data and forecasts are available, the likely future community profile will be considered.

12.3 Consultation and engagement

Stakeholder engagement

- 12.3.1 Stakeholder feedback will be sought in order to further understand the specific characteristics, concerns and perceptions of local communities that may not be picked up through a review of publicly available data. This will enable the susceptibility of communities to health and wellbeing effects to be more fully understood.

Responses to consultation on the Sustainability Statement (2013 and 2016)

- 12.3.2 During the consultation on the Sustainability Statement, PHE provided a number of responses which have been addressed within this section and within the health aspects of the climate change, flood risk and socio-economics sections of this SMR.

The methodology for establishing a baseline, stakeholder consultation and the definition of health determinants reported in this section have incorporated PHE feedback.

Engagement as part of the EIA process

- 12.3.3 The integrated approach to health and environmental assessment includes an emphasis on integrated stakeholder engagement. Information obtained through stakeholder engagement will help to inform the health assessment. Engagement on health issues will form part of the wider EIA consultation process and health considerations will be a key element of community engagement activities.
- 12.3.4 In conjunction with the wider consultation process, further engagement with relevant organisations and communities will be carried out. This will be undertaken on a community specific, and route wide, basis.
- 12.3.5 Key health sector stakeholders will include PHE, Public Health Directors and representatives of mental health trusts and local authority health and wellbeing boards.
- 12.3.6 Local and regional health stakeholders will be identified through contact with parish councils and local authorities. Relevant organisations and special interest groups may be identified via national, regional and local databases, websites and other sources. Engagement will focus on groups that are well-positioned to provide information relating to the affected communities and identified information gaps.
- 12.3.7 Vulnerable groups in the population will be identified through consultation with local stakeholders and community representatives.
- 12.3.8 In line with HS2 Equality, Diversity and Inclusion (EDI) Policy, consultation and engagement will be accessible and inclusive in its approach. This will involve planning and implementing measures to reduce and remove both spatial and non-physical barriers to involvement in the consultation and engagement processes.

12.4 Key aspects of the Proposed Scheme for the topic

- 12.4.1 The assessment of health effects will consider impacts on health determinants during the construction and operation of the Proposed Scheme. The following aspects are likely to be particularly relevant to the health assessment:
- provision of new public transport infrastructure and public realm;
 - land required temporarily or permanently, including loss of residential and commercial property, public open space, PRow, land or property used for sport/leisure, community, healthcare and cultural and faith uses;
 - impacts on residential properties;
 - impacts on educational facilities;
 - impacts on access to health care and medical services;

- construction activities, including:
 - site clearance and demolition;
 - earthworks and site preparation;
 - location and management of construction compounds;
 - construction traffic, including HGVs;
 - mitigation, including air, noise and vibration control measures, visual screening and traffic management;
 - employment generation; and
 - accommodation and welfare for construction staff¹⁷¹.
- permanent aspects:
 - passing trains (causing noise and visual effects);
 - presence of physical structures (affecting local views and/or causing severance);
 - electromagnetic interference;
 - severance or re-routing of local roads and PRow;
 - direct and indirect employment and regeneration effects; and
 - direct and indirect impacts on community facilities and resources.

12.5 Scope of assessment

Spatial scope

- 12.5.1 The health and wellbeing effects of the Proposed Scheme will be considered for populations at the local and route-wide level.
- 12.5.2 The community level assessment of health and wellbeing effects will be aligned with the study areas for related environmental topics, where relevant. The study areas for each environmental topic will be defined according to the individual assessment methodologies and protocols. However, as far as possible, the study areas will be consistent to enable an assessment of the combined effects of different environmental and social impacts on communities.

Temporal scope

- 12.5.3 The temporal scope is outlined in Section 4.2 (Scope of the assessment) of this SMR. Health effects during the pre-construction period, the construction and commissioning period and operational period will be considered.

¹⁷¹ Occupational health and safety assessments for the workforce are separate to HIA which is for the community, but where there are overlaps they will be included in the HIA

Technical scope

Health pathways and potential effects

- 12.5.4 Health effects may arise when a proposed development impacts upon factors known as 'health determinants', which have an influence on health and wellbeing. A 'health pathway' (Figure 10) is the series of links or stages between an aspect of a proposed development, its ability to change or influence a health determinant, a community's exposure to change(s) in a health determinant(s) and the generation of a health effect.

Figure 10 - Health pathways



- 12.5.5 Health effects may be defined as changes in the levels of the following public health outcomes:

- communicable diseases;
- non-communicable diseases;
- nutritional disorders;
- injuries;
- physical wellbeing; and
- mental health and wellbeing.

Scope of health assessment

- 12.5.6 The population considered in the assessment will be primarily that which is affected by the construction and operation of the Proposed Scheme along its route. Key health pathways arising from the planning, construction and operation of the Proposed Scheme, leading to potential health effects, may include, (but is not limited to):

- changes in employment and income opportunities during construction and operation – both positive and negative;
- displacement of occupants from residential and commercial properties, with impacts on housing, jobs and social capital;
- impacts on green space, affecting opportunities for physical activity and contact with nature;
- impacts on, or loss of, community facilities;
- impacts of exposure to noise and air emissions during construction and operation;
- visual impacts resulting in changes to the character of the local environment;

- temporary or permanent severance and/or diversion of public transport routes, and active travel routes such as footpaths and cycleways;
- changes to traffic flows and vehicle types on local roads during construction; and
- presence of a large construction workforce (particularly important in less populated rural areas).

12.5.7 Based on the health pathways described above, the following health determinants have been identified for inclusion in the assessment:

- education;
- employment and income;
- transport – including traveller stress and road safety;
- housing;
- social capital;
- noise and vibration;
- air quality;
- neighbourhood quality – including greenspace and contact with nature, landscape and visual, crime and safety;
- opportunities for physical activity; and
- access to services, health and social care.

In combination effects

12.5.8 The combined effects of the Proposed Scheme on community receptors will be considered. Such effects may arise where a number of impacts on different health determinants are experienced together, either at a common location or by a particular population group. The combined impacts will be qualitatively assessed, in conjunction with the community assessment, drawing on the conclusions from other assessment topics in order to identify potential wellbeing effects at community level.

12.6 Assessment methodology

Legislation

12.6.1 The health assessment methodology has been developed in accordance with the amended EIA Directive 2014 and the EIA Regulations 2017 regarding the assessment of the effects of certain public and private projects on the environment. This requires that EIA should 'identify, describe and assess' the effects of a project on 'population and human health'.

Guidance

12.6.2 There is no definitive guidance or methodology for assessing the health effects of projects. Furthermore, at the time of writing this methodology, no guidance exists on

how to incorporate health into EIA as required by the EIA Directive 2014 and the EIA Regulations 2017. There are, however, numerous well established 'toolkits' and guides available, such as:

- Institute of Environmental Management and Assessment, 2017: Health in Environmental Assessment, a primer for a proportionate approach;
- NHS London Healthy Urban Development Unit (HUDU), 2015. Healthy Urban Planning Checklist and Rapid Health Impact Assessment Tool;
- Wales Health Impact Assessment Unit, 2012: HIA a practical guide;
- National Mental Wellbeing Impact Assessment Development Unit 2011: Mental Wellbeing Impact Assessment Toolkit;
- Health Scotland *et al*, 2007: Health Impact Assessment for Transport: A Guide;
- London Health Observatory, 2006: A Guide to Reviewing Published Evidence for use in Health Impact Assessment; and
- Institute of Public Health in Ireland, 2005: Health Impacts of Transport.

12.6.3 The proposed scope and methodology as set out in this SMR takes account of the above guidance documents, as well as recent good practice and feedback from the Phase 2a assessment. The assessment will be undertaken as an iterative process whereby information from the initial assessment and consultation is fed back to the design and wider EIA process.

Construction effects

12.6.4 Construction effects will be assessed following the health assessment process described below.

Operational effects

12.6.5 Operational effects will be assessed following the health assessment process described below.

Evidence base

12.6.6 The literature review undertaken for the Phase 2a EIA¹⁷² will be updated to take account of more recent information, where it exists. Evidence of health effects from other major infrastructure projects will be sought through consultation with local health authorities and other project proponents. However, previous investigations indicate that there has been no widespread monitoring of health effects associated with major infrastructure projects. International case studies from high speed rail projects will also be sought.

12.6.7 The literature review for Phase One and Phase 2a identified evidence for links between health determinants and potential health outcomes. Evidence was drawn from published research, literature reviews and policy documents. The extent of

¹⁷² Hs2 Ltd (July 2017), *West Midlands to Crewe, Health Impact Assessment*, DfT

available evidence varies between the different health determinants considered in the assessment. This ranges from concentration-response functions based on large bodies of research for which scientific consensus is established, to less well defined linkages drawn from a smaller number of studies where there is no clear consensus on the exact causal relationships between the health determinant and health outcomes.

- 12.6.8 The evidence obtained through the literature review will support the assessment of health effects. It should be noted that the strength of evidence is not proportional to the importance of a determinant and its potential effect on health and wellbeing.

Qualitative assessment

- 12.6.9 The assessment of health effects will be based on evidence from published research. Where there is sufficient information available, and it is judged to be appropriate to do so, the health effects of the Proposed Scheme will be quantitatively assessed. However, many potential health effects cannot be quantified because there are currently no robust or scientifically widely agreed upon methods for quantifying them, or because the types of data required cannot realistically be obtained. Therefore it is anticipated that the assessment will be largely qualitative.
- 12.6.10 The assessment of health effects will be based on a set of criteria informed by available, up to date guidance, and developed using professional judgement and precedent from other large scale Health Assessments. There is no recognised guidance or framework for evaluating the significance of health effects. In the absence of such guidance, the assessment will provide a commentary on the importance of any health effects identified. A large part of this will depend on the magnitude and severity of the impacts on health determinants, which can be identified and described with greater certainty than the consequent health effects.
- 12.6.11 The assessment will utilise the following when forming a judgement on the importance of impacts:
- description of change;
 - exposure;
 - strength of evidence; and
 - health inequalities and vulnerable groups.

Description of change

- 12.6.12 The change to the health determinant is described, including commentary on the following factors:
- the aspect of the Proposed Scheme causing the change;
 - how the impact on a health determinant may change, including the direction of this change (beneficial or adverse); and
 - the duration and frequency of change (operational effects are assumed to be permanent in most cases; construction effects may be short term if under six months, medium term if six months to two years, or long term if more than two years in duration).

Exposure

- 12.6.13 The degree of exposure of a population to changes in health determinants is assessed in terms of the 'extent' of exposure and 'intensity' of exposure, described as follows:
- the extent of exposure is judged to be low, medium or high depending on the number of people in the affected population likely to be exposed to the change in a health determinant;
 - the intensity of exposure is judged to be low, medium or high. Factors such as the severity and duration of impact and/or the value of the affected resource will be taken into account when considering intensity, as will the frequency of the exposure for intermittent impacts; and
 - the extent and intensity of exposure are described where it is practical to do so. In some cases, such as impacts that could potentially affect an unknown number of individuals along the route as a whole, exposure may not be defined using the terms low/medium/high.

Strength of evidence

- 12.6.14 The evidence on which the link (or 'association') between a change in health determinant and a health effect is based will be described in the assessment as:
- anecdotal: based on the opinions or experiences of members of the public and other stakeholders consulted during the assessment process;
 - weak: a few peer-reviewed research studies to suggest an association; or the studies show conflicting findings;
 - moderate: a range of international (but not necessarily national) peer-reviewed research studies showing similar associations and strength of associations; the association is widely accepted by the public health community; and there may be debate about the specific causal factors, the mechanism of effect and/or the strength of association; and
 - strong: a wide range of national and international peer-reviewed research studies showing similar associations and strengths of association. The association is widely accepted by the public health community and there is consensus on the specific causal factors, the mechanism of effect and the strength of association.
- 12.6.15 It should be noted that a lack of research studies or lack of consensus among the public health community does not necessarily mean that a link does not exist, but that there is currently uncertainty in the likelihood of an effect.

Health inequalities and vulnerable groups

- 12.6.16 The assessment will consider the potential for an impact to exacerbate existing health inequalities across a population. The sensitivity of the population exposed to the change in health determinant will be considered in the assessment. This will be done qualitatively, based on the community profiling exercise and evidence base compiled for the health assessment, which will provide an indication of which groups are likely

to be most affected, and their presence within the communities along the route. The community profiles will use, amongst other sources, Office for National Statistics (ONS) data on the socio-economic circumstances of populations at ward level and the public health profiles produced by Public Health England.

12.6.17 'Vulnerable groups' are sections of the population that for certain reasons may be more likely to be exposed to a change in a health determinant, or more likely to experience health effects as a result of this exposure. Consideration of vulnerable groups will take into account:

- how an impact on a health determinant is shown (in scientific literature) to affect a particular section of the community;
- whether the affected community is already facing existing deprivation (social, economic or environmental) that could make them more vulnerable; and
- characteristics such as age, health conditions, or other physical or mental characteristics that make people more vulnerable to impacts on one or more determinants, recognising that there could be multiple impacts on some vulnerable parts of the population.

12.6.18 The health assessment will also evaluate potential inequalities in health impacts based on population characteristics, including for example age, health status, gender, disability, ethnicity, income and place (disadvantaged locations). The assessment will refer to the separate EQIA, as appropriate, to evaluate potential inequalities in health impact. In addition the health assessment will explore the potential impacts on groups that are not covered by the protected characteristics under the Equalities Act 2010.

Quantitative assessment

12.6.19 Where a quantitative assessment of health effects is undertaken, for example, for health and wellbeing effects associated with noise and air quality, this will be based on established assessment methodologies for these health determinants.

12.6.20 The likely extent and intensity of exposure to noise and air emissions will be reviewed at an early stage in the EIA process in order to determine whether quantitative health assessment is required. Professional judgement will be used to determine whether quantitative assessment methods are justified, based on the size of the exposed population and the level of exposure.

12.6.21 The proposed approaches for these two topics are outlined below.

Quantifying the effects of noise and vibration on health and wellbeing

12.6.22 In line with Government noise policy and Phase One and Phase 2a, the scope and methodology for Sound, noise and vibration (Section 18) will identify effects and significant effects on health and quality of life. For completeness the following paragraphs reiterate the principle health related components of the assessment.

12.6.23 The following potential health effects may be included in the quantitative assessment of noise and vibration: annoyance, sleep disturbance, cardiovascular impacts and cognitive effects on school children.

- 12.6.24 Evidence suggests that chronic exposure to noise or vibration over a long period of time is an important factor influencing health and wellbeing. Therefore, quantitative assessment of health effects will focus on operational railway noise. The effects of construction activities will be qualitatively assessed.
- 12.6.25 The spatial scope of the study area will be defined using the Lowest Observed Adverse Effect Levels¹⁷³ for noise from high speed railway lines, during the day and night. Account will also be taken of any unique features of the Proposed Scheme's sound or impacts in the area being considered. Exposure response relationships will then be used to quantify the number of people exposed to different levels of noise or vibration from the Proposed Scheme. To provide context, the number of people exposed to different levels of noise or vibration from other sources of exposure to transport noise within the study area will be described. Significant Observed Adverse Effect Levels (SOAELs) will also be established where relevant in line with Government noise policy.
- 12.6.26 This information will be used to estimate the potential risk or scale of each health effect for each of the different sources of noise and to ensure that the mitigation strategy, within the context of Government policy on sustainable development, meets the aims of the Government's noise policy, namely to: "avoid significant adverse impacts on health and quality of life; mitigate and minimise adverse impacts on health and quality of life; and where possible, contribute to the improvement of health and quality of life."

Quantifying the effects of air quality on health and wellbeing

- 12.6.27 It is now well understood that long term exposure to PM_{2.5} and NO₂ is associated with health effects, including premature mortality. Methods are available that would allow a change in concentrations within an exposed population to be expressed in terms of specific health effects such as premature mortality and hospital admissions. In circumstances where any air quality changes are obviously very small and/or the exposed population is also small, then such quantification would lead to a conclusion that the health effects are inconsequential. The findings from the air quality assessment will be reviewed to determine whether quantitative assessment of health effects is merited, on the basis that the change in exposure would be sufficiently large to cause a consequential change in health outcomes, such as mortality rate.
- 12.6.28 The techniques for quantifying these health effects have been applied at the national level by the Committee on the Medical Effects of Air Pollutants (COMEAP) and also at local authority level by PHE, for example. These approaches can be adapted to quantify the effect that a change in NO₂ or PM_{2.5} resulting from a development proposal is likely to have on health outcomes. This requires:
- knowledge of a reliable 'concentration response function (as recommended by the WHO, for example);
 - knowledge of the baseline rates of certain health outcomes in the population, e.g. mortality;

¹⁷³ In line with the Noise Policy Statement for England - Department for the Environment, Food and Rural Affairs (Defra) (2015), *Noise Policy Statement for England*, Defra

- air quality dispersion modelling output, defining the change in exposure of PM_{2.5}, PM₁₀ or NO₂ at all locations; and
- the population numbers within the affected area.

Cumulative effects

- 12.6.29 As outlined in Section 4.4 (Cumulative effects) of this SMR, the assessment will consider the interaction between the Proposed Scheme, Phase One, Phase 2a and other existing and/or approved projects in the vicinity of the Proposed Scheme which are under construction or have been consented which may give rise to significant cumulative effects.
- 12.6.30 The health effects identified in the assessment will be considered in the context of the potential effects of future climate change. The potential for the combined impacts of the Proposed Scheme and climate change to increase the intensity of health effects will be considered.
- 12.6.31 Interactive effects between the different environmental topics will also be assessed.

12.7 Mitigation

- 12.7.1 During the assessment process, recommendations to address the negative effects and maximise the positive effects on health will be fed back to other EIA topics and the design team.
- 12.7.2 It is anticipated that the majority of potential design based interventions for health improvement will be incorporated through the scheme design and wider EIA process, for example, route design to avoid (where reasonably practicable) residential properties and other sensitive receptors, vertical alignment, incorporation of bunds and other measures to minimise the noise and visual effects of the alignment. This embedded mitigation will form part of the Proposed Scheme assessed in the EIA. Other, non-design related mitigation measures may be made in relation to the construction process and ongoing management and delivery of the Proposed Scheme. These will be incorporated into the CoCP and other HS2 strategies and policies as appropriate.
- 12.7.3 Local and central government strategies, programmes and frameworks aimed at enhancing health and wellbeing will be reviewed and opportunities for the Proposed Scheme to align with these programmes will be identified where practicable. Initiatives which HS2 Ltd is already pursuing, for example, in relation to community outreach, education and training will also be reviewed in relation to the scope of the health assessment and the potential for positive health outcomes.
- 12.7.4 The proposed means of incorporating health recommendations into the Proposed Scheme will be described. This may comprise the inclusion of specific measures within documents such as the CoCP or EMRs.

12.8 Assumptions

- 12.8.1 For assessment purposes it will be necessary to assume that the baseline characteristics established during the health assessment process will remain largely unchanged, as mentioned in Section 12.2 of this SMR. However, where it is possible to predict change this will be incorporated into the future baseline.
- 12.8.2 The community profiles will be limited by the extent of publicly available data and data obtained through consultation and engagement with communities.
- 12.8.3 The assessment will be supported by a review of published research, using the most up to date and credible sources. The strength of evidence is in some cases is well supported by research evidence and in other cases is weak or non-existent. Consequently, professional judgement will be necessary concerning the likely way in which potential health effects may occur.

13 Historic Environment

13.1 Introduction

- 13.1.1 This section describes the methodology to be used in the assessment of the likely significant effects upon heritage assets and the historic environment affected by the construction and operation of the Proposed Scheme.
- 13.1.2 Heritage assets are defined by the Government in the NPPF Annex 2 Glossary as: 'A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions. Heritage assets include designated heritage assets and assets identified by the local planning authority (including local listing)' ¹⁷⁴.
- 13.1.3 Heritage assets include those that are designated under legislation (refer to the NPPF Annex 2 Glossary Designated heritage assets) as well as those that are non-designated. Non-designated assets include heritage assets identified as such by local authorities through their inclusion within the local Historic Environment Record (HER) and those that are identified from other sources during the course of research and survey. Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, are considered subject to the policies for designated heritage assets¹⁷⁵.
- 13.1.4 The NPPF Annex 2 Glossary defines the historic environment as: 'All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora'.
- 13.1.5 Historic environment is generally and most easily divided into three key areas as follows:
- archaeological and palaeo-environmental remains including geological deposits that may contain evidence of the human past;
 - historic landscapes; and
 - historic buildings and the historic built environment.

13.2 Establishment of baseline

- 13.2.1 The baseline to be assessed is that which is current at the time of the commencement of the ES or at subsequent refresh points up to the date of publication.
- 13.2.2 Work will be undertaken in accordance with the appropriate guidance and good practice advice provided by the Chartered Institute for Archaeologists (CIfA).
- 13.2.3 While the Proposed Scheme passes through a largely rural environment of variable historical characteristics, both the western and eastern sections terminate at stations in urban environments. In the process of data gathering it is recognised that there are interfaces with other disciplines, for example ecology, water resources and flood risk,

¹⁷⁴ Department for Communities and Local Government (2012), *National Planning Policy Framework*, Annex 2: Glossary p52

¹⁷⁵ Department for Culture, Media and Sport (2010). *Scheduled Monuments: Identifying, Protecting, Conserving and Investigating Nationally Important Archaeological Sites under the Ancient Monuments and Archaeological Areas Act 1979*

sound, noise and vibration, landscape and visual and community. These interfaces will be actively addressed as part of the EIA process to ensure that an integrated assessment is undertaken.

13.2.4 Data in respect of heritage assets will be collected for the following designated and non-designated assets:

Designated assets:

- World Heritage Sites;
- Listed Buildings, Grade I, II* and Grade II;
- Scheduled Monuments;
- Registered Parks and Gardens;
- Conservation Areas; and
- Registered Historic Battlefields;

Non-designated assets:

- non-designated historic buildings, structures and built monuments including:
 - a. locally listed buildings; and
 - b. buildings, structures and monuments included in the HER which are of heritage significance.
- non-designated archaeological or historic landscape sites including:
 - a. archaeological sites recorded in the HER and/or the Historic England Archives dataset;
 - b. archaeological and other heritage assets predicted or known from desk based research or fieldwork;
 - c. palaeo-environmental remains and geological deposits predicted or known to contain evidence for the human past;
 - d. known historic settlements including those identified as being of archaeological interest;
 - e. non-designated historic parks, gardens and battlefields; and
 - f. non-designated assets determined to be of national importance by the Secretary of State.

13.2.5 Baseline data sources will include:

- details of designated sites held by Historic England;
- local authority conservation area appraisal and management documents and their mapping;

- records of ancient woodland maintained by Natural England, Defra and the Forestry Commission;
- historic landscape characterisation (HLC) mapping undertaken by local planning authorities;
- HER data, held by local planning authorities;
- National Record of the Historic Environment held by Historic England;
- aerial photographs and satellite images held by Historic England, local authorities, and other appropriate repositories;
- geological mapping and borehole information as held by the British Geological Survey;
- documentary, cartographic and other resources as deposited within local studies libraries, county and national records libraries and archives, including historic Ordnance Survey maps, tithe, estate and other maps, and other relevant primary sources;
- readily available published and unpublished sources, building surveys and gazetteers;
- data sets held by other bodies, such as Canal & River Trust and the National Trust who have specific data on the assets for which they have a responsibility;
- local authority or ecclesiastic sources such as faculties, historic maps and documentary sources for burial grounds; and
- urban characterisation reports, extensive urban surveys (EUS) and urban archaeological databases (UADs) held by Historic England and local planning authorities.

13.2.6 As a minimum, data collected during the EIA process will include:

- data from preliminary works such as boreholes or test pits;
- data from a programme of non-intrusive survey;
- data from high resolution satellite imagery, multi and hyperspectral and light detection and ranging (LiDAR) aerial survey;
- data from previous intrusive studies, for example coring, trial trenching and building survey;
- data in respect of the zone of theoretical visibility (ZTV) as identified by the landscape and visual assessment, where this is available (see Section 15 Landscape and Visual); and
- data obtained through site visit and walkover survey from PRoW, or from private land where access has been previously arranged and approved.

- 13.2.7 The scope of non-intrusive, and potentially intrusive survey (subject to land access), is to be developed and agreed in consultation with Historic England and other appropriate bodies including Local Authority Archaeological and Conservation Officers. HS2 Ltd has prepared a Technical note Cultural heritage – Risk based approach to archaeological assessment (referenced in Annex A of this SMR) setting out a risk based methodology required to prioritise areas of the Proposed Scheme for additional archaeological survey beyond walkover/field visits for the ES. In addition to this approach to archaeological survey, a pragmatic approach to surveys, where land access is forthcoming, will be considered. This will be outlined in the ES.

Study area

- 13.2.8 The Proposed Scheme study area for data gathering to identify impacts upon non-designated assets will encompass the entire land requirement plus 500m either side in rural areas and 250m in urban areas. The study area for data gathering to identify impacts upon designated heritage assets, and to understand the historic landscape, will be 2km either side of the land required in rural areas and urban areas. In order to obtain a degree of proportionality a degree of professional judgement will be required in order to determine an appropriate extent for the study area within which designated assets are to be assessed. The setting of designated assets within the study area will be cross-referenced to the ZTV as this becomes available. The extent of the ZTV will be identified by the landscape and visual assessment within the ES.
- 13.2.9 The study area for designated and non-designated assets in the vicinity of bored tunnels will be 100m either side of the extent of tunnelling to allow assessment of the impact of ground movements/settlement on heritage assets.

13.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

- 13.3.1 A number of consultation responses were received regarding the Phase Two Consultation Sustainability Statement in respect of heritage assets. These included those from Historic England, the National Trust, and local planning authorities. Other responses received included those from local amenity societies and specialist interest groups.
- 13.3.2 The response from Historic England focused on matters affecting the setting of heritage assets, including experience of place and understanding of the history of assets. Historic England was concerned over the use of graduated 'buffer zones' in assessing direct and indirect impacts upon different types of designated heritage assets. All designated assets within the ZTV defined for the area of assessment of visual impact (see Section 15 landscape and visual) will be assessed, and will be further informed by data gathered from the site walkover as the baseline setting for heritage assets is established. A degree of professional judgement will need to be applied, particularly within urban areas, in order to determine an appropriate extent for the study area within which the designated assets are to be assessed. It is however, acknowledged that other factors such as noise and light impacts may extend beyond the ZTV, and these will be further assessed within the respective sections of the ES. The Technical note Assessment of the setting of heritage assets (referenced in Annex

A of this SMR) is being developed to support the assessment of setting of heritage assets in the ES.

- 13.3.3 Historic England was also concerned over the omission from the Sustainability Statement of known but non-designated archaeological assets. They were concerned that the assessment did not take into account those non-designated archaeological assets of schedulable quality or other non-designated archaeological assets. Their response identified areas in Phase 2 where non-designated assets of potentially national significance may exist. The analysis of impact undertaken during the EIA will therefore assess these areas, and will include consideration of non-designated assets potentially of schedulable quality¹⁷⁶.
- 13.3.4 Concerns along both the eastern and western sections focused on changes to the settings of Scheduled Monuments and listed buildings, that were considered to have a major impact, however recognising that the effects on listed buildings in many locations will depend on the impact of the Proposed Scheme. The eastern section directly impacts on one Scheduled Monument (the Roman site at Ratcliffe on Soar) and affects the settings of three others. The route passes to the west of Hardwick Hall (Scheduled and Grade I listed) and between the Conservation Areas, Scheduled Monuments and listed buildings of Sutton Scarsdale Hall and Bolsover Castle. The Sustainability Statement recognised these as areas of landscape much changed in the 20th century. The EIA will explore the issue of setting, including the development of design options as appropriate.
- 13.3.5 Responses were received from the National Trust, Staffordshire Gardens and Parks Trust and Cheshire Gardens Trust. Concerns were noted over changes to the route and supporting infrastructure at Nostell Priory near Wakefield, Hardwick Hall in Derbyshire and Dunham Massey and Tatton Park in Cheshire; it was noted by the parties that the route could have major impacts on these assets. Concerns were also noted regarding the potential impacts of the route on Calke Abbey and Staunton Harold Church in Derbyshire. These potential impacts on these assets will be assessed as part of the EIA process.

Engagement as part of the EIA process

- 13.3.6 Historic England is the Government's advisor on heritage, and will be consulted throughout the course of the EIA.
- 13.3.7 Consultees for this topic will also include the Local Authority Archaeological Officers and Conservation Officers or their equivalents within the western section for East Cheshire, West Cheshire, Warrington and Greater Manchester, and within the eastern section for Warwickshire, Leicestershire, Nottinghamshire, Nottingham, Derbyshire, South Yorkshire, North Yorkshire, West Yorkshire and York.
- 13.3.8 The National Trust, Battlefields Trust, the Canal & River Trust and the Gardens Trust are proposed as additional consultees. Engagement will take place with these organisations and other relevant parties that make representations to HS2 Ltd with reference to the Proposed Scheme during the EIA process.

¹⁷⁶ Historic England (2017). *Scheduling Selection Guides*. Available online at: <https://historicengland.org.uk/listing/selection-criteria/scheduling-selection>

13.4 Key aspects of the Proposed Scheme for the Historic Environment

13.4.1 Key aspects of the Proposed Scheme for this topic include:

- construction works which require the physical excavation of, demolition or removal of, or alteration to heritage assets;
- settlement of heritage assets resulting from tunnelling, deep excavations or construction of retaining walls;
- protection of heritage assets during construction activities;
- temporary setting effects on designated or other heritage assets during construction;
- permanent setting effects on designated and other heritage assets arising from construction or operation;
- ground disturbance caused by the implementation of ecological and other mitigation measures;
- vibration effects upon heritage assets during both construction and operation;
- increased noise effects upon heritage assets where a particular level of noise forms a part of the assets setting during both construction and operation;
- damage to waterlogged deposits through changes to groundwater regimes following construction;
- impacts on the long-term viability of heritage assets as a result of changes in access and/or use;
- beneficial impacts on heritage assets through the removal or alteration of negative aspects of elements of the assets setting; and
- beneficial impacts where conservation and reinstatement of heritage assets is undertaken.

13.5 Scope of assessment

13.5.1 Effects to be assessed are direct and indirect, temporary, permanent and cumulative. Each of these is examined below in the context of the historic environment assessment to be presented in the ES. Of note is that these effects can be both adverse and beneficial. A Technical note that provides the historic landscape assessment methodology is in development by HS2 Ltd, in collaboration with Historic England's landscape specialists. The note will reflect an updated position in respect of the assessment of historic landscape character, which will form the basis of historic landscape assessment of the Proposed Scheme.

- 13.5.2 A direct effect is one that will occur to the physical fabric or land of an asset and its curtilage, and any effect upon the setting of that asset arising directly from the Proposed Scheme.
- 13.5.3 An indirect effect is one that might arise as a consequence of the construction or operation of the Proposed Scheme by, for example, adversely affecting viability of land leading to dereliction of buildings, or beneficial effects through changes in the management or land use of archaeological or historic landscape features.
- 13.5.4 A permanent effect will occur, for example, as a result of the construction and operation of the railway including the permanent works for the railway. A permanent effect is not reversible and may (by definition) result in the permanent loss of, or harm to, a heritage asset including its setting. Alternately it may have a beneficial effect through change in land management and associated agricultural practices, or through the removal of negative aspects of the assets setting.
- 13.5.5 Temporary activities such as soil storage, contractor's site compounds and access routes, as well as the activities associated with the erection of other facilities and structures, where the site will be returned to its former condition, may have temporary effects (for example on setting) or permanent effects (for example where sub surface deposits are affected).
- 13.5.6 A cumulative effect is one arising from the incremental effects of multiple developments on heritage assets.

Spatial scope

- 13.5.7 As noted in the Study Area section (see above), the impact of the scheme on all heritage assets within 500m in rural areas and 250m in urban of the land requirement for the Proposed Scheme will be assessed; tunnelled areas will examine 100m either side of the extent of tunnelling.
- 13.5.8 The impact of the scheme on the historic landscape and designated heritage assets within an area 2km either side of the land requirement will be assessed. A degree of professional judgement, guided by the zone of theoretical visibility (ZTV) will be required in order to determine an appropriate extent for the study area within which designated assets are to be assessed.

Temporal scope

- 13.5.9 In addition to considering the effects of construction resulting from the Proposed Scheme, the historic environment assessment will consider effects relating to the operational phases. Construction works for the Proposed Scheme are anticipated to take place between 2023 and 2033 (including commissioning). Effects arising from the operation of the Proposed Scheme will be assessed taking into account the services to be expected when HS2 reaches maximum capacity.
- 13.5.10 The temporal scope of the assessment assumes a baseline with current conditions as of 2018.

Technical scope

- 13.5.11 All cultural heritage assets with the potential to be directly or indirectly affected by the Proposed Scheme will be considered. The heritage significance/value of all

heritage assets within the study area will also be considered. Where the Proposed Scheme is predicted to have an impact upon the setting or fabric of an asset, such that its significance/value (archaeological, architectural, artistic, or historic) would be affected, the magnitude of this impact will be assessed in line with the methodology below. Similarly, the resulting effect will be assessed in line with the methodology below.

- 13.5.12 Ecological significance of veteran trees, historic hedgerows and ancient woodland along with the wider landscape is addressed in Section 10 (Ecology) and Section 15 (Landscape and visual). Ancient woodland and historic hedgerows are heritage assets and will be described in the gazetteer as well as included within the description of the broader historic landscape.

13.6 Assessment methodology

Legislation and guidance

- 13.6.1 Policy in respect of heritage assets is set out in the NPPF (Section 12: Conserving and enhancing the historic environment)¹⁷⁷. These policies form the basis for the policies set out in the Historic Environment section of the National Policy Statement (NPS) for National Networks, paras 5.120 - 5.142 (Department for Transport, 2014)¹⁷⁸.
- 13.6.2 The practical application of these policy documents is presented following the approach in DMRB (Volume 11: Environmental Assessment)¹⁷⁹, the International Council on Monuments and Sites (ICOMOS)¹⁸⁰, guidance on Heritage Impact Assessments for Cultural World Heritage Properties (see section 13.6.3) and Conservation Principles, Policies and Guidance published by English Heritage (now Historic England) in 2008 (see section 13.6.4). The resulting methodology is, therefore, informed by national guidance, NPPF, NPPG and professional judgement.
- 13.6.3 In January 2011, ICOMOS issued guidance on Heritage Impact Assessments for Cultural World Heritage Properties. Though specifically addressing World Heritage Sites and development impact on their Outstanding Universal Value, the document provides an approach to assessment and evaluation of impact.
- 13.6.4 Conservation Principles, Policies and Guidance was published by English Heritage (now Historic England) in 2008. The guidance sets out the key principles behind sustainable management of the Historic Environment, as well as establishing the key aspects of the significance (heritage value) of heritage assets¹⁸¹.
- 13.6.5 In May 2011, Historic England published its guidance *Seeing History in the View*¹⁸². This guidance, which deals specifically with assessing impact upon heritage views and multiple assets, contains an approach to baseline analysis and the

¹⁷⁷ Department for Communities and Local Government (DCLG) (2016), *National Planning Policy Framework*. DCLG. Bressenden Place, London

¹⁷⁸ Department for Transport (2014). National Policy Statement for National Networks. www.gov.uk/government/publications

¹⁷⁹ Highways Agency (2009), *Design Manual for Roads and Bridges: Volume 11*. IC London: the Stationery Office

¹⁸⁰ ICOMOS (2011), *Heritage Impact Assessments for Cultural World Heritage Properties*. ICOMOS. 49-51 rue de la Fédération 75015 Paris, France

¹⁸¹ Historic England (2008), *Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment*. English Heritage, Waterhouse, London.

¹⁸² English Heritage (2011), *Seeing History in the View: A method for assessing heritage significance within views*. English Heritage, Waterhouse, London

assessment of impact; with a series of tables to assist the process. More recently, in March 2015, Historic England published its Good Planning Advice Notes, number 2 of which (Managing Significance in Decision-Taking in the Historic Environment) discusses how National Planning Policy should be implemented in development projects. Good Practice Advice Note 3¹⁸³ (The Setting of Heritage Assets) sets out an approach to the analysis and assessment of setting and its relationship to the heritage significance of an asset. This is due to be superseded by a new document Settings and views of heritage assets which has been subject to the consultation process and will be published shortly¹⁸⁴. In addition, in January 2017 Historic England provided a consultation draft advice note on Listed Buildings and Curtilage¹⁸⁵, which details advice regarding the assessment of the extent of the curtilage of a listed building and buildings and other structures that predate July 1948 that fall within this curtilage.

- 13.6.6 The NPPF's Planning Practice Guidance contains a section on *Conserving and Enhancing the historic environment*¹⁸⁶. Additional guidance in respect of the Historic Environment is set out in the Historic England Good Practice Advice Notes 1¹⁸⁷ and 2¹⁸⁸ in support of the NPPF, which replaced Planning Policy Statement 5 (PPS5): Planning for the Historic Environment, in March 2012.
- 13.6.7 The risk of unviability of heritage assets will be assessed using professional judgement, taking account of impacts identified from other disciplines (e.g. community, agriculture and socio-economics). This will refer to existing national policy and guidance including the NPPF, NPPG and Historic England's Conservation Principles.

Field visits

- 13.6.8 Field visits within the study area will comprise field inspection to identify heritage assets and their setting and to examine the character and form of the historic landscape. The purpose of the survey will be to verify the baseline research, assess the setting, nature and condition of known heritage assets and identify previously unidentified assets which may be affected by the Proposed Scheme. These activities will provide an understanding of the characteristics of the landscape and the assets that are contained within it and their contribution to the overall historic landscape within the study area.

Approach

- 13.6.9 The methodology set out in the above legislation and guidance is summarised as follows:
- identify the baseline heritage assets (defined as all data collected from a range of desk based sources and, as appropriate, surveys) and their setting;

¹⁸³ Historic England (2015), Historic Environment *Good Practice Advice Note 3: The Setting of Heritage Assets*. English Heritage, Waterhouse, London

¹⁸⁴ Historic England (not yet published), *Forthcoming Historic Environment Good practice Advice in Planning Note 3: Settings and Views of Heritage Assets*

¹⁸⁵ Historic England (2017), Advice Note Consultation Draft: *Listed Buildings and Curtilage*

¹⁸⁶ Department for Communities and Local Government (DCLG) (2016), *National Planning Policy Framework*. DCLG. Bressenden Place, London

¹⁸⁷ Historic England (2015), *Good Practice Advice Note 1: The Historic Environment in Local Plans*. English Heritage. Waterhouse Square, London

¹⁸⁸ Historic England (2015), *Good Practice Advice Note 2: Managing Significance in Decision-Taking in the Historic Environment*. English Heritage. Waterhouse Square, London.

- assess the heritage significance of the baseline assets and the contribution of their settings to this heritage significance;
- identify and define the magnitude of impact and the significance of the effects;
- if possible, identify mitigation required and its methodology in terms of spatial extent and techniques to be employed; and
- assess the development impact and its effect on the heritage significance of the asset and its setting, taking into consideration any mitigation proposed.
- This methodology is detailed in the Specification for Historic Environment Investigations.

Significance criteria

- 13.6.10 The significance of a heritage asset is defined as 'The value of a heritage asset to this and future generations because of its heritage interest; that interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting' (NPPF Annex 2, Glossary). Historic England defines 'significance' and 'heritage values' as being a collective term for the sum of all the heritage values attached to a place, be it a building an archaeological site or a larger historic area such as a whole village or landscape¹⁸⁹. In assessing the significance of an asset, Historic England has outlined values which contribute to overall significance including evidential, historical, aesthetic and communal value¹⁹⁰.
- 13.6.11 Designated Assets are a "A World Heritage Site, Scheduled Monument, Listed Building, Protected Wreck Site, Registered Park and Garden, Registered Battlefield or Conservation Area designated under the relevant legislation." (NPPF, Annex 2, Glossary). It should be noted that the fact that a monument is not scheduled does not necessary imply that it is not nationally important¹⁹¹. Heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for assets that have been granted statutory protection.
- 13.6.12 The setting of a heritage asset is defined as: 'The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral' (NPPF Annex 2, Glossary).

¹⁸⁹ Historic England (2008), *Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment*. English Heritage. Holborn, London

¹⁹⁰ Historic England (2008), *Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment*. English Heritage. Holborn, London

¹⁹¹ Department for Culture, Media and Sport (2010). Scheduled Monuments: Identifying, protecting, conserving and investigating nationally important archaeological sites under the Ancient Monuments and Archaeological Areas Act 1979

- 13.6.13 Setting can also contribute to heritage significance. Setting is not simply a visual consideration and specific guidance on the analysis of setting is set out by Historic England¹⁹². It is acknowledged that setting could be affected by other scheme factors including noise; where relevant, the contribution of the existing sound environment to the heritage value of the asset will be identified and the potential change to this will be considered as part of the impact assessment process.
- 13.6.14 Taking these criteria into account, each identified baseline heritage asset will be assigned a level of heritage significance (value) in accordance with a four-point scale as shown in Table 19. This table provides guidance as to significance (value) but professional judgment will be applied in all cases regarding the appropriate category for individual heritage assets. Where it is assessed that an asset is of greater or lower value than noted in the guidance table, justification will be provided within the ES. The nature and character of Conservation Areas varies greatly from urban areas to houses set in country parks. The special character of these areas comes not only from the quality of their buildings but also from elements that provide value and character to the wider landscape. In consideration of this Conservation Areas feature in both the High and Moderate asset categories and professional judgement will need to be applied in order to determine to which asset category a Conservation Area belongs.

Table 19 - Factors for assessing the significance/value of heritage assets

Significance (value)	Asset categories
High	World Heritage Sites Grade I and Grade II* Listed Buildings Grade I and Grade II* Registered Parks and Gardens Scheduled Monuments Registered Battlefields Conservation Areas (as appropriate) Non-designated heritage assets (archaeological sites, buildings, monuments, parks, gardens or landscapes) that can be shown to have demonstrable national, international or universal importance (value) Burial Grounds and Cemeteries Well preserved historic landscape character areas, exhibiting considerable coherence, time-depth or other critical factor(s)
Moderate	Grade II listed Buildings Conservation Areas (as appropriate) Grade II Registered Parks and Gardens Locally listed buildings as recorded on a local authority list Non-designated heritage assets (archaeological sites, buildings, monuments, parks, gardens or landscapes) that can be shown to be of regional importance (value)

¹⁹² Historic England (2015), *Good Practice Advice Note 3: The Setting of Heritage Asset*. English Heritage, Holborn, London

Significance (value)	Asset categories
	<p>Historic Townscapes with historic integrity in that the assets that constitute their make-up are clearly legible</p> <p>Averagely well-preserved historic landscape character areas with reasonable coherence, time-depth or other critical factor(s)</p>
Low	<p>Non-designated heritage assets (archaeological sites, buildings, monuments, parks, gardens or landscapes) that can be shown to be of limited or of local interest only (value)</p> <p>Assets whose values are compromised by poor preservation or survival or of contextual associations to justify inclusion into a higher grade</p> <p>Historic landscape character areas whose value is limited by poor preservation and/or poor survival of contextual associations</p>
Not significant	<p>Assets identified as being of no historic, evidential, aesthetic or communal interest</p> <p>Assets whose values are compromised by poor preservation or survival or of contextual associations to justify inclusion into a higher grade</p> <p>Landscape with no or little significant historical interest</p>

Magnitude of impact

- 13.6.15 Impacts can be direct or indirect, and can be characterised in terms of timing, scale, duration, reversibility and the likelihood of the impact occurring. Impacts can be permanent or temporary and can be beneficial, neutral or adverse.
- 13.6.16 The magnitude of an impact can vary from 'high' to 'no change' as set out in
- 13.6.17 Table 20, and can be beneficial or adverse.

Table 20 - Factors influencing the assessment of magnitude of impacts

Impact rating	Description of impact
High	Change such that the significance of the asset is totally altered or destroyed. Comprehensive change to setting affecting significance, resulting in changes in our ability to understand and appreciate the resource and its historical context and setting
Medium	Change such that the significance of the asset is affected. Changes such that the setting of the asset is noticeably different, affecting significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting
Low	<p>Change such that the significance of the asset is slightly affected</p> <p>Changes to the setting that have a slight impact on significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting</p>
Minimal	Changes to the asset that hardly affect significance. Changes to the setting of an asset that have little effect on significance and no real change in our ability to understand and appreciate the resource and its historical context and setting
No change	<p>The Proposed Scheme does not affect the significance of the asset.</p> <p>Changes to the setting that do not affect the significance of the asset or our appreciation of it</p>

Significance of effects

- 13.6.18 Assessment of the significance of effects will take into consideration embedded mitigation associated with the Proposed Scheme, for example landscape planting, ecological compensation and noise barriers. It should be recognised that some mitigation measures can themselves be a source of impact on heritage assets.
- 13.6.19 The assessment of the level of overall significance of the effect, taking into consideration embedded mitigation, is determined by cross referencing the significance value of the asset (Table 19) and the magnitude of impact (
- 13.6.20 Table 20) as shown in Table 21.
- 13.6.21 Major and moderate impacts may be considered to be significant effects. The assessment of overall effect can be either adverse, neutral or beneficial.

Table 21 - Matrix for establishing overall significance of effect

Significance (value) of asset	Magnitude of impact				
	High	Medium	Low	Minimal	No change
High	Major	Major	Moderate	Minor	Neutral
Moderate	Major	Moderate	Minor	Minor	Neutral
Low	Moderate	Minor	Minor/Negligible	Negligible	Neutral
Not significant	Negligible	Negligible	Negligible	Negligible	Neutral

Construction effects

- 13.6.22 Construction effects will be assessed following the general EIA assessment process including the establishment of the baseline, consultations, assessment of impacts and effects against key aspects of the Proposed Scheme, the scope of the assessment and using the significance criteria outlined in this section. Further assessment of impacts identified through other EIA work, for example for water resources and flood risk, sound, noise and vibration, landscape and visual, and ecology will be undertaken.
- 13.6.23 Effects upon the heritage significance of assets (such as those due to a change in their setting) which are identified during the assessment of construction and continue to apply during operation will be identified as a construction effect.

Operational effects

- 13.6.24 The same process will be used for the assessment of operational effects as outlined for construction effects above.

Cumulative effects

- 13.6.25 The construction of the Proposed Scheme, combined with the developments that are already taking place or anticipated along the route of the Proposed Scheme, will result in increased pressure on heritage assets through total or partial loss, impacts on

significance value or increased urbanisation resulting in adverse impacts on the setting of heritage assets. The criteria for the selection of developments included in the cumulative impact assessment are provided in Section 4.4 (Cumulative effects) of this SMR.

13.7 Assumptions

- 13.7.1 Key assumptions for this topic are that relevant data will be available from the various archive and record holding bodies consulted (i.e. HERs, Historic England, the National Record of the Historic Environment), records of designated sites (including the National Heritage list for England); and that collections of historic maps and other sources held by external record offices (such as local studies libraries, county and national archives) will be available.
- 13.7.2 It is assumed that all heritage assets within the proposed land required will be removed unless expressly excluded as a result of the mitigation process.
- 13.7.3 It is recognised that, within certain areas, access for heritage surveys will be restricted (e.g. to PRow) or will be denied. Surveys will, therefore, necessarily be constrained to those areas where landowner access is granted.
- 13.7.4 The assessment within this section considers heritage assets from the perspective of the historic environment. The value of heritage assets from the perspective of other disciplines is covered in discipline specific sections.
- 13.7.5 This includes assessing the value of heritage assets from a social, recreational, ecological and landscape points of view in Section 9 (Community), Section 10 (Ecology) and Section 15 (Landscape and visual) of this SMR, respectively.

14 Land quality

14.1 Introduction

14.1.1 This section of the SMR covers land quality which includes the environmental topic areas of land contamination, mineral resources and sites of geological interest. These were considered within the Sustainability Statement and its updates within the wider topic of 'Land use resources'.

14.1.2 In this context, 'land contamination' includes both soil and water contamination, i.e. releases to ground and surface water bodies. Wider issues of groundwater and surface water resources are contained within Section 21 (Water resources and flood risk) of this SMR.

Land contamination

14.1.3 Land and groundwater along the route of the Proposed Scheme may have become contaminated through previous industrial or agricultural practices. Such land or groundwater could adversely affect people and the wider environment; including effects on groundwater quality, surface water quality and ecology. Contamination may be present in topsoils, subsoil, deeper geology, groundwater or as ground gases/vapours. Construction of the Proposed Scheme will require excavation of the ground, cuttings and embankments, cut and cover and bored tunnelling, deep foundations, borings, temporary borrow pits if required, temporary and permanent dewatering and other construction activities. Where the route crosses or lies close to existing sources of contamination, these activities could result in the mobilisation of the contamination, which would need to be assessed and mitigated.

14.1.4 The land quality section of the ES will present a baseline assessment of potentially contaminative current and historical land use. This will be based on available maps, consultation and other information obtained along the Proposed Scheme. An assessment of temporary and permanent effects will then be made, including a screening and ranking of risk. Where appropriate, a range of measures will be proposed in order to mitigate the potential effects of contamination.

14.1.5 Contaminated land or groundwater currently present may already be causing environmental impairment. The purpose of the land quality assessment is to inform the EIA by assessing the possible impacts and significant effects arising from interaction with contamination. Construction and operation of the Proposed Scheme should manage existing contamination pre-dating the project and should not introduce new sources or pathways by which contamination can spread. Where there is a significant risk of this happening, the land quality assessment will consider mitigation measures to avoid this.

14.1.6 The land quality section will interact with the Agriculture, forestry and soils (Section 6), Health (Section 12), Major accidents and disasters (Section 16), Waste and material resources (Section 20) and Water resources and flood risk (Section 21) of this SMR.

Geological and mineral features

14.1.7 Along the route of the Proposed Scheme there may also be areas of land that have special geological significance, either from a scientific, or mineral resources point of view, such as:

- geological SSSI or Local Geological Sites (LGS);
- currently permitted and proposed future mineral and resource extraction areas which may be compromised or sterilised by the construction and operation of the Proposed Scheme. These include;
 - designated mineral resources for example: Mineral Preferred Areas (MPA) and Mineral Safeguarding Areas (MSA);
 - designated shale gas and Coal Bed Methane exploration areas and areas subject to Petroleum exploration and production licences;
 - existing or proposed shallow, deep and opencast coal mining; and
 - existing or proposed brine extraction.

14.2 Establishment of baseline and definition of survey

14.2.1 The method for determining the baseline conditions will involve access to a combination of the following:

- data collected for the Sustainability Statement;
- analysis of the results of previous investigations, if readily available, carried out in the immediate area of the Proposed Scheme;
- historical Ordnance Survey mapping;
- published geological and hydrogeological mapping/information;
- data made available by local authorities, including the adopted Mineral Plan;
- Coal Authority environmental records, including environmental monitoring data;
- route wide site inspections of key sites, including depot areas, where access is available;
- Foot and Mouth Disease (FMD) and Anthrax burials data; and
- other relevant publicly available environmental data.

14.2.2 Documentary data are available from a number of governmental and non-governmental organisations including:

- Environment Agency;
- water companies;
- British Geological Survey;

- the Coal Authority;
- Network Rail;
- the Ministry of Defence (MoD);
- the Crown Estate;
- Public Health England;
- Food and Environment Research Agency (FERA) and the Animal and Plant Health Agency (APHA);
- Natural England;
- local geological trusts;
- mining and quarrying companies; and
- local authorities (including unitary authorities, county and district councils).

14.2.3 Much of the data is also held on commercial environmental databases. Site inspections at key sites will be used to supplement the documentary study data obtained.

14.2.4 Generally, a zone extending to 250m either side of the boundary of the land required for the construction of the Proposed Scheme including land required for construction of stations, depots, construction/storage sites and other land required for the works will be reviewed. The extent of this zone has been developed using professional judgement on the basis that contamination migration beyond this distance is likely to be minimal or could be mitigated. This principle has been applied in assessing previous railway projects such as Crossrail and was used in the Phase One and Phase 2a assessments. The 250m zone may be widened where evidence suggests that it is required. The assessment of groundwater as a receptor will extend to 1km from the boundary of the land required for the construction of the Proposed Scheme.

14.2.5 A risk based approach in accordance with Defra and the Environment Agency guidance will be taken in assessing contamination which may have a significant effect upon the construction and operation of the Proposed Scheme, or upon the wider environment as a consequence of the Proposed Scheme. This will use the well-established conceptual site model (CSM) approach.

14.2.6 Intrusive investigations would be carried out after the completion of the ES and review of the desk study data, the Sustainability Statement and site inspections, therein: where the identified past uses of land indicate a high risk of previous significant contamination and potential risk to receptors. Such investigations would be undertaken in conjunction with geotechnical investigations in order to provide additional data upon which risks and impacts can be assessed and would be based upon the Model Procedures for the Management of Land Contamination: Contaminated Land Report 11¹⁹³ and BS10175: 2011¹⁹⁴ and the developed conceptual site model.

14.2.7 With regards to sites of geological interest, information will be obtained from Natural England, the British Geological Survey, The Coal Authority, local geological trusts and from local authorities (usually county councils) who may hold information on such sites.

14.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

14.3.1 During the consultation on the Sustainability Statement and its updates, both the Environment Agency and local authorities were consulted. Comments were reviewed but there were none which altered the proposed assessment methodology.

Engagement as part of the EIA process

14.3.2 During the preparation of the ES, wider and more comprehensive consultation on land quality will be undertaken as appropriate, with the following organisations:

- Environment Agency;
- the Canal & River Trust;
- Natural England (if 'geological SSSI' are affected);
- GeoConservation UK and local geological trusts;
- British Geological Survey;
- Network Rail;
- landfill and mineral abstraction companies;
- the Coal Authority;
- APHA and FERA;
- Health and Safety Executive;
- mining and quarrying companies;

¹⁹³ Defra and the Environment Agency (2004), Model Procedures for the Management of Land Contamination: Contaminated Land Report 11, Environment Agency

¹⁹⁴ British Standards Institute (BSI) (2011), BS10175 Investigation of potentially contaminated sites. Code of practice (+A1:2013), BSI

- local authorities (primarily Environmental Health Officers, Petroleum Officers/Fire Brigade and Contaminated Land Officers);
- county councils; and
- water companies.

14.4 Key aspects of the Proposed Scheme for the topic

14.4.1 There is the potential for contaminants to already be present on land that will be required for the Proposed Scheme. Contaminants could be disturbed during site clearance, movement of construction vehicles, and construction activities during the construction phase (e.g. cuttings, temporary borrow pits, if required, construction of portals, tunnels or ventilation shafts) or where the ground is disturbed (e.g. through site clearance and removal of existing structures). Soil and groundwater contamination may be present as a result of historical potentially contaminative activities at a particular location or as a result of current contaminative land uses.

14.4.2 Contaminated sites may exist in both urban and rural areas and may include localised industries, old and existing landfill sites, chemical works, sewage farms, mine sites, spoil heaps, and other land uses that will need to be assessed with respect to contaminative effects. Adverse effects can occur due to the presence of contaminant linkages, potentially resulting in an impact and/or harm to a sensitive receptor, for example excavation into a landfill might allow leachate to impact a drinking water abstraction unless mitigation is undertaken.

14.4.3 The impairment or destruction of identified LGS would be considered an adverse impact.

14.4.4 The sterilisation of identified mineral resources by the Proposed Scheme would be considered an adverse impact for which mitigation measures will be proposed.

14.5 Scope of assessment

14.5.1 The ES will assess the likelihood of existing contamination being encountered during the construction process, such that it could cause significant environmental harm or adverse health effects if not addressed adequately at the construction and/or operational stages.

14.5.2 The construction of the railway will entail bringing materials onto site (such as fuel) which if spilt or leaked could result in new land or groundwater contamination.

14.5.3 Impairment and sterilisation of geological and mineral resources will also be addressed.

14.5.4 Although the maintenance of the railway once it is operational will be required to be in compliance with appropriate environmental legislation, the major operational sources of contamination will be reviewed and appropriate mitigation measures proposed in order to prevent future land, surface water or groundwater contamination. In addition, during the operational period, monitoring works (such as for groundwater, gas/vapours and leachate) may continue in order to demonstrate the effectiveness of any remedial works, or as part of a strategy of any agreed Monitored Natural Attenuation (MNA) at specific sites.

14.6 Assessment methodology

Legislation

- 14.6.1 Part 2A of the Environmental Protection Act 1990 (as amended)¹⁹⁵ provides a statutory definition of contaminated land: “contaminated land is any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that – (a) significant harm is being caused or there is a significant possibility of such harm being caused; or (b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused”.

Guidance

- 14.6.2 In the guidance that accompanies the Environmental Protection Act 1990, there is advice on what constitutes significant harm and what constitutes a significant possibility. The following reports provide further guidance on the risk assessment process, and introduce the Contaminated Land Exposure Assessment (CLEA) model:

- Model Procedures for the Management of Land Contamination: Contaminated Land Report 11 (Defra and the Environment Agency);
- Guidance on the legal definition of contaminated land¹⁹⁶;
- Human Health Toxicological Assessment of Contaminants in Soil¹⁹⁷;
- Updated Technical Background to the CLEA Model¹⁹⁸; and
- Guiding Principles on Land Contamination¹⁹⁹.

- 14.6.3 The impacts associated with contaminated land are generally assessed by means of a source/contaminant-pathway-receptor methodology in accordance with Model Procedures for the Management of Land Contamination: Contaminated Land Report 11 (CLR11) and BS10175: 2011. CLR11 introduced the concept of a conceptual site model (CSM) to identify and assess contaminant linkages and this has been further updated by the revised Part 2a Contaminated Land Statutory Guidance (2012)²⁰⁰. The following definitions apply:

- contaminant: contamination that has the potential to cause unacceptable adverse impacts to a receptor. It may comprise chemical, biological or physical agents.
- receptor: a target that may be affected by contamination; examples include human occupants or users of the site, water resources or structures; and

¹⁹⁵ *Environmental Protection Act 1990*. London, The Stationery Office

¹⁹⁶ Department of Environment, Food and Rural Affairs (Defra) (2008), Guidance on the legal definition of contaminated land, Defra

¹⁹⁷ Environment Agency (2008), Science Report – SC050021/SR2 - Human Health Toxicological Assessment of Contaminants in Soil, Environment Agency

¹⁹⁸ Environment Agency (2008), Science Report – SC050021/SR3 - Updated Technical Background to the CLEA Model, Environment Agency

¹⁹⁹ Environment Agency (2010), Guiding Principles on Land Contamination, Environment Agency

²⁰⁰ Defra (2012) Environmental protection Act 1990: Part 2A. Contaminated Land Statutory guidance

- pathway: a route whereby a contaminant may come into contact with the receptor; examples include ingestion of contaminated soil and leaching of contaminants from soil into water resources.

Significance criteria

- 14.6.4 The previously described approach forms the basis of the methodology to be used in the assessment of land quality. For contamination to present a significant potential effect, a contaminant linkage must first be established using the CSM approach. The likelihood must be demonstrated that there is an identifiable source of contamination (be it an onsite or off site source), sensitive receptors and a viable pathway through which the former may affect the latter.
- 14.6.5 The sensitivity of potential receptors can be described qualitatively according to the categories shown in Table 22.

Table 22 - Criteria for assessing receptor sensitivity²⁰¹

Receptor sensitivity/ Value of Resource	Receptor/ Resource ²⁰²
High	Residential areas, schools and playing fields Surface water bodies of high quality and/or Principal aquifers Nationally designated areas e.g. SSSI Major strategic mineral resource areas Strategic underground storage space
Moderate	Retail and business parks (public and work places) Allotments and market gardens Surface water bodies of moderate quality, and/or Secondary A Aquifers Regionally designated areas e.g. local nature reserves or LGS Regionally or locally important mineral resource areas (MPA or MSA)
Low	Commercial or industrial development Mineral Areas of Search/ Consultation Areas (MCA) Secondary B and undifferentiated aquifers

- 14.6.6 Construction and/or maintenance workers are not included in the list of receptors, as it will be a fundamental requirement that any construction/maintenance workers on the project are adequately protected from the effects of any contamination by the CoCP via project specific health and safety plans and procedures which will be put in place prior to the construction phase. This will include construction workers' temporary accommodation sites. Railway users are considered to be protected from any residual land quality impact by ensuring the design of the scheme provides

²⁰¹ Based on the Highways Agency (2008), Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects, The Stationery Office

²⁰² Resource applies to both minerals and geological sites and is defined as a "mineral body including aggregates, salt, coal and other hydrocarbons and a site of local geological interest"

suitable protection measures built into structures and public areas. Furthermore, new utilities built within the boundary of existing highway construction and within road sub-base materials or natural ground below are also scoped out of the assessment as they present a very low risk of interacting with contaminated sites nearby and causing an impact on sensitive receptors such as housing or aquifers.

- 14.6.7 The magnitude of the effects of land contamination are assessed by comparing the difference in risk of each contaminant linkage at baseline to those at construction and at post construction stages. This provides a way of assessing both the adverse and beneficial effects during construction and the post construction period. An example of this is given in Table 23:

Table 23 - Summary of temporary (construction) effects²⁰³

Name and area ref	Receptor	Main baseline risk	Main construction risk	Temporary effect
Tank within farmyard at Upper Hanyards Farm 2-56	Human health (direct contact, ingestion, inhalation of vapours from contaminated soils, waters and inhalation of ground gases on site)	Moderate/low to moderate	N/A (exposure pathways removed)	Moderate beneficial (significant)
	Human health (direct contact, ingestion and inhalation of vapours from contaminated water offsite)	Moderate	N/A (exposure pathways removed)	Moderate beneficial (significant)
	Controlled waters - groundwater	High	Moderate/low	Moderate beneficial (significant)
	Property (direct contact with contaminated soil and water)	Moderate/low	Very low	Moderate beneficial (significant)

²⁰³ taken from HS2 Ltd (2016), High Speed Two Phase 2a: West Midlands to Crewe Working Draft Environmental Impact assessment Report: Volume 2: Community Area 2 Report (Colwich to Yarlet). Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/552374/C8_web_tagged_07-09-16.pdf

14.6.8 The significance of potential Proposed Scheme impacts regarding land quality issues will be assessed using a four-point scale as shown in Table 24.

Table 24 - Impact magnitude criteria²⁰⁴

Impact Magnitude	Criteria	Examples
High	Results in loss of attribute and/or likely to cause exceedance of statutory objectives and/or breach of legislation	Likely significant human health impact ²⁰⁵ , contamination of a Principal aquifer, or loss or isolation of strategic mineral resource
Moderate	Results in impact on integrity of attribute/or loss of part of attribute, and/or possibly cause exceedance of statutory objectives and/or breach of legislation	Reduction in the value of a feature, moderate human health impact, loss or isolation of regional/local mineral resource
Low	Results in minor impacts on attribute	Measurable change in attribute, but of limited size/proportion
Negligible	Results in no change or impact on attribute	No significant loss in quality of feature/attribute

14.6.9 The assessment of significance is based on the magnitude of the impact and the importance or sensitivity of the receptors. The significance of the potential effects is identified, as well as those of the residual effects for geological and mineral impacts. Appropriate mitigation measures will be recommended in order to reduce/control any significant adverse effects on sensitive receptors. Once remediated, there should be no residual effects with respect to land contamination issues.

14.6.10 Effects have the potential to be adverse, beneficial or neutral. For example, in terms of beneficial effects, the Proposed Scheme may remove a source of contamination or it may break a pathway that currently links a source to a receptor.

14.6.11 The significance of the effect will be affected by:

- the value of the resource;
- the sensitivity of the receptor;
- the strength and length of the pathway; and
- the size of the area affected.

14.6.12 Adverse and beneficial effects are further classified as being minor, moderate or major in significance, with only moderate or major significant effects being reported.

²⁰⁴ Based on the Highways Agency(2008), Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects, The Stationery Office

²⁰⁵ Defined in DEFRA (2012). *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (Section 4.1)*. Her Majesty's Stationery Office, London

14.6.13 Table 25 summarises the criteria for assessing effect significance.

Table 25 - Significance of effects criteria²⁰⁶

Significance	Description
Major adverse	Considerable detrimental effect (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability/legislation/policy standards
Moderate adverse	Limited detrimental effect (by extent, duration or magnitude) that may be considered significant
Minor adverse	Slight, very short or highly localised detrimental effect
Neutral	No appreciable effect
Minor beneficial	Minor reduction in risk (slight, short or highly localised effect)
Moderate beneficial	Moderate reduction in risk
Major beneficial	Major reduction in risk ²⁰⁷

Construction effects

- 14.6.14 The impact of existing land contamination will predominantly occur during the construction phase. A fundamental requirement of the project will be to carry out sufficient mitigation or remediation of contamination such that, following construction, there are no continuing significant adverse effects from the contamination during the operational phase of the Proposed Scheme.
- 14.6.15 Remediation of contaminated land, and other construction activities, can lead to a number of secondary effects such as potential issues of dust migration and surface water impairment during the remediation and construction processes. Any such effects would be controlled through use of the CoCP.
- 14.6.16 Where remediation of soil and groundwater is carried out for the Proposed Scheme, this would be regarded as a beneficial effect, as future risks to human health and the wider environment from the pre-existing contamination would have been reduced by the remedial works.

Operational effects

- 14.6.17 The major operational sources of contamination will be reviewed and appropriate mitigation measures proposed. In addition, during the operational period, monitoring works (such as for groundwater, gas/vapours and leachate) may continue in order to demonstrate the effectiveness of any remedial works at specific sites.

Cumulative effects

- 14.6.18 The assessment of cumulative effects would be limited to those areas/sites at which contamination remediation is likely to be required and at which construction of the

²⁰⁶ Generally based on the Highways Agency (2008), Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects, The Stationery Office

²⁰⁷ Defined in HS2 P2b Land Quality Technical Note – Detailed Methodology for Contaminated Land Assessment (TN5)

Proposed Scheme would be undertaken at the same time as other nearby construction work within an area of contaminated land.

- 14.6.19 Cumulative effects would also need to be taken into account, for example, when assessing the Proposed Scheme impact on mineral resources; effects at a local scale on a number of mineral resources may have a cumulative effect at a regional scale.
- 14.6.20 HS2 Phase One and Phase 2a will materially alter the land quality baseline conditions. These effects will be considered in-combination with the Proposed Scheme and reported under the assessment of cumulative effects during construction.

14.7 Assumptions

- 14.7.1 The semi quantitative assessment within this topic area considers land quality from the perspective of land contamination. It excludes soils quality from an agricultural or forestry perspective. Such an assessment will be found in Section 6 (Agriculture, forestry and soils) of this SMR.
- 14.7.2 Land contamination has the potential to affect groundwater resources. There will be significant interaction between the land quality and water resources assessments in order to determine the potential effects on the quality of groundwater from contaminated land. Wider issues of groundwater and surface water resources are contained within Section 21 (Water resources and flood risk) of this SMR.
- 14.7.3 Land contamination has the potential to affect ecological resources.²⁰⁸ Other ecological issues are addressed in Section 10 (Ecology) of this SMR.
- 14.7.4 Remediation of contamination can lead to a requirement for treatment and/or disposal of contaminated materials. Issues of onsite treatment and re-use of contaminated materials will be dealt with in the land quality assessment whereas issues of the disposal of contaminated soils off site are dealt with in Section 20 (Waste and material resources) of this SMR.

²⁰⁸ DEFRA (2012), *Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (Section 4.3)*. Her Majesty's Stationery Office, London

15 Landscape and visual

15.1 Introduction

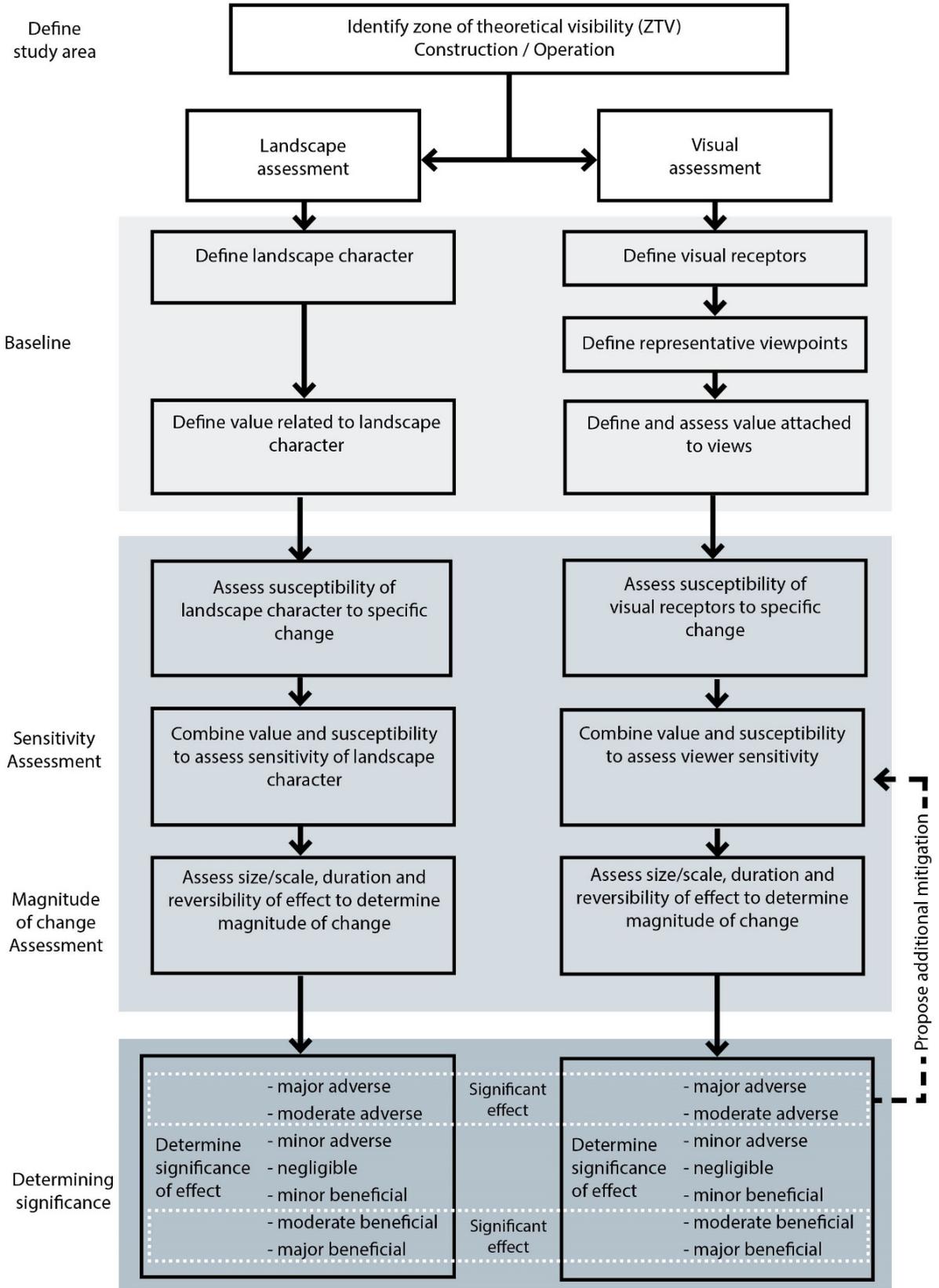
- 15.1.1 This section of the SMR covers landscape and visual which includes the environmental topic areas of changes to landscape character and views. The definition of landscape is 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (European Landscape Convention (ELC) – Council of Europe 2000²⁰⁹). Changes in views may result in a change in visual amenity experienced by people (visual receptors).
- 15.1.2 The ELC gives an inclusive definition of landscape with the need to take into account all landscapes, recognising that it is not just the special or designated places that have value but also 'ordinary' landscapes. For this assessment, the term 'landscape' encompasses rural, urban and peri-urban landscapes, all types and forms of open space and development in the countryside, villages, towns and cities, in line with the ELC.
- 15.1.3 The topic specific methodology presented in this section builds upon the general assessment methodology summarised in Section 1 (EIA methodology) of this SMR. This has been developed to take account of the range of likely significant environmental effects on the landscape and visual receptors arising from the construction, existence and operation of the Proposed Scheme. The methodology has also been designed to be consistent with the approach set out in the Guidelines for Landscape and Visual Assessment, 3rd Edition ('GLVIA3')²¹⁰. Where relevant account has also been taken of the Design Manual for Roads and Bridges (DMRB) Volume 11²¹¹.
- 15.1.4 The process for the landscape and visual assessment is illustrated in Figure 12. Each stage of the assessment process is then described in more detail through the following sections. A key principle is for the landscape baseline and the visual baseline to first be identified and understood before assessment takes place. The assessment of significant effects is a judgement based on a combination of receptor sensitivity and magnitude of change.

²⁰⁹ Council of Europe, 20/10/2000 Florence, European Landscape Convention CETS No.: 176

²¹⁰ Landscape Institute and Institute of Environmental Management and Assessment (2013), *Guidelines for Landscape and Visual Impact Assessment*. 3rd Edition. Routledge. New York.

²¹¹ Highways Agency (2009), Design Manual for Roads and Bridges: Volume 11: *Environmental Assessment*. London: The Stationery Office

Figure 11- Assessment process for the landscape and visual assessment



15.2 Establishment of baseline and definition of survey

15.2.1 The Proposed Scheme will pass through a wide range of different landscape character areas between the rural and agricultural landscapes of Warwickshire, Leicestershire, Staffordshire, Cheshire and Lancashire, Nottinghamshire, Derbyshire, South Yorkshire and West Yorkshire as well as the cities of Manchester and Leeds. The overall character of the study area from south to north is as follows:

Western leg of the route:

- ancient woodlands and small scale field patterns around Madeley, and the rural landscapes of East Cheshire.
- the 19th century townscape of Crewe and the area around Crewe Station;
- the rural landscapes of East Cheshire between Sandbach and Winsford;
- the Manchester Ship Canal; and
- Manchester city centre through which the route runs to terminate in a new station alongside Manchester Piccadilly Station, with a spur crossing the M62 west of Manchester to join the conventional rail network south of Wigan.

Eastern leg of the route:

- the rural, wooded and post-industrial landscapes of the Forest of Arden and the wetlands of the Kingsbury Water Park north of Birmingham;
- the low lying and undulating farmland landscape of the Anker valley and River Mease;
- the transport corridor of the M42, A42 and M1;
- the broad floodplain of the River Trent and urban edge of Nottingham, including Long Eaton and Toton;
- proximity to a range of historic landscape assets of national significance – the parklands and associated settings at Hardwick Hall, Sutton Scarsdale Hall, Bolsover Castle, Nostell Priory;
- the Dearne Valley; and
- the Leeds cityscape including a section of the River Aire which the Proposed Scheme crosses on viaduct on the approach to the Leeds HS2 Station which joins with the existing Leeds Station.

15.2.2 The landscape character of the study area and the nature of existing views will be established through desk based research, field survey and reviews of consultation responses on the Sustainability Statement and its updates.

15.2.3 The landscape and visual surveys will be carried out by Chartered Landscape Architects experienced in EIA. Surveys and Assessments made will be verified by at least two other Chartered Landscape Architects experienced in EIA. Survey work will be carried out in both winter and summer, in order for seasonal change to be

considered in the assessment. The survey work will be undertaken in a methodical order as follows:

- verification of the zone of theoretical visibility (ZTV) to inform the study area (see Section 15.5 Scope of assessment - Spatial Scope);
- definition and verification of the landscape character (in consultation with relevant disciplines such as historic environment and ecology and reviewing and adapting information in existing landscape character assessments);
- determination of the value of the landscape;
- assessment of the susceptibility of the landscape character to the specific changes arising from the scheme;
- assessment of the sensitivity of the landscape character based on value and susceptibility;
- definition of groups of visual receptors (people who may be affected by the Proposed Scheme) and definition of representative, specific and illustrative viewpoints within the ZTV;
- definition of the type and nature of the view from each viewpoint;
- determination of the value of each of the viewpoints (where published information is available);
- assessment of the viewer's susceptibility to change in the view at each of the viewpoints; and
- consideration of size/scale, geographical extent, duration and reversibility to determine the magnitude of change for landscape character and viewpoints.

15.2.4 The field study will include a comprehensive photographic record carried out in both the summer and winter, to illustrate the landscape character and viewpoints.

Landscape baseline

15.2.5 The landscape baseline will include an overview of the elements that form the baseline within the study area, using text and plans to describe:

- topography, drainage, water bodies and geology;
- cover, distribution and type of land use (past and present) and open space;
- statutory and non-statutory designations relevant to the landscape and visual assessment, with consideration of appropriate special qualities for which they are designated and setting issues;

- development patterns and scale, including age, relationship to historic patterns, massing and density of buildings, levels of enclosure, skyline characteristics, building materials and landmark features;
- vegetation patterns and extents derived from aerial photography and site visits, plus use of Integrated Habitat Survey/Phase 1 Ecological Survey;
- access and connectivity, including PRow, National Trails public access land, and other routes to include roads, railways, cycleways, bridleways, footpaths, historic green lanes and drovers roads and waterways;
- historic landscape and heritage features, including conservation areas, listed buildings, registered parks and gardens and other historic landscape characterisation (HLC); and
- existing landscape character assessments, designated landscape Management Plans (where appropriate), local landscape designations, local green infrastructure strategies or plans prepared by authorities, National Character Areas and Profiles from Natural England.

Landscape character assessment and ascribing landscape value

- 15.2.6 The landscape baseline elements will be used to prepare a character area assessment covering the full extent of the study areas. Landscape character areas are defined as areas with broadly homogenous characteristics²¹². The identification of character areas will be influenced by published character assessments, including those prepared at national, county and district scales, plus the work undertaken by other assessment topics, such as Historic environment (Section 13). If these are sub-divided to create units of character appropriate to the scale of the Proposed Scheme, this will be clearly set out in the ES. The character area boundaries will follow natural changes in the landscape rather than political or administrative boundaries.
- 15.2.7 The character of each landscape character area will be described with reference to the following seven criteria, which also inform the discussion on landscape value:
- geological, topographical and hydrological (physiographic) interest;
 - cultural pattern and historic landscape interest;
 - natural landscape interest;
 - recreational value;
 - perception of the landscape;
 - landscape condition; and
 - scenic and special qualities.
- 15.2.8 For each criterion the value will be determined in a five point scale from low to high using professional judgement with reference to site visits and existing documentation

²¹² The approach used for this is consistent with that set out in Natural England (2014), *An Approach to Landscape Character Assessment*.

including local authority character assessments, historic landscape character assessments and conservation area character appraisals where available.

- 15.2.9 An overall level of value for each landscape character area will be determined by comparing the judgements made for each category described above and by bringing out the elements contributing most strongly to value, through use of professional judgement.
- 15.2.10 Further detail on the attributes that influence the value judgements for each criteria will be described in a Technical note Approach to landscape sensitivity (as referenced in Annex A of this SMR). This will be developed through engagement with relevant environmental stakeholders.

Visual baseline

Selection of viewpoints

- 15.2.11 Representative, specific and illustrative viewpoints will be selected to allow an assessment of effects upon visual receptors within the study area. Visual receptors are divided into the following categories: residential, recreational, hotel, healthcare, educational, transport, active sports and employment.
- 15.2.12 All viewpoints will be agreed²¹³ wherever possible with local planning authorities and in consultation with other relevant stakeholders as appropriate, for example Historic England, the National Trust, Natural England, Forestry Commission and the Canal & River Trust.
- 15.2.13 Photos taken during both winter and summer periods will be included in the ES for each viewpoint. The composition of the view will be described, including foreground, middle ground and background characteristics, the nature of the view towards the land to be acquired or used for the Proposed Scheme. Elements which obstruct the view (if anything) and whether a view is panoramic, framed, glimpsed or sequential (e.g. promoted long distance routes, canal paths), will also be described.
- 15.2.14 The view at night will be described in cases where significant effects arising from lighting during construction or operation are likely as described in Technical note Approach to night time 'darkness' surveys (referenced in Annex A of this SMR).

Determining view value

- 15.2.15 Value of a viewpoint can only be determined if the view is recorded in a View Management Framework; or if the view is identified as an important view in a Conservation Area Appraisal; or a designed view important to the setting of a heritage asset (as recorded in the relevant citations accompanying any designation, and taking appropriate account of Historic England guidance on setting of heritage assets); or if the view is an advertised viewpoint which appears in a guide book or interpretive material. In these instances the information source and reasons for the value and importance of the view will be captured.
- 15.2.16 For each viewpoint any particular elevated value will be determined where appropriate using professional judgement and with reference to site visits and existing

²¹³ Viewpoints cannot provide an exhaustive picture, hence the need for selection

documentation. Some views may be specifically recognised, for example in relation to heritage assets, or through planning designations. Value may also be indicated by appearance in guidebooks or on tourist maps.

15.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

- 15.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for the landscape and visual assessment for the Proposed Scheme.

Engagement as part of the EIA process

- 15.3.2 Consultees for this section of the ES will include (but not be limited to) local planning authorities, county councils, Natural England, Historic England, the National Trust, the Forestry Commission, the Canal & River Trust and other groups with appropriate technical knowledge.

Key aspects of the Proposed Scheme for the topic

- 15.3.3 The main features of relevance to the landscape and visual assessment during construction include:
- construction sites (including vehicles, construction lighting);
 - construction plant, such as cranes;
 - site compounds and storage areas, including temporary fencing and signage;
 - earthworks (including temporary stockpiles or earth bunds for screening);
 - construction of buildings and structures such as stations, headhouses, depots, tunnels, viaducts, overbridges and electrical apparatus;
 - construction of embankments, cuttings and associated drainage works, plus construction of balancing ponds;
 - demolition of existing buildings and structures and vegetation clearance, for example felling of woodland and trees, loss of hedgerows;
 - construction traffic, including use of existing roads as haul routes and the construction of bespoke routes, movement of excavated materials and movements on public roads; and
 - infrastructure and utility diversions.
- 15.3.4 The main features of relevance to the landscape and visual assessment during operation include:
- the track and track bed;
 - traffic (including trains and maintenance vehicles), and 'arcing' from trains;

- the OLE, lighting, communication masts and signage;
- tunnel portals and ventilation shafts;
- viaducts and bridges (including both road and pedestrian);
- earthworks including cuttings, embankments, cut and cover 'green tunnels' and earthworks such as earth bunding and regrading works, much of which would assist with screening and integrating the Proposed Scheme;
- planting, for example new woodland, copse, specimen trees, hedgerows;
- balancing ponds and other drainage features plus new ecological ponds;
- noise barriers and visual screens;
- new and redeveloped stations, depot and infrastructure maintenance facilities;
- associated development such as road widening, junction changes and increased traffic, plus new permanent buildings such as tunnel headhouses and auto-transformer stations and auto-transformer feeder stations; and
- associated developments, such as utility and permanent road diversions or upgrading, plus diverted highways and footpaths.

15.4 Scope of assessment

- 15.4.1 The methodology for the landscape and visual assessment follows the guidance set out in the GLVIA3²¹⁴ and, where appropriate, the Design Manual for Roads and Bridges (DMRB)²¹⁵ and subsequent highway guidance such as IAN 135/10²¹⁶.
- 15.4.2 The assessment will also draw upon other topic assessments where relevant, such as historic environment, ecology, community and health. The methodology in this section is compatible with these other topics to ensure that all data generated can be shared in a logical and transparent way. The methodology in this section describes the assessment process for effects on landscape character, the physical landscape and on visual receptors. Section 13 (Historic environment) of this SMR will consider the effects of the Proposed Scheme on the setting of individual cultural and heritage assets. For example this may include effects on the setting of scheduled monuments, listed buildings and registered parks and gardens.

Spatial scope

- 15.4.3 The landscape and visual assessment study area will be determined through the production of ZTV models, within 1.5km either side of the Proposed Scheme alignment, for:

²¹⁴ Landscape Institute and Institute of Environmental Management and Assessment (2013), *Guidelines for Landscape and Visual Impact Assessment, 3rd edition*, Routledge, New York.

²¹⁵ Highways England (2015), *Design Manual for Roads and Bridges (DMRB)*. London: The Stationery Office.

²¹⁶ Highways England (2010), *Interim advice note 135/10 Landscape and visual effects assessment*

- construction – defined as the area over which the proposed construction activity would be visible;
- operation year 1 – defined as the area over which the components of the Proposed Scheme (including trains) would be visible; and
- operation year 15 – defined as the area over which the components of the Proposed Scheme (including trains) will be visible taking into account the screening effect new planting established as part of the Proposed Scheme may have in summer after 15 years of growth.

15.4.4 The landscape study area will be defined by the maximum extent of all character areas located partially or entirely within the ZTV. The visual assessment area will be defined by the maximum extents of the ZTV.

15.4.5 The ZTVs will be based on the most recently available and consistent topographic data (digital terrain model or DTM) and digital surface model (DSM) data. A datum of 1.6m above ground level will be used to represent the eye level view of an average height person. The validity of the route wide ZTV will be checked on site, using professional judgement, to ensure the output is a fair representation of the theoretical visibility of the Proposed Scheme, in line with guidance provided by the Landscape Institute. The detailed methodology for producing the ZTV is described in the Zone of Theoretical Visibility Production Methodology Technical note (referenced in Annex A of this SMR).

Temporal scope

15.4.6 The landscape and visual assessment will be undertaken for the following years:

- construction - an assessment of effects in winter during the construction phase;
- operation year 1 - an assessment of effects in winter and summer during operation year 1²¹⁷;
- operation year 15 - an assessment of effects in summer during operation year 15, once any vegetation planted as part of the Proposed Scheme has matured or has achieved its design intention; and
- operation year 60 - to consider the benefits and/or negative effects in summer of maturity of tree planting.

Climate change

15.4.7 Projections of future climate change will be incorporated in the definition of the future baseline for the landscape assessment. The methodology and timeframes for assessing climate change impacts on sensitive receptors and significant effects assessed by the Landscape topic are set out in Section 8 (Climate Change) of this SMR.

²¹⁷ The landscape assessment does not consider seasonal variations e.g. winter/summer, since these do not affect character. Such scenarios are only considered in the visual assessment in relation to years 1 and 15

15.5 Assessment methodology

15.5.1 Physical changes to the landscape may give rise to effects on character. Effects may be direct (whereby landscape components are lost, damaged or altered by the construction or operation of the Proposed Scheme), or indirect (whereby the proposed development alters the setting of surrounding character areas).

Landscape assessment methodology

Determining landscape character sensitivity

15.5.2 Landscape character sensitivity is derived from judgements about the susceptibility of landscape character to the type of change arising from the Proposed Scheme; and the value attached to the landscape in the baseline (refer to paragraphs 15.2.7 to 15.2.10).

15.5.3 The susceptibility of the landscape will be assessed against the following six criteria, which are related to but separate from the value criteria set out above. The focus in the below criteria is on understanding characteristics of the landscape which are vulnerable to change arising from the Proposed Scheme:

- Landform and prominent landmarks;
- cultural and landscape pattern;
- landscape scale;
- scenic and special qualities;
- perceptual aspects and tranquillity; and
- visual character sensitivities.

15.5.4 For each criterion the susceptibility will be assessed on a five point scale from low to high using professional judgement with reference to site visits and existing documentation, including local authority character assessments, historic landscape character assessments and conservation area character appraisals where available.

15.5.5 An overall level of susceptibility for each landscape character area will be assessed by comparing the judgements made for each category described above and drawing out the elements most important to character in each case.

15.5.6 Further detail on the attributes that influence the susceptibility judgements for each criterion will be described in the Technical note Approach to landscape sensitivity (referenced in Annex A of this SMR).

15.5.7 With reference to the overall value and susceptibility of the landscape to change, the sensitivity of the landscape will be assessed. The assessment of sensitivity requires the application of professional judgement, in line with guidance provided by the Landscape Institute. The presence of any combination of attributes within the criteria described may be considered when assessing the sensitivity of a character area. This allows professional judgement to be used when determining the relative importance of different attributes.

15.5.8 The attributes that influence the sensitivity of the landscape character area described in Table 26 and in the Technical note, Approach to landscape sensitivity (referenced in Annex A of this SMR).

Table 26 - Landscape sensitivity

Sensitivity	Where the character area:
High	<p>Is mostly unspoilt and of high scenic or townscape quality</p> <p>is intact or mostly intact</p> <p>Is highly valued by virtue of its designation or recreational value</p> <p>Is predominantly characterised by landscape components that are rare and distinctive and/or listed</p> <p>Has a strong sense of tranquillity and remoteness</p> <p>Is highly susceptible to specific change arising from the Proposed Scheme</p> <p>Has components that are not easily replaced or substituted (e.g. mature trees)</p> <p>Has very limited scope for effective mitigation in character with the existing landscape</p> <p>Is well maintained and in a good condition</p>
Medium-high	<p>Is mostly unspoilt and of notable scenic or townscape quality</p> <p>Is largely intact</p> <p>Is valued by virtue of its designation or recreational value</p> <p>Is largely characterised by landscape components that are distinctive, rare and/or listed</p> <p>Has a largely strong sense of tranquillity and remoteness</p> <p>Is susceptible to specific change arising from the Proposed Scheme</p> <p>Has components that are not easily replaced or substituted (e.g. mature trees)</p> <p>Has relatively limited scope for effective mitigation in character with the existing landscape</p> <p>Is mostly well maintained and in a good condition</p>
Medium	<p>Displays some scenic or townscape qualities albeit with some erosion around infrastructure and settlement edges</p> <p>Has a generally intact landscape with the presence of some uncharacteristic development</p> <p>Is valued locally for its recreational facilities and footpath network</p> <p>Has many components that are rare and distinctive and/or listed</p> <p>Has a moderate sense of tranquillity and remoteness</p> <p>Has a moderate degree of susceptibility to specific change arising from the Proposed Scheme</p> <p>Has components that are relatively easily replaced or substituted</p> <p>Has some scope for effective mitigation in character with the existing landscape</p> <p>Is in a fair condition</p>

Low-medium	<p>Displays few scenic or townscape qualities albeit degraded around infrastructure and settlement edges</p> <p>Has a partially intact landscape with a clear presence of uncharacteristic development</p> <p>Has some elements that are of local or communal value</p> <p>Has some components that are rare and distinctive and/or listed</p> <p>Has localised areas with a sense of tranquillity and remoteness</p> <p>Has a relatively low degree of susceptibility to specific change arising from the Proposed Scheme</p> <p>Has many components that are easily replaced or substituted</p> <p>Has scope for effective mitigation in character with the existing landscape or for the creation of new landscape character</p> <p>Is in a fair, albeit partly degraded condition – land management issues may be evident</p>
Low	<p>Has a landscape or townscape affected heavily by uncharacteristic development eroding scenic qualities</p> <p>Very little sense of intactness or with character substantially eroded</p> <p>Has limited landscape value with few recreational facilities or footpath networks</p> <p>Has few or no distinctive components, or components that detract from the overall character of the landscape</p> <p>Has limited sense tranquillity or remoteness by virtue of the dominance of infrastructure and human activity</p> <p>Has limited susceptibility to specific change arising from the Proposed Scheme</p> <p>Has components that are easily replaced or substituted</p> <p>Has considerable scope for effective mitigation in character with the existing landscape, and opportunities for an improvement in character or for creation of new landscape character</p> <p>Is in a poor condition and/or defined by 'uncharacteristic' or unsympathetic land management</p>

Determining magnitude of change

- 15.5.9 The magnitude of change on the landscape is influenced by:
- size and scale of the change - for example if there is a complete or partial loss of a particular element of the landscape;
 - geographical extent of the area that will be altered; and
 - duration of the change and its reversibility.
- 15.5.10 A combination of the above factors may influence magnitude of landscape change and this will be considered using professional judgement when carrying out the assessment.

- 15.5.11 Factors that will be considered in assessing the magnitude of change to landscape character are summarised in Table 27. These criteria are based on guidance provided by the Landscape Institute.

Table 27 - Landscape magnitude of change

Impact magnitude	Definition
High	<p>Total loss of or substantial alteration to key characteristics of the character and/or setting of the character area</p> <p>Addition of new uncharacteristic features or components that substantially alter character and/or a large part of the setting of the character area</p> <p>Introduction of irreversible change over a substantial area of an LCA or its setting</p> <p>Introduction of long term or permanent change uncharacteristic of the area</p>
Medium	<p>Noticeable change or alteration to one or more key characteristics of the character and/or setting of the character area</p> <p>Addition of new features or components that form prominent elements of the character and/or setting of the character area, but are largely characteristic of the existing setting</p> <p>Uncharacteristic changes across only a proportion of the character area or its setting</p> <p>Introduction of some irreversible changes in parts of a character area or its setting</p> <p>Introduction of medium to long term uncharacteristic changes and/or permanent changes largely characteristic of the existing setting</p>
Low	<p>Slight loss or alteration to one or more characteristics of the character and/or setting of the character area</p> <p>Addition of new features or components that form largely inconspicuous elements of the existing character and/or setting</p> <p>Introduction of short to medium term uncharacteristic changes and/or long term/permanent changes in a small proportion of a character area or its setting</p>

Assessing significance of effects

- 15.5.12 Assessment of the significance of an effect requires the application of impartial professional judgement including experience of other major infrastructure schemes to weigh the findings of the sensitivity of the landscape character area and the magnitude of change. This approach is recommended by the Landscape Institute. The presence of any combination of factors may be considered when assessing the level of effect. This allows professional judgement to be used when determining the relative importance of different factors, which varies on a site specific basis. Effects may be adverse or beneficial. The broad criteria that influence the level of landscape effects are noted in Table 28. Both the major and moderate categories are considered to comprise a significant effect as these would discernibly alter the character of an area. Any one aspect described may result in a categorisation within that significance level. These criteria are based on guidance provided by the Landscape Institute.

Table 28 - Significance of effects for landscape assessment

Significance level	Description The proposed development would result in effects that:
Major beneficial – significant	Would considerably and distinctly improve and enhance the existing character Would restore or enhance valued characteristic features substantially or entirely lost through other land uses
Moderate beneficial – significant	Would markedly improve and enhance the existing character Would restore or enhance valued characteristics substantially lost through other land uses
Minor beneficial	Would slightly enhance the existing character Would restore valued characteristic features partially lost through other land uses
Negligible	Would be compatible with the existing character
Minor adverse	Would be slightly at variance with the existing character Would damage or partially remove some valued characteristic features
Moderate adverse – significant	Would be at variance with the existing character Would degrade, diminish or destroy valued characteristic features, elements and/or their setting Would not be wholly compatible with local environmental policies for the protection and enhancement of the landscape
Major adverse – significant	Would be at considerable variance with the existing character, degrading its integrity Would permanently degrade, diminish or destroy the integrity of valued characteristic features, characteristic, aesthetic or perceptual qualities, elements and/or their setting, particularly rare or distinctive landscapes Would comprehensively conflict with national, regional or local environmental policies for the protection and enhancement of the landscape

Visual assessment methodology

Determining viewer sensitivity

- 15.5.13 The sensitivity of viewers is made up of judgements about susceptibility of the visual receptor to the type of change arising from the Proposed Scheme; and the value attached to the certain views that are experienced.
- 15.5.14 Susceptibility to change of visual receptors depends on occupation or activity of people and the extent to which attention is focused on views and visual amenity.
- 15.5.15 The most susceptible visual receptors (people) include:
- residents at home;

- people engaged in outdoor recreation whose interest is likely to be focused on landscape and views (e.g. users of open access land, long distance routes, PRowS and the canal network);
- visitors to heritage assets or other attractions where views are important to the experience; and
- communities where views contributing to landscape setting are enjoyed by residents.

15.5.16 Those less likely to be focused on the landscape and views include:

- people engaged in outdoor sport or recreation not involving appreciation of views of the landscape;
- people at places of work where setting is not important to quality of working life; and
- travellers on road, rail or other routes may fall into an intermediate category using professional judgement depending on whether travel involves recognised scenic routes or depending on the nature, character and speed of the route. For instance travellers on rural B roads and winding rural lanes will have a higher sensitivity to visual change than would travellers on motorways or busy A roads due to the relative importance of their visual surroundings to their travel experience.

15.5.17 The sensitivity of visual receptor types will be mapped by category. A typical hierarchy is shown in Table 29. It should be noted that these can vary according to view value and context. Professional judgment will need to be applied in each case.

Table 29 - Visual sensitivity

Sensitivity	Level of interaction with the landscape
High	Occupiers of residential properties Recreational users or tourists whose attention is focussed on the landscape (e.g. visitors to the Registered Parks and Gardens, users of the promoted route/long distance path/PRowS and canal network) Designated or protected views
Medium-high	Users of local PRowS Locally designated or protected/advertised views (Note: The medium-high category is likely to include elements from the high and medium sensitivity categories and professional judgement will be used)
Medium	People travelling along rural roads/lanes/scenic routes through the landscape where their attention is likely to be focussed to a degree on their surroundings People staying in hotels and healthcare institutions People walking along residential streets

Sensitivity	Level of interaction with the landscape
Medium-low	<p>People travelling along main A and B roads where their attention is proportionately less focussed on their surroundings</p> <p>People at work in outdoor environments/in a setting where their surroundings make a contribution to their experience at work</p> <p>(Note: The medium-low category is likely to include elements from the low and medium sensitivity categories and professional judgement will be used)</p>
Low	<p>People at work and in educational institutions (although users of residential educational institutions will have a higher sensitivity)</p> <p>People engaged in formal sports activities</p> <p>People walking through urban areas (for example commuters)</p> <p>People travelling on high speed main roads/rail routes through the landscape</p>

15.5.18 Visual effects relate to:

- the changes that arise in visual amenity and the composition of available views as a result of changes arising from the Proposed Scheme; and
- people's likely responses to changes.

15.5.19 For sites where substantial lighting is anticipated during construction or operation, an assessment of visual effects at night time arising from additional lighting will also be made, in line with the methodology described for the day time assessment below.

15.5.20 The construction phase assessment will be undertaken during winter, when construction works are likely to be most visible.

15.5.21 The operation year 1 assessment will be undertaken during winter and summer to account for seasonal change in the visibility of the proposed development.

15.5.22 The purpose of the operation year 15 and 60 assessments will be to account for any vegetation planted as part of the Proposed Scheme that has matured or has achieved its design intention, and would be in full leaf. Therefore, the assessment for these years would be undertaken during summer.

Determining magnitude of change

15.5.23 The magnitude of the change to views is made up of judgements about:

- size and scale of the effect - for example if there is complete or partial loss of a particular element in the view;
- geographical extent of changes in view; and
- duration of the change and their reversibility.

15.5.24 A combination of the above factors may influence magnitude of visual change and this will be considered using professional judgement when carrying out the assessment.

15.5.25 The factors that will be considered in assessing the magnitude of change on views and on representative viewpoints are summarised in Table 30.

Table 30 - Visual magnitude of change

Impact magnitude	Definition
High	<p>Total loss or substantial alteration to key characteristics of the view from a receptor</p> <p>Addition of new features or components that are continuously highly visible across the majority of the view and incongruous with the existing view from a receptor</p> <p>Substantial changes in close proximity to the visual receptor, within the direct frame of view</p> <p>Introduction of long term or permanent change uncharacteristic of the view</p>
Medium	<p>Noticeable change or alteration to one or more key characteristics of the view from a receptor</p> <p>Addition of new features or components that may be continuously highly visible across much of the view, but are largely characteristic of the existing view from a receptor</p> <p>Changes a relatively short distance from the receptor, but viewed as one of a series of components in the middle ground of the view</p> <p>Substantial change partially filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor</p> <p>Introduction of medium to long term change uncharacteristic of the view and/or permanent changes largely characteristic of the existing view or in a small proportion of the view</p>
Low	<p>Slight loss or alteration to one or more characteristics of the view from a receptor</p> <p>Addition of new features or landscape components that may be continuously or intermittently visible in part of the view, but are largely characteristic of the existing view from a receptor</p> <p>Changes within the background of the view, viewed as one of a series of components in the wider panoramic view from a receptor</p> <p>Change largely filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor</p> <p>Introduction of short to medium term change uncharacteristic of the view and/or long term/permanent changes in a small proportion of the view</p>
Negligible	<p>No change to, or barely perceptible loss or alteration of inconspicuous characteristics of the view from a receptor</p> <p>Addition of new features or landscape components that are largely inconspicuous and characteristic of the existing view when viewed from a receptor</p> <p>Changes within the background of the view, viewed as an inconspicuous element within the wider panoramic view from a receptor</p> <p>Change from a visual receptor almost entirely obscured by intervening vegetation and/or built form</p> <p>Short term changes in a small proportion of the view</p>

Assessing significance of effects

15.5.26 Assessment of the significance of an effect requires the impartial application of professional judgement to weigh the sensitivity of the representative viewpoint with the magnitude of the change. Effects may be adverse or beneficial. The broad criteria that influence the level of significance of visual effects are set out in Table 31. Both the

major and moderate categories are considered to comprise a significant effect as these would discernibly alter the existing view. The significance for visual effects follows the guidance provided by the Landscape Institute.

Table 31 - Significance of effects for visual assessment

Significance level	Description
	The proposed development would result in:
Major beneficial – significant	A prominent improvement in the existing view
Moderate beneficial – significant	A marked improvement in the existing view
Minor beneficial	A discernible improvement in the existing view
Negligible	No perceptible deterioration or improvement in the existing view
Minor adverse	A discernible deterioration in the existing view
Moderate adverse – significant	A marked deterioration in the existing view
Major adverse – significant	A prominent deterioration in the existing view

15.5.27 Residual significant effects are reported for those effects that will persist after any mitigation. For construction, residual effects associated with construction activities will be temporary, lasting the duration of the peak construction phase. For operation residual effects will be reported only for significant effects that persist from year 15 after opening, on the basis that the planting incorporated into the design of the Proposed Scheme would mitigate other effects reported at year 1.

Verifiable photomontage methodology

15.5.28 In some locations, to be agreed with statutory consultees, the assessment of visual effects would be accompanied by the production of verifiable photomontages, recognising that photomontages can only be an aid to assessment and decision-making. These would be prepared for viewpoints where:

- the receptor is highly sensitive to change and/or the viewpoint is identified in the Local Plans and Supplementary Planning Guidance (SPG), Conservation Area character appraisals or Management Plans for protected landscapes (where relevant); or
- the magnitude of change cannot be easily assessed with reference to plans, sections, elevations and 3D visualisations (e.g. where views may be partially filtered or partially screened by vegetation or built form, or where the precise position of elements has a particular importance in relation to the composition of a view).

15.5.29 Verifiable photomontages would be produced for construction, operation year 1, and operation year 15 as required. The detailed methodology for producing the verifiable photomontages is described in the Technical note Approach to verifiable

photomontages (referenced in Annex A). The methodology has been informed by Landscape Institute Advice Note 01/11²¹⁸ and GLVIA3.

Cumulative effects assessment

- 15.5.30 Cumulative effects (also known as in-combination effects) arising from the Proposed Scheme in conjunction with other developments within the study area would be described with reference to how the findings of the main assessment would change.
- 15.5.31 The construction phase cumulative assessment would consider the effects of construction of the Proposed Scheme in conjunction with all other major developments likely to be under construction at the same time within the construction phase study area.
- 15.5.32 The operation year 1 cumulative assessment would consider the effects of the operation of the Proposed Scheme in conjunction with all other major developments in operation in year 1 within the operational phase study area.

15.6 Assumptions

- 15.6.1 The assessment is based on professional judgement and takes into account both the adverse and beneficial contribution that new development can have upon the existing landscape character and on the visual resource of surrounding receptors.
- 15.6.2 During the baseline survey there may be some areas which are inaccessible (such as private land, commercial premises and residential buildings). In these instances, professional judgement will be used to approximate the likely views from these locations. Where viewpoints are selected to reflect the visibility of the Proposed Scheme from tall residential properties, a photo will be included from public land close to the property, taken at ground level, and a commentary included as to the likely appearance of the view from a higher elevation. In line with industry accepted guidance, in these instances, no photomontages will be included from an elevated perspective.
- 15.6.3 The ZTVs will be generated using (LiDAR) topographic data (where available) or Ordnance Survey Landform Profile data. It is acknowledged that changes in the assessment area through new development and/or demolition will not necessarily be identified by this model. However, professional judgement will be used to verify the ZTVs on site as far as possible.

²¹⁸ Landscape Institute (2011), *Photograph and photomontage in Landscape and Visual Impact Assessment: Advice Note 01/11*. Landscape Institute, London.

16 Major accidents and disasters

16.1 Introduction

- 16.1.1 This section of the SMR covers the potential vulnerability of the Proposed Scheme to a major accident and/or disaster and considers the potential for likely significant environmental effects arising from such an event.
- 16.1.2 The assessment of the vulnerability of the Proposed Scheme to major accidents and disasters is considered following changes to EU and UK legislation. The revised EIA Directive 2014/52/EU (revised Directive) which entered into force on 15 May 2014, and the amended Town and Country Planning (EIA) Regulations 2017 (amended regulations) which entered into force on 16 May 2017, transposing the revised Directive, state the need to assess the expected significant adverse effects of the project on the environment arising from the vulnerability of the project to risks of major accidents or disasters that are relevant to the project concerned (Schedule 4 Paragraph 8 of the amended regulations).
- 16.1.3 Furthermore, as derived from Schedule 4 Paragraph 8 of the amended regulations, a description of the measures envisaged to prevent or mitigate the significant adverse effects of major accidents and/or disasters on the environment and details of the preparedness for and proposed response to such emergencies should be provided.
- 16.1.4 The full excerpt of Schedule 4 Paragraph 8 states that:
- “(8) A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU(c) of the European Parliament²¹⁹ and of the Council or Council Directive 2009/71/Euratom(d)²²⁰ or UK environmental assessments may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.”
- 16.1.5 The Proposed Scheme will be designed to reduce as far as practicable the risk of major accidents occurring. The Proposed Scheme, as a modern, high-speed railway with stations, will be designed, built and operated in line with best international current practice with embedded climate change resilience. HS2 Ltd has committed to deliver levels of passenger safety performance in line with best current international practice which is as good, or better than, HS1²²¹.

²¹⁹ Directive 2012/18/EU Seveso III on the control of major-accident hazards involving dangerous substances (amending Council Directive 96/82/EU)

²²⁰ Council Directive 2009/71 establishing a country framework for the nuclear safety of nuclear installations

²²¹ HS2 and Department for Transport (2014), Development Agreement: relating to the High Speed Two Project. Simmons & Simmons, London. Available online at: <https://www.gov.uk/government/publications/hs2-development-agreement-december-2014>

- 16.1.6 A guiding principle of safety risk management for the Proposed Scheme, is to manage all risks to be ALARP as set out in HS2's Development Agreement and accepted by the Office of Road and Rail (the regulator). For example:
- for construction, the HS2 Corporate Health and Safety Strategy 'Safe at Heart' is applied to identify and mitigate accident risks; and
 - for operation of the high speed railway, the safety of the railway is considered under application of EU Regulation 402/2013 (as amended) the Common Safety Method for Risk Evaluation and Assessment (CSM-RA)²²². Under CSM-RA, hazards with the potential to cause a major accident during railway operation are identified, assessed and mitigated.
- 16.1.7 The assessment of major accidents and disasters will identify whether an appropriate risk management structure is in place, for both health and safety and environmental risks. Furthermore, it will report whether the potential for major accidents and/or disasters to impact on human health or the environment has been identified and will be managed to be ALARP by HS2 Ltd and its suppliers. This will be achieved through a review of available documentation and legal and regulatory requirements; the EIA will not involve assessment from 'first principles'. The assessment will present any identified risks which may require further precautionary mitigation actions beyond those already integrated into the design and execution of the Proposed Scheme.
- 16.1.8 The methodology presented in this section builds upon the general assessment methodology summarised in Section 1 of this SMR. It sets out how the vulnerability (exposure and resilience) of the Proposed Scheme to major accidents and/or disasters will be assessed, with reference to available relevant information.

16.2 Establishment of baseline and definition of assessment process

- 16.2.1 The assessment will use baseline information collected from other sections of the ES to define the receptors and the Proposed Scheme's risk to a major accident or disaster. In particular baseline information on climate change, community, ecology, health, socio-economics, traffic and transport and water resources and flood risk is pertinent to the assessment. Close interaction with these disciplines is important to gather this information.
- 16.2.2 In accordance with Schedule 4 Paragraph 8 of the amended regulations²²³, safety assessments undertaken for the Proposed Scheme will be used to inform the identification and assessment of likely significant environmental effects. For the purposes of the Proposed Scheme these will include Construction, Design and Management (CDM) risk registers and system safety hazard records current at the time of undertaking the assessment. Application and acceptance of the ALARP principle is within the remit of the regulator (Office of Rail and Road) and the Health

²²² Commission Implementing Regulation (EU) No 402/2013 of 30 April 2013 on the common safety method for risk evaluation and assessment and repealing Regulation (EC) No 352/2009

²²³ Schedule 4 Paragraph 8 of the Town and Country Planning (Environmental Impact Assessment) 2017 Regulations states "Relevant information available and obtained through risk assessments pursuant to EU legislation such as Directive 2012/18/EU(c) of the European Parliament and of the Council or Council Directive 2009/71/Euratom(d) or UK environmental assessments may be used for this purpose provided that the requirements of this Directive are met." The referenced Directives relate to operating sites which contain large quantities of dangerous substances (for example oil refineries, oil storage depots and nuclear facilities) which are not relevant to the Proposed Scheme

and Safety Executive and not part of the EIA. The assessment will be based on a review of available documentation and legal and regulatory requirements.

- 16.2.3 Additional baseline information will be required on features external to the Proposed Scheme which could contribute a potential source of hazard to the Proposed Scheme. This information would be obtained from a desk based study. Such features may include, but are not limited to:
- Presence of COMAH sites;
 - Potentially hazardous ground conditions; and
 - Proximity to other infrastructure (road, rail, aviation, energy).
- 16.2.4 The assessment of significant adverse effects on the environment will be undertaken with reference to the regulatory requirements, legislation and design standards in place for the construction and operation of the Proposed Scheme, including those referred to in paragraph 16.1.5.
- 16.2.5 The assessment will provide a collation and review of existing risk assessments, as defined in paragraph 16.2.1, to identify whether significant effects on the environment have been determined, and whether such risks have been managed and mitigated to be ALARP.

16.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

- 16.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for the major accidents and disasters assessment for the Proposed Scheme.

Consultation as part of the EIA process

- 16.3.2 General consultation on the scope, methodology and outcomes of the EIA, including major accidents and disasters assessment will be undertaken with appropriate bodies.
- 16.3.3 Consultation will be undertaken in an integrated way in conjunction with the consultation proposed for the other environmental topic areas. These topic areas will already be considering routine events (those predicted to happen or which are likely to happen) and some non-routine events (which 'might' happen) in their assessment of likely significant effects. This topic will not duplicate those assessments; however it will make reference to existing assessments where relevant.

16.4 Scope of assessment

Terminology

- 16.4.1 For the purposes of this assessment, vulnerability is defined as the 'exposure and resilience' of the Proposed Scheme to the risk of a major accident and/or disaster. Vulnerability is influenced by sensitivity, adaptive capacity and magnitude of impact.
- 16.4.2 A risk is defined as the likelihood of an impact occurring, combined with effect or consequence(s) of the impact on a receptor if it does occur.

- 16.4.3 A major accident, in the context of the Proposed Scheme, is defined²²⁴ as an event that threatens immediate or delayed serious damage to human health, welfare and/or the environment and requires the use of resources beyond those of the HS2 Ltd or its contractors. Serious damage includes the loss of life or permanent injury and/or permanent or long-lasting damage to an environmental receptor that cannot be restored through minor clean-up and restoration efforts. The significance of this effect will take into account the extent, severity and duration of harm and the sensitivity of the receptor.
- 16.4.4 A disaster, in the context of the Proposed Scheme, is a naturally occurring phenomenon such as an extreme weather event (e.g. storm, flood, temperature) or ground-related hazard events (e.g. subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a major accident as defined in paragraph 16.4.3.

Receptors

- 16.4.5 The assessment of significant adverse effects will consider all factors defined in the amended regulations, i.e. population and human health, biodiversity, land, soil, water, air and climate and material assets, cultural heritage and the landscape. For the purpose of assessment, an environmental receptor will therefore be considered to be any of these. Relevant receptors for this topic include:
- members of the public and local communities;
 - infrastructure and the built environment;
 - the natural environment, including ecosystems, land and soil quality, air quality, surface and groundwater resources and landscape; and
 - the historic environment, including archaeology and built heritage.
- 16.4.6 Assessments within the ES such as the resilience of the Proposed Scheme to climate change, and the flood risk assessment are relevant to this topic. However, they are not receptors as defined above, but are potential hazards that may lead to risk events, and will be considered accordingly.
- 16.4.7 Certain receptors will be excluded from the assessment, for the reasons described in Table 32.

²²⁴ These definitions are consistent with those used in the HS2 Phase 2a Environmental Statement

Table 32 - Receptors to be excluded from assessment of major accidents and/or disasters

Excluded Receptors	Reason for Exclusion
Employees of HS2 Ltd and/or its suppliers, whether during construction, operation or maintenance of the Proposed Scheme	HS2 Ltd's commitment and obligations to manage risks to employees are described in other documents
Train staff and passengers (of the Proposed Scheme)	Comprehensive demonstration to the regulator (the Office of Road and Rail) that the risk of accidents on the Proposed Scheme are being managed as low as reasonably practicable is a fundamental requirement of the licence to operate a railway. This assessment goes through an independent review process, is approved by the regulator, and is not repeated here ²²⁵
Members of the public who are wilfully trespassing	The safety and security of the Proposed Scheme from trespassers is mandated within a number of documents including the development agreement, the Supply Chain health and safety standard, and the Code of Construction Practice. There are measures described to educate the local communities including school children on the risks associated with the Proposed Scheme. On the basis that these measures are required to be in place to demonstrate compliance with these standards, it is assumed that any members of public who are wilfully accessing unauthorised areas are not a valid receptor in the context of this assessment
HS2 Ltd as an organisation, i.e. programme or cost of the Proposed Scheme, or HS2 Ltd's reputation.	These will be managed in accordance with the development agreement between HS2 Ltd and the DfT

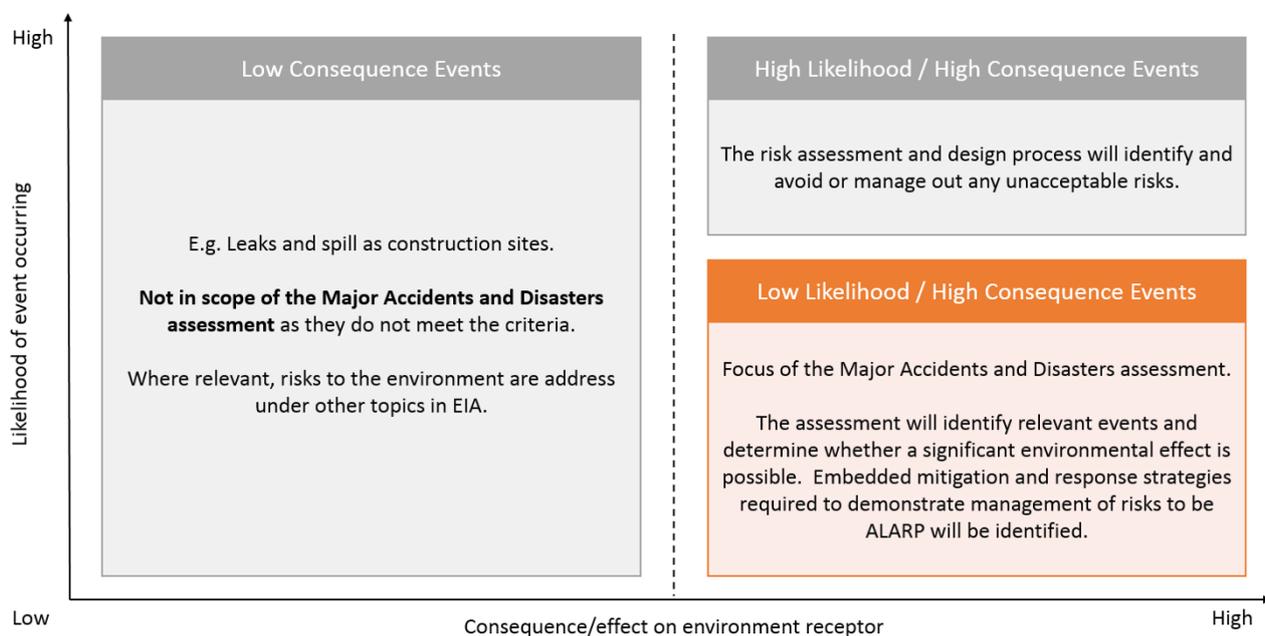
Risk identification

- 16.4.8 The major accidents and disasters considered in the assessment are rare events.
- 16.4.9 All *low consequence* events, whatever their likelihood, do not meet the definition of major accidents and/or disasters given in paragraphs 16.4.3 and 16.4.5. For example minor spills which may occur during construction, but would be limited in area and volume and temporary in nature do not meet the definition of a major accident. Such minor events would be dealt with under the contractors' Environmental Management System (EMS) and do not fall within the scope of this assessment.
- 16.4.10 It is envisaged that this assessment will focus on low likelihood but potentially high consequence events (see Figure 12).
- 16.4.11 Low likelihood is defined for the purposes of this assessment, as:
- May occur during the lifetime of the Proposed Scheme, so no more than once in 10 years for the construction phase, and no more than once in 120 years for the operational phase.*
- 16.4.12 This is an upper boundary for low likelihood. Very low likelihood events will also be included in the assessment, which may only occur at most once in every 1,000 years. Mitigation measures will reflect what is reasonable for such rare events, considering their potential consequence, within the guiding principle of risks being ALARP.

²²⁵ The potential for an accident causing harm to an environmental receptor, as well as train staff and passengers, is considered in other regulatory processes (refer to Table 33)

- 16.4.13 High consequence events are considered to lead to a significant adverse effect which will typically align with definitions given for each environmental topic.

Figure 12 - Summary of risk events considered in the scope of the assessment for major accidents and/or disasters



Spatial scope

- 16.4.14 The assessment will be undertaken at a route-wide level but will, where relevant, reflect any locations, including stations, considered more vulnerable to a major accident and disaster and/or sensitive to significant adverse effects.

16.5 Assessment methodology

- 16.5.1 The potential for identified relevant major accident and/or disaster events to result in a significant adverse environmental effect will be evaluated using a risk based approach. The approach will consider the environmental consequences of a risk scenario, the likelihood of these consequences occurring, taking into account planned mitigation, and the acceptability of the subsequent risk to the environment. The process followed includes: identifying risks, screening these risks, defining the impact, assessing the likelihood and then assessing the risk.

Identify risks

- 16.5.2 Risk identification will use existing sources of information wherever possible, as described in Section 16.2, such as risk assessments undertaken for the Proposed Scheme as part of other processes (many of which are required by law) or risk events identified within the UK's current National Risk Register²²⁶. It is envisaged that no additional risk assessments will be undertaken. The risk identification activity will focus on collating and reviewing these existing sources.

²²⁶ HM Government (2015), *National Risk Register of Civil Emergencies, 2015 Edition*, Cabinet Office.

16.5.3 In order to identify whether a risk event has the potential to be a major accident and/or disaster, which also has the potential to have a significant adverse effect on an environmental receptor, three components need to be present: a source, a pathway (between source and receptor) and a receptor. As such, and as recommended by Defra (2011)²²⁷, the assessment will use the following conceptual model:

- the **source** is the original cause of the hazard, which has the potential to cause harm, for example a moving train with the potential to derail. There are a number of generic risk events related to high speed rail which are not relevant to the Proposed Scheme as the source is not present (e.g. level crossing, conductor rail);
- the **pathway** is the route by which the source can reach the receptor, for example via the derailment of a train; and
- the **receptor**, which is the specific component of the environment that could be adversely affected, if the source reaches it (e.g. an ancient woodland).

16.5.4 Risk events which do not have all three components will be screened out from the assessment.

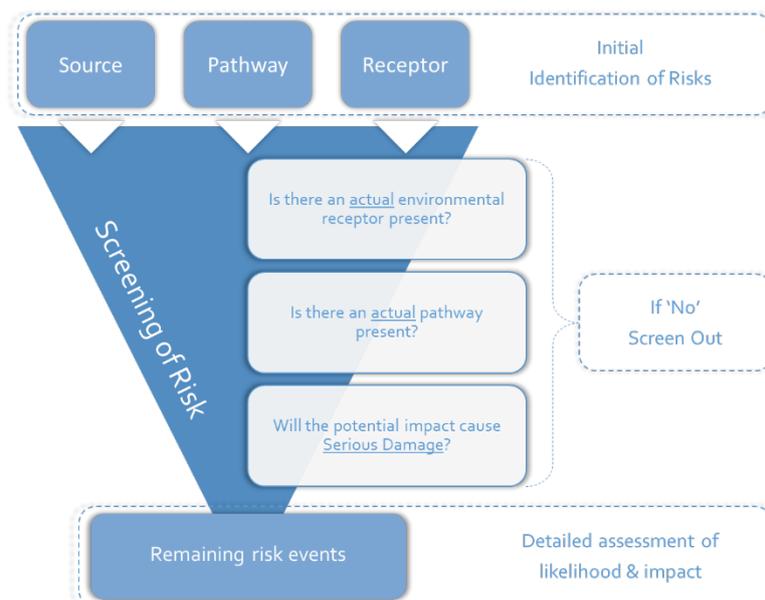
Screen risks for those within scope

16.5.5 The following screening process will be used to identify those risk events which may require further consideration within the assessment (Figure 13):

- is there a potential source, pathway and receptor as defined in Paragraph 16.5.3 above? If not, no further assessment required;
- is there a relevant environmental receptor (Section 16.4) present in the locations where the risk event could occur, and a pathway whereby the source of harm can reach the receptor? If not, no further assessment required; and
- does the potential impact on the environmental receptor meet the definition of a significant adverse effect given in Paragraph 16.4.7? If not, no further assessment required.

²²⁷ Defra (2011), Guidelines for Environmental Risk Assessment and Management: Green Leaves III, Cranfield University and Department for Environment, Food and Rural Affairs, November 2011

Figure 13 - Screening process flow diagram



- 16.5.6 For those risk events which are not screened out during the three step process, the following assessment methodology will be used. The assessment will form the basis for recommending additional mitigation measures, as appropriate.

Embedded mitigation

- 16.5.7 Several mechanisms are in place to reduce the vulnerability of the Proposed Scheme to major accidents and/or disasters, or mitigate significant effects on the environment should they occur. All measures to manage and reduce risk of significant adverse effects occurring as a result of the vulnerability of the Proposed Scheme to major accidents and/or disasters will be considered to be 'embedded' mitigation measures for the purposes of the assessment. This framework and the measures therein of relevance to the assessment will be described in the ES.

Define impact

- 16.5.8 A reasonable worst case environmental impact(s) will be identified for each risk event which remains in scope following assessment through a qualitative assessment, supported where necessary by consultation with relevant disciplines for each environmental topic within the ES. This does not have to be an extensive or quantitative assessment, but must answer the question 'could this event constitute a major accident or disaster in terms of the definitions provided (see Section 16.4)?' Where relevant, specific sensitive receptors along the route of the Proposed Scheme will be considered. The Environmental Risk Record, which sets out the results of the review process undertaken for major accidents and disasters, will be updated reflecting this review, and recording the consultation outcome.

Assess embedded mitigation measures

- 16.5.9 The likelihood of the reasonable worst case environmental effect(s) occurring will be evaluated taking into account:
- the likelihood of the risk event occurring considering the measures already embedded into the design and execution of the Proposed Scheme; and
 - the likelihood that an environmental receptor is affected by the risk event.
- 16.5.10 Likelihood assessments need not be quantitative, but will evaluate whether the effect (for example, loss of life) is a possible outcome of the risk event.
- 16.5.11 This evaluation will refer to existing risk assessments as well as consultation with relevant discipline specialists as defined in Section 16.5.8, with reference to the definition of *low likelihood* in Section 16.4.11.

Assess risk

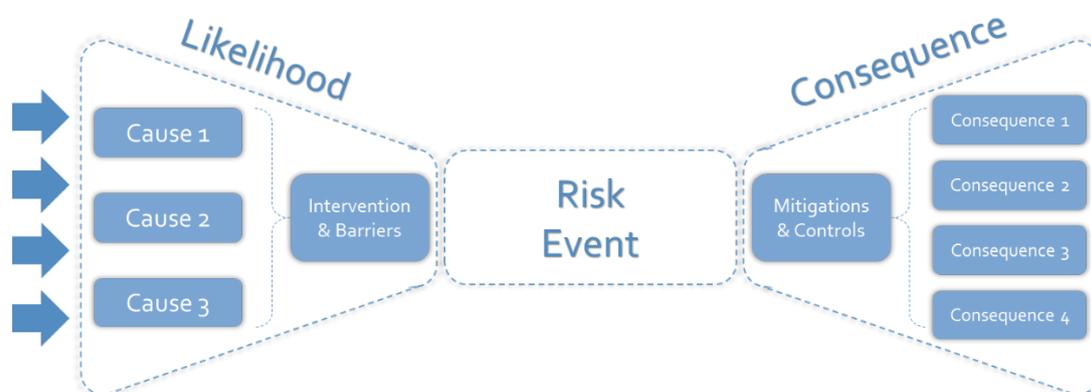
- 16.5.12 The assessment of the risk will be carried out with and the results presented in an Environmental Risk Record. Where likely significant adverse effects are identified, mitigation measures must be in place, commensurate with the likelihood of the event occurring. The assessment will consider, in consultation with relevant disciplines, whether the risk to the environmental receptor is managed to be ALARP with the existing measures. If gaps are identified, where the existing measures do not represent management of risks to an environmental receptor to be ALARP, then additional measures may be required.

Appraise risk management options

- 16.5.13 Risk management options, including embedded mitigation (refer to Section 16.5.7), will fall into one of the following categories consistent with the mitigation hierarchy used for the EIA:
- **eliminate** (or 'avoid') the risk, by adopting alternative processes in order to eliminate the source of the hazard, or remove the receptor;
 - **reduce** the risk by adapting proposed processes such that either the likelihood or the impact of the risk event can be reduced;
 - **isolate** the risk, by using physical measures to ensure that should the risk event occur, it can be effectively isolated such that there is no pathway;
 - **control** the risk, by ensuring that appropriate control measures are in place (e.g. emergency response) so that should a risk event occur, it can be controlled and managed appropriately. The EIA mitigation hierarchy of repair and compensate any significant damage to environmental receptors may then apply following a control measure; and
 - **exploit** the risk, if it presents potential benefits or new opportunities.

- 16.5.14 Figure 14 shows the principles of managing risk, where measures to prevent a risk event occurring are barriers or intervention measures (for example appropriate site selection), or mitigation measures and controls in place should an event occur (for example, firewater containment measures).

Figure 14 - The principles of managing risks both pre-and post-event



- 16.5.15 As safety risks will be required to be adequately addressed within the regulatory framework for the Proposed Scheme, it is not anticipated that significant residual effects will be identified.

Legislation

- 16.5.16 Relevant EIA legal framework surrounding the topic is provided in 16.1. The other legal obligations covering design, construction, operation and maintenance of the Proposed Scheme are as listed in Table 33.

Table 33 - Legislation applicable to the Proposed Scheme of relevance to the assessment of Major Accidents and Disasters

Legislation	Overview description	Relevance to the EIA
Construction (Design and Management) Regulations 2015 (CDM)²²⁸	These regulations place legal duties on almost all parties involved in construction work. The regulations place specific duties on clients, designers and contractors, so that health and safety is taken into account throughout the life of a construction project from its inception to its subsequent final demolition and removal. Under CDM regulations, designers have to avoid foreseeable risks so far as is reasonably practicable by: eliminating hazards from the construction, cleaning, maintenance, and proposed use and demolition of a structure, reducing risks from any remaining hazard, and giving collective safety measures priority over individual measures.	<p>Hazards with the potential to cause a major accident during railway construction, operation and maintenance are identified, assessed and mitigated.</p> <p>The regulations ensure that mechanisms are in place to continually identify, evaluate and manage safety risks throughout the design and construction phases of the Proposed Scheme. Many of the risks identified and managed out at the design phase also serve to eliminate or reduce the risk of a major accident (and therefore environmental consequence) occurring during the operational phase.</p>

²²⁸ The Construction (Design and Management) Regulations 2015 (SI 2015 No. 51). London: The Stationery Office.

<p>Health and Safety at Work etc. Act 1974 (HSWA)²²⁹</p>	<p>The Act provides the framework for the regulation of industrial health and safety in the UK. It places general duties on employers, people in control of premises, manufacturers and employees. The overriding principle is that foreseeable risks to persons will be reduced so far as is reasonably practicable and that adequate evidence will be produced to demonstrate that this has been done.</p> <p>Health and safety regulations made under this Act contain more detailed provisions. For example, the Management of Health and Safety at Work Regulations 1999 (MHSWR) make more explicit what employers are required to do to manage health and safety under the HSWA.</p>	<p>The Act provides a regulatory mechanism for occupational safety hazards and risks to be continually identified, evaluated and managed throughout the design, construction and operational lifetime of the Proposed Scheme. This serves to eliminate or reduce the risk of a major accident (and therefore environmental consequence) occurring</p>
<p>Regulation (EU) No 402/2013 on the Common Safety Method on Risk Evaluation and Assessment (CSM-RA) (as amended by Regulation EU 2015/1136)</p>	<p>The CSM-RA was introduced to ensure that levels of safety are maintained or improved when and where necessary and reasonably practicable, in accordance with the Railway Safety Directive (2004/49/EC). The CSM-RA describes a common mandatory European risk management process for the rail industry to assess compliance with safety levels and safety requirements. It applies when any technical, operational or organisation change is proposed to the railway system which has the potential to impact on safety.</p> <p>There is also a CSM-RA independent assessment body (AsBo) which reviews, assesses and reports on the safety assessment. The assessment and the AsBo report both go to the regulator (Office of Rail and Road (ORR)) to get permission for authorisation to place into service and put into use. ²³⁰</p>	<p>Under the CSM-RA, HS2 Ltd is conducting a systematic risk assessment of all aspects of the operational railway. This includes infrastructure, railway systems, rolling stock, operations (including all procedures) and the organisational structure of the operators. This assessment will ensure that all hazards have been identified and the risk reduced ALARP.</p> <p>Furthermore, the CSM-RA establishes a mandatory mechanism for safety hazards and risks to be continually identified, evaluated and managed throughout the design, construction and operational lifetime of the Proposed Scheme. This serves to eliminate or reduce the risk of a major accident (and therefore environmental consequence) occurring</p>

²²⁹ *The Health and Safety at Work etc. Act 1974* (c. 37). London: The Stationery Office.

²³⁰ Office of Rail Regulation (2015), *Common safety method for risk evaluation and assessment: Guidance on the application of Commission Regulation (EU) 402/2013*. Open Government License. Kew, London

<p>The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) (as amended)²³¹</p>	<p>The ROGS place a duty on Railway Undertakings (RUs) and Infrastructure Managers (IMs) to:</p> <ul style="list-style-type: none"> • develop safety management systems (SMS) that must meet certain requirements; • have a safety certificate (for RUs) or a safety authorisation (for IMs); • show that they have procedures in place to introduce new or altered vehicles or infrastructure safely; • carry out risk assessments and put in place the safety measures they have identified as necessary to make sure that the transport system is run safely; and • work together to make sure the transport system is run safely (ROGS regulation 22). 	<p>The Regulations ensure that mechanisms are in place and implemented for the operation of the Proposed Scheme that will eliminate or reduce the risk of a major accident (and therefore environmental consequence) occurring.</p>
<p>The Railways (Interoperability) Regulations 2011 (as amended) (RIR)²³²</p>	<p>These regulations implement the EU Railway Interoperability Directive 2008/57/EC²³³, which had the purpose of establishing common operational standards and practices across European railways, including adoption of the CSM-RA.</p>	<p>HS2 Ltd is designing a railway according to the European Technical Specifications for Interoperability (TSIs)</p> <p>Technical Specifications for Interoperability (TSIs) define the technical standards required to satisfy the essential requirements set out in the Directive to achieve interoperability. These requirements include safety, reliability and availability, health, environmental protection and technical compatibility along with others specific to certain subsystems. The development process for TSIs are managed and published by the European Union Agency for Railways (formerly the European Railway Agency).</p>

Guidance

- 16.5.17 There is currently no published guidance for the application of the amended regulations to major accidents and disasters. The scope and methodology presented may therefore be subject to change on the basis of new guidance or professional judgement.

²³¹ *The Railways and Other Guided Transport Systems (Safety) Regulations 2006* (SI 2009 No. 599) (as amended). London: The Stationery Office.

²³² The railways (interoperability) regulations 2011 No 2011

²³³ *Directive of the European Parliament and of the Council on the Interoperability of the Rail System in the Community*, 17 June 2008, 2008/57/EC.

16.5.18 However, selected relevant guidance for the risk assessment methodology is available, as presented in Table 34.

Table 34 - Guidance relevant to the assessment

Guidance	Description
Defra (2011) 'Green Leaves III' Guidelines for Environmental Risk Assessment and Management ²³⁴	<p>These guidelines provide generic guidance for the assessment and management of environmental risks. A cyclical framework for risk management is provided which identifies four main components of risk assessment:</p> <ol style="list-style-type: none"> 1. formulating the problem; 2. carrying out an assessment of the risk; 3. identifying and appraising the management options available; and 4. addressing the risk with a risk management strategy. <p>A source-pathway-receptor model is suggested as a tool to assist in risk screening and an example is provided of applying the following filters to prioritise significant hazards for further investigation:</p> <ul style="list-style-type: none"> • the plausibility of linkages between the source of a hazard and a receptor; • the relative potency of a hazard, availability of a pathway, or vulnerability of a receptor; • the likelihood of an event, on the basis of historic occurrence or of changed circumstances; or • a view on the performance of current risk management measures that, if they were to fail, may increase the potential for future harm.
Chemical and Downstream Oil Industries Forum, (2013), Guideline – Environmental Risk Tolerability for COMAH Establishments	<p>These guidelines provide a common screening methodology for carrying out an environmental risk assessment under the COMAH Regulations. Amongst other things, the guidance:</p> <ul style="list-style-type: none"> • defines the types of harm that should be considered in an environmental risk assessment, and how the harm should be characterised for the assessment; • defines the risk criteria to be used in assessing tolerability of the environmental risk from an establishment, and where appropriate, individual scenarios; and • explains how risks may be evaluated. <p>The guidelines present a series of thresholds that can be used to 'screen' the potential for a Major Accident to the Environment (MATTE) to relevant environmental receptors. The thresholds have been developed based on the criteria for reporting a major accident to the European Commission defined in the Seveso III Directive and COMAH Regulations, and to guidance on MATTE issued by the then Department of the Environment, Transport and the Regions in 1999²³⁵. The thresholds are presented in two dimensions, namely (i) extent and severity and (ii) duration of harm; and thresholds for both dimensions must be exceeded for the scenario to be considered a potential MATTE.</p>

²³⁴ Defra (2011), Guidelines for Environmental Risk Assessment and Management: Green Leaves III, Cranfield University and Department for Environment, Food and Rural Affairs, November 2011.

²³⁵ Department of the Environment, Transport and the Regions (DETR) (1999), Guidance on the Interpretation of Major Accident to the Environment for the Purposes of the COMAH Regulations, Department of the Environment, Transport and the Regions, 1999.

<p>The International Standards Organization's ISO 31000: 2009 Risk Management – principles and guidelines</p>	<p>This guideline identifies a number of principles that need to be satisfied to make risk management effective. If the standards are adopted and applied the management of any risk should help minimise losses, improve resilience, improve controls and improve the identification of opportunities and threats.</p> <p>The ISO standard states that when defining risk criteria the following factors should be considered:</p> <ul style="list-style-type: none"> • the nature and types of causes and consequences that can occur and how they will be measured; • how likelihood will be defined; • the timeframe(s) of the likelihood and/or consequence(s); • how the level of risk is to be determined; • the views of stakeholders; • the level at which risk becomes acceptable or tolerable; and • whether combinations of multiple risks should be taken into account and, if so, how and which combinations should be considered.
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Significance criteria

- 16.5.19 No additional significance criteria are anticipated for this topic. Significance will be considered for each identified receptor in conjunction with the appropriate environmental topics for this EIA.
- 16.5.20 Factors to consider in determining whether potential adverse effects are significant include:
- the geographic extent of the effects. Effects beyond the project boundaries are more likely to be considered significant;
 - the duration of the effects. Effects which are permanent (i.e. irreversible) or long lasting are considered significant;
 - the severity of the effects in terms of number, degree of harm to those affected and the response effort required. Effects which trigger the mobilisation of substantial civil emergency response effort are likely to be considered significant;
 - the sensitivity of the identified receptors; and
 - the effort required to restore the affected environment. Effects requiring substantial clean-up or restoration efforts are likely to be considered significant.
- 16.5.21 For the Proposed Scheme, a significant adverse effect is considered to mean the loss of life or permanent injury, and/or permanent or long-lasting damage to an environmental receptor. The significance of this effect takes into account the extent, severity and duration of harm and the sensitivity of the receptor.

16.6 Assumptions

16.6.1 Key assumptions for the major accidents and disasters assessment are that:

- the Proposed Scheme will not carry freight;
- there will be no level crossings included as part of the Proposed Scheme design, and
- only those hazard events with a feasible source-pathway-receptor model will be considered.

16.6.2 In terms of the assessment methodology, the following assumptions are made:

- no site visits will be conducted, the assessment will be desk-based;
- no modelling or detailed calculations will be undertaken, the qualitative assessment will take the form of 'sign-posting' to existing risk assessments, and assessment of potential gaps or residual risks which are not considered to be managed using the ALARP principle;
- where information is not available, professional judgement will be used to reach a conclusion. Reference may be made to existing information from both UK railways, and international high speed rail projects; and
- in accordance with good safety management principles, it is assumed that all risks that have the potential to be major accidents or disasters, and could impact a local environmental receptor, will be managed using the ALARP principle.

17 Socio-economics

17.1 Introduction

17.1.1 This section of the SMR sets out the methodology for the socio-economic assessment, which focuses on identifying significant economic and employment effects during the construction and operational phases of the Proposed Scheme. Future catalytic development, associated with the Proposed Scheme is outside the scope of this assessment. The need for a socio-economic assessment results from the potential for the Proposed Scheme to generate impacts on:

- existing businesses and organisations;
- local economies, including employment;
- planned growth and development; and
- wider concentrations of economic activity.

17.1.2 The assessment will draw upon other assessments where relevant, such as agriculture, forestry and soils, sound, noise and vibration, landscape and visual, air quality and traffic and transport. Specifically the socio-economic topic will focus on the implications for employment.

17.1.3 The assessment is distinguished from the wider business case in that it will identify direct and significant impacts on local economies. The wider business case is related to, but differs from, the socio-economic assessment in that it predicts overall benefits to the output of the national economy. Benefits to the national economy arise through the circulation of monies over a wide area, which may not have directly observable or significant consequences in the context of the EIA.

17.2 Establishment of baseline and definition of survey

Characteristics of communities

17.2.1 The need to minimise negative socio-economic effects and enhance positive socio-economic effects has influenced the design development of the Proposed Scheme.

Baseline data and methods

17.2.2 The assessment will rely on two general sources of information, namely technical evidence and stakeholder views. Stakeholder views will inform how best to approach the more qualitative aspects of the assessment.

17.2.3 The baseline information will be developed following an integrated approach with health and community. Baseline information will be presented against comparable performance statistics for areas associated with communities where impacts are being assessed, known as benchmark areas. Benchmark areas will include the host district and wider areas or a region where appropriate. The baseline for the benchmark areas will draw upon a number of sources and data covering:

- existing planning, economic and regeneration plans and strategies;
- population;

- labour supply;
- employment and unemployment;
- enterprises;
- development potential/ capacity; and
- existing studies on wider economic effects during operation of the Proposed Scheme.

17.2.4 Data will be collected by a variety of methods including: accessing national data sets, requesting and accessing local information; exchange of information with other environmental topics; and carrying out investigations into the character and nature of businesses in the area.

17.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

17.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for socio-economics for the Proposed Scheme.

Engagement as part of the EIA process

17.3.2 Relevant stakeholders will be contacted as part of the EIA process including local authorities along the route of the Proposed Scheme including proposed stations, rolling stock depots, junctions and the infrastructure maintenance depot (and potentially local authorities affected by any secondary effects on other routes).

17.4 Key aspects of the Proposed Scheme for the topic

17.4.1 Relevant aspects of the Proposed Scheme include:

- direct and indirect effects of construction and operation;
- demand for labour, particularly during construction, including labour skills and sources; and
- relocation of businesses during construction e.g. for development of new infrastructure.

17.5 Scope of assessment

Spatial scope

17.5.1 The spatial scope of the assessment will vary according to the type of resource and receptor as shown in Table 35.

Table 35 - Socio-economic assessment: resources, receptors and spatial scope

Resource	Impacts	Effects:		Spatial scope
		On resources	On receptors	
Existing businesses and organisations – land required and in-combination effects of noise, HGV traffic, vibration, air quality and visual impacts on businesses and organisations' operations ²³⁶	Businesses (non-community) lost to land required	Loss or impairment of business activities	Change in employment and skills mix	Direct land required by the Proposed Scheme
	Community activities lost to land required	Loss or impairment of community activities	Change in employment and skills mix	Direct land required by the Proposed Scheme
	In combination effects of noise, HGV traffic, vibration, air quality and visual impacts on businesses and organisations' operations	Character or quality of businesses and organisations' environment changes as a result of noise, HGV traffic, vibration; air quality and visual impacts	Impact on (non-community) businesses	Relevant impact area from the edge of the Proposed Scheme is a minimum 250m in both urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure (used for employment purposes) from receptors resulting in an impact on businesses and organisations' operations	Physical e.g. islanding or isolation of resource results in change to business and organisations' environment	Impact on (non-community) businesses	All or part of the catchment area of affected resource where it is subject to severance ²³⁷
Employment associated with construction	Direct employment opportunities associated with the construction phase	Demand for construction sector services	Demand for construction sector jobs and changes in opportunities for local employment	Travel to Work Area of construction sites for daily commute workforce and UK wide for migrant workers
	Indirect impacts on the economy of the construction phase	Indirect impacts on other construction sector projects, multiplier impacts on the wider economy	Demand for construction sector jobs and changes in opportunities for local employment	UK

²³⁶ Noise, HGV traffic, vibration, air quality and visual's significant effects will be identified for the in-combination assessment as it is those effects which are most likely to potentially contribute to a change of amenity value of infrastructure (used for employment purposes)

²³⁷ The distance of the diversion and duration are factors in determining whether or not there is an impact

Employment associated with operations	Direct employment opportunities associated with the operational phase	Demand for operational phase services	Demand for operational phase associated jobs and change in opportunities for local employment	Travel to Work Areas associated with stations and depots during the operational phase employment locations
	Indirect impacts on the economy of the operational phase	Indirect impacts on sectors of the economy, multiplier impacts on the wider economy	Change in employment and skills and change in opportunities for local employment	Induced effects are most likely to occur in those areas with stations and depots where the operational workforce is located. Indirect (supplier based) effects are likely to occur within the UK

Temporal scope

- 17.5.2 The temporal scope is outlined in Section 2.2 (Scope of assessment) of this SMR. Socio-economic impacts will generally be assessed for the construction period (2023 – 2033, including commissioning) and 2033 for operation (i.e. the first year of operation of the Proposed Scheme).

17.6 Assessment methodology

- 17.6.1 The effects of the Proposed Scheme will be considered at varying spatial levels according to the nature of the effect in each case, through comparison of the baseline conditions and those as a result of the Proposed Scheme.

Legislation and guidance

- 17.6.2 The available guidance on socio-economic assessment sets out the overarching principles, including the assessment of gross and net impacts and recognition of the wider economic impacts of transport schemes. The HCA employment densities guide²³⁸ will be used where necessary to estimate employment in identified floorspace where it is not practical to undertake a direct survey. Other relevant guidance includes:

- Treasury Green Book: Appraisal and Evaluation in Central Government²³⁹ ;
- DfT WebTAG guidance (on wider economic effects of transport)²⁴⁰; and
- Homes and Communities Agency (2014) Additionality Guide²⁴¹.

²³⁸ Homes and Communities Agency (HCA) (2015) *Employment Density Guide, 3rd edition*. Homes and Communities Agency, London.

²³⁹ HM Treasury (2003), *The Green Book: Appraisal and Evaluation in Central Government*. London: The Stationary Office

²⁴⁰ Department for Transport (DfT) (2017) *Transport analysis guidance: WebTAG*. Available online at: <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

²⁴¹ Homes and Communities Agency (2014), *Additionality Guide: Fourth Edition 2014*. Homes and Communities Agency, London.

17.6.3 The methodology will also take into account good practice from other infrastructure project EIAs, for example, HS2 Phase One, Phase 2a, Crossrail and Thames Tideway Tunnel.

Significance criteria

17.6.4 Since there is no definitive guidance on significance criteria for socio-economic effects, the assessment will draw on existing industry accepted practice. The significance of a socio-economic effect will be determined by assessing both the:

- magnitude of the impact; and
- sensitivity of receptors.

Determining magnitude of impacts

17.6.5 The magnitude of an impact represents its severity or scale, and is influenced by:

- spatial extent (localised/ isolated versus widespread with potential secondary effects);
- extent (number of employees or businesses affected);
- duration;
- conformity with standards for provision or accessibility (as set out in regional, sub regional or local planning guidance);
- permanence;
- likelihood of occurrence;
- the scope for incorporated environmental design features or mitigation; and
- value of the resource.

17.6.6 Table 36).

Table 36 - Socio-economic impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very adverse/ beneficial, and very likely to affect large numbers of businesses and/ or people (with numbers depending on the local context and nature of impact), and that will usually continue and effectively constitute a permanent, long term impact on the baseline conditions
Moderate	An impact that is likely to affect a moderate number of businesses and/ or people (with numbers depending on the local context and nature of the impact)
Low	An impact that is likely or may affect a small number of businesses and/ or people (with numbers depending on the local context and nature of the impact) and/ or that usually does not extend beyond the life of the project so that the baseline is not affected beyond a short or medium term duration

Impact magnitude	Definition
Negligible	An impact that is temporary in nature and/ or is anticipated to have a slight or no effect on the well-being of businesses and/ or people

Determining receptor sensitivity

17.6.7 Guideline criteria have been established using professional judgement and existing industry accepted practice to determine the sensitivity of the receptors as shown in Table 37.

Table 37 - Socio-economic receptor value/sensitivity criteria

Receptor value and/ or sensitivity	Definition
High	Businesses, workforces or economies that are at risk and that have little or no capacity to experience the impact without incurring a significant socio economic loss (or gain) of an economic resource, or employment
Moderate	Businesses, workforces or economies that have a limited or average capacity to experience the impact without incurring a significant socio economic loss (or gain) of an economic resource, or employment
Low	Businesses, workforces or economies that generally have adequate capacity to experience impacts without incurring a significant socio-economic loss (or gain) of an economic resource, or employment

Determining the significance of effects

17.6.8 The significance of a socio-economic effect is a product of the magnitude of the impact and the sensitivity of the receptor, and will be assessed on the basis of professional judgement and existing industry accepted practice.

17.6.9 The approach to determining significance is summarised in Table 38.

Table 38 - Socio-economic - significance of effect criteria

Significance		Impact magnitude			
		High	Medium	Low	Negligible
Sensitivity of receptor	High	Major adverse/beneficial – significant	Major adverse/beneficial – significant	Moderate adverse/beneficial – significant	Minor adverse/beneficial – not significant
	Moderate	Major adverse/beneficial – significant	Moderate adverse/beneficial – significant	Minor adverse/beneficial – not significant	Negligible – not significant
	Low	Moderate adverse/beneficial – significant	Minor adverse/beneficial – not significant	Negligible – not significant	Negligible – not significant

17.6.10 Effects are considered to be significant if both impact magnitude and receptor sensitivity are high or medium. Additionally, effects are considered to be significant if impact magnitude is high and receptor sensitivity is low, or alternatively, if receptor sensitivity is high and impact magnitude is low. This equates to major and moderate adverse/ beneficial effects.

17.6.11 Other effects equating to minor adverse/ beneficial and negligible effects, are not considered to be significant.

Construction effects

17.6.12 Construction effects will be assessed following the accepted EIA assessment processes including:

- establishment of the baseline with definition and collection of relevant data and information as outlined in Section 17.2 (Establishment of baseline and definition of survey);
- consultation including those outlined in Section 17.3 (Consultation);
- assessment of impacts and effects against key aspects of the Proposed Scheme as outlined in Section 17.4 (Key aspects of the Proposed Scheme for the topic), covering the scope outlined in Section 17.5 (Scope of assessment) and using the significance criteria outlined in Table 38; and
- iterative further assessment of impacts identified through other environmental topics as part of the EIA.

Operational effects

- 17.6.13 The same process will be used for assessment of operational effects as outlined for construction effects.

Cumulative effects

- 17.6.14 Cumulative effects will be identified on the basis of a high level assessment of other developments individually or cumulatively in the planning pipeline that have the potential to interact significantly with the Proposed Scheme. Other developments will include major infrastructure projects such as HS2 Phase One and Phase 2a and large scale urban developments (e.g. urban extensions). The known characteristics of such developments will be converted into an employment effect using employment density assumptions and identified in relation to the Proposed Scheme's own timeline.

17.7 Assumptions

- 17.7.1 Key assumptions include:
- construction labour productivity underpinning the construction labour demand curve remains constant over the life of the Proposed Scheme (e.g. no major changes in technology and method of work that lead to changes in the skills mix); and
 - projections of the baseline/ counterfactual (without HS2 economic trends) remain constant over the lifespan of the Proposed Scheme (in terms of known major projects, macro-economic conditions etc.).

18 Sound, noise and vibration

18.1 Introduction

- 18.1.1 This section of the SMR covers noise and vibration effects. It has been divided into two parts, the first dealing with ground-borne noise and vibration and the second dealing with airborne noise.
- 18.1.2 The terms sound and noise are used in this section. 'Sound' is the neutral term used to describe the fluctuating pressure waves in the air that stimulate the sense of hearing. Noise is often defined as unwanted sound. The term sound is used in this scope and methodology where appropriate because during consultation for Phase One in 2011, communities along HS2's line of route requested that the 'sound quality' in their local area be taken into consideration when assessing the effects of HS2.
- 18.1.3 The Scope and Methodology Report for the Proposed Scheme builds on that from Phase One and Phase 2a.
- 18.1.4 The Phase One and 2a approaches to the assessment and control of noise and vibration effects caused by the construction and operation of the Proposed Scheme anticipated the changes²⁴² in EIA regulations that were made into UK law in May 2017²⁴³.
- 18.1.5 The HS2 scope and method for the assessment of noise or vibration likely significant effects is developed in alignment with Government noise policy. HS2 Phase One was the first major infrastructure project to set out the interaction between Government noise policy²⁴⁴ and the Environmental Impact Assessment (EIA) regulations.
- 18.1.6 The SMR for Phase One was published in 2012 at a time when the implementation of Government noise policy within planning policy and planning practice guidance was only emerging following the publication of the National Planning Policy Framework in 2012. During the parliamentary examination of the Phase One hybrid Bill, HS2 Ltd's implementation of the above policies and guidance was clarified and presentationally simplified in a number of Information Papers, E20-E23^{245,246,247,248}.
- 18.1.7 When the Phase 2a SMR was published (in 2016) the Phase One hybrid Bill was still being examined by Select Committee. The Phase 2a SMR took account of any changes in scope and method arising from the examination of the Phase One hybrid Bill but retained the form of presentation used for the Phase One SMR.
- 18.1.8 The Phase One hybrid Bill was enacted in February 2017 and with final versions of Information Papers E20-E23 as assurances. This scope and methodology for the Proposed Scheme therefore maintains the methodology from Phase 2a but simplifies its presentation consistent with the Phase One final Information Papers and, where

²⁴² The two main changes in the EIA regulations with regard to noise and vibration relate to the greater emphasis on firstly monitoring and secondly the assessment of effects on health.

²⁴³ *The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017 No. 571)*. London, Her Majesty's Stationery Office

²⁴⁴ Noise Policy Statement for England, (2015) Department for Environment, Food & Rural Affairs

²⁴⁵ High Speed Two Phase One (2017), *Information Paper E20: Control of airborne noise from altered roads and the operational railway*

²⁴⁶ High Speed Two Phase One (2017), *Information Paper E21: Control of ground-borne noise and vibration from the operation of the temporary and permanent railways*

²⁴⁷ High Speed Two Phase One (2017), *Information Paper E22: Control of noise from the operation of stationary systems v1.4*

²⁴⁸ High Speed Two Phase One (2017), *Information Paper E23: Control of construction noise and vibration*

appropriate, adjusts the scope of the Proposed Scheme assessment in line with Phase One following parliamentary scrutiny of its EIA.

Key changes

- 18.1.9 The differences in the text of this SMR compared to that of Phases One and 2a are mainly presentational and have been made for the following reasons:
- a. Accessibility; HS2's approach to the assessment and control of noise and vibration caused by the construction and operation of the Phase One scheme was subjected to extensive scrutiny during consideration by Parliament of the Phase One Hybrid Bill. Whilst the approach was accepted, the Phase One parliamentary process revealed that the language used to describe the approach could be made more accessible. This was particularly with regard to the interaction between Government noise policy²⁴⁹ and the EIA regulations.
 - b. Presentational consistency with Phase One Information Papers; HS2 Phase One Information Papers E20-E23 present HS2's implementation of Government noise policy, planning policy and planning practice guidance drawn from the Phase One SMR. This section of the Phase 2b SMR adopts the clearer language and tables from the Information Papers in place of the Phase One and 2a SMR language and tables.
- 18.1.10 Additionally, this section presents a number of changes to the scope of the assessment where HS2 Phase One, in line with best practice, has shown that mitigation incorporated into the Proposed Scheme can avoid likely significant effects associated with a number of sources of noise and vibration and a number of types of receptor. These are brought forward into the Proposed Scheme SMR in order to reduce the scale of final EIA reporting.

Government noise policy and environmental impact assessment

Legislation and planning policy and guidance

- 18.1.11 The EIA must identify 'likely significant effects' resulting from the Proposed Scheme. The assessment will be carried out in the context of the noise policy, and planning policy and guidance in England. This section sets out the approach taken to the relationship between planning policy and guidance and EIA. The approach is common to the sub-topics of noise and vibration.
- 18.1.12 Relevant regulation includes the EIA Regulations 2017²⁵⁰. Relevant policy and guidance includes the Noise Policy Statement for England 2010²⁵¹, (NPSE), the National Planning Policy Framework (NPPF), and the Government's planning guidance on noise (PPGN)²⁵².

²⁴⁹ Noise Policy Statement for England (2015), Department for Environment, Food & Rural Affairs

²⁵⁰ *The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017 No. 571)*. London, Her Majesty's Stationery Office

²⁵¹ Department for Environment, Food and Rural Affairs (Defra) (2010), Noise Policy Statement for England, Defra

²⁵² Department for Communities and Local Government (DCLG) (2014), Planning Practice Guidance – Noise. Available online at: <https://www.gov.uk/guidance/noise--2>

- 18.1.13 The aims of the NPSE are, “Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:
- avoid significant adverse impacts on health and quality of life;
 - mitigate and minimise adverse impacts on health and quality of life; and
 - where possible, contribute to the improvement of health and quality of life.”
- 18.1.14 The explanatory note to NPSE makes use of the following concept:
- Lowest Observed Adverse Effect Level²⁵³ (LOAEL) - the level above which adverse effects on health and quality of life can be detected;
- and goes on to define:
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.
- 18.1.15 Thresholds for identifying these policy adverse effect levels are not defined numerically in any Government document. For HS2 Phase One they are defined in the HS2 Information Papers E20-E23 included in the register of undertakings and assurances.
- 18.1.16 The EIA Regulations require the identification of ‘likely significant effects’. Where, in terms of government noise policy, the predicted noise or vibration indicates a significant adverse effect on health and quality of life (i.e. the level exceeds the relevant SOAEL), then the assessment will identify a likely significant observed adverse effect at each receptor. In accordance with PPGN this is where, for example, noise would disrupt activities indoors.
- 18.1.17 In line with best practice ²⁵⁴ and recent projects²⁵⁵, this assessment will also consider situations where the predicted noise or vibration is above LOAEL but below SOAEL based on the change in noise or vibration caused by the scheme, and other evaluative criteria. This assessment leads to the identification of effects that are likely to be considered significant on a community basis, and consequently inform proposals for mitigation. An example of such ‘other evaluative criteria’ is the number of dwellings in a community that are subject to the change (see Section 18.2.31). With regard to PPGN, such likely significant effects relate for example to a change in the perceived ‘acoustic character’ of an area and may be either adverse, due to a noise increase, or beneficial, due to a noise reduction, caused by the Proposed Scheme.
- 18.1.18 Table 39 summarises how noise and vibration levels in terms of Government noise policy and, for example, change in noise or vibration levels, will be collectively used with other contextual information to identify effects that are likely to be significant at

²⁵³ World Health Organisation (2009), Night Noise Guidelines for Europe, WHO Regional Office for Europe, Denmark.

²⁵⁴ Institute of Environmental Management and Assessment (IEMA) (2014), IEMA Guidelines for Environmental Noise Impact Assessment Available online at: <https://www.iema.net/event-reports/2016/01/07/Launch-Webinar-IEMA-Guidelines-for-Environmental-Noise-Impact-Assessment-2014/>

²⁵⁵ HS2 Phase One, A14 Cambridge to Huntingdon Improvement Scheme and Thames Tideway Tunnel

individual dwellings or on a community basis. The table is based on the noise exposure hierarchy presented in PPGN. Sections 18.2.31 and 18.3.34 provide further guidance.

- 18.1.19 Policy and regulation that are specific to individual sub-topics of noise and vibration are presented within the appropriate paragraphs of this section. The relevant LOAEL and SOAEL values criteria are presented for each sub-topic.

Table 39 - Noise and vibration assessment approach for dwellings: interaction between Government policy and guidance, and EIA requirements (based on the noise hierarchy table presented in PPGN)

	Government noise policy and planning practice guidance			EIA		Mitigation		
	Perception	Effect	Action	Assessment ²⁵⁶	Effect	Source	Receptor	
← Increasing level of noise or vibration	Not noticeable	No effect	No specific measures required	None	Adverse effect unlikely	Special cases only	None	
	Noticeable and not intrusive	No observe and adverse effect	No specific measures required					
	Lowest Observed Adverse Effect Level – LOAEL							
	Noticeable and intrusive	Observed adverse effect [increasingly likely]	Mitigate and reduce to a minimum	Noise level change + contextual significance criteria	Change in noise level may cause adverse effect on acoustic character of an area. This may be considered a likely <i>significant</i> effect in EIA terms on a community basis	Take all reasonable steps to mitigate and reduce to a minimum	None	
	Significant Observed Adverse Effect Level – SOAEL							
	Noticeable and disruptive	Observed Significant adverse effect [very likely]	Avoid	Exceeding SOAEL – likely significant effect	Likely significant adverse effect on each receptor	Maximise mitigation as far as sustainable	Noise insulation ²⁵⁷	
	Noticeable and very disruptive	Unacceptable adverse effect	Prevent	Exceeding this effect level – each receptor is a significant effect			Prevent at source or compensate (e.g. temporarily rehouse during construction)	

²⁵⁶ Provision is made under HS2 implementation of policy and EIA for Special Cases whereby a receptor specific assessment may be necessary to determine whether an adverse or significantly adverse effect is likely, potentially leading to reasonable adjustments to the mitigation

²⁵⁷ Permanent residential buildings, subject to eligibility criteria, see IP E23

- 18.1.20 In order to express the range of outcomes typically identified in an EIA, the concept of flow through the table has been added for the identification of effects as noise or vibration increases. Additional words (in square brackets) have been added to the PPGN description to reflect the changing situation as noise and vibration increases, working down the table.

18.2 Ground-borne noise and vibration

Introduction

- 18.2.1 This section presents the proposed approach for assessing ground-borne noise and vibration associated with the construction, operation and maintenance of the Proposed Scheme.
- 18.2.2 Ground-borne vibration created either by construction activities, maintenance or train services propagates through the ground to surrounding buildings where it may result in the vibration of floors, walls and ceilings which could also be heard as a low frequency 'rumbling' sound (called ground-borne noise).
- 18.2.3 The assessment will cover all homes, businesses, amenities and facilities referred to as receptors, including, where appropriate, those for which planning permission has been granted before the safeguarding date but are not yet completed, subject to the screening distances discussed within the specific subject areas. Where a receptor has multiple uses, the assessment will be made based on the most sensitive use.

Establishment of baseline and definition of survey requirements

- 18.2.4 Absolute criteria, rather than change criteria, generally apply for ground-borne noise and vibration for the following reasons:
- there is rarely any appreciable existing ground-borne noise or vibration at a receptor;
 - the character and nature of ground-borne noise and vibration generally differs from other ambient noise heard inside buildings;
 - the body of experience and research available with regard to human response to ground-borne noise and vibration has mostly been based on the assessment of the exposure to the source being assessed; and
 - ground-borne noise and vibration can affect any room in a property so the criteria consider situations where for example existing internal background sound/noise levels are at their lowest for a particular classification of receptor (e.g. rooms on a quiet façade of a residential receptor, auditoria, recording or broadcasting studios, rooms used for acoustic test measurements);
 - it provides a reasonable worst case assessment.
- 18.2.5 Ground-borne noise or vibration baseline surveys will generally not be carried out except for example as part of a site specific risk assessment.

Consultation and engagement

Consultation on the Sustainability Statement (2013 and 2016)

- 18.2.6 Consultation responses on the Phase Two Sustainability Statement and its updates were reviewed and none was considered to alter the scope and methodology for ground-borne noise and vibration for the Proposed Scheme.

Engagement as part of the EIA process

- 18.2.7 Principal consultees on the approach to the assessment of ground-borne noise and vibration are the relevant local planning authorities.
- 18.2.8 Dialogue with local stakeholder groups will be via community areas during the design and assessment of the Proposed Scheme as well as through public consultation on the ES.

Key aspects of the Proposed Scheme for the topic

- 18.2.9 The key aspects for ground-borne noise and vibration are the following generic types of potential significant adverse effect that could occur without control measures:

- potential cosmetic damage to buildings, but only at very high levels of vibration which rarely if ever occur during construction or operation because of the use of modern, e.g. non-percussive, piling techniques and current industry standards for trains and track;
- perceptible ground-borne noise and/or vibration in residential buildings;
- low levels of ground-borne noise caused by imperceptible vibration could adversely affect buildings where low ambient sound levels are critical to their operation (e.g. recording and broadcast studios, concert halls and theatres); and
- low levels of vibration that would be imperceptible to people can adversely affect facilities where low ambient vibration is critical to operations (e.g. nanotechnology laboratories).

- 18.2.10 The following are potential sources of ground-borne noise and vibration:

- temporary sources: e.g. tunnel boring machine(s) (TBMs) and their supporting temporary construction railways, some types of piling and vibro-compaction; and
- permanent sources: train operation and train and railway maintenance.

Sources, receptors and types of effect that can be mitigated to avoid significant effects²⁵⁸

- 18.2.11 The Phase One and Phase 2a EIAs reported, in line with industry best practice, that likely significant noise and/or vibration effects from a number of sources or at a

²⁵⁸ GBNV sensitive receptors will be the subject of site specific risk assessment, see Table 43

number of types of receptor are avoided by mitigation incorporated into the Proposed Scheme. The sources and receptors described in the following paragraphs will therefore not be subject to a quantitative assessment for the Proposed Scheme with the exception of special cases which will be considered individually.

- 18.2.12 Building damage due to vibration: a scheme designed, constructed and operated to current engineering standards for modern high-speed railway including the adoption of a CoCP will avoid any risk of damage to any building (including cosmetic damage).
- 18.2.13 TBMs: to excavate tunnels TBMs will be used, which can generate ground-borne noise and vibration as the rotating head of the TBM 'cuts' through the ground. TBMs can therefore give rise to ground-borne noise and vibration that is perceptible, albeit only for short periods of time (generally a matter of days) at any individual receptor. Due to the low level and short duration of ground-borne noise or vibration that results, there is a low likelihood of tunnel boring resulting in the identification of likely significant effects.
- 18.2.14 Temporary construction railways (within tunnels): materials (including tunnel lining segments) and equipment are likely to be transported from the surface to the TBM using a temporary railway which travels at relatively low speeds. It should be noted that other methods of moving material and equipment are available, but the temporary railway is the most likely and is also the method which represents a reasonably foreseeable worst case in terms of ground-borne noise or vibration impacts. Supply trains can also be used to transport spoil from the TBM to the surface, but it is more likely to be undertaken by conveyor. The temporary railway can generate ground-borne noise and vibration in the same way as the permanent railway. HS2 will employ similar measures to those used by Crossrail to reduce vibration transfer through the rail support structures, and therefore significant effects from supply train ground-borne sound and vibration are considered unlikely. The Phase One construction design and EIA demonstrated how any residual ground-borne noise or vibration effects can be mitigated by a CoCP.
- 18.2.15 Temporary construction traffic (road vehicles): based on the commitment given in the CoCP that the surface of temporary and permanent access roads and temporary haul routes for the Proposed Scheme will be maintained through the construction of the Proposed Scheme, the effects of ground-borne noise or vibration from construction road traffic are not considered to be significant. The Phase One construction design and EIA demonstrated how any residual ground-borne noise or vibration effects can be mitigated by a CoCP.
- 18.2.16 Vibro-compaction: it is considered that the use of vibratory rollers for minor works, such as road surfacing, reinstatement after utility diversions etc. will generate perceptible vibration²⁵⁹. However, the Phase One construction design and EIA showed that with due warning and the other mitigation measures committed to in a CoCP, they will not result in significant adverse effects due to the limited nature and short duration of such works.
- 18.2.17 Pneumatic breakers: pneumatic breakers are commonly required to break up existing concrete structures during demolition works. The use of such equipment can generate

²⁵⁹ Transport Research Laboratory (TRL) (2000), *TRL Report 429: Groundborne vibration caused by mechanised construction works*, TRL

perceptible vibration. However, any adverse effects are generally limited to receptors in very close proximity of the equipment. The Phase One construction design and EIA demonstrated that based on the limited extent and duration of such works, and with due warning and the other mitigation measures committed to in a CoCP, any adverse vibration effects are considered unlikely to be significant.

- 18.2.18 Operation of the Proposed Scheme – ‘Rayleigh or bow waves’ (analogous to the bow waves caused by a ship on the surface of the water): the occurrence of high levels of vibration from ‘bow waves’ is a rare situation which can occur where trains are travelling at a speed, known as the critical speed, over a railway situated on very soft ground. The critical speed is dependent on the ground conditions below and is not confined to high speed railways. This phenomenon is well understood is mitigated by appropriate design and construction techniques (e.g. HS1 across Wennington Marshes). Where this could occur, measures such as soil strengthening or bridging over soft ground to ensure bow waves do not adversely affect train operations, or damage the infrastructure, will be incorporated. Based on this the Phase One design and EIA showed that any effects are unlikely to be significant.
- 18.2.19 Maintenance: ground-borne noise and vibration could be generated by activities such as ballast tamping or repair of slab track. Given the irregularity of the activity and short duration at any one location, maintenance work is considered unlikely to give rise to significant ground-borne noise or vibration effects on residential properties.

Scope of assessment

- 18.2.20 Temporal scope: the construction of the Proposed Scheme will be assessed throughout the construction period. The operation of the Proposed Scheme will be assessed at the year of opening and for the year with the highest traffic patterns forecast for the first 15 years of operation. These will be compared, as necessary, with the future baseline in the year of opening (without the Proposed Scheme).
- 18.2.21 Spatial scope for direct effects is based on the High Speed Rail (London - West Midlands) Act 2017, the United States (US) Federal Railroad Administration guidance²⁶⁰, Federal Transit Administration guidance²⁶¹ and previous UK infrastructure projects. For a scheme designed, constructed and operated to current engineering standards, and taking account of reasonably foreseeable worst case assumptions, the US guidance sets the following screening distances for the assessment of the potential impact arising from the operation of a new rail system. A quantitative assessment will be undertaken for all receptors within the following areas:
- residential and non-residential receptors (except as defined below) - whichever is the greater of either 85m from the centreline of the track or nearest construction activity or the area within which impacts from ground-borne noise and/or vibration from the Proposed Scheme are forecast; and

²⁶⁰ U.S. Department of Transportation and the Federal Railroad Administration (Office of Railroad Development) (2005), *High-Speed Ground Transportation Noise and Vibration Impact Assessment, Federal Railroad Administration*

²⁶¹ U.S. Department of Transportation and the Federal Transport Administration (2006), *Transit Noise and Vibration Impact Assessment Guidance Manual, Federal Transit Administration*

- non-residential receptors / land uses where low ambient vibration or sound is critical to operations, for example, very sensitive laboratory equipment such as nanotechnology laboratories, sound recording / broadcast studios, large auditoria / theatres or concert halls - 200m from centreline of the track or nearest construction activity.

18.2.22 Indirect effects: a qualitative assessment will be made where the increase or decrease in rail traffic volumes or types caused by the Proposed Scheme would cause a change in the baseline Vibration Dose Value (VDV) from existing railways greater than 25% (refer to Table 41).

Assessment methodology

Legislation, policy, standards and guidance

18.2.23 Relevant legislation includes the Control of Pollution Act 1974²⁶², the Environmental Protection Act 1990, the Noise and Statutory Nuisance Act 1993²⁶³ and the Land Compensation Act 1973²⁶⁴ (all as amended).

18.2.24 Relevant regulation includes the EIA Regulations 2017²⁶⁵.

18.2.25 Relevant policy and guidance is set out in Section 18.1 of this section.

18.2.26 Relevant standards include:

- BS5228-2 Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 2: Vibration²⁶⁶;
- BS6472-1 Guide to evaluation of human exposure to vibration in buildings: 1-Vibration sources other than blasting²⁶⁷; 2-Blast-induced vibration²⁶⁸;
- BS7385-2 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration²⁶⁹;
- ISO14837-1 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General Guidance²⁷⁰.

²⁶² *Control of Pollution Act 1974*. London: The Stationery Office

²⁶³ *Noise and Statutory Nuisance Act 1993*. London: The Stationery Office.

²⁶⁴ *Land Compensation Act 1973*. London: The Stationery Office

²⁶⁵ The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017 No. 571), London, Her Majesty's Stationery Office

²⁶⁶ British Standards Institute (BSI) (2009+A1:2014), *BS 5228-2 Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 2: Vibration*, BSI

²⁶⁷ British Standards Institute (BSI) (2008), *BS6472-1 Guide to evaluation of human exposure to vibration in buildings: 1-Vibration sources other than blasting*, BSI

²⁶⁸ British Standards Institute (BSI) (2008), *BS6472-2 Guide to evaluation of human exposure to vibration in buildings: 2-Blast-induced vibration*, BSI

²⁶⁹ British Standards Institute (BSI), *BS7385-2 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration*, BSI

²⁷⁰ International Standards Organisation (ISO) (2005), *14837 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General Guidance*, ISO

Calculation methods

- 18.2.27 The ground-borne noise and vibration potentially generated by the majority of construction activities will be calculated using the guidance in Transport Research Laboratory (TRL) Report 53²⁷¹ and TRL Report 429²⁷², and guidance in BS5228-2²⁷³.
- 18.2.28 The ground-borne noise and vibration potentially generated by rail operations associated with the Proposed Scheme, both temporary operations during construction and permanent, will be calculated using the calculation method developed and validated for the design and construction of Phase One²⁷⁴. The method is empirical, developed from thousands of measurements, is fully consistent with ISO 14837²⁷⁵, and takes account of all key parameters, including train design, train speed, track design, tunnel design, tunnel depth, ground conditions, receiving building foundations and receiving building type. The method has been further tested, validated and scrutinised at public inquiry on many urban mass transit systems around the world.

Significance criteria – direct effects | residential receptors

- 18.2.29 With regard to the implementation of Government noise policy the ground-borne noise and vibration adverse effect thresholds set out in Table 40 for permanent residential buildings are those defined by the High Speed Rail (London - West Midlands) Act 2017.

Table 40 - Ground-borne noise and vibration effect levels for permanent residential buildings

Sub- topic	Effect Level		dB L _p AS _{Max}
Ground-borne noise	Lowest Observed Adverse Effect Level LOAEL		35
	Significant Observed Adverse Effect Level SOAEL		45
Sub-topic	Effect Level	Time of day	VDV m/s ^{1.75}
Vibration	Lowest Observed Adverse Effect Level LOAEL	Daytime (0700-2300)	0.2
		Night time (2300 – 0700)	0.1
	Significant Observed Adverse Effect Level SOAEL	Daytime (0700-2300)	0.8
		Night time (2300 – 0700)	0.4

²⁷¹ Transport Research Laboratory (TRL) (1986), *TRL Report 53: Ground vibration caused by civil engineering works*, TRL

²⁷² Transport Research Laboratory (TRL) (2000), *TRL Report 429: Groundborne vibration caused by mechanised construction works*, TRL

²⁷³ British Standards Institute (BSI)(2009+A1:2014), *BS 5228-2 Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 2: Vibration*, BSI

²⁷⁴ HS2 Ltd, 2013, London-West Midlands Environmental statement, November 2013, HS2 Phase One Environmental Statement Volume 5, *Appendix SV-001-000 Methodology, assumptions and assessment (route-wide) - Sound, noise and vibration*. Available at: http://assets.hs2.org.uk/sites/default/files/Vol5_Scope_and_methodology_addendum_CT-001-000.2.pdf

²⁷⁵ International Standards Organisation (ISO) (2005), *14837 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General Guidance*, ISO

- 18.2.30 Where the predicted groundborne noise or vibration level exceeds the relevant SOAEL value in Table 40 then a likely significant adverse effect will be reported for each affected dwelling.
- 18.2.31 For residential receptors, effects likely to be considered significant on a community basis will also be determined where the calculated groundborne noise and or vibration level exceeds the relevant LOAEL but is less than the relevant SOAEL values in Table 40 by taking into account:
- the type of effect being considered (e.g. annoyance);
 - the magnitude of the effect (i.e. the calculated noise or vibration level compared the relevant LOAEL and SOAEL values and available dose-response information);
 - the change in vibration level where relevant as classified using Table 41;
 - the number and grouping of residential receptors affected;
 - the potential combined effect of airborne sound, ground-borne noise and ground-borne vibration;
 - any unique features of the Proposed Scheme's noise or vibration in the area being considered (which may require secondary acoustic indicators/criteria);
 - the frequency and duration over which temporary construction impacts may occur; and
 - the effectiveness of mitigation through design or other means.

Table 41 - Vibration change criteria for the assessment of disturbance (annoyance) of occupants and building users

Change classification	Impact criteria where appreciable existing levels of vibration ²⁷⁶ exist
	% increase or decrease in VDV
Negligible	≤ 25
Minor	25 to 40
Moderate	> 40, to 100
Major	>100

²⁷⁶ Where there is an appreciable existing level of vibration and daytime and night-time vibration dose values (VDVs) exceed $0.2\text{ms}^{-1.75}$ and $0.1\text{ms}^{-1.75}$ respectively

Significance criteria – direct effects | non-residential receptors

18.2.32 For non-residential receptors, significant effects will be determined on a receptor by receptor basis taking into account:

- the use and sensitivity of the receptor;
- the type of effect being considered;
- whether the calculated magnitude of ground-borne noise or vibration exceed the screening criteria set out in Table 42 and Table 43 and then:
- the design of the receptor affected;
- the existing ambient sound and vibration levels in the receptor affected;
- the potential combined impacts of airborne sound, ground-borne sound and vibration;
- any unique features of the Proposed Scheme’s sound or vibration impacts in the area being considered (which may require secondary acoustic indicators/criteria);
- the frequency and duration over which temporary construction impacts may occur; and
- the effectiveness of mitigation through design or other means.

Table 42 - Ground-borne noise screening criteria for non-residential receptors

Category of building	Screening criterion dB L_{pASmax} (predicted inside the noise sensitive part of the receptor)
Theatres/large auditoria and concert halls	25
Sound recording/broadcast studios	30
Places of meeting for religious worship/ courts/cinemas lecture theatres/museums/small auditoria or halls	35
Offices/ schools/colleges/hospitals/hotels/libraries	40

Table 43 - Ground-borne vibration screening criteria for non-residential buildings

Examples	VDV _{day} m/s ^{1.75}	VDV _{night} m/s ^{1.75}
Hotels; hospital wards; and education dormitories	0.2	0.1
Offices; Schools; and Places of Worship	0.4	n/a
Workshops	0.8	n/a
Vibration sensitive research and manufacturing (e.g. computer chip manufacture); hospitals with vibration sensitive equipment/operations; universities with vibration sensitive research equipment/operations	Risk assessment will be undertaken based on the information currently available for the relevant equipment/process, or where information provided by the building owner or equipment manufacturer.	

Significance criteria - indirect impacts

- 18.2.33 Changes in road / rail traffic flows on the existing network will be used to calculate changes in vibration, at source, in VDV. These changes will be classified using the criteria in Table 4.1. Changes classified as minor, moderate or major will be used to inform a qualitative assessment of likely significant effects.

Cumulative effects

- 18.2.34 Noise and vibration impacts, both permanent and temporary, will be identified for the Proposed Scheme and other developments, either under construction or consented as referred to in Section 4 of this SMR. The results of these assessments will then be used to qualitatively assess potential cumulative significant effects arising from the Proposed Scheme and any other developments having regard to, amongst other things, spatial and temporal overlap of the noise and vibration impacts.
- 18.2.35 Community, ecological, heritage or health adverse effects arising from impacts and effects identified for ground-borne noise and vibration will be considered and reported in the relevant sections of the ES.

Assumptions

- 18.2.36 Assumptions, relevant to scope and methodology, for the ground-borne noise and vibration assessment include:
- design assumptions (e.g. train and track specification, revenue service speeds and timetables);
 - construction methods (e.g. type of piling, vibratory compaction methods); and
 - maintenance specifications.

18.3 Airborne noise

Introduction

- 18.3.1 This section presents the proposed approach to assessing airborne noise associated with the construction, operation and maintenance of the Proposed Scheme. Airborne

noise generated by the Proposed Scheme has the potential to cause disturbance to neighbouring homes, businesses, facilities and amenities, referred to as receptors.

- 18.3.2 During construction, airborne noise would be generated by construction equipment, construction worksites, construction vehicles on haul routes and public roads, and changes to road traffic.
- 18.3.3 During operation and maintenance, airborne noise would be generated by high speed trains in service, inspection/maintenance trains and other (fixed) sources such as: power supply equipment, ventilation shafts, depots and station building services. The Proposed Scheme may also cause changes in road and rail traffic flow on the current road and rail networks in addition to noise from altered roads and railways.
- 18.3.4 The assessment will cover all receptors, including those for which planning permission has been granted before the safeguarding date but are not yet completed, subject to the screening distances discussed within the specific subject areas. Where a receptor has multiple uses the assessment will be made based on the most sensitive use.

Establishment of baseline and definition of survey

- 18.3.5 To facilitate dialogue with stakeholders, baseline information will be gathered incrementally through field surveys focused on locations where predicted effects are likely to be significant on an individual receptor or community basis. The baseline and impact assessment for the Proposed Scheme will be developed and refined in three stages.
- 18.3.6 Initially, existing data will be gathered to form the desk top baseline (Baseline 1). Baseline 1 data will be used early in the programme to support initial dialogue, assessment work and design development. Following Baseline 1, initial field surveys will be undertaken to fill gaps in Baseline 1 data and provide more detailed information at locations where significant effects are likely. Combined with Baseline 1, these data will form Baseline 2, to be used for the working draft ES. Further, more targeted surveys will be undertaken in responses to the findings of the working draft ES assessments and ongoing stakeholder dialogue. Combined with Baseline 2, these data will provide Baseline 3 for the ES.
- 18.3.7 The baseline data gathering will focus not just on collecting objective data that describes the ambient sound environment, but also information on the character of the local sound environment.

Consultation and engagement

Consultation on the Sustainability Statement (2013 and 2016)

- 18.3.8 Consultation responses to the Phase Two Sustainability Statement and its updates were considered not to alter the scope and methodology for airborne sound for the Proposed Scheme.

Engagement as part of the EIA process

- 18.3.9 Principal consultees on the approach to the assessment of airborne noise are the relevant local planning authorities.

- 18.3.10 Engagement with local stakeholder groups will be via community areas during the design and assessment of the Proposed Scheme.

Key aspects of the Proposed Scheme for the topic

- 18.3.11 The following are potential sources of airborne noise:
- temporary sources:
 - direct effects could be caused by airborne noise from construction activities such as tunnelling, demolition, earthworks, viaducts, bridges, road realignments, utility works and track works. These activities would be supported from local work compounds close to the structure or tunnel being constructed, local worksites, or larger worksites from where activities are coordinated; and
 - indirect effects could be caused by temporary changes to road and rail traffic patterns on the existing networks during construction;
 - permanent sources:
 - direct effects could be caused by the operational railway and its supporting systems (e.g. rolling stock and infrastructure maintenance depots, vent shafts, other line side equipment and maintenance); and
 - indirect effects could be caused by long term changes to road and rail traffic patterns on the existing networks.

Sources, receptors and types of effect that can be mitigated to avoid significant effects

- 18.3.12 The HS2 Phase One and Phase 2a EIAs reported, in line with industry best practice, that likely significant noise and/or vibration effects from a number of sources or at a number of types of receptor are avoided by mitigation incorporated into the Proposed Scheme. The sources and receptors described in the following paragraphs will therefore not be subject to a quantitative assessment for the Proposed Scheme with the exception of special cases which will be considered individually.
- 18.3.13 Facilities that permit occasional overnight stays such as static moorings, camp sites or caravan parks but do not permit long term residential use are not considered to be significantly affected by noise during construction or operation of the Proposed Scheme due to the short and irregular exposure of occupants to noise from the Proposed Scheme.
- 18.3.14 Public Rights of Way (PRoW) are by their nature transitory in their use, with users not staying in any one location for any length of time. Levels of noise from the construction and operation of the Proposed Scheme will vary as the right of way moves closer to and further from the Proposed Scheme. Noise effects would generally be reduced by the control measures defined in the CoCP during construction. During operation, noise levels on PRoW would be reduced by engineering cuttings, landscape earthworks provided to reduce the visual impact of the scheme and noise mitigation provided to protect adjacent residential and non-residential receptors. Train noise

from the Proposed Scheme is intermittent. Significant noise effects are therefore considered unlikely on PRow during either construction or operation.

- 18.3.15 Public open spaces and outdoor sports / recreation community facilities (e.g. football pitches, golf courses) are, by their nature, transitory in their use. Outdoor sport activities are unlikely to be significantly affected by noise at the levels associated with construction or operation of the Proposed Scheme, outside the route corridor or outside of any construction sites. Increases in noise due to construction and operation of the Proposed Scheme may adversely affect the acoustic character of the area around such facilities. However, as users will not be exposed to any increased noise for long periods the adverse noise effects on users are not considered significant. Quantitative assessments will be undertaken for any outdoor community facility formally identified or designated as a quiet area under Government regulations or policy.
- 18.3.16 Construction noise from standard utilities work rises and falls in level as the works pass by a given receptor, usually within a period of less than one month. With due warning and the other mitigation measures committed to in the CoCP noise impacts from such works is of insufficient duration to cause significant effects.
- 18.3.17 It is anticipated that there may be some night-time working during works alongside, to cross, or to tie into existing roads and railways during possessions (for example a weekend). The duration of any noise exposure would be short-term and will be controlled and reduced by the management processes set out in the CoCP. With due warning and the other mitigation measures committed to in the CoCP, the effects are therefore considered unlikely to be significant.
- 18.3.18 Track laying, power system and signalling installation works along the line of route are likely to occur for a short duration in close proximity to any individual community or receptor. Noise effects will be of short duration and would be controlled and reduced by the management processes set out in the CoCP. With due warning and the other mitigation measures committed to in the CoCP these works are therefore considered unlikely to result in significant construction noise effects.
- 18.3.19 Noise can be generated at exits from tunnels due to pressure waves created inside the tunnel as the train enters. This is a well understood phenomenon and is mitigated by appropriate design and construction techniques. Porous tunnel portals, tunnels and vent shafts (where required) will be designed to avoid any significant airborne noise effects caused by the trains entering the tunnel.
- 18.3.20 Permanent static equipment will be designed so that it will avoid significant effects and will minimise adverse noise effects as far as sustainable. This was achieved on Phase One via the assurances provided in Information Paper E22²⁷⁷. The effects are therefore considered unlikely to be significant.
- 18.3.21 During maintenance, airborne noise would be generated along the route by specialist engineering trains, rail grinding, ballast tamping and inspection. Given the irregularity and short duration at any one location of maintenance activities associated with these

²⁷⁷ High Speed Two Phase One Information Paper (2017), E22 – Control of noise from the operation of stationary systems v1.4

specific sources, maintenance work is considered unlikely to give rise to significant noise effects.

Scope of assessment

- 18.3.22 Temporal scope: the construction of the Proposed Scheme will be assessed on a monthly basis throughout the construction period. The operation of the Proposed Scheme will be assessed, as necessary, in the short term at the year of opening; and in the long-term with the highest rail traffic patterns forecast for the first 15 years of operation. These will be compared, as necessary, with the future baseline in the year of opening (without the Proposed Scheme).
- 18.3.23 Spatial scope for direct effects - for the Proposed Scheme, and taking account of reasonably foreseeable worst case assumptions, the following screening distances will be used which are consistent with Phase One and 2a, HS1 and in excess of guidance from sources such as US Federal Railroad Administration Guidance for high speed rail:
- construction (from BS5228-1²⁷⁸) - 300m from any construction activity or the area within which sound levels from the Proposed Scheme are forecast to give rise to potential impacts, whichever is the greater; and
 - operational Proposed Scheme - 500m and 1km from the centreline of the HS2 line of route or re-aligned rail or road routes in urban and rural areas respectively, or the area within which sound levels from the Proposed Scheme are forecast to give rise to potential impacts, whichever is the greater.
- 18.3.24 Spatial scope for indirect effects - a qualitative assessment will be made where the increase or decrease in road or rail traffic volumes or traffic types caused by the construction or operation of the Proposed Scheme would be likely to cause a change in noise level (equivalent continuous sound level, $L_{pAeq,T}$) from that road or rail traffic exceeding 1dB during either the day (0700 to 2300) or night time periods (2300 to 0700).

Assessment methodology

Legislation and guidance

- 18.3.25 Relevant legislation includes the Control of Pollution Act 1974, the Environmental Protection Act 1990, the Noise and Statutory Nuisance Act 1993, the Land Compensation Act 1973 (including the Noise Insulation Regulations) and the European Communities Act 1972 (including the Environmental Noise (England) Regulations 2006) (all as amended).
- 18.3.26 Relevant policy and guidance are set out in Section 18.1.
- 18.3.27 Relevant guidance and standards include, in part, the Transport Analysis Guidance²⁷⁹, and as identified in each of the following sections.

²⁷⁸ British Standards Institute (BSI) (2009+A1:2014), *BS 5228-1 Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 1: Noise*, BSI

²⁷⁹ Department for Transport (DfT) (2015), *Transport Analysis Guidance (TAG), Unit A3 Environmental Impact Appraisal, Section 2, Noise Inputs*, DfT

Calculation Methods

- 18.3.28 The airborne noise generated by construction activities will be predicted in line with the method set out in BS5228-1.
- 18.3.29 The airborne noise generated by rail operations associated with the Proposed Scheme, high speed trains running on high speed tracks, connecting chords, and conventional lines will be calculated using the calculation method developed and validated for the Phase One environmental assessment²⁸⁰ and being used on Phase 2a. The method is empirical, developed from over a thousand measurements. The method calculates maximum sound levels for each train, as well as equivalent continuous sound levels.
- 18.3.30 The Calculation of Road Traffic Noise (CRTN) 1988²⁸¹ will be used to predict the airborne sound from road traffic within the spatial scope (see Section 19, Traffic and transport).
- 18.3.31 The number and location of properties estimated to qualify under the Noise Insulation Regulations and the HS2 construction and operational policies will be reported.

Significance criteria - direct impacts | residential receptors

- 18.3.32 With regard to the implementation of Government noise policy during the EIA the construction and operational airborne noise effect thresholds are set out in Table 44²⁸² and Table 45 respectively for permanent residential receptors.

Table 44 - Airborne noise from construction of the Proposed Scheme – adverse effect thresholds for environmental impact assessment stage for permanent residential buildings (façade levels)

Time of day	Lowest Observed Adverse Effect Level LOAEL ⁽¹⁾	Significant Observed Adverse Effect Level SOAEL
Day (0700-1900) $L_{pAeq, 12hr}$	65 dB	75 dB or the ambient sound level, whichever is the higher
Evening (1900–2300) $L_{pAeq, 4hr}$	55 dB $L_{pAeq, T}$	65 dB or the ambient sound level, whichever is the higher
Night (2300 – 0700) $L_{pAeq, 8hr}$	45 dB $L_{pAeq, T}$	55 dB or the ambient sound level, whichever is the higher

Note: (1) consistent with the BS5228 ABC Method, the LOAEL is increased by 5 or 10 dB in higher baseline noise environments.

²⁸⁰ HS2 Phase One Environmental Statement Volume 5, *Appendix SV-001-000 Methodology, assumptions and assessment (route-wide) - Sound, noise and vibration*. Available at: http://assets.hs2.org.uk/sites/default/files/Vol5_Scope_and_methodology_addendum_CT-001-000.2.pdf

²⁸¹ Department of Transport Welsh Office (1988), *Calculation of Road Traffic Noise*, HMSO

²⁸² For this assessment the thresholds for construction noise are based upon the BS5228-1 'ABC Method', and reflect the level of detail of construction information that is available at EIA stage. At delivery stage further detailed construction noise predictions will be completed. These predictions will enable implementation, as necessary, of HS2 Ltd's commitments on noise insulation and temporary rehousing, to prevent significant adverse effects at residential properties, as laid out for Phase One in Information Paper E23 and the CoCP. At delivery stage the noise predictions would be carried out by the contractor. The detail construction information available later in the delivery stage will also enable the preparation of Section 61 consents to control and minimise construction noise as required on Phase One by its CoCP.

Table 45 - Airborne noise from operation of the Proposed Scheme – adverse effect thresholds for permanent residential buildings (free-field levels)

Time of day	Lowest Observed Adverse Effect Level LOAEL	Significant Observed Adverse Effect Level SOAEL
Day (0700 – 2300) dB L _{pAeq} , 16hr	50 dB	65 dB
Evening (1900 – 2300) pAeq,	40 dB	55 dB
Night (2300 – 0700) L _{pAFMax}	60 dB (at the façade, from any night time noise event)	80 dB (at the façade, from more than 20 night time train passbys), or 85 dB (at the façade, from 20 or fewer night time train passbys)

18.3.33 Where the predicted construction or operational noise level exceeds the relevant SOAEL values then a likely significant adverse effect will be reported for each receptor affected.

18.3.34 For residential receptors, likely significant adverse effects (positive from noise reductions and negative from noise increases) will also be determined on a community basis where the calculated noise level exceeds the relevant LOAEL but is less than the relevant SOAEL values in Table 44 or Table 45 by taking into account the following factors:

- type of effect being considered (e.g. annoyance);
- the magnitude of the predicted noise level compared to the relevant LOAEL and SOAEL values and available dose-response information;
- for construction of the Proposed Scheme the assessment category as identified using Table 46;
- for the operation of the Proposed Scheme the predicted change in noise level (day or night) as classified using Table 47;
- the existing sound environment in terms of the absolute level²⁸³ and the character of the existing environment;
- the number and grouping of receptors subject to noise effect and noise change²⁸⁴;
- any unique features of the Proposed Scheme or the receiving environment;
- the potential combined impacts of sound and vibration;

²⁸³ As one example: for operational rail sound, greater weight will be given to a sound level change between 1 dB and 3 dB if the area is already exposed to high levels of noise. High levels of noise exposure will be evaluated having regard to the criteria contained in the Noise Insulation (Railway and Other Guided Transport Systems) Regulations 1996 (SI 1996 No. 428), and the Noise Action Plans in England (Defra 2012) for 'First Priority Locations' and 'Important Areas'

²⁸⁴ Evaluated using the impact criteria set out earlier in this section

- the duration of impact for temporary sources; and
- the effectiveness of mitigation through design or other means.

18.3.35 Construction noise categories are set out in Table 46 in line with BS5228-1 and what is referred to as the 'ABC Method'.

Table 46 - Airborne noise from construction - criteria at residential receptors (construction noise only)

Period	Assessment category		
	A	B	C
Day (0700-1900) $L_{pAeq, 12hr}$	>65 dB $L_{pAeq,T}$	>70 dB $L_{pAeq,T}$	>75 dB $L_{pAeq,T}$
Evening 1900–2300 $L_{pAeq, 4hr}$	>55 dB $L_{pAeq,T}$	>60 dB $L_{pAeq,T}$	>65 dB $L_{pAeq,T}$
Night (2300 – 0700) $L_{pAeq, 8hr}$	>45 dB $L_{pAeq,T}$	>50 dB $L_{pAeq,T}$	>55 dB $L_{pAeq,T}$

Notes:

All sound levels are defined at the façade of the receptor.

Assessment Category A: criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are less than these values.

Assessment Category B: criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are the same as category A values.

Assessment Category C: criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are higher than category A values.

If the ambient sound level exceeds the Assessment Category C threshold values given in the table (i.e. the ambient sound level is higher than the above values), then an effect on a residential receptor is deemed to occur if the construction $L_{pAeq,T}$ for the period is greater than the ambient sound level.

18.3.36 Noise change criteria for the operation of the scheme are set out in Table 47.

Table 47 - Airborne noise from operational train and road movements – classification of noise change permanent residential receptors²⁸⁵.

Long term Noise change classification	Short term Noise change classification	Noise level change dB $L_{pAeq, T}$ (positive or negative) T = either 16hr day or 8hr night
Negligible	Negligible	≥ 0 dB and < 1 dB
	Minor	≥ 1 dB and < 3 dB
Minor	Moderate	≥ 3 dB and < 5 dB
Moderate	Major	≥ 5 dB and < 10 dB
Major		≥ 10 dB

²⁸⁵ Based on the Highways Agency (2011), *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 Noise and Vibration document HD213/11*

Significance criteria - non-residential receptors and land uses

18.3.37 For non-residential receptors and land uses, significant effects will be determined, on a receptor-by-receptor basis, by taking into account:

- the type of effect being considered;
- the use and sensitivity of the receptor or land use;
- the calculated level of noise compared to the precautionary screening criteria in Table 48; and then
- the design of the receptor or land use affected;
- the existing sound environment in the receptor, or on the land use, affected;
- the potential combined impacts of sound and vibration;
- any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators/criteria);
- the frequency and duration over which temporary construction impacts may occur; and
- the effectiveness of mitigation through design or other means.

Table 48 - Noise screening criteria for noise sensitive non-residential buildings and external amenity spaces

Examples	Day (0700-2300)	Night (2300-0700)
Large and small auditoria; concert halls; sound recording & broadcast studios; and theatres	60 dB L_{pAFMax} or 50 dB $L_{pAeq, 16hr}$	60 dB L_{pAFMax} or 50 dB $L_{pAeq, 8hr}$
Places of meeting for religious worship; courts; cinemas; lecture theatres; museums; and small auditoria or halls	50 dB $L_{pAeq, 16hr}$	n/a
Schools; colleges; hospitals; hotels; and libraries	50 dB $L_{pAeq, 16hr}$	45 dB $L_{pAeq, 8hr}$
Offices and external amenity spaces	55 dB $L_{pAeq, 16hr}$	n/a

Significance criteria - quiet areas

18.3.38 Quiet areas comprise:

- areas designated under Local Plans as being prized for their tranquillity;
- areas designated under Local Plans or Neighbourhood Development Plans as Local Green Spaces; and
- areas identified as Quiet Areas through implementation of the Environmental Noise Regulations.

- 18.3.39 Tranquillity assessment is multi-disciplinary and will be led for this EIA by the Landscape and Visual topic area. The methodology employed is set out in Section 15, Landscape and visual of this SMR and is centred on assessing tranquillity on designated Landscape Character Areas. Sound (or the absence of man-made sound) is only a potentially material consideration where areas are assessed as having high tranquillity.
- 18.3.40 Effects on quiet areas or other resources which are valued for providing tranquillity will be assessed on a receptor by receptor basis having regard to:
- the type of effect being considered;
 - the criteria set out in the Noise Action Plans in England for 'Quiet Areas'²⁸⁶;
 - tranquillity indicators (for land use) - refer also to Section 15;
 - any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators criteria)
 - the duration over which temporary construction impacts may occur; and
 - the effectiveness of mitigation through design or other means.

Significance criteria - indirect impacts

- 18.3.41 Changes in traffic flows on the existing road and rail network will be used to calculate changes, at source, in equivalent continuous sound level ($L_{pAeq,16hr}$). A minor impact (3dB or greater change) will be taken as an indicator of a potential significant effect unless the area being considered is currently exposed to high levels of sound, in which case, a change of 1dB or greater may be taken as an indicator of potential significance. Communities and receptors subject to noise changes exceeding these indicators will be subject of a qualitative assessment.

Cumulative effects

- 18.3.42 Noise and vibration impacts, both permanent and temporary, will be identified for the Proposed Scheme and other developments, either under construction or consented as referred to in Section 4.4 (Cumulative effects) of this SMR. The results of these assessments will be used to qualitatively assess potentially significant cumulative effects arising from the Proposed Scheme and these committed developments having regard to, amongst other things, spatial and temporal overlap of the sound and vibration impacts.

²⁸⁶ Department for Environment, Food and Rural Affairs (Defra), *Environmental Noise; Noise Action Plans* (2014), Accessed online at: <https://www.gov.uk/government/publications/noise-action-plans-large-urban-areas-roads-and-railways>

Assumptions

18.3.43 Assumptions, relevant to scope and methodology, for the airborne sound assessment include:

- design assumptions (e.g. train specification, revenue service speeds and timetables);
- maintenance specifications;
- construction methods (e.g. type of piling, vibratory compaction methods); and
- sound emission limits as set by the Technical Specification for Interoperability as amended²⁸⁷.

²⁸⁷ European Commission (2014), *Commission Regulation (EU) No 1304/2014 of 26 November 2014 on the technical specification for interoperability relating to the subsystem 'rolling stock - noise' amending Decision 2008/232/EC and repealing Decision 2011/229/EU*

19 Traffic and transport

19.1 Introduction

- 19.1.1 This section of the SMR covers traffic and transport which includes the environmental topic areas of traffic, infrastructure, journey times, accessibility and interchanges.
- 19.1.2 The traffic and transport assessment will present an assessment of the impacts on pedestrians, cyclists, equestrians, mobility impaired people, highways and public transport. It will cover the impacts that are likely to occur during both the construction and, where appropriate, the operational periods of the Proposed Scheme. The principles set out in this section should be applied wherever there are impacts attributable to the Proposed Scheme although a simplified approach may be appropriate where traffic and transport impacts are considered to be limited.
- 19.1.3 The Proposed Scheme is a transport project and therefore by its very nature will affect existing transport networks. A transport assessment is being undertaken which will inform the traffic and transport section of the ES.

Issues to be considered:

- 19.1.4 The following key effects will be among those assessed:
- changes in traffic (including heavy goods vehicles (HGV)), public transport, pedestrian and cyclist flows;
 - the impacts of alterations to road layout/ closures/ diversions/ widening/ alterations (including stopping and passing places)/ junction improvements/ diversion of PRoW;
 - changes to journey times and journey distances for private and commercial vehicle occupants;
 - changes in accessibility, journey times and public transport;
 - changes to interchange, parking, taxi parking/operation, and delivery and servicing;
 - changes to bus routes and stop locations; and
 - changed journey times and distances, and changes in amenity and ambience, for vulnerable road users and waterway users.
- 19.1.5 Effects will be classified according to the following four broad levels: no impact, minor, moderate and major.

19.2 Establishment of baseline and definition of survey

- 19.2.1 Traffic data, traffic surveys and, where appropriate, modelling will be undertaken to inform the transport assessment along the route of the Proposed Scheme. This transport data will also be used to provide information to determine the baseline for the traffic and transport assessment within the ES.

- 19.2.2 The future baseline will include consideration of the growth in travel demand, including the changes arising from other developments and proposed transport network improvements.

19.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

- 19.3.1 Traffic and transport was not specifically covered by the Sustainability Statement as an individual topic. This is because the effects on traffic and transport from the construction and operation of the Proposed Scheme are dependent on detailed information that was not available at the early strategic stage of the AoS.
- 19.3.2 Nevertheless, a number of consultation responses received were about the impacts on local communities from construction traffic. These comments were made largely in relation to the noise, dust, emissions, disruption and congestion that construction traffic would cause.

Engagement as part of the EIA process

- 19.3.3 The following organisations will be amongst those to be consulted on traffic and transport issues:
- highway authorities;
 - Highways England; and
 - Network Rail.
- 19.3.4 As the Proposed Scheme develops, other relevant stakeholders may also be consulted.

19.4 Key aspects of the Proposed Scheme for the topic

- 19.4.1 Construction and operation of the following elements, where relevant to the phase of the Proposed Scheme being assessed and to the topic of traffic and transport, will include:
- the route itself;
 - new and redeveloped stations;
 - stabling, infrastructure maintenance and rolling stock depots;
 - interfaces with other public transport and highway networks including changes to existing, new and improved infrastructure and services;
 - PRow and users (pedestrians, cyclists etc.);
 - all construction including tunnelling, tunnel portals and vent shafts, HGV routes and points of access, haul routes and construction sites;
 - car parking; and
 - waterway users.

19.5 Scope of assessment

Spatial scope

19.5.1 The spatial scope of the traffic and transport assessment will be different for the construction and operational impacts being assessed.

Spatial scope – construction

19.5.2 The assessment will focus on traffic and transport issues resulting from land required for the Proposed Scheme, land required for worksites, the presence of construction traffic on the local road network, and effects on routes crossing the construction areas (PRoW and highways). The extent of the assessment will include:

- the highway network (including parking, loading and access arrangements) affected by construction worksites and on routes used by construction traffic, focusing on routes between worksites and the strategic road network surrounding the Proposed Scheme;
- public transport networks affected by construction works including rail, bus and coach services, including lines, routes, services and stations/interchanges that may be indirectly affected by the Proposed Scheme;
- transport interchange arrangements such as bus to rail in the vicinity of the Proposed Scheme;
- pedestrian, cyclist and equestrian routes in the vicinity of the Proposed Scheme;
- railways used to transport materials and excavated materials; and
- navigable waterways.

Spatial scope – operation

19.5.3 The spatial scope will include the transport routes where there is a substantial change in the usage either through people accessing the Proposed Scheme, or from changes to travel demand on other routes or modes. It will also include roads and other rights of way that are permanently diverted or stopped up.

19.5.4 The assessment will therefore include:

- the highway network where changes are likely to occur as a result of the Proposed Scheme;
- the public transport system (and transport networks used to access the public transport system) where it is affected by the increased usage or changed journey patterns arising from the Proposed Scheme, including heavy and light rail and bus and coach services;
- pedestrian, cyclist and equestrian routes in the vicinity of the Proposed Scheme; and
- navigable waterways potentially affected by the Proposed Scheme.

Temporal scope

- 19.5.5 Potential effects of the Proposed Scheme will be considered for the following:
- construction Period 2023-2033 (including commissioning) to be assessed against a common base year: impacts arising from construction;
 - opening year for operation (2033): impacts associated with operation; and
 - future assessment year for operation consistent with the Phase One assessment and assumed to reflect the full technical capacity and operation of HS2 as a whole (Phase One, Phase 2a and Phase 2b). This will be determined to coincide with appropriate census year data²⁸⁸, and is likely to be 2046.

19.6 Assessment methodology

- 19.6.1 The traffic and transport effects arising from the construction strategy and engineering design for the Proposed Scheme will be assessed as part of the EIA process. The traffic and transport assessment developed for the Proposed Scheme will provide the forecasts of passenger and vehicle movements and transport network characteristics that will be used in the EIA.
- 19.6.2 Having established the likely changes on the road, public transport, PRoW or waterway networks during construction and operation, impacts will be assessed using a set of criteria developed for the Proposed Scheme.
- 19.6.3 The criteria used for the identification and assessment of potentially significant impacts are provided below. The magnitude of each impact and its significance will be assessed by a variety of mechanisms, including as necessary computer modelling and professional judgement.

Guidance

- 19.6.4 Whilst there is no legislation on how traffic and transport assessments should be undertaken the following guidance documents are relevant:
- DfT's Guidance on Transport Assessment²⁸⁹ (now archived);
 - National Planning Policy Framework (NPPF), March 2012 and associated Planning Policy Guidance on Travel Plans, Transport Assessments and Statements (March 2014); and
 - DCLG, March 2014, Guidance on Travel Plans, transport assessments and statements in decision-taking²⁹⁰.

Significance criteria for construction assessment

- 19.6.5 The criteria outlined below will be used to assess the significance of temporary traffic and transport impacts during the construction of the Proposed Scheme from work

²⁸⁸ The UK census is undertaken every ten years with transport modelling forecasts often coinciding with 5 year intervals from an appropriate census year

²⁸⁹ Department for Transport (DfT) (2007), *Guidance on Transport Assessment*, DfT – now archived

²⁹⁰ Department for Communities & Local Government (2014), *Guidance on Travel Plans, transport assessments and statements in decision-taking*.

sites along the route. Some of the significance criteria may be further refined in the development of the traffic and transport assessment.

19.6.6 The criteria have been based on information included in the guidance documents previously referenced, in the following documents, and using professional judgement:

19.6.7 DMRB Volume 11: Environmental Assessment (1993 and updates):

- DfT's WebTAG;
- Guidelines for the Environmental Assessment of Road Traffic²⁹¹;
- Guidelines for Traffic Impact Assessment²⁹²; and
- Assessment criteria used for assessing Crossrail ²⁹³ and other major schemes including HS2 Phase One²⁹⁴.

19.6.8 With the exception of accidents and safety, impacts with duration of less than four consecutive weeks in any 12 month period are not generally considered significant.

Public transport delay

19.6.9 A significant impact on journeys by bus and heavy and light rail affected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results; and is defined as any of the following where this lasts for more than four consecutive weeks in any 12 month period:

- a change of more than 10% in a majority of journey times by any public transport mode;
- a change in journey distance by bus of more than 400m in urban areas and 1km in rural areas;
- a relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area; and
- a relevant change to service frequency, capacity, loss of through connections or reduction in hours of operation.

Station/interchange impacts

19.6.10 Potential impacts during construction and operation will be assessed at new and redeveloped stations. A significant impact on stations/interchanges is defined as a change in the vicinity of stations/interchanges that lasts for more than four consecutive weeks in any 12 month period including:

- loss of physical linkage for the next stage of the journey;

²⁹¹ Institute of Environmental Assessment (IEA) (1993), *Guidelines for the Environmental Assessment of Road Traffic*, IEA

²⁹² Institution of Highways and Transportation (1994), *Guidelines for Traffic Impact Assessment*, Institution of Highways and Transportation

²⁹³ Crossrail (2005), Crossrail Environmental Statement: Volume 8a Appendices Transport Assessment: Methodology and Principal Findings (Section 5 Assessment Criteria). Available online at: http://74f85f59f39b887b696f-ab656259048fb93837ecc0ecbcfoc557.r23.cf3.rackcdn.com/assets/library/document/v/original/volume_08a.pdf

²⁹⁴ HS2 Ltd (2013). London-West Midlands Environmental Statement November 2013 Volume 1: Introduction to the Environmental Statement and the Proposed Scheme, HS2 Ltd.

- loss of or relocation of more than 100m of bus facilities and operations (e.g. of bus stops, passenger waiting facilities, bus stands or operator facilities);
- loss of or relocation of more than 100m of taxi facilities and operations (e.g. taxi stands, passenger waiting facilities or operator facilities); and
- loss of or relocation of more than 100m of 'park-and-ride' facilities or operations (e.g. dropping off areas).

Traffic delays to vehicle occupants

19.6.11 A significant change in driver/vehicle passenger delay (including delays to bus and coach passengers) is defined as any one of the following:

- a diversion for more than four consecutive weeks in any 12 month period that leads to an increase in journey length of more than 1km on a route carrying more than 100 vehicles per day, or 5km on a route carrying more than 40 vehicles per day, or 10km on any other route;
- where a significant change in delay relating to junction congestion resulting from the construction of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. This will be measured either as the forecast ratio of flow to capacity or degree of saturation. The junctions for consideration will be discussed with the local Highways Authority; and
- where there is a change in traffic flow along a road link and the capacity of that link is constrained to a greater extent than the junctions along it, then a similar approach will be used to assess potential delays to road users.

Vulnerable road users

19.6.12 Vulnerable road users, which include pedestrians, cyclists and equestrians, are affected by traffic related severance, severance caused by extended travel distances or broken links (barriers to movement) and changes to amenity and ambience.

Traffic related severance

19.6.13 A change in traffic levels can result in changes to traffic-related severance for non-motorised road users, particularly pedestrians using or seeking to cross a road. A significant change is defined as a 30% increase in daily traffic flows (either HGVs or all vehicles), where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas.

19.6.14 Where HGV traffic, including HS2 related traffic, is less than 10% of total traffic, the significance level of any adverse effect would be reduced such that, for example, what would otherwise be assessed as a major effect would be considered to be a moderate effect.

19.6.15 Where the road affected by increased traffic levels is not, in any case, suitable for pedestrians crossing (such as a high speed dual carriageway) or safe and adequate

crossing points exist, increased traffic levels would not generally be considered significant in relation to traffic-related severance for non-motorised users.

Non-traffic related severance

- 19.6.16 Severance due to, for example, extended travel distances or broken links, can affect travellers using non-motorised modes, especially pedestrians. Where reasonable, practicable, public footpaths and routes will be reinstated or convenient alternatives provided. Cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although there may still be significant impacts on these groups.
- 19.6.17 To ensure a consistent approach, the classification and assessment will be based only on pedestrian movements unless a change in route is only relevant for cyclists and/or equestrians in which case the distances set out as having the potential to result in significant effects would be adjusted accordingly. The proposed categories of effect are discussed in the following paragraphs.
- 19.6.18 Minor: In general the current journey pattern is likely to be maintained, but there may be some hindrance to movement for example:
- pedestrians at-grade crossing of a new road carrying less than 8,000 vehicles per day (AADT) in the opening year without adequate priority crossings; or
 - a new bridge or subway, which involves a material change in levels to be climbed/descended; and/or
 - journey lengths being increased by up to 100-250m (less than 100m increase in journey length is considered to be of no impact).
- 19.6.19 Moderate: Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive, for example:
- two or more of the hindrances set out under 'minor' applying to an individual journey; or
 - pedestrians at-grade crossing of a new road accommodating between 8,000-16,000 vehicles per day (AADT) in the opening year without adequate priority crossings; and/or
 - journeys lengths being increased by 250 - 500m.
- 19.6.20 Major: People are likely to be deterred from making trips to an extent sufficient to induce a change in their habits. This could lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be caused to people making their existing journeys. Such impacts can result from:
- pedestrians at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT) in the opening year without adequate priority crossings;
 - journey lengths being increased by over 500m; and/or

- three or more of the hindrances set out under 'minor' or two or more set out under 'moderate'.

19.6.21 An overall assessment for the option will then be based on the following guidelines (in each case, the assessment is beneficial if severance is reduced and adverse if severance is increased):

- the overall assessment is likely to be of no impact if increases in severance are broadly balanced by relief of severance;
- the overall assessment is likely to be minor where change in severance is slight or the total numbers of people affected across all levels of severance is minor (less than 200 per day);
- the overall assessment is likely to be major where change in severance is major, and affects a moderate or high number of people or the total numbers of people affected across all levels of severance is major (greater than 1,000); and
- the overall assessment is likely to be moderate where greater than 200 and less than 1,000 people are affected.

Amenity and ambience

19.6.22 The convenience and attractiveness of the routes for vulnerable users will be assessed in relation to the scale of any change although this will require a more qualitative assessment. WebTAG Unit 3.3.13's The Journey Ambience Sub-Objective document²⁹⁵, describes the assessment of ambience, which includes traveller's amenity. Traveller's journey ambience can be affected by:

- traveller care;
- travellers' views; and
- traveller stress.

19.6.23 Traveller care for pedestrians, cyclists, equestrians and others will be considered in relation to changes to the provision and design of facilities (e.g. footpaths, cycle lanes and crossings, information), as well as their cleanliness and environment.

19.6.24 The extent to which travellers can see the landscape view will vary with the relative height of the Proposed Scheme and the surrounding ground, vegetation, buildings and structures. Views can be categorised as providing:

- no view - where the route is in a deep cutting, a tunnel or surrounded by environmental barriers;
- restricted view - where there are frequent cuttings, tunnels or barriers;
- intermittent view - where there are shallow cuttings or barriers; and
- open view - where the view extends over many miles.

²⁹⁵ Department for Transport (DfT) (2003), Transport Analysis Guidance (TAG), The Journey Ambience Sub-Objective: WebTAG Unit 3.3.13, DfT

- 19.6.25 Traveller stress is the adverse mental and physiological effects experienced by travellers. Three main factors influence traveller stress:
- frustration;
 - fear of potential accidents; and
 - route uncertainty.
- 19.6.26 Taken together, these can lead to feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the quality and safety of a journey.
- 19.6.27 Assessments will be made of the traveller care, travellers' views and traveller stress ambience factors using the matrix in Table 49. These assessments will consider the impact of the Proposed Scheme on each of these sub-factors using a simple three point scale (i.e. better, neutral or worse than existing ambience).

Table 49 - Environment: journey ambience

Factor	Sub-factor	Better	Neutral	Worse
Traveller care	Facilities			
	Cleanliness			
	Information			
	Environment			
Travellers' views	-			
Traveller stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

- 19.6.28 An overall impact score for the quality of a journey will be determined using the following guidelines:
- the overall assessment is likely to be neutral if the assessment is neutral for all or most of the sub-factors, or improvements on some sub-factors are generally balanced by deterioration on others; and
 - if the change in impact across the sub-factors is, on balance, for the better, the assessment is likely to be beneficial, and, conversely, it is likely to be adverse if there is an overall change for the worse.
- 19.6.29 The scale of impact will vary with both the numbers of travellers affected and the scale of the change in amenity and ambience as set out in Table 50. For example, major adverse effects will only occur when both the change in amenity and ambience

and the number of travellers affected are major whereas moderate effects will occur when changes are major and numbers of travellers moderate or where changes are moderate and numbers of travellers major.

Table 50 - Effect levels for travellers affected by changes to amenity and ambience during construction

Changes in amenity and ambience	Number of travellers affected		
	Major	Moderate	Minor
Minor	Minor	Neutral	Neutral
Moderate	Moderate	Minor	Neutral
Major	Major	Moderate	Minor

19.6.30 The methodology, set out above will be applied to the Proposed Scheme on a locational basis where amenity or ambience issues for pedestrian, cyclists, equestrians and others are considered likely to be of concern.

Accidents and safety

19.6.31 Significant impacts on accidents and safety risks will be defined for links and junctions for which data is available that have experienced more than nine personal injury accidents in the latest available three-year period²⁹⁶ and which would also be subject to an increase of 30% or more in total traffic flow during construction.

Parking and loading

19.6.32 A significant impact arising from the Proposed Scheme on parking and loading, where facilities are identified to be heavily used, is defined as a change for more than four consecutive weeks in any 12 month period of:

- a predicted increase of 10 spaces or more, or 10%, whichever is the greater, in on-street parking demand;
- a loss of any designated on-street or off-street spaces, including spaces for disabled persons, buses, taxis, doctors, ambulances, police vehicles and car club bays;
- a loss of 10 or more, or 10%, whichever is the greater, of on-street parking including restricted on-street parking (such as residents' parking bays) and of private off-street car parking spaces;
- a loss of 10 or more, or 10%, whichever is the greater, off-street station car parking spaces;

²⁹⁶ Where more than 3 years accident data are available, then the number of accidents should be pro-rated to represent three years' worth of data e.g. if five years accident data were available the number of accidents would be multiplied by 3/5

- a loss of 10 or more, or 10%, whichever is the greater, pedal or motorcycle parking spaces; and
- a loss of 10% or more designated loading bay spaces or facilities.

Waterways

- 19.6.33 British Waterways' (now the Canal & River Trust) document Third Party Works' Procedures, Section 2, Code of Practice²⁹⁷ (Sections 4.1 - 4.3) identifies their requirements that need to be followed in relation to works affecting the navigation or amenity of canals. In summary, these are that generally no stoppages of the canal or navigation or towpath will be allowable, except for technical reasons. Stoppages must be discussed and agreed in advance with the Canal & River Trust and the duration of stoppages must be minimised. For the purpose of the ES, a significant stoppage is defined as occurring when an unbroken stoppage exceeding six weeks in duration is required, as this is when specific arrangements regarding the transfer of boats around the works by road may be required.
- 19.6.34 The Canal & River Trust also require that towing paths must remain open wherever possible. If a diversion is unavoidable, these should be localised. They may be used by the Canal & River Trust's maintenance plant and be of a standard to allow continued use by existing visitors – walkers, anglers, people with disabilities, cyclists etc. Only as an unusual event would towing paths be permitted to be used for access to the temporary and permanent works for the Proposed Scheme because of conflict with visitors and the unsuitability of the towing path for vehicular use. Impacts on pedestrians, cyclists, mobility impaired persons and equestrians using the towing paths will be assessed in relation to the vulnerable road user and ambience heading and associated criteria.

Significance criteria for operational assessment

- 19.6.35 The criteria outlined below will be used to assess the significance of traffic and transport impacts during the operational phase of the Proposed Scheme.

Public transport delay

- 19.6.36 Significant permanent impacts on journeys by bus and heavy and light rail affected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results; and are defined as any of the following:
- changes of more than 10% in a majority of journey times by any public transport mode;
 - a change in journey distances by bus of more than 400m in urban areas and 1km in rural areas;
 - a relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area; and
 - a relevant change to service frequency, capacity, loss of through connections or reduction in hours of operation.

²⁹⁷ British Waterways (2012), *Third Party Works' Procedures Section 2 Code of Practice*, British Waterways

Station/interchange impacts

19.6.37 Stations/ interchanges within the Proposed Scheme will be assessed for potential impacts. Impacts that may be caused by additional passengers of the Proposed Scheme arriving and departing at the stations/interchanges will be assessed to identify any changes in forecast numbers of additional passengers. Where the change in forecast passenger numbers is expected to be minor, no further assessment will be undertaken. Where it is considered that any change may have a significant effect, further assessment will be undertaken taking account of:

- forecast numbers of additional passengers;
- local transport conditions at each location;
- resulting increases in congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme; and
- any loss of physical linkage for the next stage of the journey.

19.6.38 The results from the traffic and transport assessment and modelling will be used to identify if there are any significant journey time, interchange and accessibility changes for travellers.

Traffic flows and delays to vehicle occupants

19.6.39 A significant change in driver and vehicle passenger delay will be defined as any of the following:

- a permanent diversion that results in an increase in journey length of more than 1km;
- where a significant change in delay relating to junction congestion resulting from the operation of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. This will be measured either as the forecast ratio of flow to capacity or degree of saturation. The junctions for consideration will be discussed with the local Highways Authority; and
- where there is a change in traffic flow along a road link and the capacity of that link is constrained to a greater extent than the junctions along it, then a similar approach will be used to assess potential delays to road users.

Vulnerable road users

19.6.40 Vulnerable road users, which include pedestrians, cyclists and equestrians, are affected by traffic related severance, severance caused by extended travel distances or broken links (barriers to movement) and changes to amenity and ambience.

Traffic related severance

- 19.6.41 A change in traffic levels can result in changes to traffic-related severance for non-motorised road users, particularly pedestrians using or seeking to cross a road. A significant change is defined as:
- a 10% increase change in peak hour two-way traffic flows where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas; and
 - a 30% increase in the average daily two-way traffic flows where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas.
- 19.6.42 Where HGV traffic, including HS2 related traffic, is less than 10% of total traffic, the significance level of any adverse effect would be reduced such that, for example, what would otherwise be assessed as a major effect would be considered to be a moderate effect.
- 19.6.43 Where the road affected by increased traffic levels is not, in any case, suitable for pedestrians crossing (such as a high speed dual carriageway) or safe and adequate crossing points exist, increased traffic levels would not generally be considered significant in relation to traffic-related severance for non-motorised users.

Non-traffic related severance, amenity and ambience

- 19.6.44 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Accidents and safety

- 19.6.45 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Parking and loading

- 19.6.46 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Waterways

- 19.6.47 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

19.7 Assumptions

19.7.1 The following assumptions are relevant to the traffic and transport assessment:

- operational patterns and capacities of the Proposed Scheme;
- number of train services associated with the Proposed Scheme;
- change in operational patterns and stations serviced by other operators;
- changes to both temporary and permanent PRoW; and
- construction related volumes (HGV and other) and workforce trips.

19.7.2 The traffic and transport assessment will require a number of assumptions to be made, including:

- committed developments and transport schemes;
- socio-economic forecasts (e.g. population, employment and economic conditions);
- demand forecasts; and
- travel characteristics including:
 - modal share of trips;
 - traffic flows;
 - public transport passenger flows;
 - traffic speeds and congestion; and
 - journey times.

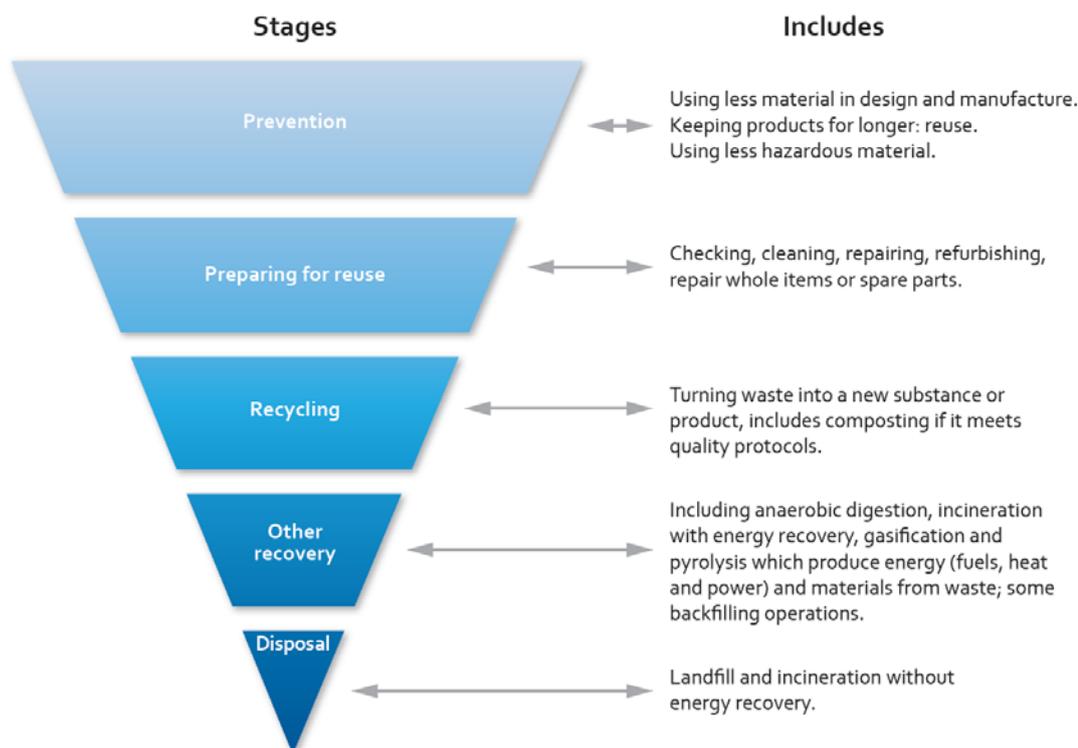
20 Waste and material resources

20.1 Introduction

- 20.1.1 This section of the SMR covers waste and material resources which includes the environmental topic areas of solid waste and the beneficial reuse of materials during construction and operation of the Proposed Scheme.
- 20.1.2 Liquid waste such as wastewater from dewatering operations is covered in Section 21 (Water resources and flood risk) of this SMR. Other liquid waste, such as waste oil, will not be considered as it will be insignificant compared to solid waste. It is typically being recovered as the landfill disposal of liquid waste was banned in 2007.
- 20.1.3 The consideration of material resources in the context of this SMR comprises maximising the beneficial reuse of materials arising from the construction of the Proposed Scheme (e.g. excavated material). Only if excavated material is not required or is unsuitable for the construction of the Proposed Scheme will it potentially become waste.
- 20.1.4 The likely significant environmental effects from the use of materials (e.g. aggregate, concrete, brick and steel) for the construction of the Proposed Scheme will not be addressed in the ES.
- 20.1.5 Safeguarding and extraction of mineral resources located along the route of the Proposed Scheme will be considered as part of the route engineering design, and construction logistics, as well as within Section 14 (Land quality).
- 20.1.6 The principal objective of sustainable waste and material resource management is to use material resources more efficiently, thereby preventing and reducing the amount of waste generated as well as minimising the quantity of waste that requires final disposal to landfill as a last resort. This will include incorporating circular economy principles, where practicable, to prevent waste generation and extracting the maximum value from resources whilst in use, then recovering/regenerating products and materials at the end of each service life²⁹⁸.
- 20.1.7 Where waste is generated, HS2 Ltd proposes that it will be dealt with in line with the Government's waste hierarchy (see Figure 15), which is a guide to sustainable waste and material resource management, and implements the EU Waste Framework Directive²⁹⁹.

²⁹⁸ Waste and Resources Action Programme (2017), *WRAP and the circular economy*. Available online at: <http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy>

²⁹⁹ The EU Waste Framework Directive was adopted on 20 October 2008, signed on behalf of the European Parliament and the Council on 19 November 2008, and published in the Official Journal of the European Union on 22 November (L312/3) as Directive 2008/98/EC. The revised WFD entered in to force on 12 December 2008. Available online at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:EN:PDF>

Figure 15 - The Government's Waste Hierarchy³⁰⁰

20.1.8 The waste hierarchy generally describes a priority order of what constitutes the best overall environmental option for the management of waste. It advocates the use of disposal only as a last resort, due to the loss of finite resources and the range of potential adverse environmental effects associated with its use, such as loss of valuable land resources, GHG emissions, and nuisance effects (e.g. dust and odour emissions).

20.1.9 The following types of waste to be generated by construction of the Proposed Scheme will be considered in the assessment:

- excavation wastes;
- demolition wastes;
- construction wastes; and
- worker accommodation site waste.

20.1.10 The following types of waste to be generated by operation of the Proposed Scheme will be considered in the assessment:

- railway station and train waste;
- rolling stock maintenance waste;
- track maintenance waste; and
- ancillary infrastructure waste.

³⁰⁰ DEFRA (2011), *Government Review of Waste Policy in England 2011*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69401/pb13540-waste-policy-review110614.pdf (Accessed 8 May 2017).

20.2 Establishment of baseline and definition of survey

20.2.1 A baseline will be developed for waste and material resources as part of the ES. Baseline conditions will be identified with respect to:

- types, quantities and management of construction, demolition and excavation waste arisings generated in England and within each of the county, unitary and/or former regional planning jurisdictions through which the route of the Proposed Scheme will pass;
- types, quantities and management of commercial and industrial waste generated in England and within each of the county, unitary and/or former regional planning jurisdictions through which the route of the Proposed Scheme will pass; and
- availability (types and capacity) of waste infrastructure within each of the county, unitary and/or former regional planning jurisdictions through which the route of the Proposed Scheme will pass.

20.2.2 The local area will be defined as the relevant unitary or county council or combined authority of the recognised regional areas, which include: East Midlands; Yorkshire and the Humber; and North West³⁰¹. Waste planning authorities are usually constituted at a county or unitary authority (e.g. most cities and larger towns) level, sometimes operating as combined authorities.

Local and regional baseline - waste arisings

20.2.3 Data on construction, demolition and excavation waste arisings for the route of the Proposed Scheme will be identified as part of baseline data gathering where this information exists using information from, for example, the Environment Agency and other public sources.

20.2.4 Data on commercial and industrial waste generated for the route of the Proposed Scheme will be identified as part of the baseline data gathering where this information exists. Sources of information will include:

- operational waste data from train operating companies, where available; and
- operational waste data for existing railway stations along the route of the Proposed Scheme (e.g. Birmingham New Street and Crewe) and rail stabling and maintenance depots operated by Network Rail, where available.

Local and regional baseline - waste management infrastructure capacity

20.2.5 Information on the availability of waste management infrastructure will be identified as part of the baseline data gathering from published sources of information and in consultation with the relevant waste planning and disposal authorities. Sources of

³⁰¹ Local Government Boundary Commission for England (2017). Available online at: www.lgbce.org.uk

information that will be used to provide this information include, but will not be limited to:

- Defra Waste and Recycling Statistics³⁰²;
- Environment Agency Waste Data and Information³⁰³; and
- relevant waste planning authority Waste and Minerals Development Plan Documents (e.g. Nottinghamshire Waste Core Strategy, Cheshire West and Chester Local Plan, and Wakefield Core Strategy).

20.2.6 Waste and minerals plans, together with any relevant supporting evidence and up to date waste capacity information held by the Environment Agency, will be used to indicate where and how much landfill void space is likely to be available during construction (2023 to 2033) and operation (2033) of the Proposed Scheme. This information will be used to assess whether or not there is likely to be a shortfall of suitable landfill void space for the management of waste requiring off-site disposal to landfill.

20.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

20.3.1 Consultation responses on the Phase Two Sustainability Statement were reviewed and none were considered to alter the scope and methodology for the assessment of waste and material resources for the Proposed Scheme.

Engagement as part of the EIA process

20.3.2 Consultation will be undertaken primarily with the Environment Agency to confirm the previously agreed approach for reuse of excavated material and other materials resulting from construction is applicable to the Proposed Scheme, for example, in scheme-wide landscaping works such as construction of noise and landscape bunds.

20.3.3 Consultation will also be undertaken with county and unitary councils (i.e. the waste planning authorities) to identify and confirm the following:

- waste arisings used to inform the baseline and assessment of the likely significant environmental effects of waste;
- availability of waste infrastructure to be used to inform the baseline and assessment of the likely significant environmental effects of waste; and
- planning, development management and waste management policies to be considered during the assessment process; and particularly with respect to defining any mitigation measures required.

20.3.4 This information will be used to establish the baseline waste quantities, understand the future disposal capacity within the appropriate study area and to identify

³⁰² DEFRA (2013), *Statistics; Environment and wildlife statistics; Waste and recycling*. Available online at: www.defra.gov.uk/statistics/environment/waste/

³⁰³ Environment Agency; Waste Data Interrogator information. Available online at: <https://data.gov.uk/dataset/waste-data-interrogator-2015> and <https://www.gov.uk/government/statistics/waste-management-for-england-2015>

opportunities for reuse and recovery of excavation and demolition materials from the Proposed Scheme.

20.4 Key aspects of the Proposed Scheme for the topic

- 20.4.1 The construction of the Proposed Scheme will generate large quantities of excavated material and other aggregate materials mainly associated with the excavation of cuttings, cut and cover tunnels, bored tunnels, foundations and drainage, and if required borrow pits.
- 20.4.2 The demolition of existing commercial and residential buildings within the line of the route of the Proposed Scheme will generate demolition materials such as steel, concrete, timber and brick. The development of stations, rebuilding of highways and bridges and the construction of stabling and maintenance depots will also generate construction waste.
- 20.4.3 Waste may also arise from the interaction with operational and closed landfill sites, removal of fly-tipped waste, and management of contaminated land where present along the route: see Section 14 (Land quality).
- 20.4.4 Waste will be generated during the operation of the Proposed Scheme by passengers, railway staff and maintenance activities. Environmental effects associated with the management of this waste are likely to be relatively small compared with the management of excavated material that is surplus to the requirements of the Proposed Scheme during construction.

20.5 Scope of assessment

- 20.5.1 The likely significant environmental effects of solid waste generation and management associated with the Proposed Scheme will be assessed with respect to both the construction and operational phases. These effects may be negligible, beneficial or adverse dependent on the measures employed to prevent and/or manage the waste generated.

Construction

- 20.5.2 Construction effects will address the permanent, indirect impacts of solid waste that will be generated by earthworks, demolition and construction activities and that may require off-site disposal during the proposed construction period. Demolition materials will be generated as a result of site clearance works and from the demolition of buildings and other structures currently in existence along the route of the Proposed Scheme. Natural, uncontaminated and contaminated excavated material is likely to be generated as a result of construction of the Proposed Scheme. It is likely that the majority of the excavated material will comprise natural and inert soils.
- 20.5.3 The assessment of contaminated soils and materials is addressed in Section 14 (Land quality) of this SMR. The quantity and type of waste likely to be generated from contaminated land after remedial measures have been applied will be assessed and the impacts and effects assessed in the ES.
- 20.5.4 Solid waste is likely to be generated during the construction and fit-out of above ground structures such as new and redeveloped stations, stabling and infrastructure maintenance depots. Waste would also be generated by the construction and

installation of rail infrastructure components, including stations, tunnelling sections, the laying of new tracks and installation of line-side equipment, including new power supply connections and sub-stations.

- 20.5.5 Excavated material that can be used, in its natural state, for site engineering and restoration purposes will be excluded from the assessment of likely significant environmental effects of construction. This is in accordance with the scope of the EU Waste Framework Directive (2008/98/EC) and should reflect the incorporated mitigation measures considered during the design phase to prevent waste³⁰⁴. It is also assumed that such materials will meet the requirements of The Definition of Waste: Development Industry Code of Practice³⁰⁵. This industry Code of Practice has been developed to enable the transfer or reuse of excavated material, and provides a framework for proactively managing contaminated materials on the sites of production or their movement between sites. Consultation will be undertaken with the Environment Agency to confirm the approach adopted for Phases One and 2a, for the reuse of materials resulting from construction, remains applicable to this phase of the Proposed Scheme.
- 20.5.6 Borrow pits can provide a local source of the granular minerals (usually sand and gravel) required for the construction of the Proposed Scheme, for example, rail embankments. The resultant void can then be backfilled with suitable excavated material arising from construction of the Proposed Scheme. Consequently, they avoid the need for longer distance transport of both remote-won mineral and materials to an off-site deposition destination. Consultation will be undertaken with the Environment Agency and other relevant authorities to confirm the approach to be adopted regarding the location and restoration of borrow pits. Consequent effects on residential property and community infrastructure/organisations are addressed in Section 9 (Community).

Operation

- 20.5.7 Operational effects will address the permanent, indirect impacts of solid waste that will be generated and require off-site disposal to landfill during the first full year of operation of the Proposed Scheme. This includes solid waste that will be generated by passengers and staff at stations, and at staff depots and rail maintenance facilities. Waste will also be generated by passengers and staff on trains whilst these are in use along the route of the Proposed Scheme and from track maintenance works. The Proposed Scheme incorporates terminal stations (where train waste will be unloaded), such that train waste will be reported in the assessment recognising that some of this may have originated from Phase 2a.

Spatial scope

- 20.5.8 Waste and material resources will be assessed on a route-wide basis having regard to the local (i.e. counties or unitary authorities) and regional (i.e. former regional planning jurisdictions) areas along the route of the Proposed Scheme. The latter is

³⁰⁴ The scope of Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives excludes 'uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated'

³⁰⁵ Contaminated Land: Applications in Real Environments (CL:AIRE), (2011), *The Definition of Waste: Development Industry Code of Practice*, CL:AIRE

significant with respect to historical methods of waste infrastructure planning and capacity reporting.

Temporal scope

- 20.5.9 The temporal scope of the assessment will be 2023 to 2033, including commissioning, for construction (i.e. the proposed construction period) and 2033 for operation (i.e. the first full year of operation of the Proposed Scheme).

20.6 Assessment methodology

- 20.6.1 There is no recognised methodology or waste significance criteria to assess the likely significant environmental effects of solid waste generation from either construction or operation. The proposed assessment methodology is, therefore, based on EIA practitioners' professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects such as HS2 Phase One and Phase 2a.

- 20.6.2 The assessment will consider the types and quantities of solid waste that will be generated during construction and operation, and the severity of the likely significant environmental effects that may arise from the quantity of waste requiring disposal to landfill (this being the least preferred waste management option, with a finite usable capacity). The assessment will consider waste arisings and waste infrastructure capacity in county and unitary authorities through which the route of the Proposed Scheme will pass.

Legislation and guidance

- 20.6.3 The assessment will consider relevant waste management legislation, policies and guidance applicable to all buildings and infrastructure components along the route of the Proposed Scheme. This will include, but will not be limited to the legislation, policy and guidance set out within this section.

Legislation

- 20.6.4 The Environmental Protection Act 1990 defines the fundamental structure and authority for waste management and control of emissions into the environment. It outlines:
- definition of controlled waste;
 - requirements of the duty of care in respect of waste and transferral of waste; and
 - waste collection and waste disposal authorities and their roles.

- 20.6.5 The Waste (England and Wales) Regulations 2011 SI No. 988³⁰⁶ (as amended), which transpose the provisions of the EU Waste Framework Directive (2008/98/EC)³⁰⁷ into England and Wales.
- 20.6.6 The Controlled Waste (England and Wales) Regulations 2012 SI No. 811³⁰⁸ (as amended), which sets out the definition of controlled waste to which regulatory waste management controls apply.
- 20.6.7 The Environmental Permitting (England and Wales) Regulations 2016 (SI2016/1154, as amended (the 2016 Regulations) provide a consolidated system for permitting of waste operations and came into force on 1 January 2017. The 2016 Regulations will replace and revoke Environmental Permitting (England and Wales) Regulations 2010 SI No 675³⁰⁹ (as amended) with the exception of Regulations 1, 67 and 107.
- 20.6.8 The Hazardous Waste (England and Wales) Regulations 2005 SI No. 894³¹⁰ (as amended), which sets out the regime for the control and tracking of the movement of hazardous waste.
- 20.6.9 EU Landfill Directive 1999/31/EC, transposed into UK legislation through the Landfill (England and Wales) Regulations 2002 (as amended). These regulations require that landfill sites are classified into one of three categories (hazardous, non-hazardous and inert) dependent on the chemical composition of the waste that it may accept. Prior to disposal (if required), all waste must be pre-treated and waste producers must apply the waste hierarchy in the management of their wastes.
- 20.6.10 Following amendments made to Decision 2000/532/EC in December 2014, the List of Wastes (England) Regulations 2005 SI No. 895³¹¹ (as amended) has been revoked, in order to reflect changes to EU chemicals classifications. This Decision combines and simplifies existing provisions by establishing a single, integrated Community list of wastes in accordance with Directive 2008/98/EC, on waste. This list is commonly referred to as the European Waste Catalogue.
- 20.6.11 The Site Waste Management Plans Regulations 2008 SI No. 314³¹² were repealed on 1 December 2013, as part of the Defra Red Tape Challenge³¹³. The purpose of the site waste management plan was to identify opportunities to design out waste; as well as identifying the types and quantities of waste likely to be produced during construction; the opportunities for sustainable management of the waste to be identified; and to monitor and report on the actual management of these wastes throughout the construction period. HS2 Ltd will apply these principles to the construction of the Proposed Scheme ensuring an integrated approach to the design of the Proposed Scheme, aiming to maximise the beneficial reuse of excavated material where possible, and minimise the generation of waste, which will be facilitated through the implementation of the CoCP for the Proposed Scheme.

³⁰⁶ *The Waste (England and Wales) Regulations 2011* (SI 2011 No. 988). London, Her Majesty's Stationery Office

³⁰⁷ *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives*

³⁰⁸ *The Controlled Waste (England and Wales) Regulations 2012* (SI 2012 No. 811). London, Her Majesty's Stationery Office

³⁰⁹ *The Environmental Permitting (England and Wales) Regulations 2010* (SI 2010 No. 675). London, Her Majesty's Stationery Office

³¹⁰ *The Hazardous Waste (England and Wales) Regulations 2005* (SI 2005 No. 894). London, Her Majesty's Stationery Office

³¹¹ *The List of Wastes (England) Regulations 2005* (SI 2005 No. 895). London, Her Majesty's Stationery Office.

³¹² *The Site Waste Management Plans Regulations* (SI 2008 No. 314). London, Her Majesty's Stationery Office (2008). Accessed at: <http://www.legislation.gov.uk/ukxi/2008/314/contents/made>

³¹³ Department for Environment, Food and Rural Affairs; *Red Tape Challenge – Environment Theme Proposals March* (2012). Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69584/pb13728-red-tape-environment.pdf

Policy

- 20.6.12 The Waste Prevention Programme for England, 2013 sets a number of objectives to help people and organisations make the most of opportunities to save money by reducing waste. The development of a Waste Prevention Programme is a requirement of the Waste Framework Directive (2008/98/EC) and takes forward a commitment in the Government Review of Waste Policy in England 2011.
- 20.6.13 The Government Review of Waste Policy in England 2011 sets out the Government's long-term strategy for the prevention and management of waste in England. It follows the waste hierarchy approach set out in the EU Waste Framework Directive.
- 20.6.14 The National Planning Policy Framework³¹⁴ (NPPF), published on 27 March 2012, states in Paragraph 5 that waste policy will be set out in the National Waste Management Plan for England (2013). In terms of achieving sustainable development the NPPF identifies that minimising waste and pollution is a fundamental part of the environmental role of the planning system.
- 20.6.15 National Planning Policy for Waste (2014)³¹⁵ along with the National Waste Management Plan for England (2013)³¹⁶ sets out Government policy on waste planning, which is of relevance to the management strategy for solid waste generated during the construction and operation of the Proposed Scheme.
- 20.6.16 Local planning policy, such as Nottinghamshire and Nottingham Replacement Waste Local Plan³¹⁷, which sets out strategic planning policies for the management of waste generated in Nottinghamshire and the city of Nottingham, will be relevant along the route of the Proposed Scheme. Specifically, these policies seek to minimise the amount of waste generated, increase the reuse and recycling of waste and reduce waste to landfill.

Guidance

- 20.6.17 Relevant guidance includes the CL:AIRE³¹⁸ Definition of Waste: Development Industry Code of Practice, and the Waste and Resources Action Programme (WRAP) guidance and tools developed to achieve better resource efficiency in construction projects, such as designing out waste tools (e.g. The Designing out Waste Tool for Civil Engineering Projects and Net Waste Tool)³¹⁹.

Significance criteria

- 20.6.18 There are no recognised significance criteria against which direct and indirect waste effects for both the construction and operational phases of the Proposed Scheme can be assessed. As such, the criteria for the assessment have been derived from professional experience previously gained from the application of EIA to large-scale

³¹⁴ Department for Communities and Local Government (2012), National Planning Policy Framework Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

³¹⁵ Department for Communities and Local Government (2014), National Planning Policy for Waste, The Stationery Office (2014). Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/364759/141015_National_Planning_Policy_for_Waste.pdf

³¹⁶ Department for Environment, Food and Rural Affairs (2013), National Waste Management Plan for England, The Stationery Office. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf

³¹⁷ Nottinghamshire County Council, (2013), Nottinghamshire and Nottingham Replacement Waste Local Plan. Available online at: <http://www.nottinghamshire.gov.uk/planning-and-environment/waste-development-plan/part-1-waste-core-strategy>

³¹⁸ Contaminated Land: Applications in Real Environments. <http://www.claire.co.uk/>

³¹⁹ WRAP; Designing out Waste Tool, (2016), Available online at: <http://www.wrap.org.uk/content/designing-out-waste-tool-civil-engineering>

infrastructure projects (including Phase One and Phase 2a of HS2), which take into account:

- the net change in solid waste arisings overall as a result of the Proposed Scheme;
- the magnitude of the quantity of waste requiring landfill disposal; and
- the availability of landfill disposal capacity in the local and regional area.

20.6.19 Tables 51-53 set out the significance criteria to be used for the assessment of the likely significant environmental effects of solid waste generation; further details are provided in the Technical note Rationale for landfill significance criteria (as referenced in Annex A of this SMR).

Table 51 - Inert landfill significance criteria

Degree of significance	Inert landfill criteria
Major adverse	Net increase in waste arisings relative to the future baseline leading to a severe, national and regional scale reduction in inert landfill void space capacity. Need for additional large-scale waste treatment and/or disposal capacity of greater than 10,000,000 tonnes per annum. Effect may be judged to be of importance in the national planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making.
Moderate adverse	Net increase in waste arisings relative to the future baseline leading to regional scale reduction in inert landfill void space capacity. Need for additional medium-scale waste treatment and/or disposal capacity of between 2,000,000 to 10,000,000 tonnes per annum. Effect may be judged to be of importance in the regional planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the future baseline leading to local scale reduction in inert landfill void space capacity. Need for additional small-scale waste treatment and/or disposal capacity of up to 2,000,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the future baseline or reduction in landfill void space capacity for inert waste. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the future baseline resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure.

Table 52 - Non-hazardous landfill significance criteria

Degree of significance	Non-hazardous landfill criteria
Major adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to a severe, national and regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 250,000 tonnes per annum ³²⁰ . Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in decision-making.
Moderate adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 50,000 ³²¹ to 250,000 tonnes per annum. Effect may be judged to be of importance in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme leading to local-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional small-scale waste treatment and/or disposal capacity of up to 50,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the future baseline without the Proposed Scheme or reduction in landfill void space capacity for non-hazardous waste. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure.

Table 53 - Hazardous landfill significance criteria

Degree of significance	Hazardous landfill criteria
Major adverse	Net increase in waste arisings relative to the future baseline leading to a severe national and regional-scale reduction in hazardous waste landfill void space capacity. Need for additional large-scale hazardous waste disposal capacity of greater than 100,000 tonnes per annum ³²² . Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making process.
Moderate adverse	Net increase in waste arisings relative to the future baseline leading to regional-scale reduction in hazardous waste landfill void space capacity or need for additional medium-scale waste hazardous waste disposal capacity of between 20,000 to 100,000 tonnes per annum. Effect may be judged to be of importance in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.

³²⁰ Waste throughput capacity based on large-scale waste infrastructure project experience

³²¹ The waste throughput capacity of greater than 50,000 tonnes per annum has been selected with reference to the Department for Communities and Local Government (DCLG) (1999), *Circular 02/99: Environmental Impact Assessment*, DCLG; which states in Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA, under 'Installation for the disposal of non-hazardous waste' at A36: "...EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year..."

³²² Waste throughput capacity based on National Policy Statement for Hazardous Waste: A framework document for planning decisions on Nationally significant hazardous waste infrastructure (Defra), (2013). Paragraph 1.2.1 identifies the construction or alteration of a facility for the disposal of hazardous waste by landfill that exceeds 100,000 tonnes per annum to be nationally significant. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/205568/pb13927-hazardous-waste-policy-20130606.pdf.

Degree of significance	Hazardous landfill criteria
Minor adverse	Net increase in waste arisings relative to the future baseline leading to local-scale reduction in hazardous waste landfill void space capacity or need for additional small-scale hazardous waste disposal capacity of up 20,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the future baseline or reduction in landfill void space capacity. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in hazardous waste arisings and diversion of waste from landfill relative to the future baseline resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of hazardous waste treatment and disposal infrastructure.

Construction effects

- 20.6.20 The assessment will identify the types and quantities of solid waste forecast to be generated during each of the demolition, excavation and construction stages of the Proposed Scheme. It will also identify types and quantities of waste forecast to be generated by occupants of the worker accommodation sites during the overall construction programme. Quantification will be on the basis of survey information, using published waste generation rates or forecasting tools such as the WRAP Net Waste Tool.
- 20.6.21 Assumptions regarding the type and quantity of waste to be diverted from landfill via reuse, recycling and recovery will be applied. Following this, the type and quantity of demolition materials, excavated material, construction materials and worker accommodation site waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity in the designated study areas throughout the proposed construction period.
- 20.6.22 Further information regarding the waste forecasting and assessment methodology for construction effects is provided in the Technical note Waste forecast and assessment methodology (as referenced in Annex A of this SMR).

Operation effects

- 20.6.23 The assessment will identify the types and quantities of solid waste forecast to be generated during the first full year of operation of the Proposed Scheme. This forecast will be based on an assumption of maximum capacity of the Proposed Scheme and any effects will be assumed to be annual. Quantification may be on the basis of existing operational waste management performance data or using published operational waste generation rates for the relevant land use activities.
- 20.6.24 Assumptions regarding the type and quantity of waste to be diverted from landfill via reuse, recycling and recovery will be applied. Following this, the type and quantity of station and train waste, track maintenance waste and ancillary infrastructure waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity in the designated study areas throughout the proposed construction period.

Cumulative effects

- 20.6.25 Cumulative effects will be assessed qualitatively (based on professional judgment) taking into account other major development proposals along the route of the Proposed Scheme. The cumulative impacts of construction effects of Phase One and Phase 2a will be considered.
- 20.6.26 Further information regarding the waste forecasting and assessment methodology for operational effects is provided in the Technical note 'Waste forecast and assessment methodology' (as referenced in Annex A of this SMR).

Mitigation, enhancement and off-setting

- 20.6.27 Mitigation and enhancement for waste management during construction and operation will be considered in line with the waste hierarchy and residual environmental effects identified.

20.7 Assumptions

- 20.7.1 The assessment of likely significant environmental effects resulting from waste generated due to the interaction with operational and closed landfill sites, fly-tipped waste, hazardous materials and contaminated land present along the route will be covered in Section 14 (Land quality) of this SMR. This will also include hazardous materials. The off-site disposal to landfill of hazardous materials will be included in the waste and material resources assessment.
- 20.7.2 Assumptions will be required as to the proportion of solid construction and operational waste that would be diverted from landfill via reuse, recycling and recovery. This will be informed by information gathered at the time of the assessment as to any waste management measures proposed to divert waste from landfill. Alternatively, landfill diversion performance for other similar rail-related projects, such as Crossrail, will be considered.
- 20.7.3 Waste transferred off-site would be handled by a registered waste carrier authorised by the Environment Agency and taken to a permitted or exempt facility authorised to receive and handle that waste under Duty of Care arrangements (i.e. this assessment does not consider the likely significant environmental effects of any illegal waste management and disposal). It has been assumed that all construction and operational activities will be in accordance with the relevant environmental regulatory requirements.
- 20.7.4 The assessment of likely significant environmental effects associated with waste-related transport, including the inter-related effects of air quality, climate, sound and noise will be addressed in Section 7 (Air quality), Section 8 (Climate change), Section 18 (Sound, noise and vibration) and Section 19 (Traffic and transport) of this SMR.

21 Water resources and flood risk

21.1 Introduction

21.1.1 This section of the SMR covers water resources and flood risk which includes the environmental topic areas of surface water and groundwater bodies, including their associated water resources, water quality, hydromorphology, hydrology and flood risk. Surface water includes natural water bodies such as rivers, streams and lakes, and artificial water bodies such as canals, land drainage systems, sewers (foul, surface water and combined) and reservoirs. Groundwater includes all water within soil and rock below the ground surface, within the saturated and unsaturated zones.

21.2 Establishment of baseline and definition of survey

21.2.1 The baseline conditions will be those at the time of undertaking the assessment (i.e. documented during the baseline data collection phase). Given the variable nature of the water environment through time, it is not usually feasible to set a baseline for the future (i.e. the time of construction or operation of the Proposed Scheme). Where projections of climate change effects predict a future trend, a future baseline condition will be identified based on current guidance. This future baseline is assessed as part of the in-combination climate change impacts and resilience assessments in the Climate change section (Section 8).

21.2.2 The western leg of Proposed Scheme would incorporate over 70 separate watercourse and canal crossings, including five currently navigable canals. The eastern leg of the Proposed Scheme would involve over 280 separate watercourse and canal crossings, including seven navigable watercourse crossings and four formerly navigable watercourse crossings which may require safeguarding for future restoration. The majority of these watercourses are associated with floodplain zones with elevated levels of flood risk. It is proposed to cross larger watercourses using viaducts whilst many of the smaller ordinary watercourses are likely to be culverted beneath the route.

21.2.3 Permanent diversion of over 30 watercourses along the preferred route eastern leg is envisaged at this stage, including Bramcote Brook, which is a main river. A diversion is currently proposed of the River Erewash at East Midlands Hub station. There is a potential diversion of the River Medlock, which is a main river, at Manchester Piccadilly station on the western leg.

21.2.4 The western leg intersects a number of groundwater source protection zones (SPZs), and passes close to several water supply boreholes. At Pocket Nook, the route passes in cutting through an area of SPZ2, potentially affecting abstraction from a nearby borehole. The route also passes through an extensive SPZ associated with several water supply boreholes in the Golborne area.

21.2.5 There are no occurrences on the eastern leg of any cuttings or tunnels within SPZ1 or SPZ2. The proposed route passes close to four non-potable water supply boreholes, three for industrial use and one for agricultural use.

21.2.6 Baseline conditions will be defined using existing information, supplemented by addition surveys and modelling where appropriate, as follows:

- floodplain extent (1 in 20, 100, 100 + climate change and 1,000 year return periods);
- floodplain depth/velocity/hazard (1 in 20, 100, 100 + climate change and 1,000 year return periods);
- surface water flood extent (1 in 30, 1 in 100 and 1 in 1,000 year);
- surface water quantity and quality and Water Framework Directive³²³ (WFD) Status (physico-chemical and hydromorphology quality elements³²⁴);
- surface water designations, licences/consents;
- surface water/groundwater interactions;
- hydrogeology, including geology, aquifer hydraulic parameters, groundwater level and flow directions;
- groundwater quality and quantity (including WFD quantitative and chemical quality elements);
- groundwater yield, licences/consents;
- groundwater dependent terrestrial ecosystems (GWDTEs); and
- hydrometeorological conditions and variability arising from climate change.

21.2.7 The detailed field survey requirements to refine this baseline will be defined based on desk study review of all existing information held by the consultees outlined in Section 21.3 below followed by a walkover survey of key features along the route. It is foreseen that additional topographical survey will be required in order to better define flood risks. Specialist WFD surveys will also be undertaken, where required and where land access is possible. These surveys will be undertaken in collaboration with ecology specialists.

³²³ European Commission (EC) (2000) *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*. Strasbourg, European Parliament and European Council

³²⁴ Biological quality elements are considered within the ecology assessments of the EIA, but consideration of all quality elements will be included in a WFD compliance assessment

Baseline data and sources

21.2.8 Table 54 sets out the baseline data to be collected (or generated if applicable, e.g. flood risk), along with the likely source.

Table 54 - Baseline data and sources

Baseline data	Sources
Floodplain extent, depth, velocity, hazard	Targeted hydraulic modelling or calculations, making best use of existing information held by the Environment Agency, Lead Local Flood Authorities (LLFAs), Canal & River Trust and water companies. Information contained within local planning authorities' Strategic Flood Risk Assessments and Surface Water Management Plans. Guidance on hydro-meteorological conditions and variability arising from climate change. Topographical surveys of the channel and WFD surveys. Site walkovers. Groundwater and hydrogeological data from the Environment Agency, British Geological Survey and water companies
Surface water flood extents	
Groundwater level and flow directions	
Groundwater yield	
Aquifer extent (vertical and horizontal) and hydraulic parameters	
Surface water quality, groundwater quality	Targeted water sampling and testing at accredited laboratory. Information held by the Environment Agency including within River Basin Management Plans, Local Authorities, Natural England and water companies
Surface water designations	Information held by the Environment Agency and Natural England
Groundwater dependent terrestrial ecosystems	
Surface water licences/consents/permits	Information held by the Environment Agency Information held by the Environment Agency Information held by local authorities
Groundwater licences/permits	
Unlicensed abstractions	
Hydro-meteorological data, as needed	Met Office, Environment Agency

21.3 Consultation and engagement

Responses to consultation on the Sustainability Statement (2013 and 2016)

21.3.1 The following key organisations responded to the consultation on the Phase Two Sustainability Statement:

- Environment Agency;
- local authorities (including LLFAs);
- Canal & River Trust;
- Natural England;
- the Inland Waterways Association;

- water and sewerage companies; and
- water supply companies.

21.3.2 The EIA will take concerns raised by these organisations into consideration as part of the impact assessment.

Engagement as part of the EIA process

21.3.3 As part of the EIA process, the following organisations as a minimum will be consulted:

- Environment Agency;
- local authorities (including LLFAs);
- Internal Drainage Boards (IDBs);
- Canal & River Trust;
- Natural England;
- water and sewerage companies;
- water supply companies; and
- landowners.

21.4 Key aspects of the Proposed Scheme for the topic

21.4.1 The following aspects of the Proposed Scheme are of particular relevance to this topic:

- sections of the Proposed Scheme are located in Flood Zone 2 (land assessed as having between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability of river flooding) and Flood Zone 3 (land assessed as having a 1 in 100 (1%) or greater annual probability of river flooding), as well as areas at heightened risk of surface water flooding. It also passes through areas that are at potential risk of inundation from reservoirs in the event of a dam failure. Flood risk from all sources will be considered, including impacts on flood risk during construction and operation of the Proposed Scheme, taking account of potential climate change impacts;
- the assessment will consider whether existing drainage systems will be impeded. Where this is the case, the assessment will identify appropriate mitigation measures;
- the assessment will consider the likely effects of increases in impermeable area on surface water flood risks and appropriate mitigation measures will be identified;
- physical modification of some water bodies will be required, including diversions, realignments and culverting operations. The assessment will incorporate summary information from a separate WFD compliance assessment demonstrating how any related impacts would be reduced as

far as reasonably practicable;

- potential impacts on the hydrology and hydrogeology of water dependent habitats (aquatic and terrestrial) will be assessed in close consultation with the ecology teams and appropriate mitigation identified where necessary;
- potential impacts on water quality within the groundwater and surface water bodies potentially affected by the Proposed Scheme will be considered, as well as the risk of pollution from the construction and operation of the Proposed Scheme. Appropriate measures will be identified to mitigate these effects as far as is reasonably practicable; and
- sections planned to be in cutting or in tunnel may require temporary or permanent groundwater dewatering. The assessment will consider the likely effects on the quality and yield of the aquifer's protected rights and how these can be mitigated.

21.4.2 Environmental benefits that may result from the Proposed Scheme include the creation of new landscaped water features and diverted/realigned watercourses of enhanced ecological value. There may also be opportunities to reduce flood risk.

21.5 Scope of assessment

Spatial scope

21.5.1 The spatial scope of the assessment will be based upon the identification of surface water and groundwater features within 1km of the centreline of the Proposed Scheme, except where there is clearly no hydraulic connectivity with the Proposed Scheme. In urban areas the distance will be 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Consideration will nevertheless be given to potential hydraulic connectivity to very high value receptors beyond these distances. Professional judgement will then be used to decide whether additional assessment of these is required.

21.5.2 Where works extend more than 200m from the centreline, for example at stations and depots, professional judgement will be used in selecting the appropriate limit to the extension in spatial scope required.

21.5.3 Exceptions to the above will be required in some locations where:

- major groundworks are required (e.g. tunnels and associated portals);
- infrastructure is to be placed within floodplains;
- the route of the Proposed Scheme is within a groundwater SPZ or overlies a Principal aquifer where the abstraction may be over 1km away;
- pathways are identified to the wider environment (e.g. canal or stream routing to distant river or highly transmissive aquifer);
- the route of the Proposed Scheme intersects the inundation area of a reservoir; and

- other scenarios, as deemed appropriate when the route is reviewed in line with data received.

21.5.4 When considering the possible effects of the Proposed Scheme on a watercourse or aquifer, the assessment will consider the possible effects throughout the catchment of the affected watercourse or the wider aquifer extent.

Temporal scope

21.5.5 The effect of construction impacts will be assessed up to when the Proposed Scheme is due to open. The permanent effects of the scheme will be assessed for the year when the Proposed Scheme goes into operation. Where impacts are likely to vary with time, for example where features such as wetlands will take time to become fully established, the temporal scope will be adjusted accordingly.

21.5.6 The methodology and timeframes for assessing climate change impacts on flood risk will align with the latest guidance issued by the Environment Agency³²⁵. These assessments will inform the in-combination climate change impact and resilience assessments in Section 8 (Climate change) of this SMR.

21.6 Assessment methodology

Legislation and guidance

21.6.1 The following legislation, policy and guidance will be taken into account in the assessment of water resources and flood risk. Assessment of the Proposed Scheme and its impacts in relation to the provisions of this legislation and policy will form an essential step in the assessment of the significance of effects associated with the Proposed Scheme.

- EU WFD³²⁶; EU Groundwater Directive³²⁷; EU Floods Directive³²⁸ and associated UK Flood Risk Regulations 2009³²⁹;
- EU Habitats Directive³³⁰;
- Flood and Water Management Act³³¹; Water Act³³²; the Environmental Protection Act 1990; the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009³³³; Land Drainage Act³³⁴;
- water and flood risk local planning policy for local authorities along the

³²⁵ Environment Agency (2017), Flood Risk Assessments: climate change allowances. Available online at: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

³²⁶ *The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (SI 2003 No. 3242)*, London: The Stationery Office.

³²⁷ Official Journal of the European Union (2006), *Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration*, European Commission.

³²⁸ Official Journal of the European Union (2007), *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*, European Commission.

³²⁹ *The Flood Risk Regulations 2009 (SI 2009 No. 3042)*. London: The Stationery Office.

³³⁰ Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Strasbourg, European Parliament and European Council

³³¹ *Flood and Water Management Act 2010*. London: The Stationery Office.

³³² *The Water Act 2003 (Commencement No. 11) Order 2012*. London: The Stationery Office.

³³³ *Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 (SI 2009/3104)*. London: The Stationery Office.

³³⁴ *Land Drainage Act 1994*. London: The Stationery Office.

route of the Proposed Scheme (saved local plan policies and adopted Local Development Framework policy);

- government groundwater protection guides covering: requirements, permissions, risk assessments and controls³³⁵; and
- Non statutory technical standards for sustainable drainage systems, Defra, 2015³³⁶.

21.6.2 The assessment will also need to have due regard to the NPPF and its Technical Guidance, and also to Environmental Permitting Regulations and amendments³³⁷.

Significance criteria

21.6.3 The significance of an effect is defined by the magnitude of the impact and the overall value of the receiving water body or receptor (the 'attribute') (see Table 55 - Significance of effects). Tables 56 – 57 have been adapted from the tables in the DMRB (Volume 11.3.10: Road Drainage and the Water Environment). Significant effects on the water environment are those that have a moderate significance of effect or greater.

Table 55 - Significance of effects

Value of receptor	Magnitude of impact			
	Negligible	Minor	Moderate	Major
Very high	Negligible - not significant	Moderate adverse - significant	Major adverse - significant	Major adverse – significant
High	Negligible - not significant	Moderate adverse - significant	Moderate adverse - significant	Major adverse – significant
Moderate	Negligible - not significant	Minor adverse - not significant	Moderate adverse - significant	Moderate adverse - significant
Low	Negligible - not significant	Negligible - not significant	Minor adverse - not significant	Minor adverse - not significant

³³⁵ Environment Agency and Defra (2017) *Groundwater protection guidance*. Available online at: (<https://www.gov.uk/government/collections/groundwater-protection>),

³³⁶ Defra (2015), *Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems, 2015*. Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

³³⁷ *The Environmental Permitting (England and Wales) (Amendment) Regulations 2012* (SI 2013 No. 390). London: The Stationery Office.

21.6.4 Table 56 provides an indication of possible impacts and their magnitude. These may be reported as either beneficial or adverse. The list is not exhaustive and is intended as a guide.

Table 56 - Magnitude of possible impacts

Magnitude	Criteria	Examples
Major	<p><u>Adverse</u>: Loss of an attribute and / or quality and integrity of an attribute</p> <p><u>Beneficial</u>: Creation of new attribute or major improvement in quality of an attribute</p>	<p>Adverse: Increase in peak flood level* (> 100mm); loss of a fishery; <i>deterioration</i> in surface water ecological or chemical WFD element status or groundwater qualitative or quantitative WFD element status.</p> <p>Beneficial: Creation of additional flood storage and decrease in peak flood level* (> 100mm); increase in productivity or size of fishery; <i>improvement</i> in surface water ecological or chemical WFD element status; <i>improvement</i> in groundwater qualitative or quantitative WFD element status.</p>
Moderate	<p><u>Adverse</u>: Loss of part of an attribute or decrease in integrity of an attribute</p> <p><u>Beneficial</u>: Moderate improvement in quality of an attribute</p>	<p>Adverse: Increase in peak flood level* (> 50mm); partial loss of fishery; measurable decrease in surface water ecological or chemical quality or flow <i>with potential for deterioration in WFD element status</i>. Reversible change in the yield or quality of an aquifer, such that existing users are affected, <i>with potential for deterioration in WFD element status</i>.</p> <p>Beneficial: Creation of flood storage and decrease in peak flood level* (> 50mm); <i>measurable increase in surface water ecological or chemical quality or flow with potential for WFD element status to be improved</i>. <i>Measurable increase in the yield or quality of an aquifer, benefiting existing users, with potential for WFD element status to be improved</i>.</p>
Minor	<p><u>Adverse</u>: Measurable change to the integrity of an attribute</p> <p><u>Beneficial</u>: Measurable increase, or reduced risk of negative effect to an attribute</p>	<p>Adverse: Increase in peak flood level*(> 10mm); measurable decrease in surface water ecological or chemical quality or flow; decrease in yield or quality of aquifer, not affecting existing users or changing any WFD element status.</p> <p>Beneficial: Creation of flood storage and decrease in peak flood level* (> 10mm); measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD element status.</p>
Negligible	No change to integrity of attribute	Negligible change to peak flood level* (< +/- 10mm); discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity.

* Peak flood level for floods up to and including a 1% annual probability event, including climate change. Where access or egress routes are affected, the magnitude of the impact will be defined by the change in the Flood Hazard Rating as defined in Defra/Environment Agency report FD2320

21.6.5 Table 57 provides an indication of the value of receiving water body or receptor. The examples, and in particular the specified Q₉₅³³⁸ flow thresholds, are not exhaustive and are intended as a guide.

Table 57 - Examples of the value of possible water bodies or receptors

Value	Criteria	Examples
Very high	Nationally significant attribute of high value	Watercourse with a Q ₉₅ ²⁹⁹ flow $\geq 1.0 \text{ m}^3/\text{s}^*$, public drinking water supply, within a Principal aquifer, essential infrastructure or highly vulnerable development**
High	Locally significant attribute of high value	Watercourse with a Q ₉₅ flow $> 0.01 \text{ m}^3/\text{s}^*$, industrial/ agricultural water abstraction $> 100 \text{ m}^3/\text{d}$, private drinking water supply, Principal aquifer, more vulnerable development**
Moderate	Of moderate quality and rarity	Watercourses with a Q ₉₅ flow $> 0.002 \text{ m}^3/\text{s}$ to $\leq 0.01 \text{ m}^3/\text{s}^*$, Secondary aquifer, less vulnerable development**
Low	Lower quality	Watercourses with a Q ₉₅ flow $\leq 0.002 \text{ m}^3/\text{s}^*$, surface water sewer, minor pond or ditch, non-aquifer, water compatible development**

* based on watercourse Q₉₅ flow estimate at location of Proposed Scheme and intended as a guide only.

** as defined in Table 2 of the Flood Risk section of the Technical Guidance to the NPPF.

Construction effects

21.6.6 The following possible effects arising from the construction of the Proposed Scheme will be considered:

- effects on the water quality of receiving surface water and groundwater bodies due to the deposition or spillage of soils, sediment, fuels or other construction materials, or through mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff;
- effects on river or stream flows during temporary disruption, discharges or diversion of surface water or groundwater flows, during adjacent works;
- effects on GDWTE and water bodies that support habitats and ecosystems;
- effects on aquifers from groundworks, abstractions/dewatering, discharges to ground, and obstructions to groundwater flow by tunnelling, cuttings, cut offs etc.;
- effects on areas with critical drainage problems (as notified by the Environment Agency, LLFAs and local planning authorities);
- effects of liquid wastes generated by construction activities on the environment;

³³⁸ Q₉₅ is defined as the flow in a watercourse that is equalled or exceeded for 95% of the time.

- effects on flood risk receptors, flood defence assets and schemes;
- effects on water abstractors; and
- effects on local flood risk due to uncontrolled site runoff, deposition of silt, sediment in drains or ditches, temporary diversion of rivers, sewers or ditches, temporary earthworks affecting natural drainage paths.

21.6.7 The effects on groundwater, both in quantitative and qualitative terms, will be assessed using a suitable combination of professional judgement, analytical calculation and computational modelling. This will include the impacts of any contaminated land causing an effect on groundwater quality; see Section 14 Land quality of this SMR.

21.6.8 The assessment of flood risk will be made using the Planning Practice Guidance and associated Environment Agency guidance. Flood risk assessments will also be prepared as separate, stand-alone documents, but these will similarly inform the ES and mitigation proposed.

21.6.9 Where significant adverse effects are identified on groundwater, the design will be amended as far as is reasonably practicable to mitigate the effects, for example by reducing the effect of dewatering through use of cut off walls or by recharging water to aquifers. In some cases, groundwater sources may need to be augmented with alternative supplies or boreholes deepened, with agreement from owners.

21.6.10 Potential ecological and human health impacts associated with changes in the water environment will be considered by those undertaking the ecology and land quality assessments, see Sections 10 and 14 respectively of this SMR.

21.6.11 Assessment of the effects arising from construction of the Proposed Scheme will take into account the requirements of the CoCP and will include proposals for ongoing environmental monitoring.

Operational effects

21.6.12 The following examples of possible effects will be assessed:

- effects on water quality due to the contamination of groundwater or surface waters from both routine discharges from the railway or associated infrastructure and from accidental spillages;
- effects on water bodies that support habitats and ecosystems; and
- effects on water abstractors.

21.6.13 When assessing the effects on the quality of surface watercourses, details of the receiving watercourse and an estimate, based on a combination of expert judgement and analysis, for the quantity of pollution that could be released during routine operations, will be used. Estimates will generally be conservative and assume little or no dispersion. An assessment will be made of the risk of accidental spillages and the possible effects on water quality.

- 21.6.14 Effects on surface waters could be mitigated as far as reasonably practicable by the use of sustainable drainage systems. Pollution risk could similarly be mitigated through pollution prevention measures.
- 21.6.15 The assessment will include recommendations for ongoing environmental monitoring of measures designed to mitigate the impacts of significant effects.
- 21.6.16 A separate stand-alone, route-wide WFD compliance assessment will be undertaken. This assessment will be a comprehensive review of the impacts of the Proposed Scheme on the aspects of the water environment covered by WFD legislation. It will outline measures that would be taken to ensure that the Proposed Scheme achieves compliance with this legislation. The outputs from the WFD compliance assessment will help to inform the ES of issues related to impacts on water quantity, quality and hydromorphology. These effects will be reported in the water resources and flood risk section of the ES. The WFD compliance assessment will also be used to inform the ES of issues related to impacts on ecological habitats that are dependent on surface water and/or groundwater. These effects will be reported in the ecology section of the ES. Discussions are currently in progress with the Environment Agency to assess whether there is further scope to refine the manner in which impacts and effects related to WFD compliance issues are reported in the ES. It is possible that minor amendments may be made to the SMR issued for consultation as a result of these discussions.

Cumulative effects

- 21.6.17 Cumulative effects may occur due to the combination of one or more separate impacts. These may be due to the coincidence of impacts or the cumulative impact of separate events occurring at different times. The following are examples of possible cumulative effects that may be assessed:
- impacts from the Proposed Scheme will be assessed together with impacts from adjacent development, such as flood defence schemes, to derive an assessment of the cumulative effects from all the schemes;
 - accumulation of minor, moderate or major impacts on a river or aquifer that, when considered together, constitute a major impact leading to a significant effect; and
 - a minor impact on river hydrology which, together with a minor impact on the riparian habitat (an ecological impact), when considered together, constitute a major impact leading to a significant effect.

21.7 Assumptions

- 21.7.1 The assessment will assume that track drainage will, wherever reasonably practicable, be kept separate from existing land drainage that crosses the route.
- 21.7.2 Discharges of surface water from the new infrastructure will, wherever reasonably practicable, be managed in accordance with the principles of the non-statutory technical standards for sustainable drainage systems (Defra, 2015) and reference to CIRIA C753v2 The SuDS Manual³³⁹.
- 21.7.3 Effects on watercourses that are affected by third party abstractions and discharges will be taken into consideration where records are available.

³³⁹ The SuDS Manual, CIRIA C753 (2015)

Part C

22 Structure of the Environmental Statement

- 22.1.1 There is no legally prescribed form or structure for the contents of an ES. The intention is that it will provide an assessment of the environmental impacts of the Proposed Scheme in accordance with the requirements of the EIA Regulations, incorporating the requirements of the EIA Directive 2014. The ES will be structured in a logical and comprehensible manner, taking account of the need for the information to be accessible, understandable and readable to a broad audience. It is intended that it will contain appropriate signposting and web-links (in the case of the electronic version) to make navigation through the document easier for those seeking information relevant to their needs.
- 22.1.2 It is anticipated that the ES will comprise several volumes dealing with the following matters:
- description of the HS2 project, the need for the project and the reasonable alternatives studied;
 - the EIA processes and the consultation that has been carried out;
 - description of the environmental baseline, environmental effects and mitigation, set out in a number of sections (anticipated to comprise 26 community areas) along the route;
 - project-wide and cumulative effects assessment;
 - non-technical summary; and
 - environmental mapping, Proposed Scheme drawings, and other illustrations.
- 22.1.3 Further documents will be produced to meet hybrid bill requirements and to support the ES including:
- SMR (this document);
 - Environmental Minimum Requirements (EMRs); and
 - CoCP (standalone document as part of the EMRs).

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Glossary of terms

air quality limit values	A maximum concentration to be achieved in the atmosphere, either without exception or with a permitted number of exceedances. Limit values are defined in European Union Directives and implemented in United Kingdom legislation.
air quality management area	An area within a local authority boundary where the air quality objectives are not likely to be achieved. The local authority is required to declare the area as an air quality management area and to prepare a local air quality action plan.
air quality objective	Objectives are policy targets generally expressed as a maximum ambient pollutant concentration to be achieved. The objectives are set out in the UK Government's Air Quality Strategy for the key air pollutants.
air quality standard	Air quality limit values and objectives.
ALARP principle	As low as reasonably practicable – A rule which involves weighing a risk against the time and money needed to control it.
ambient sound	The all-encompassing sound at a given location and time. It will generally include sound from many sources near and far. Ambient sound can be quantified in terms of the equivalent continuous sound pressure level, $L_{pAeq,T}$.
ancient woodland	Land that has been continually wooded since at least 1600 AD.
aquifer	A geological formation that is sufficiently porous and permeable to store and yield a significant quantity of water to a borehole, well or spring.
auger	A drilling device, or drill bit, that usually includes a rotating helical screw blade. The rotation of the blade causes the material to move out of the hole being drilled.
baseline	Existing environmental conditions present on, or near a site, against which future changes can be measured or predicted.
biodiversity action plan	A nationally established programme that seeks to protect and restore threatened species, habitats and biological systems.
borehole	A hole bored into the ground, usually as part of investigations, typically to test the depth and quality of soil, rock and groundwater. A borehole can also be used to dewater the ground.
built heritage	A heritage asset that is a structure or building visible above the land surface.
Central Association of Agricultural Valuers	A specialist professional body representing, qualifying and briefing members practicing a diverse range of agricultural and rural work throughout the UK.

climate change adaptation	The adjustment in natural or human systems in response to actual or expected climatic changes or their effects, which moderates harm or exploits beneficial opportunities.
climate change projections	Projections of changes in climate variables expressed in terms of the difference between the absolute future climate and a baseline climatology for a given location, time period and emissions scenario of greenhouse gases.
climate change resilience	The capacity of natural and human systems to retain their original form and function, and to survive and adapt in the context of the stresses and shocks imposed upon them by climate change.
Climate Change Risk Assessment	A Government commissioned assessment of the risks posed to the UK by the changing climate.
code of construction practice	A document setting out the measures and standards to which a developer or contractor must adhere in order to provide effective planning, management and control of potential impacts on individuals, communities and the environment during construction.
Committee on Climate Change	An independent advisory body, established under section 32 of the Climate Change Act 2008, tasked with helping the UK Government set and meet carbon budgets and adapt to climate change.
concentration response	A known functional relationship between exposure to a stressor (i.e. a pollutant or chemical) and the effect on a biological receptor (i.e. number of people who experience ill health or death).
conservation	The preservation or enhancement of a species or building/structure.
Conservation area	An area designated under section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990 as being of special architectural or historic interest the character or appearance of which it is desirable to preserve or enhance.
conurbation	A region comprising a number of cities, large towns and other urban areas that, through population growth and physical expansion, have merged to form one continuous urban and industrially developed area.
conventional compatible trains	HS2 trains that will run on both the high speed track and the existing rail network.
conventional line	The existing UK rail network (excluding HS1).
Country Land and Business Association	A membership organization for owners of land, property and business in rural England and Wales.

Country Park	Country Parks were established as a result of the 1968 Countryside Act. Natural England recognises Country Parks as significant places that contribute to England's accessible natural greenspace.
CO ₂ e	carbon dioxide equivalent.
Department for Transport	Government department responsible for transport policy in the UK (where powers have not been devolved).
Directive	European Commission Directives impose legal obligations on European Member States. They are binding as to the results to be achieved, but allow individual states the right to decide the form and methods used to achieve the results.
displacement (economic)	Loss of local economic activity as a direct consequence of a proposed development.
dust	All airborne particulate matter.
East Coast Main Line	The Existing rail route connecting London King's Cross, Peterborough, Doncaster, Wakefield, Leeds, York, Darlington, Newcastle and Edinburgh.
Edge effect	Effects that occur on the edge of a woodland due to increased exposure to wind and light.
EMC zone	A bounded area in which specific levels of electromagnetic energy exist. Some EMC zones contain higher levels of electromagnetic energy than others. In the railway environment the zone containing most energy in these EMC zones exists on the trackside of the railway close to traction or non-traction power distribution equipment.
environmental impact assessment	A process of systematically assessing the likely environmental effects of proposed development projects. EIA is a legal requirement for certain public and private projects in EU countries under Directive 2014/52/EU.
environmental statement	A suite of documents produced as part of an environmental impact assessment. It must include all information that is reasonably required to assess the likely significant environmental effects of a proposed development.
Environmental Stewardship and Countryside Stewardship	A scheme run by the Department for Environment, Food, and Rural Affairs in England which aims to promote responsible use and protection of the natural environment through conservation and sustainable practices.
Erewash Valley Line	A railway which runs from Trent junction near Long Eaton northwards to Clay Cross south of Chesterfield.
floodplain	Land adjacent to a watercourse that is subject to flooding.

Flood Zones 1, 2 and 3	<p>A system devised by the Environment Agency for classifying flood zone areas. The zones are:</p> <ul style="list-style-type: none"> - Flood Zone 1: land outside the floodplain. There is little or no risk of flooding in this zone; - Flood Zone 2: the area of the floodplain where there is a low to medium flood risk; and - Flood Zone 3: the area of the floodplain where there is a high risk of flooding.
Grade 1 (Agricultural Land Classification)	<p>Excellent' quality agricultural land with no or very minor limitations to agricultural use. A very wide range of agricultural and horticultural crops can be grown, commonly including top fruit, soft fruit, salad crops and winter-harvested vegetables. Yields are high and less variable than on land of lower quality.</p>
Grade 2 (Agricultural Land Classification)	<p>Very good' quality agricultural land with minor limitations that affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown. However, on some land in the grade there may be reduced flexibility due to difficulties with the production of more demanding crops, such as winter-harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than Grade 1.</p>
Grade 3 (Agricultural Land Classification)	<p>Land with 'moderate' limitations. This affects the choice of crops that can be grown, the timing and type of cultivation, and harvesting or yield levels. The yields of more demanding crops are generally lower or more variable than on land in grades 1 and 2. See Subgrades 3a and 3b.</p>
Grade 5 (Agricultural Land Classification)	<p>'Very poor' quality agricultural land with very severe limitations that restrict use to permanent pasture or rough grazing.</p>
Grade I listed building	<p>A listed building of exceptional interest, sometimes considered to be internationally important.</p>
Grade II* listed building	<p>A listed building of particular importance, of more than special interest.</p>
Grade II listed building	<p>Nationally important buildings that are of special interest.</p>
green tunnel	<p>A cut-and-cover tunnel with soil spread on top to integrate it into the landscape, thus minimising visual impacts and making the presence of a railway less noticeable. Access tracks and vegetation can be placed on the surface above the tunnel and it can be used for amenity, parkland and agricultural uses etc.</p>
Greenhouse gas	<p>A gas such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxide, ozone, and water vapour that contributes to the greenhouse effect by absorbing infrared radiation.</p>

groundwater	All water that is below the surface of the ground and within the permanently saturated zone.
habitat	The living place of an organism characterised by its physical or biotic properties.
Habitat Suitability Index	An HSI is a numerical index evaluating habitat quality and quantity for a particular species, where a value of 1 represents optimum habitat and 0, habitat of no value. The HSI for great crested newt incorporates 10 suitability indices, all of which are factors known to affect this species.
heritage asset	A building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions. Heritage assets are the valued components of the historic environment. They include designated heritage assets and assets identified by the local planning authority during the process of decision-making or through the plan-making process (including local listing).
High Speed 1	High speed rail line from St Pancras International Station in London to the Channel Tunnel. Formerly known as the Channel Tunnel Rail Link.
Highways England	The Government company that operates, maintains and improves England's motorways and major A roads.
Historic England	The Government's statutory advisor on the historic environment. Officially known as Historic Buildings and Monuments Commission for England, Historic England is an executive Non-Departmental Public Body sponsored by the Department for Culture, Media and Sport.
High Speed Two Limited	The company set up by the Government to develop proposals for a new high speed railway line between London and the West Midlands and to consider the case for new high speed rail services linking London, northern England and Scotland.
Hybrid bill	Hybrid Bills mix the characteristics of public and private bills. The provisions in a hybrid Bill would affect the general public, but would also have particular effects on specific individuals or groups.
hydrogeology	The nature, distribution and movement of groundwater in soils and rocks, including in aquifers.
Hydromorphology	The physical characteristics of the shape, boundaries and content of a water body.
in-combination effects	A combination of environmental effects on community or business establishments (for example, from sound, noise and vibration; dust and air quality).

in-combination climate change effects	<p>The combined significant effects of the Proposed Scheme and potential climate change impacts on the receiving environment and community.</p> <p>Not to be confused with uses of the terms 'combined effects' and 'cumulative effects' in EIA.</p>
index of multiple deprivation	<p>The official measure of relative deprivation for small areas (or neighbourhoods) in England. The index of multiple deprivation ranks every small area in England from 1 (most deprived) to 32,844 (least deprived). The level of deprivation is based on 37 separate indicators, organised into seven distinct groups (for example employment deprivation, education deprivation, etc.).</p>
inert waste	<p>Defined in Article 2(e) of the EU Landfill Directive (1999/31/EC) as waste that does not undergo significant physical, chemical or biological transformations.</p>
infrastructure maintenance depot	<p>A facility providing logistical support for the maintenance and repair of the HS2 railway track and associated infrastructure (excluding trains).</p>
Institute of Environmental Management and Assessment	<p>Professional membership organisation for environmental practitioners.</p>
Intergovernmental Panel on Climate Change	<p>A scientific intergovernmental body, tasked with the production of assessments of overall understanding of the scientific, environmental, technical and socio-economic risks from and likely responses required to climate change.</p>
intrusive investigation	<p>An in-depth investigation involving further sampling and analysis, such as the gathering of samples from the ground, walls, ceilings for the detection of contamination, asbestos and or archaeological remains.</p>
LiDaR	<p>Light detection and ranging (LiDAR) is a high resolution remote sensing technology which uses a laser to measure distance between a satellite, aerial, terrestrial or mobile source and the ground, buildings and vegetation to create a three-dimensional model.</p>
listed building	<p>A building of special architectural or historic interest. Listed buildings are graded I, II* or II, with Grade I being the highest. Listing includes the interior, exterior and the setting of the building.</p>
Main River	<p>A river maintained directly by the Environment Agency. They are generally larger arterial watercourses.</p>
Midlands Main Line	<p>The route running from London St Pancras to Sheffield, via Luton, Bedford, Corby, Leicester, East Midlands Parkway, Derby, Nottingham and Chesterfield.</p>

mitigation	The measures put forward to prevent, reduce and where possible, offset any significant adverse effects on the environment.
modal (mode) shift	A shift from one transport type to another, e.g. from road travel to rail travel.
National Farmers Union	Member organisation/industry association for Welsh and English farmers.
National Forest Inventory	A record of the size and distribution of forests and woodlands in Great Britain and information on key forest attributes run by the Forestry Commission.
National Trust	A UK conservation charity protecting historic places and green spaces and opening them up for everyone.
National Vegetation Classification	A comprehensive classification and description of the plant communities of Britain, administered by the Joint Nature Conservation Committee.
Natural England	Executive non-departmental public body constituted under the Natural Environment and Rural Communities Act 2006 (section 2(1)) to ensure that the natural environment is conserved, enhanced and managed for the benefit of present and future generations, thereby contributing to sustainable development.
net	After all deductions have been made.
nitrogen dioxide	A gas produced when fuels are burned and is often present in motor vehicle and boiler exhaust fumes. It is an irritant to the respiratory system.
non-governmental organisation	A legally constituted organisation that is independent of government. It is ordinarily non-profit and may be organised at a local, national or international level.
Non-hazardous waste	Any waste not defined as 'hazardous' under Directive 91/689/EEC. Examples include soils from ground/site clearance and demolition wastes.
non-technical summary	A report that briefly describes the main points discussed in an environmental statement or environmental impact assessment report without using technical language.
Northern Powerhouse	UK Government initiative to attract investment into northern towns and cities, with the aim of redressing the north-south economic imbalance.
Palaeo-environmental	An environment at a period in the geological past.
particulate matter	Discrete particles in ambient air, with dimensions ranging between nanometres (billionths of a metre) to tens of micrometres (millionths of a metre).

pathways (pollution)	The routes by which impacts are transmitted through air, water, soils or plants and organisms to their receptors.
Phase One	Phase One of the proposed HS2 network, a high speed railway between London and the West Midlands with a connection via the West Coast Main Line at conventional speeds to the North West and Scotland. Phase One includes stations at London Euston, Old Oak Common (West London), Birmingham Interchange (near the National Exhibition Centre and Birmingham Airport) and Curzon Street (Birmingham city centre).
phase 1 habitat survey	A habitat classification and field survey technique to record semi-natural vegetation and other wildlife habitats.
Phase Two	Phase Two of the proposed HS2 network extends the high speed railway beyond the West Midlands to Manchester and Leeds with connections to conventional railway lines via the West Coast and East Coast Main Lines.
Phase 2a	The section of the Phase Two route between the West Midlands and Crewe. It will include a connection with Phase One at Fradley, to the north-east of Lichfield, and a connection with the West Coast Main Line (WCML) south of Crewe.
Phase 2b	The section of the Phase Two route from Crewe to Manchester and from the West Midlands to Leeds, completing what is known as the 'Y network'.
photomontage	The process and result of inserting an image of the Proposed Scheme onto a photograph to show how existing views could be changed by the Proposed Scheme.
porous (tunnel) portal	Perforated structures at tunnel portals (entrances), usually formed of concrete, designed to allow the passage of air from the tunnel. These reduce both air pressure changes and the noise generated when a high speed train enters or leaves a tunnel.
Proposed Scheme	Proposals for a high speed railway from Crewe to Manchester and from the West Midlands to Leeds, completing what is known as the 'Y network'.
public realm	Outdoor areas, other than highways, accessible to the public in towns and cities
Public right(s) of way	A highway where the public has the right to walk; and, depending on its class, use for other modes of travel. It can be a footpath (used for walking only), a bridleway (used for walking, riding a horse and cycling), a restricted byway (as a bridleway, but use by non-motorised vehicles also permitted) or a byway that is open to all traffic (include motor vehicles).
receptor	A component of the natural or built environment (such as human being, water, air, a building, animal or a plant) affected by an

	impact of the construction and/or operation of a proposed development.
Registered historic battlefields	Historic England’s non-statutory register which identifies important English battlefields. Its purpose is to offer them protection and to encourage a greater understanding of their significance.
Registered historic parks and gardens	Historic England’s non-statutory register which identifies over 1,600 sites of historic interest in England assessed to be of national importance. Its purpose is to offer them protection and to encourage a greater understanding of their significance.
residual impacts	Those impacts of the development that cannot be mitigated following implementation of mitigation proposals.
riparian area	The interface between land and a river or stream.
risk assessment	An assessment of the probability of a hazard occurring that could result in an impact.
river corridor survey	The mapping of vegetation and physical features along the watercourse corridor using standard symbols, with cross-sections of river channel form, including land to either side of the river channel.
River habitat survey	A survey method designed to characterise and assess the physical structure of watercourses involving the recognition of vegetation types and an understanding of basic geomorphological principles.
rolling stock	Passenger or freight vehicles that operate on a railway.
rolling stock and maintenance depot	a workshop within which trains are maintained.
scheduled monument	Nationally significant heritage assets protected by the Ancient Monuments and Archaeological Areas Act 1979.
scoping	An initial stage in the environmental impact assessment process to determine the nature and potential scale of environmental effects arising as a result of a proposed development, and an assessment of what further studies are required to establish their potential environmental impacts and effects. This will often include the identification of the proposed methodologies for the further studies.
setting (historic environment)	The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive, negative or neutral contribution to the significance of an asset and may affect the ability to appreciate it.

Site of special scientific interest	Area of land notified by Natural England under section 28 of the Wildlife and Countryside Act 1981 as being of special interest by reason of its flora, fauna or geological or physiological features.
Source protection zone	A defined area within which groundwater is extracted for potable water supply. The area is defined by the Environment Agency on the basis of the length of time taken for groundwater to migrate from the potable source.
threshold	A level of effect above which an assessment will be taken of whether any changes to procedures need to be made.
topography	The natural or artificial features, level and surface form of the ground surface.
tunnel boring machine	A tunnelling machine, which consists of a rotary cutting head that occupies the full face of the tunnel. A system of conveyors or pumps is used to remove the excavated material.
United Kingdom Climate Projections	The United Kingdom Climate Projections provide future projections of climate change for different time periods and different possible scenarios of greenhouse gas emissions. These illustrate a range of possible future changes to the United Kingdom's climate.
utility	A commodity or service, such as electricity, gas or fuel that is provided by a public or private service provider. These are often delivered to customers via pipes, cables etc. under the ground. They can also be delivered above the ground, for example, via overhead power lines.
utility diversion	Utilities may be diverted, or have their height or depth altered, where their current alignment, either above or below ground, would prevent the construction of certain components of the Proposed Scheme.
West Coast Main Line	Inter-urban rail line connecting London, Birmingham, Manchester, Liverpool and Glasgow.
World heritage site	A natural or man-made site, area, or structure recognised as being of outstanding international importance and therefore deserving special protection. Sites are nominated to and designated by the World Heritage Convention (an organization of UNESCO).
Y network	Completed HS2 network (both Phase One and Two), comprising a high speed rail line between London and the West Midlands, then splitting into two lines, one continuing to Manchester and the other to Leeds via the East Midlands.

Annex A – List of Technical notes

The following table sets out the Technical notes that were prepared for Phase One and Phase 2a. Technical notes for Phase 2b will be based on those prepared for Phase One and Phase 2a and updated to take into account any changes in proposed methodology as appropriate.

Environmental topic and Technical note title	Published	Amended	Document locations
Air quality guidance on assessment methodology	July 2017		Phase 2a Scope and methodology addendum
Climate: Greenhouse gases Methodology	July 2017		Phase 2a Scope and methodology addendum
Climate: Methodology for cross-topic interaction for climate change assessments	July 2017		Phase 2a Scope and methodology addendum
Community: Further assessment guidance	July 2017		Phase 2a Scope and methodology addendum
Ecology: Ecological field survey methods and standards	July 2017		Phase 2a Scope and methodology addendum
Ecology: Ecological Assessment Methodology	July 2017		Phase 2a Scope and methodology addendum
Ecology: Ecological principles of mitigation	July 2017		Phase 2a Scope and methodology addendum
Ecology: Methodology for demonstrating no net loss in biodiversity	July 2017		Phase 2a Scope and methodology addendum
Electromagnetic interference	July 2017		Phase 2a Scope and methodology addendum
Health: HIA – guide to data gathering	July 2017		Phase 2a Scope and methodology addendum
Health: Assessment of social capital	July 2017		Phase 2a Scope and methodology addendum
Health: Health assessment methodology	July 2017		Phase 2a Scope and methodology addendum
Health: Health literature review	July 2017		Phase 2a Scope and methodology addendum
Health: Quantitative assessment of health effects – noise and air quality	July 2017		Phase 2a Scope and methodology addendum
Historic environment: Risk based approach for prioritising archaeological surveys	July 2017		Phase 2a Scope and methodology addendum
Land quality: Introduction to land quality assessments	July 2017		Phase 2a Scope and methodology addendum
Land quality: Detailed methodology for land contamination assessments	July 2017		Phase 2a Scope and methodology addendum
Land quality: Mining, mineral and geological reserves	July 2017		Phase 2a Scope and methodology addendum
Land quality: Operational issues	July 2017		Phase 2a Scope and methodology addendum
Land quality: Potential mitigation measures	July 2017		Phase 2a Scope and methodology addendum

Landscape and visual: Approach to landscape sensitivity	July 2017		Phase 2a Scope and methodology addendum
Landscape and visual: Approach to night time 'darkness' surveys	July 2017		Phase 2a Scope and methodology addendum
Landscape and visual: Approach to photography	July 2017		Phase 2a Scope and methodology addendum
Landscape and visual: Approach to verifiable photomontages	July 2017		Phase 2a Scope and methodology addendum
Landscape and visual : Zone of theoretical visibility production methodology	July 2017		Phase 2a Scope and methodology addendum
Major accidents and disasters: Major accidents and disasters assessment	July 2017		Phase 2a Scope and methodology addendum
Socio-economics: Assessment	July 2017		Phase 2a Scope and methodology addendum
Traffic and transport: Guidance on further development of significance criteria	November 2013	SES2 and AP3 ES September 2015	Phase One Scope and methodology addendum 3
Waste and material resources: Construction and demolition waste forecasting methodology	July 2017		Phase 2a Scope and methodology addendum
Waste and material resources: Waste forecast and assessment methodology	July 2017		Phase 2a Scope and methodology addendum
Waste and material resources: Rationale for landfill significance criteria	July 2017		Phase 2a Scope and methodology addendum
Water resources and flood risk: Water Framework Directive Assessment	July 2017		Phase 2a Scope and methodology addendum
Water resources and flood risk:Groundwater assessment method	July 2017		Phase 2a Scope and methodology addendum
Water resources and flood risk:Surface water quality assessment	July 2017		Phase 2a Scope and methodology addendum
Water resources and flood risk: Spillage risk assessment	July 2017		Phase 2a Scope and methodology addendum

Annex B – List of consultees

The following table sets out the list of organisations who will be contacted as part of the consultation on the draft of this SMR. This includes statutory consultees as well as non-statutory organisations.

Consultees are not limited to this list: the draft SMR will be made available on the Hs2 Ltd website and comments on the proposed approach are invited from other stakeholders and members of the public. Responses on the proposed approach set out in this SMR will be taken into account where they are relevant to the EIA Scope and Methodology and a final SMR will be published.

Action on Hearing Loss

Age UK

Ancient Monuments Society

Animal and Plant Health Agency (APHA)

Annesley Parish Council

Appleby Magna Parish Council

Arriva

Ashby Canal Trust

Ashby-de-la-Zouch Parish Council

Ashfield District Council

Association of Directors of Public Health

Association of Drainage Authorities

Association of Geotechnical and Geo-environmental Specialists

Aston cum Aughton Parish Council

Ault Hucknall Parish Council

Austhorpe (East and West) Parish Meeting

Austrey Parish Council

Barkston Ash Parish Council

Barlborough Parish Council

Barnburgh with Harlington Parish Council

Barnsley Biodiversity Trust

Barnsley Clinical Commissioning Group

Barnsley MBC

Barnsley, Dearne and Dove Canal Trust

Bat Conservation Trust

Battlefields Trust

Berks, Bucks & Oxon Wildlife Trust

Birmingham and Warwickshire Archaeological and Historical Society

Blackwell Parish Council

Bolsover District Council

Braithwell with Micklebring Parish Council

Bramley Parish Council

Breedon on the Hill Parish Council

British Association of Shooting and Conservation

British Drilling Association (BDA)

British Geological Survey

British Horse Society (BHS)

British Land

British Transport Police Authority

British Waterways Marinas Limited (BWML)

Brodsworth Parish Council

Broxtowe Borough Council

Broxtowe Borough Council (Conservation Group)

Broxtowe District Council

Byways and Bridleways Trust

Campaign for Better Transport

Campaign for Better Transport - Derbyshire and Peak District

Campaign for Better Transport - Nottinghamshire

Campaign to Protect Rural England (CPRE)

Canal and River Trust

Cannock Chase AONB Unit

Carr Vale Community Association

Central Association of Agricultural Valuers

Chambers of Commerce

Chartered Institute of Highways & Transportation

Cheshire Agricultural Society

Cheshire and Warrington Local Enterprise Partnership

Cheshire Brine

Cheshire East Council

Cheshire Fire Authority

Cheshire Gardens Trust

Cheshire Police Authority

Cheshire West & Chester Council

Chesterfield and District Civic Society

Chesterfield Borough Council

Chesterfield Canal Partnership

Chesterfield Community Energy PLC

Chilterns AONB

Christie NHS Foundation Trust

Church Buildings Council

Church Commissioners

Church Fenton Parish Council

Citizens Advice (CA)

Civic Voice

Civil Aviation Authority

Clay Cross Parish Council

Clayton with Frickley Parish Council

Clowne Parish Council

Coal Authority

Coal Pro (The Confederation of UK Coal Producers)

Coleorton Parish Council

Commercial Boat Operators Association

Commission for Rural Communities

Committee on Climate Change

Community Forest - Forest of Mercia

Community Forest - Greenwood

Community Forest - Mersey

Community Forest - Red Rose

Community Forest - White Rose

Community Forest Partnership - South Yorkshire

Confederation of Forest Industries

Conisbrough Parks Parish Council

Council for British Archaeology (CBA)

Country Land and Business Association

Country Landowners Association

Countryside Alliance

Countryside Alliance Eastern Region (Leicestershire and Rutland,
Nottinghamshire)

Countryside Alliance Midlands Region (Staffordshire and Warwickshire)

Countryside Alliance Northern Region (Yorkshire, Derbyshire, Greater
Manchester and Cheshire)

Coventry and Warwickshire Local Enterprise Partnership

CPRE Cheshire

CPRE Derbyshire

CPRE East Midlands

CPRE Lancashire Branch

CPRE Leicestershire

CPRE North Yorkshire

CPRE North-West

CPRE Nottinghamshire

CPRE South Yorkshire

CPRE Warwickshire

CPRE West Yorkshire Branch

CPRE Yorkshire and the Humber

Crofton Parish Council

Crown Estate Commissioners

Culcheth and Croft Horse Riders and Bridleways Association

Curdworth Parish Council

Cycling UK

Denaby Parish Council

Department for Business, Energy and Industrial Strategy

Department for Communities and Local Government

Department for Culture, Media and Sport

Department for Environment, Food and Rural Affairs

Derby and Derbyshire Rail Forum

Derby Diocesan Board of Finance Limited

Derbyshire Community Housing Society Limited

Derbyshire County Council

Derbyshire Wildlife Trust

Design Council

Diocese of Chester

Diocese of Leeds

Diocese of Manchester

Diocese of Sheffield

Disability Charities Consortium

Disability Resource Centre

Disability Rights UK

Disabled Persons Transport Advisory Committee

Doncaster Clinical Commissioning Group

Doncaster Metropolitan District Council

Dordon Parish Council

East Midlands Health Authority

Ecclesfield Conservation and Local History Group

Eckington Parish Council (Derbyshire)

English Heritage

Environment Agency

Equality and Diversity Forum

Equality and Human Rights Commission

Equality Trust

Erewash Borough Council

Erewash Partnership

Erewash Ramblers

Felley Parish Council

Food and Environment Research Agency (FERA)

Footpaths Society

Footpaths Society - Peaks and Northern

Forestry Commission

Freight on Rail

Friends of Carlton Marsh and Rabbit Ings Nature Reserve

Friends of Haw Park Wood and Anglers Country Park

Friends of Marie Louise Gardens

Friends of Rabbit Ings

Friends of the Earth

Friends of the Earth Chesterfield & NE Derbyshire

Friends of the Earth East Midlands

Friends of Totton Fields

Garden History Society

GeoConservation UK

Georgian Group

Glapwell Parish Council

Greasley Parish Council

Greater Birmingham and Solihull Local Enterprise Partnership

Greater Manchester Coalition of Disabled People

Greater Manchester Combined Authority

Greater Manchester Local Enterprise Partnership

Greengauge21

Greenpeace

Greensqueeze (Erewash greenbelt)

Greenwood Community Forest Partnership

Hallam Land Management Ltd

Hardwick Clinical Commissioning Group

Harthill with Woodall Parish Council (Rotherham)

Harworth Estates

Harworth Estates Investments Limited

Harworth Group PLC

Havercroft with Cold Hiendley Parish Council

Hayhurst Foundation

Health and Safety Executive (HSE)

Heath and Holmewood Parish Council

Hellaby Civil Parish

Hemsworth Town Council

Heritage Alliance

Hickleton Parish Council

High Melton Parish Council

Highways England Company Limited

Hinckley and Bosworth District Council

Historic England

Historic Houses Association

Historic Stone Ltd

Hooten Pagnell Parish Council

Huddleston with Newthorpe Parish Council

Inclusive Sheffield

Inland Waterways Association

Inovyn Ltd

International Union of Railways

Joint Committee of National Amenity Societies

Joint Nature Conservation Committee

Kegworth Parish Council

Keuper Gas Storage Project

Killamarsh Parish Council

King Street Energy

Kingsbury Parish Council

Lancashire County Council

Land Trust

Laughton en le Morthen Parish Council

Lee Marston Parish Council

Leeds City Council

Leeds City Region LEP

Leeds Civic Trust

Leeds North Clinical Commissioning Group

Leeds South and East Clinical Commissioning Group

Leicester City Council

Leicestershire Archaeological and Historical Society

Leicestershire County Council

Leigh Ornithological Society

LGBT Consortium

Lifeways

Little Fenton Parish Council

Living Streets

Local Access Forum - Barnsley

Local Access Forum - Cheshire East

Local Access Forum - Cheshire West & Chester

Local Access Forum - Derby and Derbyshire

Local Access Forum – Doncaster

Local Access Forum – Leeds

Local Access Forum – Leicestershire

Local Access Forum - Manchester, Salford and Trafford

Local Access Forum – Nottinghamshire

Local Access Forum - Rotherham

Local Access Forum – Stockport

Local Access Forum – Wakefield

Local Access Forum – Wigan

Local Access Forum for North Yorkshire County Council

Local Access Forum for York

Local Flood Authorities

Local Government Association (LGA)

Long Eaton Natural History Society

Long Whatton and Diseworth Parish Council

Lowton Business Park

Manchester Airport Group

Manchester City Council

Mansfield and Ashfield Clinical Commissioning Group

Marr Parish Council

Measham Parish Council

Mencap

Mental Health trusts

Mere Estate

Mexborough & District Heritage Society

Micklefield Parish Council

Mid Cheshire Health Trust

Midlands Connect

Minerals Planning Authority

Ministry of Defence

Morton Parish Council

National Association of Areas of Outstanding National Beauty

National Association of Boat Owners

National Cycling Charity (CTC)

National Farmers Union (NFU)

National Forest Company

National Grid

National Grid Property Holdings Limited

National LGB&T Partnership

National Parks England (Formerly English National Park Authorities Association)

National Police Chiefs Council

National Trust

Natural England

North East Derbyshire Industrial Archaeology Society

Network Rail

Network Rail Infrastructure Limited

Newland-with-Woodhouse Parish Council

Newlife Foundation for Disabled Children

NHS England Midlands and East

NHS England North

NHS Staffs and Surround Clinical Commissioning Group

Normanton Town Council

North Crofton Co-operative Colliery

North Derbyshire Clinical Commissioning Group

North East Derbyshire District Council

North East Health Authority

North East Combined Transport Activists Roundtable (NECTAR)

North Staffordshire Bridleways Association

North Warwickshire Borough Council

North West Health Authority

North West Leicestershire District Council

North West Transport Activists Roundtable

North Yorkshire County Council

Nostell Estate

Nottingham City Council

Nottingham Express Transit

Nottingham Wildlife Trust

Nottinghamshire and Derbyshire Federation of Small Businesses

Nottinghamshire County Council

Nottinghamshire Wildlife Trust

Nuthall Parish Council

Official Custodian for Charities

Office of Rail Regulators and Approved Operators

Old Bolsover Town Council

Open Spaces Society

Oulton and Woodlesford Neighbourhood Forum

Packington Parish Council

Peak District National Park Authority

Peaks and Northern Footpaths Society

Peel Ports

Penny Hill Windfarm

Pilsley Parish Council

Pinxton Parish Council

Polesworth Parish Council

Police Federation of England/Wales

Public Health England (PHE)

Public Health England North West

Public Health England West Midlands

Rail Delivery Group

Rail Freight Group

Rail Future

Railway Heritage Trust

Ramblers Association

Ramblers Trafford Group, part of the Ramblers' Association

Ramblers West Riding Area

Ramblers Wetherby and District Group

Ratcliffe Coal Power Station

Ratcliffe on Soar Parish Council

Ravenfield Parish Council

RESCUE

Retford & Worksop (Chesterfield Canal) Boat Club Ltd

Ridware History Society

Risley Moss Action Group

Rother Valley Bridleways Group

Rotherham Clinical Commissioning Group

Rotherham MBC

Royal Association for Deaf People

Royal Institute of Chartered Surveyors

Royal National Institute of Blind People (RNIB)

Royal Society for the Protection of Birds (RSPB)

RSPB Midlands

RSPB Northern England

Royal Society of Wildlife Trusts

Royal Town Planning Institute (RTPI)

Rushcliffe District Council

Ryhill Parish Council

Sandiacre Parish Council

SAVE Britain's Heritage

Saxton-cum-Scarthingwell & Lead Parish Council

Scarcliffe Parish Council

Scope

Scottish Association for Public Transport

Selby District Council

Severn Trent Water Limited

Sharlston Parish Council

Sheffield Area Geology Trust

Sheffield City Region LEP

Sheffield MBC

Sherburn in Elmet Parish Council

Shirland & Higham Parish Council

Shropshire Union Canal Society

Sir John Moore Foundation

Society for the Protection of Ancient Buildings (SPAB)

South Hiendley Parish Council

South Kirkby and Moorthorpe Town Council

South Normanton Parish Council

South Staffordshire Water

South Yorkshire Industrial History Society

South Yorkshire Local Nature Partnership

Sports England

Staffordshire Archaeological and Historical Society

Staffordshire County Council

Stanton by Dale Parish Council

Stapleford Parish Council

Staveley Town Council

Stockport Council

Stonewall

Strelley Parish Council

Strelley Village Green Society

Sustrans

Sustrans East Midlands

Sutton cum Duckmanton Parish Council

Swillington Parish Council

Tame Valley Wetlands Landscape Partnership

Tamworth Borough Council

TATA Europe

Tatton Estate

Taylor Business Park

Theatres Trust

Thoroton Society

Thrumpton Parish Council

Tibshelf Parish Council

Town and Country Planning Association

Towton Parish Council

Trafford Council

Trans Pennine Trail

Transport Focus (formerly Passenger Focus)

Transport for the North

Trent and Mersey Canal Society

Trents Rivers Trust

Trowell Parish Council

Twentieth Century Society

Twycross Parish Council

UK Coal

UK Fire Service

Ulleskelf Parish Council

United Utilities Water

United Utilities Water Limited

Universities UK

Vale of York Clinical Commissioning Group

Victorian Society

Wakefield Clinical Commissioning Group

Wakefield District Biodiversity Group

Wakefield Council

Wales Parish Council

Walton Neighbourhood Plan (part of Walton Parish)

Warmfield-cum-Heath Parish Council

Warrington Borough Council

Warwickshire County Council

Water Services Regulation Authority

West Midland Bird Club

West Midlands Combined Authority

West Midlands Health Authority

West Riding Area Countryside Committee Ramblers Association

West Yorkshire Archaeology Advisory Service

West Yorkshire Combined Authority

Wigan Council

Wildlife Habitat Protection Trust

Wildlife Trust - Cheshire

Wildlife Trust - Derbyshire

Wildlife Trust - Lancashire, Manchester & North Merseyside

Wildlife Trust - Leicestershire and Rutland

Wildlife Trust - Nottinghamshire

Wildlife Trust - Sheffield and Rotherham

Wildlife Trust - Staffordshire

Wildlife Trust - Warwickshire

Wildlife Trust - Yorkshire

Wintersett Parish Meeting

Woodland Trust

Working Families

Worthington Parish Council

Yarlet Trust

Yorkshire & The Humber Health Authority

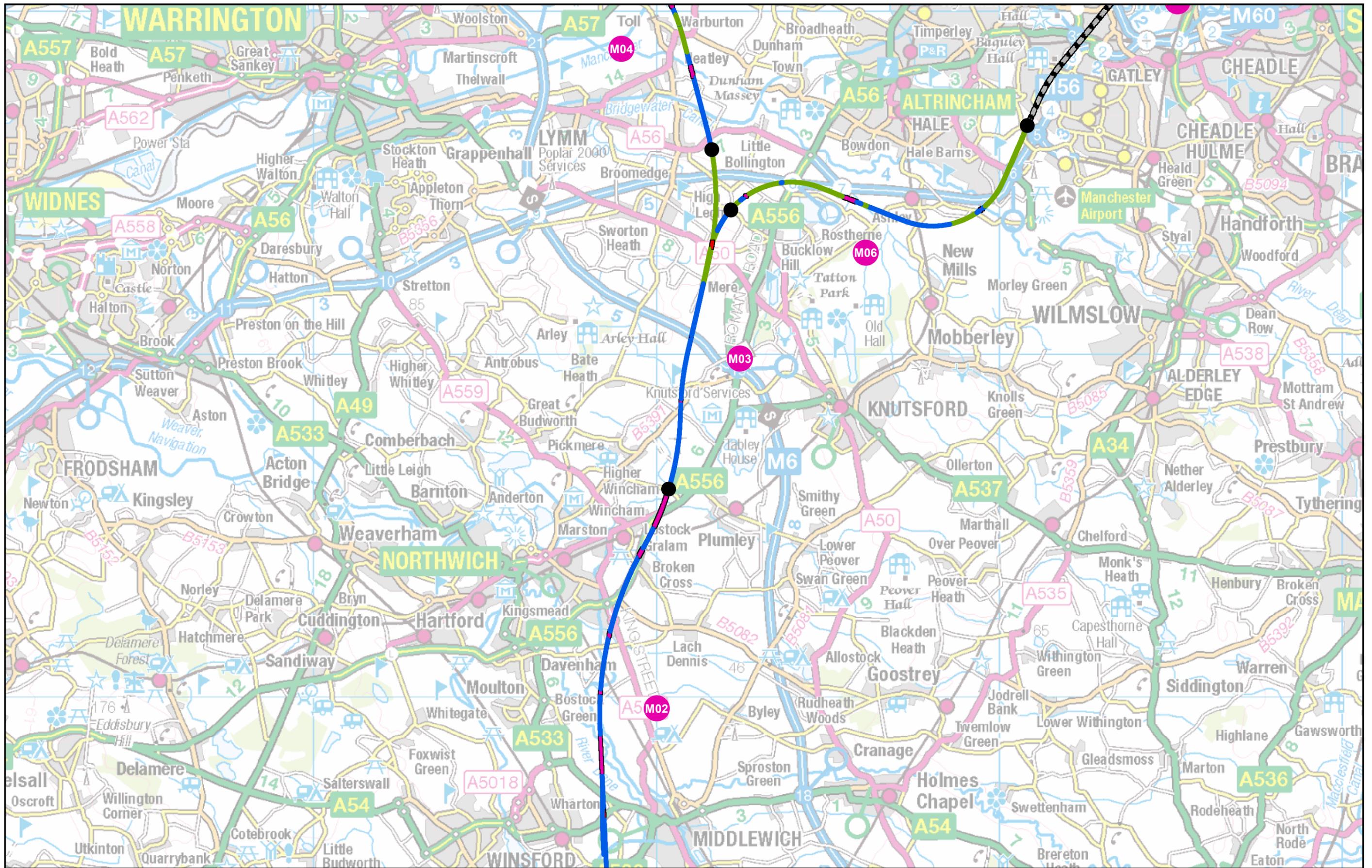
Yorkshire Farming and Wildlife Partnership

Yorkshire Flood & Coastal Committee

Yorkshire Water

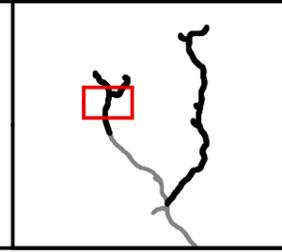
Yorkshire Water Services Limited

Annex C – Route maps



- Legend**
- Phases 1 & 2a Route
 - Route on embankment
 - Route in cut and cover tunnel
 - Route in bored tunnel
 - Route in cutting
 - Route on viaduct

- Start / End of Community Areas
- Community Areas



Map Name
Annex C - Proposed route of Phase 2b



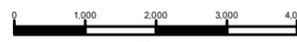
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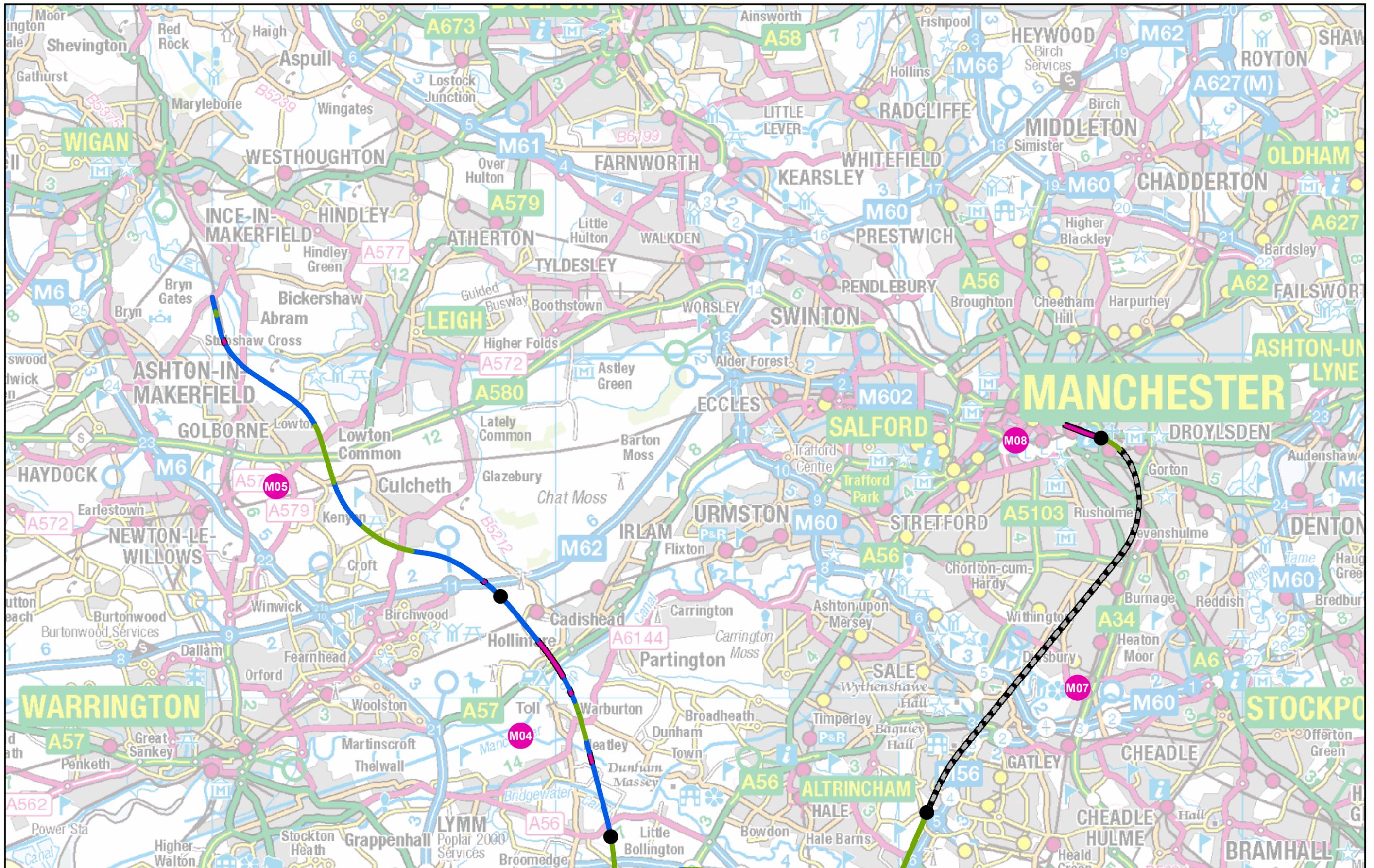


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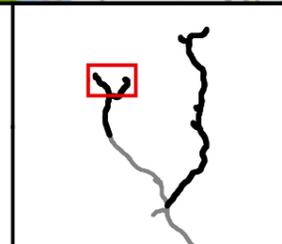


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	Route on viaduct
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	Community Areas



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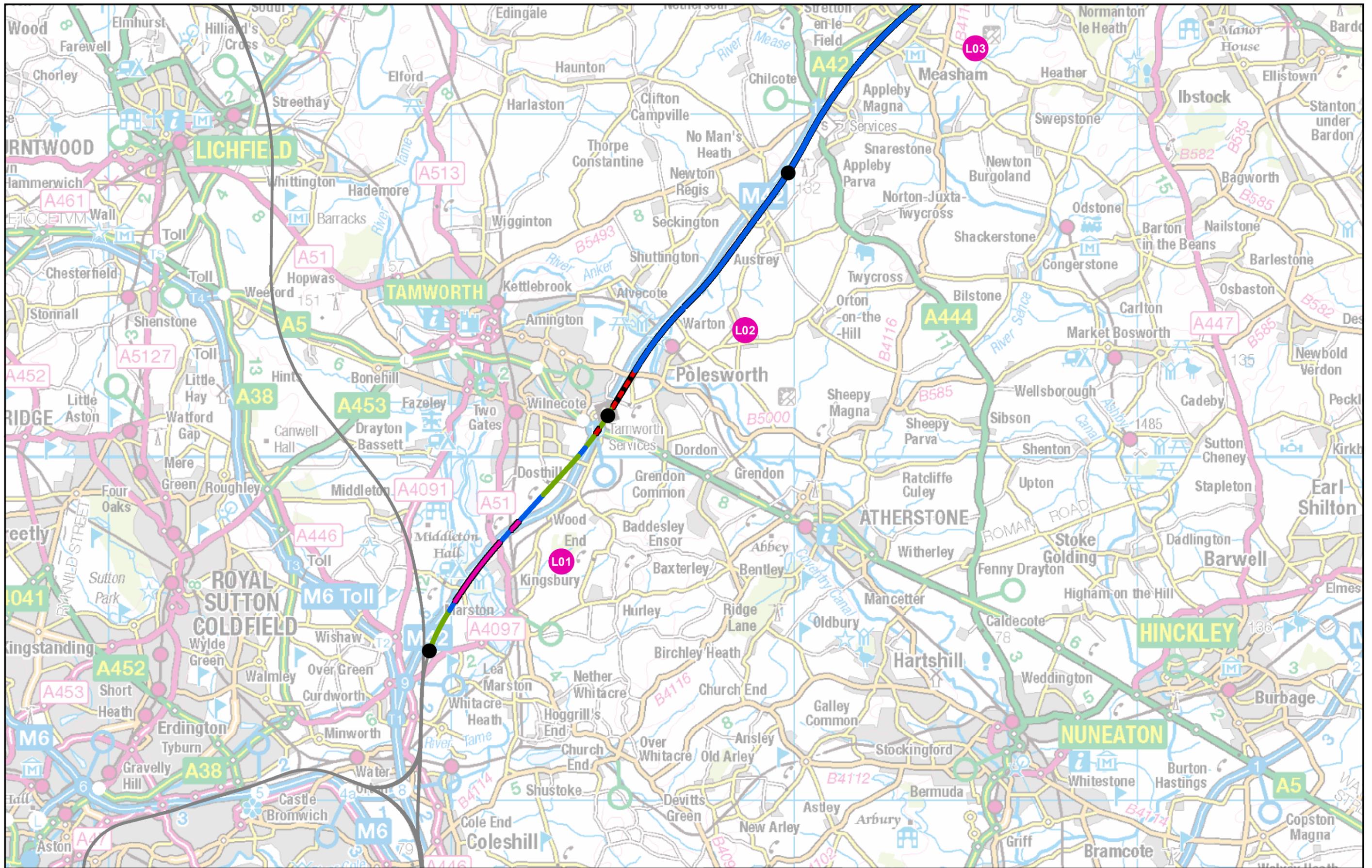
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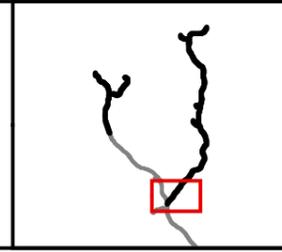
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Annex C - Proposed route of Phase 2b



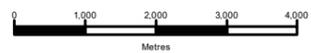
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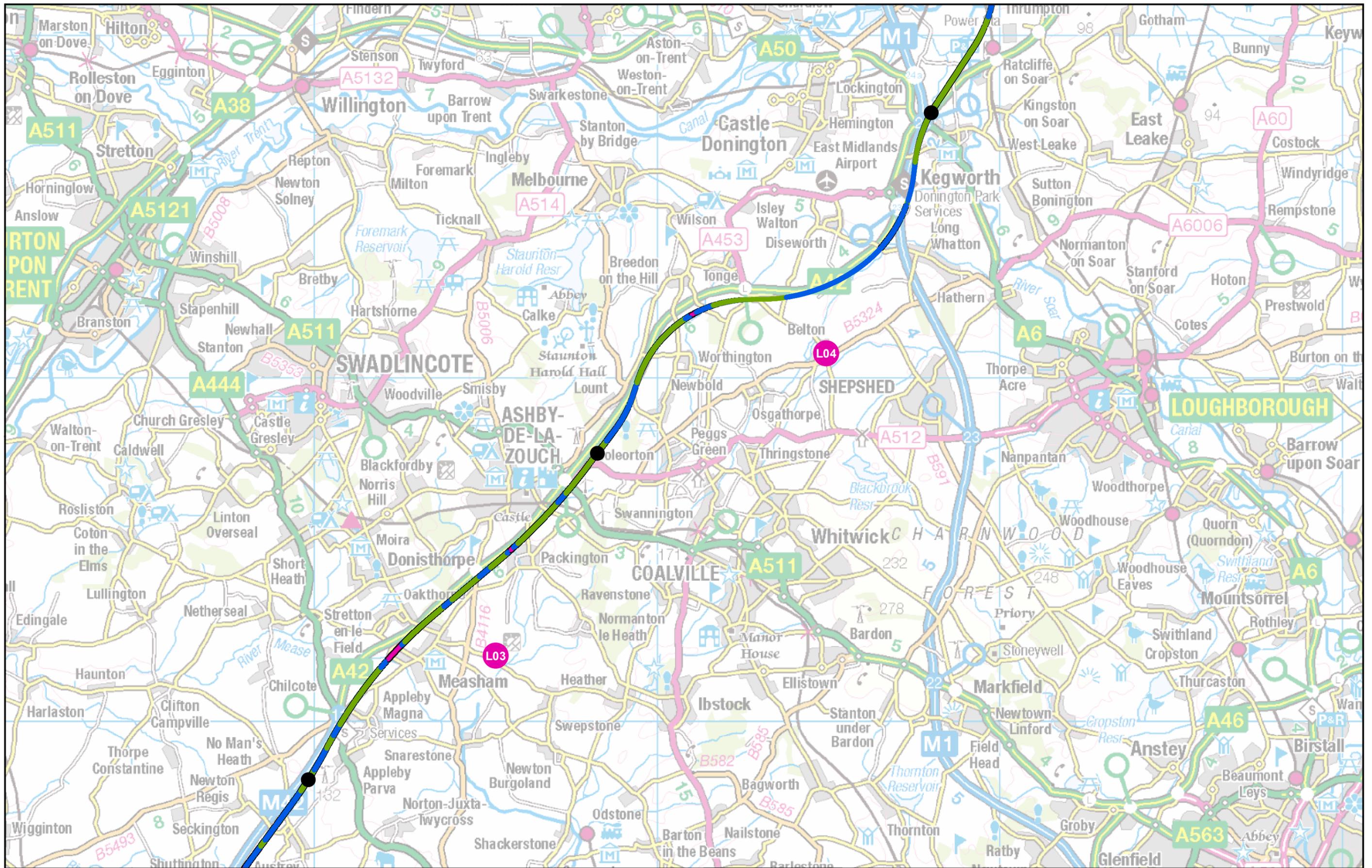
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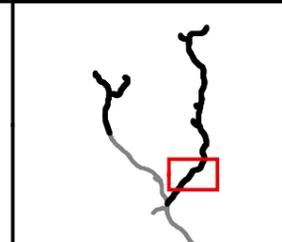


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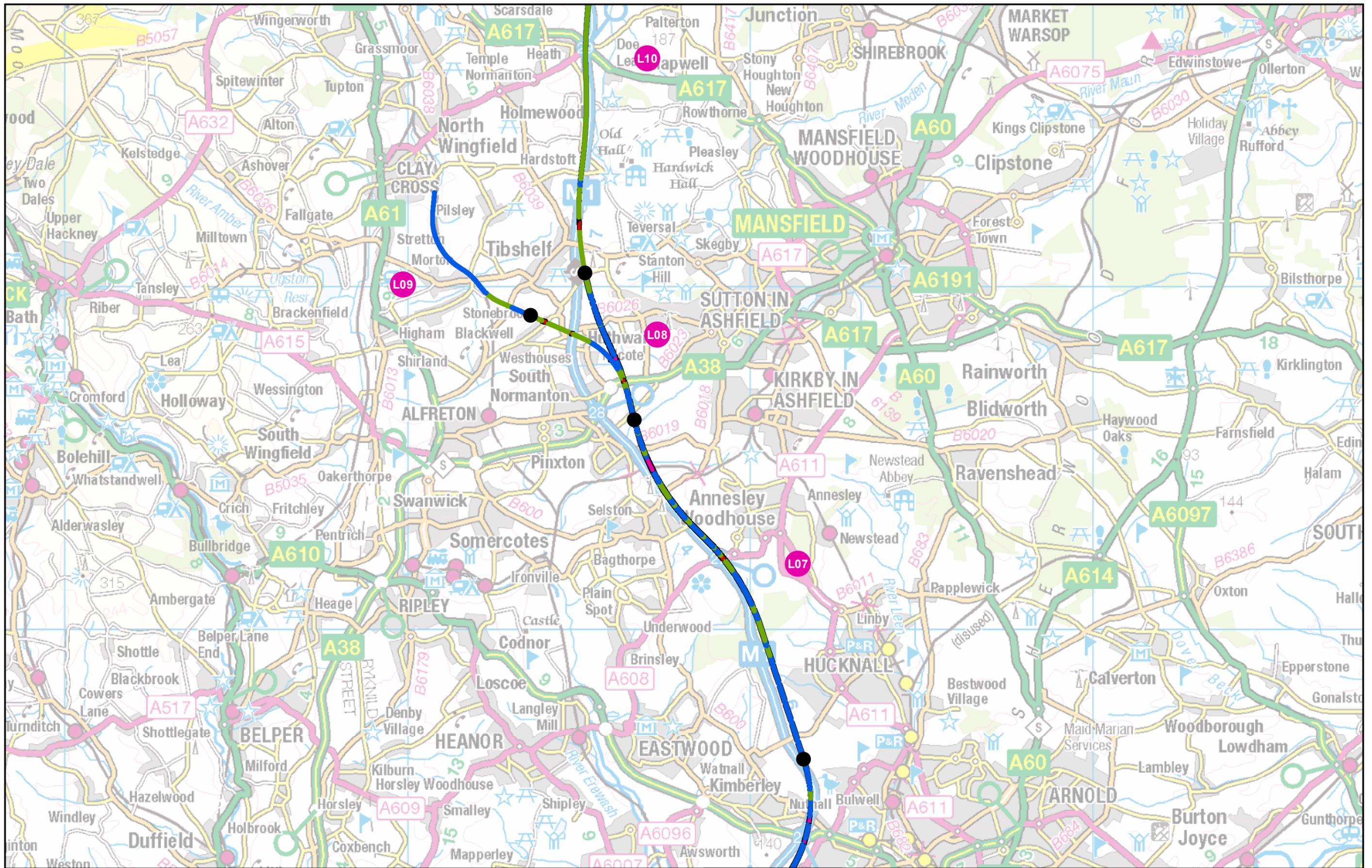
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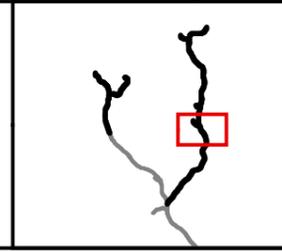
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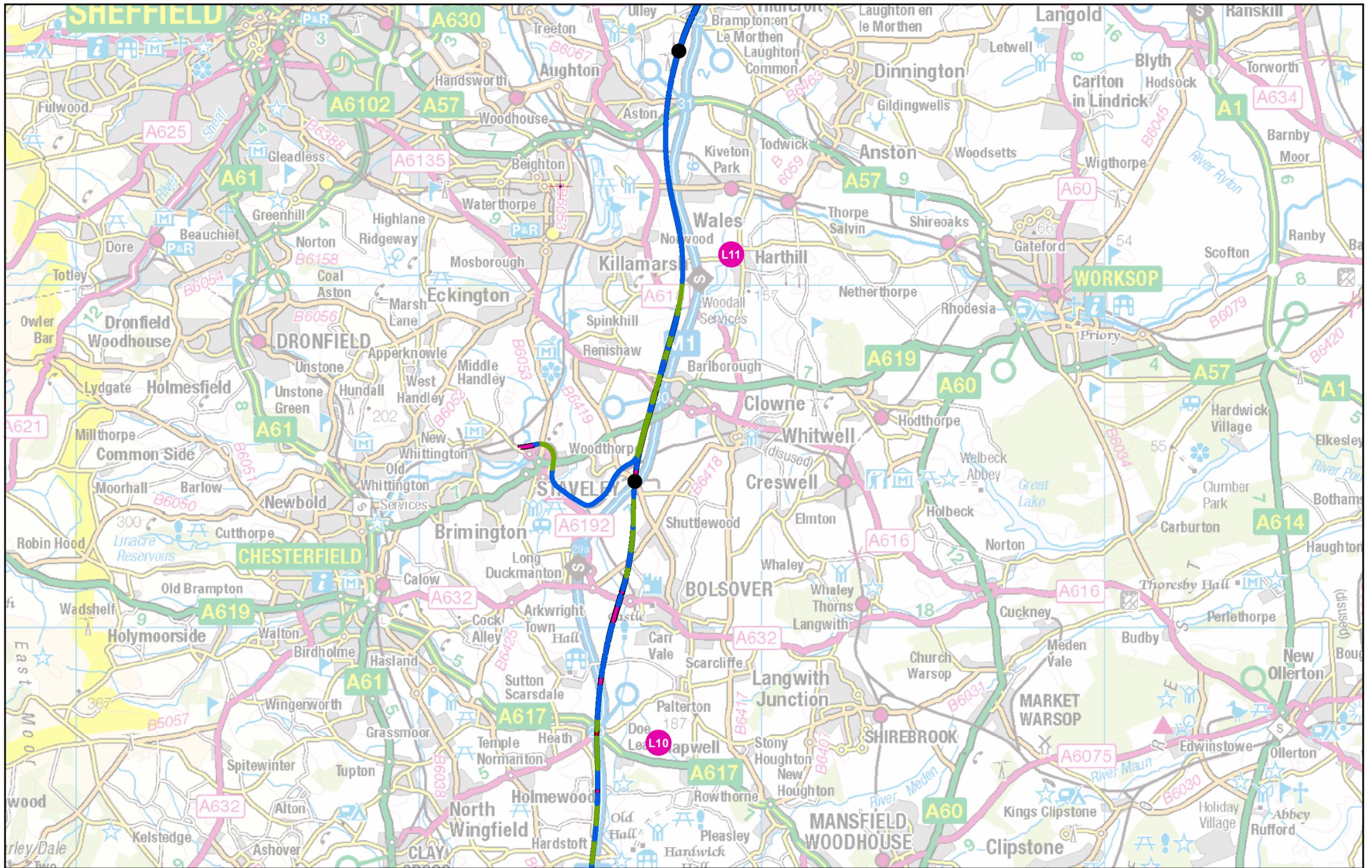
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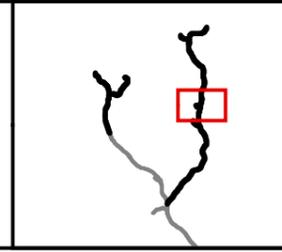
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1,000 2,000 3,000 4,000 Metres



- Legend**
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- Community Areas



Map Name
Annex C - Proposed route of Phase 2b



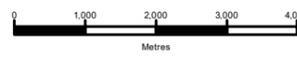
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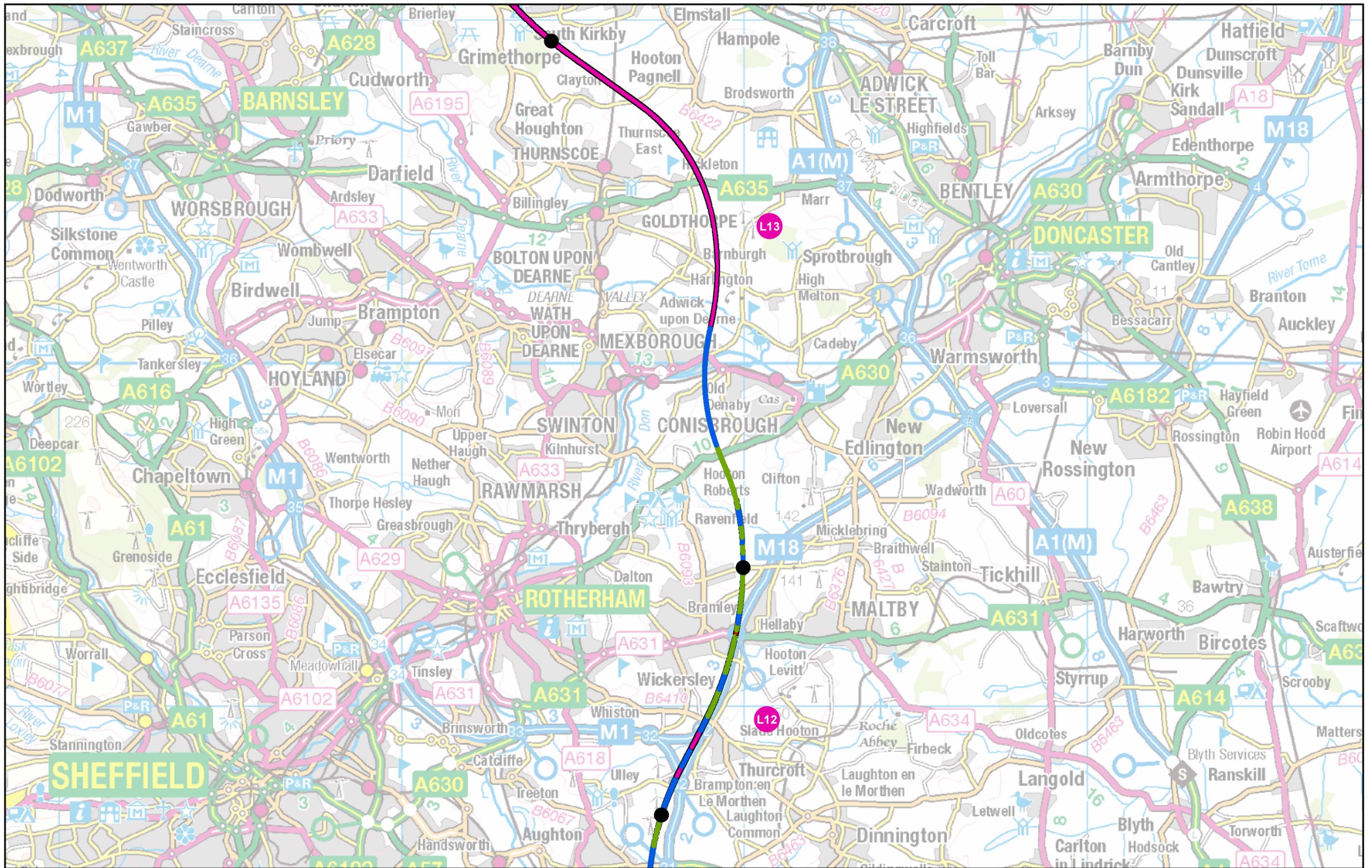


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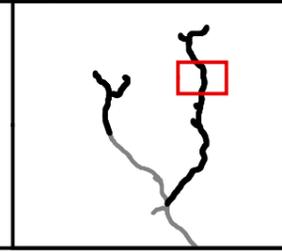
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Map Name
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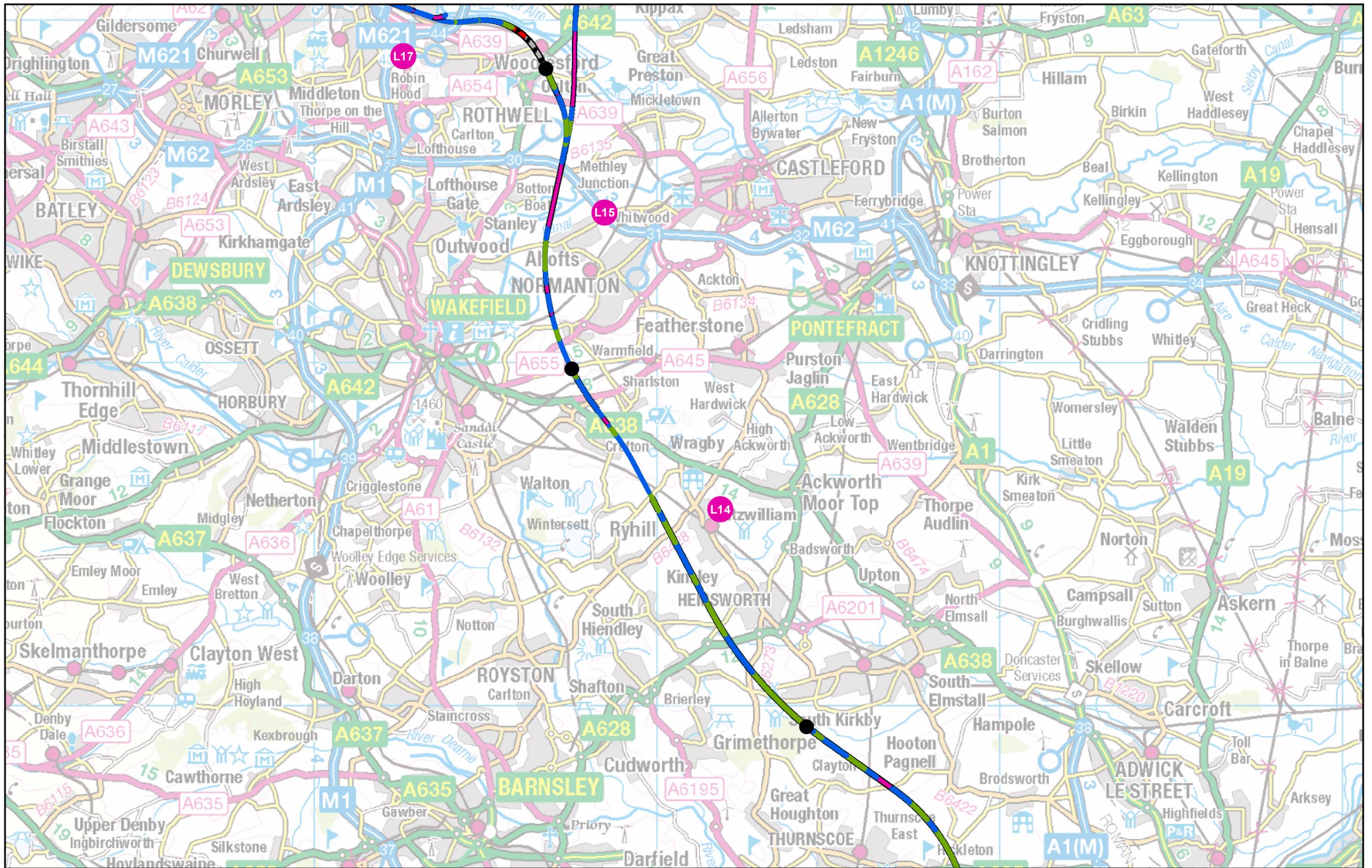
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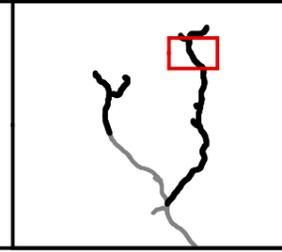
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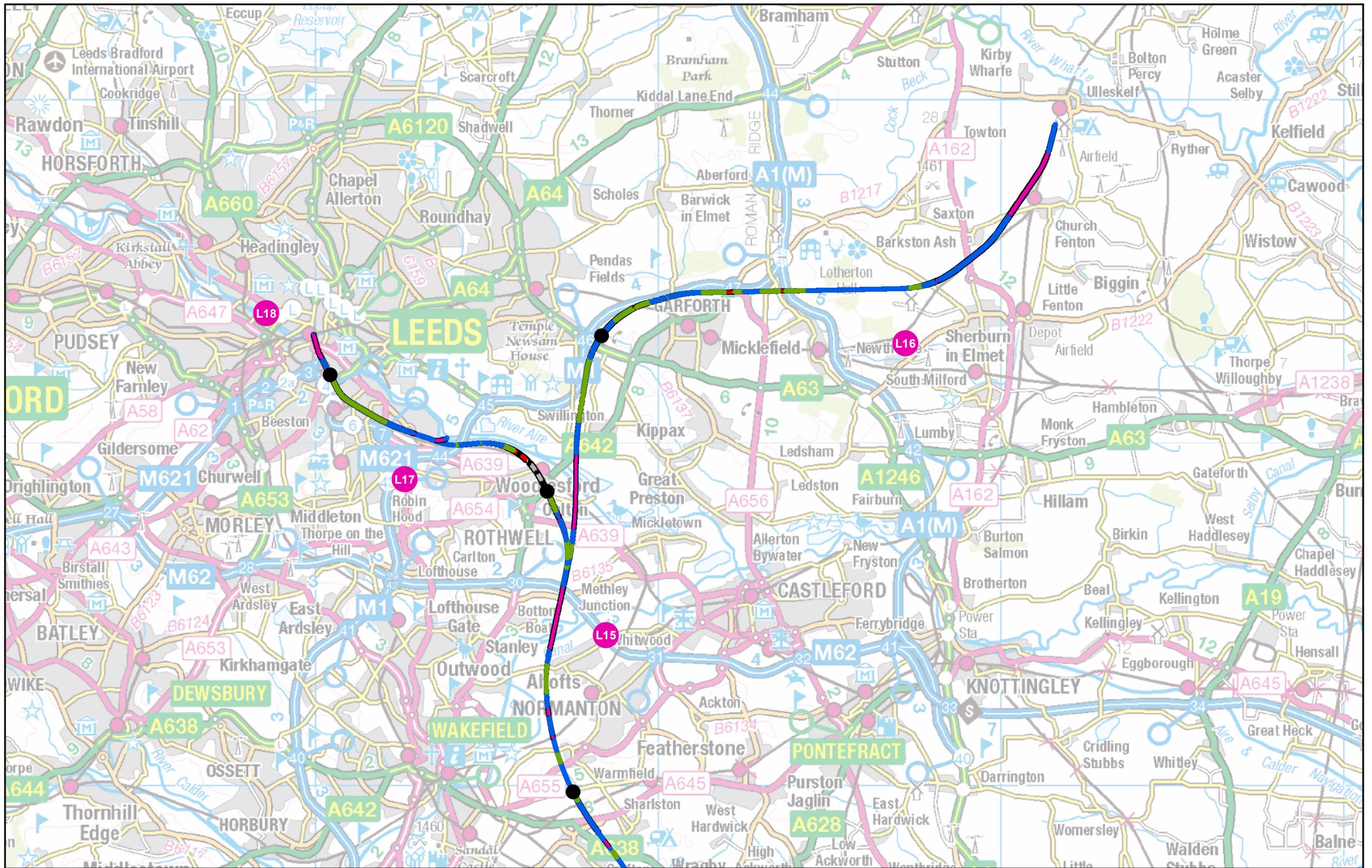
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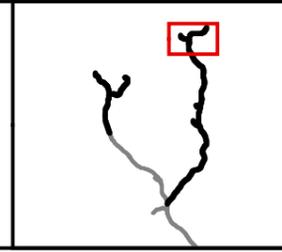
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Date: 07/07/17



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 - Route on embankment
 - Route in cut and cover tunnel
 - Route in bored tunnel
 - Route in cutting
 - Route on viaduct

- Start / End of Community Areas
- Community Areas



Map Name
Annex C - Proposed route of Phase 2b

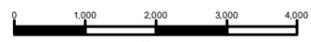


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Annex D – List of acronyms, initialism and units of measurement

μT	microtesla
AADT	annual average daily traffic
ADMS	Atmospheric Dispersion Modelling System
ALARP	As Low As Reasonably Practicable
ALC	Agricultural Land Classification
AoS	appraisal of sustainability
AP	Additional Provision
APHA	Animal and Plant Health Agency
AQMA	air quality management area(s)
ARP	Adaptation Reporting Power
BCO	British Council for Offices
BSI	British Standards Institute
CA	community area
CAZ	Clean Air Zones
CCC	Committee on Climate Change
CCRA	Climate Change Risk Assessment
CDM	Construction, Design and Management
CEMFAW	Control of Electromagnetic Fields At Work
CIEEM	Chartered Institute of Ecology and Environmental Management
CIfA	Chartered Institute for Archaeologists
CIRIA	Construction Industry Research and Information Association
CLEA	Contaminated Land Exposure Assessment
CO ₂	carbon dioxide
CoCP	Code of Construction Practice
COMAH	Control of Major Accident Hazards
COMEAP	Committee on the Medical Effects of Air Pollutants
COP	Conference of the Parties

CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
dB	decibel
DCLG	Department of Communities and Local Government
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DoS	Degree of Saturation
DSM	Digital Surface Model
DTM	Digital Terrain Model
EC	European Commission
ECML	East Coast Main Line
EDI	Equality, diversity and inclusion
eDNA	Environmental DNA
EFA	Education Funding Agency
EHRC	Equality and Human Rights Commission
EIA	environmental impact assessment
ELC	European Landscape Convention
EMC	electromagnetic compatibility
EMF	electromagnetic fields
EMH	East Midlands Hub
EMI	electromagnetic interference
EMS	environmental management systems
EMR	environmental minimum requirements
EPD	environmental product declarations
EPUK	Environmental Protection UK
EQIA	equality impact assessment
ES	Environmental Statement
EU	European Union
EUS	Extensive Urban Surveys

FCD	Field Capacity Days
FERA	Food and Environment Research Agency
FMD	Foot and Mouth Disease
FSMS	Field Survey Methods and Standards
FTA	Federal Transit Administration
GHG	greenhouse gas(es)
GLA	Greater London Authority
GWDTE	groundwater dependent terrestrial ecosystems
HCA	Home and Communities Agency
HDV	heavy duty vehicle(s)
HEAN	Historic England Advice Note
HER	historic environment record
HGV	heavy goods vehicle(s)
HIA	health impact assessment
HLC	Historic Landscape Character
HS1	High Speed One (formerly Channel Tunnel Rail Link – CTRL)
HS2	High Speed Two
HS2 Ltd	High Speed Two Limited
HSI	Habitat Suitability Index
HUDU	Healthy Urban Development Unit
Hz	hertz
IAQM	Institute of Air Quality Management
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICOMOS	International Council on Monuments and Sites
IEMA	Institute of Environmental Assessment and Management
IPCC	Intergovernmental Panel on Climate Change
Km	kilometre
kph	kilometres per hour
kV	kilovolts
LAQM	local air quality management

LGS	local geological site(s) (formerly regionally important geological sites)
LiDAR	light detection and ranging
LLFA	lead local flood authority
LULUCF	land use, land use change and forestry
m	metre
MAFF	Ministry of Agriculture, Fisheries and Food
MATTE	Major Accident to the Environment
MML	Midlands Main Line
mm/s	millimetres per second
MNA	Monitored Natural Attenuation
MoD	Ministry of Defence
MPA	Mineral Preferred Areas
mph	miles per hour
MSA	Mineral Safeguarding Areas
NAEI	National Atmospheric Emissions Inventory
NAP	National Adaptation Programme
NO ₂	nitrogen dioxide
NO _x	oxides of nitrogen
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPR	Northern Powerhouse Rail
OLE	overhead line equipment
ONS	Office for National Statistics
PFM	Planet Framework Model (also referred to as PLANET - Planning network transport forecast model)
PHE	Public Health England
PM _{2.5}	particulate matter with aerodynamic diameter of less than 2.5 micrometres
PM ₁₀	particulate matter with aerodynamic diameter of less than 10 micrometres
PPG	Planning practice guidance

PPGN	Planning Guidance on Noise
PPS	Planning Policy Statement
PPV	peak particle velocity
PRoW	public right(s) of way
RESTATS	Renewable Energy Statistics
RFC	Ratio of Flow to Capacity
RSPB	Royal Society for the Protection of Birds
RSSB	Rail Safety and Standards Board
RU	Railway undertakings
SES	Supplementary Environmental Statement
SI	Statutory Instrument
SM	scheduled monument
SMR	Scope and Methodology Report
SMS	safety management systems
SO27A	Parliament's Private Business Standing Order 27A
SOAEL	Significant Observed Adverse Effect Levels
SPG	Supplementary Planning Guidance
SPZ	source protection zone
SSSI	site(s) of special scientific interest
TBM	Tunnel Boring Machines
tCO _{2e}	Tonnes of Carbon Dioxide Equivalent
TDM	Technical Design Manual
TfN	Transport for the North
TIN	technical information note(s)
TraCCA	Tomorrow's Railway and Climate Change Adaptation
TRL	Transport Research Library
TSI	Technical Specifications for Interoperability
UAD	Urban Archaeological Databases
UK	United Kingdom
UKCP	UK Climate Projections

UNESCO	United Nations Educational, Scientific and Cultural Organisation
UKFS	UK Forestry Standard
UN	United Nations
US	United States
VDV	vibration dose value
WAC	Waste Acceptance Criteria
WCML	West Coast Main Line
WebTAG	Web Transport Analysis Guidance
WFD	Water Framework Directive
WHO	World Health Organisation
WG	Weather Generator
WRAP	Waste and Resources Action Programme
ZTV	zone(s) of theoretical visibility

Annex E – HS2 Ltd Sustainability Policy and Environment Policy

Sustainability Policy



Purpose:

This policy sets out HS2 Ltd.'s ambition to build the most sustainable high speed railway of its kind in the world. We want a high speed railway network which changes the mode of choice for inter-city journeys, reinvigorates the rail network, supports the economy, creates jobs, reduces carbon emissions and provides reliable travel in a changing climate throughout the 21st century and beyond.

Principles:

Sustainability at HS2 is about delivering social, environmental and economic benefits. This includes delivering value to the UK taxpayer and passenger through taking decisions that seek to get the **best value for money** through the whole operating life of the railway.

Our sustainability approach at HS2 groups our work into five themes reflecting the economic, environmental and social aspects of sustainability. These themes support the HS2 vision of being a **catalyst for growth across Britain** and our mission, which includes being an **exemplar project in our approach to engagement with communities, sustainability and respecting the environment**.

Our five sustainability themes are:

<p>Spreading the benefits: Economic growth and community regeneration</p> <p>Being a nationwide catalyst for regeneration and economic growth through development of an integrated transport system, maximising the benefits to communities and individuals and minimising any potential negative impacts.</p>	<p>Opportunities for all: Skills, employment and education</p> <p>Providing rewarding jobs and careers that are open to all in society, setting new standards for equality, diversity and inclusion and providing a legacy of skills, learning, expertise, and experience.</p>	<p>Safe at heart: Health, safety and wellbeing</p> <p>Creating a world-class 'safe at heart' culture where no one gets hurt, and which prioritises the health and wellbeing of those who build, operate, use and host HS2 services and infrastructure.</p>	<p>Respecting our surroundings: Environmental protection and management</p> <p>Breaking new ground wherever possible on environmental standards including resource use, waste, carbon minimisation, the protection of the natural and historic environment and safeguarding communities.</p>	<p>Standing the test of time: Design that is future-proof</p> <p>Building a network that is resilient to climate change in the long term, adaptable to future trends and demands, and built around the needs of the people who will use it, in line with our Design Vision.</p>

We will only be successful in this huge undertaking if sustainability is embedded in our DNA. Sustainability is a way of working within the HS2 culture, alongside innovation and collaboration. We will promote **innovation** to find sustainable solutions focussing on ideas and technologies for improving sustainability. We cannot deliver our ambition alone; we will work with our contractors to engender a **collaborative** culture to ensure we get the innovation we need to deliver a sustainable railway.

Executive Owner: The Technical Director is the Executive Owner of this policy and is responsible for maintaining the accuracy and relevance of its contents and for periodic review and update to reflect the changing circumstances.

Please also refer to:

- HS2 Sustainability Approach Document
- HS2 Equality Diversity and Inclusion Policy
- HS2 Environmental Policy
- HS2 Health & Safety Policy
- HS2 Circular Economy Principles

Approved on: 18 May 2017
 Mark Thurston, Chief Executive Officer, HS2 Ltd



Environmental Policy



Purpose:

This policy provides a framework for environmental protection and management for HS2 and its operations. It also acts to fulfil the environmental commitments established through HS2's Sustainability Policy and our strategic goal of creating an environmentally sustainable solution and being a good neighbour to local communities.

HS2 Ltd., in its planning, construction and operation of the railway, is committed to developing an exemplar project, and to limiting negative impacts through design, mitigation and by challenging industry standards whilst seeking environmental enhancements and benefits.

In addition, HS2 Ltd. commits to protecting the environment through the avoidance and prevention of pollution, and by meeting all compliance obligations.

HS2 Ltd. commits to continuously improving environmental performance, by means of establishing relevant objectives appropriate to the nature, scale and environmental impacts of the organisation and the project.

Our Environmental Principles:

Environmental Protection and Management is one of five key themes established in HS2's Sustainability Policy. In order to guide and manage our potential environmental impacts, we will seek to:

- achieve no net loss in biodiversity, reducing impacts on species and creating and enhancing habitats;
- design visible elements of the built and landscaped environment in both rural and urban areas to be sympathetic to their local context, environment and social setting;
- effectively manage and control noise and vibration to avoid significant adverse impacts on health and quality of life;
- minimise the carbon footprint of HS2 and deliver low-carbon, long-distance journeys that are supported by low-carbon energy;
- minimise the combined effect of the project and climate change on the environment;
- avoid pollutant emissions to air or reduce such emissions, and minimise public and workforce exposure to any such pollutant emissions;
- protect water resources and ensure no material increase of flooding to communities;
- reduce harm to the historic environment and deliver a programme of heritage mitigation including knowledge creation through investigation, reporting, engagement and archiving;
- reinstate agricultural land to its original quality where it has been disturbed as a result of construction; and
- source and make efficient use of sustainable materials, reduce waste and maximise the proportion of material diverted from landfill.

Executive Owner:

The Technical Director is the Executive Owner of this policy and is responsible for maintaining the accuracy and relevance of its contents and for periodic review and update to reflect the changing circumstances.

Mark Thurston
Chief Executive Officer
HS2 Ltd

Approved on: 11 April 2017

Document Number: HS2-HS2-EV-POL-000-000024 Revision Pos