HS2

October 2018

High Speed Rail (Crewe to Manchester and West Midlands to Leeds)

Working Draft Environmental Statement

Volume 2: Community Area report

LA14: South Kirkby to Sharlston Common

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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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Preface

The working draft Environmental Statement

This report forms part of Volume 2 of the working draft Environmental Statement (ES) for Phase 2b of High Speed Two (HS2). The purpose of the working draft ES is to provide the public and other stakeholders with an opportunity to review and comment on preliminary environmental information for Phase 2b of HS2, which is based on a stage in the ongoing design development and environmental assessment process. Nothing included at this stage is intended to limit the form of the final scheme that will be presented in the hybrid Bill and formal ES in light of further scheme development and the ongoing discussions with stakeholders such as Transport for the North and Midlands Connect. Consultation on the working draft ES is being undertaken to help inform the ongoing design and environmental assessment in advance of producing a statutory formal ES. The formal ES will accompany the deposit of the hybrid Bill for Phase 2b of HS2.

Phase 2b comprises the section of the proposed HS2 rail network, from Crewe to Manchester (and a connection onto the West Coast Main Line (WCML)) (the western leg), and from the West Midlands to Leeds (and a connection onto, and part electrification of, the Midland Main Line (MML) and a connection onto the East Coast Main Line (ECML)) via the East Midlands and South Yorkshire (the eastern leg). Collectively, this is referred to in this working draft ES as the 'Proposed Scheme'. The working draft ES describes the Proposed Scheme and reports its likely significant environmental effects and the measures proposed to mitigate those effects, based on a stage in the ongoing design and environmental assessment.

The hybrid Bill for Phase One of the HS2 network, between London and the West Midlands, was the subject of an ES deposited in November 2013, followed by ESs deposited with Additional Provisions to that Bill in 2014 and 2015. The Phase One hybrid Bill received Royal Assent in February 2017 and pre-construction work on Phase One commenced in July 2017.

The hybrid Bill for Phase 2a of the HS2 network, between the West Midlands and Crewe, was the subject of an ES deposited in July 2017, followed by a subsequent ES deposited with an Additional Provision to that Bill in March 2018. The Phase 2a Bill is expected to receive Royal Assent in 2019.

Consultation on the working draft Environmental Statement

The public has an opportunity to comment on this working draft ES. The period of public consultation is taking place during October 2018 – December 2018; the first day of the consultation period being the date the Secretary of State for Transport formally announces the consultation and the publication of the working draft ES documents on www.gov.uk/hs2.

Structure of the HS2 Phase 2b working draft Environmental Statement

This report forms part of Volume 2 of the working draft ES for Phase 2b of HS2. The working draft ES describes the design of the Proposed Scheme and reports the likely significant environmental effects of the construction and operation of the Proposed Scheme and proposed mitigation and monitoring measures, based on a stage in the ongoing design and environmental assessment process. The report will be updated for the formal ES to reflect further work on the design, assessment and mitigation and monitoring measures between now and when the hybrid Bill is deposited. The structure of the working draft ES is shown Figure 1.

This working draft ES has been prepared by persons who have sufficient expertise to ensure the completeness and technical quality of the statement.

The working draft ES comprises the following documents:

Non-technical summary

This provides a summary in non-technical language of the following, identified at a stage in the ongoing design and environmental assessment:

- the Proposed Scheme and the reasonable alternatives studied;
- the likely significant beneficial and adverse effects of the Proposed Scheme;
- the means to avoid or reduce likely significant environmental effects; and
- an outline of the monitoring measures to manage the effects of construction and the effectiveness of mitigation post construction, as well as appropriate monitoring during operation.

Glossary of terms and list of abbreviations

This contains terms and abbreviations, including units of measurement, used throughout the working draft ES.

Volume 1: Introduction and methodology

This provides:

- a description of HS2, the environmental impact assessment (EIA) process and the approach to consultation and engagement;
- details of the permanent features of the Proposed Scheme and general construction techniques, based on a stage in the ongoing design;
- a summary of the scope and methodology for the environmental topics;
- an outline of the general approach to mitigation;
- an outline of the approach to monitoring, including measures to manage the effects of construction, the effectiveness of mitigation post construction, as well as the approach to monitoring during the operational phase, based on a stage in the ongoing design; and

- a summary of the reasonable alternatives studied (including local alternatives studied prior to the Government's announcement of the preferred route in July 2017). Local alternatives studied post July 2017 are reported in the relevant Volume 2: Community area reports.

Volume 2: Community area reports and map books

These cover the following community areas:

- western leg: MA01 Hough to Walley's Green; MA02 Wimboldsley to Lostock Gralam; MA03 Pickmere to Agden and Hulseheath; MA04 Broomedge to Glazebrook; MA05 Risley to Bamfurlong; MA06 Hulseheath to Manchester Airport; MA07 Davenport Green to Ardwick; MA08 Manchester Piccadilly Station; and
- eastern leg: LA01 Lea Marston to Tamworth; LA02 Birchmoor to Austrey; LA03 Appleby Parva to Ashby-de-la-Zouch; LA04 Coleorton to Kegworth; LA05 Ratcliffe-on-Soar to Long Eaton; LA06 Stapleford to Nuthall; LA07 Hucknall to Selston; LA08 Pinxton to Newton and Huthwaite; LA09 Stonebroom to Clay Cross; LA10 Tibshelf to Shuttlewood; LA11 Staveley to Aston; LA12 Ulley to Bramley; LA13 Ravenfield to Clayton; LA14 South Kirkby to Sharlston Common; LA15 Warmfield to Swillington and Woodlesford; LA16 Garforth and Church Fenton; LA17 Stourton to Hunslet; and LA18 Leeds Station.

The reports provide the following information for each area, as identified at a stage in the ongoing design and environmental assessment:

- an overview of the area;
- a description of the construction and operation of the Proposed Scheme within the area;
- a summary of the local alternatives considered since the Government's announcement of the preferred route in July 2017;
- a description of the environmental baseline;
- a description of the likely significant beneficial and adverse effects of the Proposed Scheme;
- the proposed means of avoiding, reducing or managing the likely significant adverse effects; and
- where possible, the proposals for monitoring, including measures during and post construction, and during the operational phase.

The maps relevant to each community area are provided in a separate Volume 2: Community area map book. These maps include the location of the key environmental features (Map Series CT-10), key construction features (Map Series CT-05) and operation features (Map Series CT-06) of the Proposed Scheme. There are also specific maps showing proposed viewpoint and photomontage locations (Map Series LV-00, LV-02, LV-03, and LV-04, to be read in conjunction with Section 11, Landscape and visual of the Volume 2: Community area reports), operational sound contour maps (Map Series SV-01, to be read in conjunction with Section 13, Sound, noise and vibration of the Volume 2: Community area reports) and maps showing key surface water and groundwater features (Map Series WR-01 and WR-02, to be read in conjunction with Section 15, Water resources and flood risk of the Volume 2: Community area reports).

In addition to the community areas detailed above, reports are provided for community areas within which electrification of a section of the MML is proposed: MML01 Danesmoor to Brierley Bridge and MML02 Unstone Green to Sheffield Station. These reports are provided at an earlier stage of the design and environmental assessment process, following the amendment of the route of the Proposed Scheme to include the electrification of a section of the MML between Clay Cross and Sheffield Midland Station. This would enable high speed trains to connect to Chesterfield and Sheffield as part of the Proposed Scheme. They include for each area:

- an overview of the area;
- a description of the proposed works within the area, based on a stage in the ongoing design;
- an outline of potential effects; and
- an overview of stakeholder engagement and consultation to be carried out as part of the EIA process.

Mitigation measures have not been identified at this stage of the design and environmental assessment process in relation to the likely effects arising from construction and operation of the Proposed Scheme for the MML01 Danesmoor to Brierley Bridge and MML02 Unstone Green to Sheffield Station areas. Any required mitigation measures will be reported in the formal ES. In addition, any required environmental monitoring during operation of the Proposed Scheme will be reported in the formal ES.

Volume 3: Route-wide effects

This describes the effects that are likely to occur at a geographical scale greater than the community areas described in the Volume 2: Community area reports, based on a stage in the ongoing design and environmental assessment.

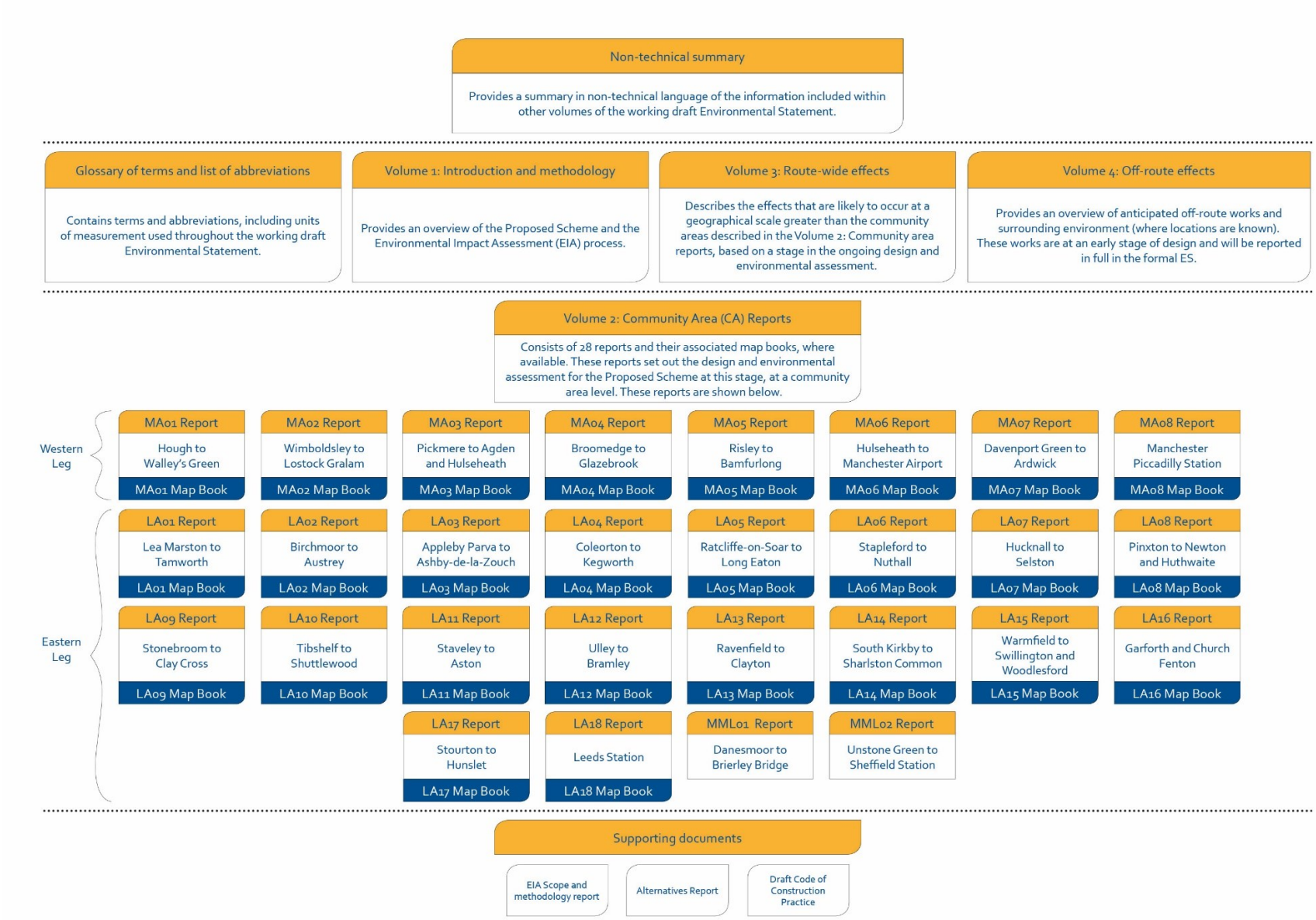
Volume 4: Off-route effects

This provides an overview of anticipated off-route works and surrounding environment (where locations are known). These works are at an early stage of design and will be reported in full in the formal ES.

Supporting documents

- EIA Scope and Methodology Report: this outlines the scope and methodology adopted for the EIA. HS2 Ltd consulted on a draft of the EIA Scope and Methodology Report (SMR) between July and September 2017. This updated version takes into consideration comments received, where appropriate, in addition to changes required as a result of updates to legislation or industry best practice guidance.
- Alternatives report: this describes the evolution of the Proposed Scheme and the reasonable alternatives considered at this stage of the design, at the strategic, route-wide, route corridor and local levels.
- Draft Code of Construction Practice (CoCP): this sets out measures and standards to provide effective planning, management and control of potential impacts on individuals, communities and the environment during construction.

Figure 1: Structure of the working draft Environmental Statement



1 Introduction

1.1 Introduction to HS2

1.1.1 High Speed Two (HS2) is a new high speed railway proposed by the Government to connect major cities in Britain. Stations in London, Birmingham, Leeds, Manchester, East Midlands and South Yorkshire will be served by high speed trains running at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph)).

1.1.2 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 Rail (London - West Midlands) Bill in November 2013. Subsequent ESs were deposited with Additional Provisions to that Bill in 2014 and 2015. The High Speed Rail (London - West Midlands) Bill received Royal Assent in February 2017 and pre-construction work on Phase One commenced in 2017.

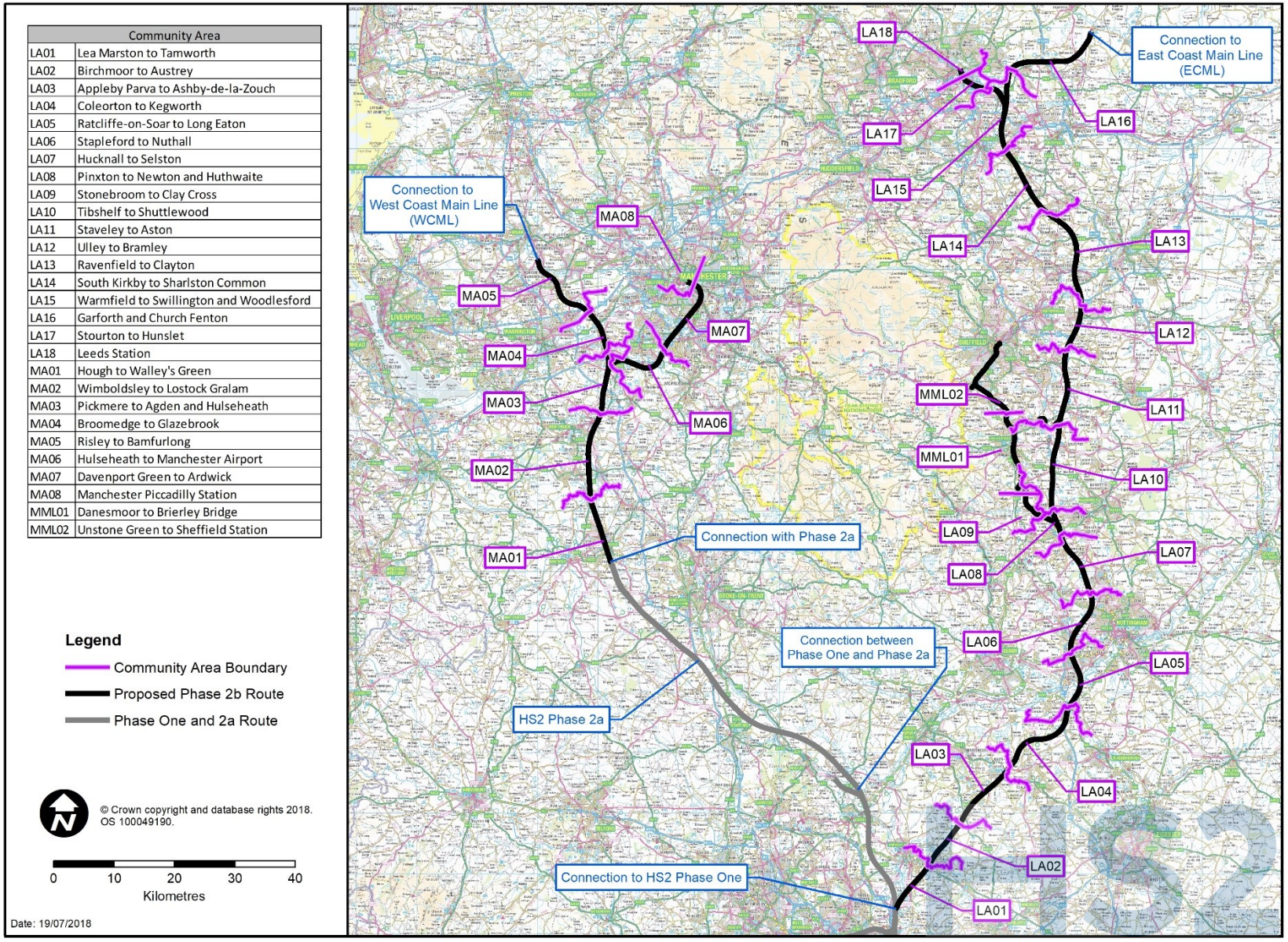
1.1.3 Phase Two of HS2 will extend the route from Phase One in the West Midlands to the north-west to Manchester (approximately 80km (50 miles) with connections to the West Coast Main Line (WCML) at Crewe and Golborne, and to the north-east to Leeds with a connection to the Erewash Valley Line and Midland Main Line (MML) 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'.

1.1.4 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. The High Speed Rail (West Midlands - Crewe) Bill, together with an ES, was prepared for the Phase 2a proposals and deposited in Parliament in July 2017. A subsequent ES was deposited with Additional Provisions to that Bill in March 2018.

1.1.5 Phase 2b (the Proposed Scheme), the subject of this working draft ES, comprises the route from Crewe to Manchester (and connections into the WCML) (referred to as the 'western leg'), and from the West Midlands to Leeds (and connections into the Midland Main Line (MML and the ECML)) via the East Midlands and South Yorkshire (referred to as 'the eastern leg'). The connection to and electrification of an approximately 30km (19 miles) section of the existing MML would enable high speed trains to connect to Chesterfield and Sheffield. Construction of the Proposed Scheme would commence in 2023, with operation planned to start in 2033.

1.1.6 For environmental assessment and community engagement purposes, the Proposed Scheme has been divided into 28 community areas (CA). These are shown in Figure 2. This CA report relates to the South Kirkby to Sharlston Common area (CA number LA14) which is located on the eastern leg of the Proposed Scheme.

Figure 2: The HS2 Phase 2b route and community areas



1.2 Purpose and status of this report

1.2.1 This working draft ES sets out the preliminary environmental information and the key features of a point-in-time design for the Proposed Scheme. It provides a description of the design of the Proposed Scheme, environmental baseline information, and the likely impacts (and where practicable, the significant effects) of the construction and operation of the Proposed Scheme on the environment within the South Kirkby to Sharlston Common area. The report also describes the proposed mitigation measures that have been identified, at this stage, to avoid, reduce or manage the likely significant adverse effects of the Proposed Scheme on the environment within the area, along with proposed monitoring measures.

1.2.2 The design development and environmental assessment process is ongoing. Consultation on the working draft ES is being carried out to assist early engagement with those potentially affected by the Proposed Scheme and to help inform the design and assessment of the Proposed Scheme. Parliamentary Standing Orders do not require a working draft ES. Developing a working draft ES and consulting on it in advance of the formal ES means that consultees have the opportunity to comment on the Proposed Scheme earlier in the process.

1.2.3 As this is a working draft ES, where information is not available at this time, professional judgement and reasonable worst case assumptions have been used to provide an indication of the likely impact to inform the consultation.

1.2.4 The likely significant environmental effects of the Proposed Scheme will be described in the formal ES to be deposited in accordance with the requirements of Parliamentary Standing Order 27A (SO27A)[1,2]. It is possible that the effects and mitigation described in the formal ES may differ from those presented in this working draft ES, due to the provisional nature of the environmental and design information that is currently available and as a result of consultation on the Proposed Scheme, as appropriate.

1.2.5 The working draft ES has been undertaken on the assumption that the policies adopted for Phase One and Phase 2a will also apply to Phase 2b. The assessment also assumes that any general mitigation measures required as a result of those policies are implemented appropriately in the delivery and operation of the Proposed Scheme. Where policies are referred to in this working draft ES it is on this basis.

1.3 Structure of this report

1.3.1 This report is divided into the following sections:

- Section 1: an introduction to HS2 and the purpose and structure of this report;
- Section 2: overview of the community area, description of the Proposed Scheme within the community area and its construction and operation, and a

[1] *Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment)*, House of Commons.
[2] House of Lords, 2005, Standing Orders of the House of Lords - Private Business, The Stationery Office.

description of the local alternatives considered;

- Section 3: consultation and stakeholder engagement; and
- Sections 4 to 15: an assessment of the following environmental topics:
  - agriculture, forestry and soils (Section 4);
  - air quality (Section 5);
  - community (Section 6);
  - ecology and biodiversity (Section 7);
  - health (Section 8);
  - historic environment (Section 9);
  - land quality (Section 10);
  - landscape and visual (Section 11);
  - socio-economics (Section 12);
  - sound, noise and vibration (Section 13);
  - traffic and transport (Section 14); and
  - water resources and flood risk (Section 15).

1.3.2 Each environmental topic section (Sections 4 to 15) comprises:

- an introduction to the topic;
- a description of the existing environmental baseline within the community area;
- a description of the impacts or likely significant environmental effects identified to date arising during construction and operation of the Proposed Scheme; and
- a description of any proposed mitigation and monitoring measures that have been identified to date to address any significant adverse effects.

1.3.3 Environmental effects have been assessed in accordance with the methodology set out in Volume 1 and the EIA Scope and Methodology Report (SMR)[3].

1.3.4 The maps relevant to the South Kirkby to Sharlston Common area are provided in a separate corresponding document entitled Volume 2: LA14 Map Book, which should be read in conjunction with this report.

[3] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

1.3.5 The Proposed Scheme described in this report is that shown on the Map Series CT-05 (construction) and CT-06 (operation) (Volume 2: LA14 Map Book). There is some flexibility during detailed design to alter the horizontal and vertical alignments and other details within the limits shown on the plans and sections submitted to Parliament and as set out in the Bill, and this flexibility is included within the scope of the environmental assessment. Further explanation is provided in Volume 1, Section 1.

1.3.6 In addition to the environmental topics covered in Sections 4 to 15 of this report, electromagnetic interference is addressed in Volume 1 and climate change, major accidents and natural disasters, and waste and material resources are addressed in Volume 3 on a route-wide basis.

2 Overview of the area and description of the Proposed Scheme

2.1 Overview of the area

General

2.1.1 The South Kirkby to Sharlston Common area covers an approximately 12.6km section of the Proposed Scheme, within the local authority areas of Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough Council (BMBC).

2.1.2 The Proposed Scheme would pass through the Hemsworth Town Council area and the parishes of South Kirkby and Moorthorpe, Huntwick with Foulby and Nostell, Crofton and Sharlston. The boundary between Clayton with Frickley parish and South Kirkby and Moorthorpe parish forms the southern boundary of this section; the boundary between Sharlston parish and Warmfield-cum-Heath parish forms the northern boundary of this section.

2.1.3 As shown in Figure 3, the Ravenfield to Clayton area (LA13) lies to the south, and the Warmfield to Swillington and Woodlesford area (LA15) lies to the north of the South Kirkby to Sharlston Common area.

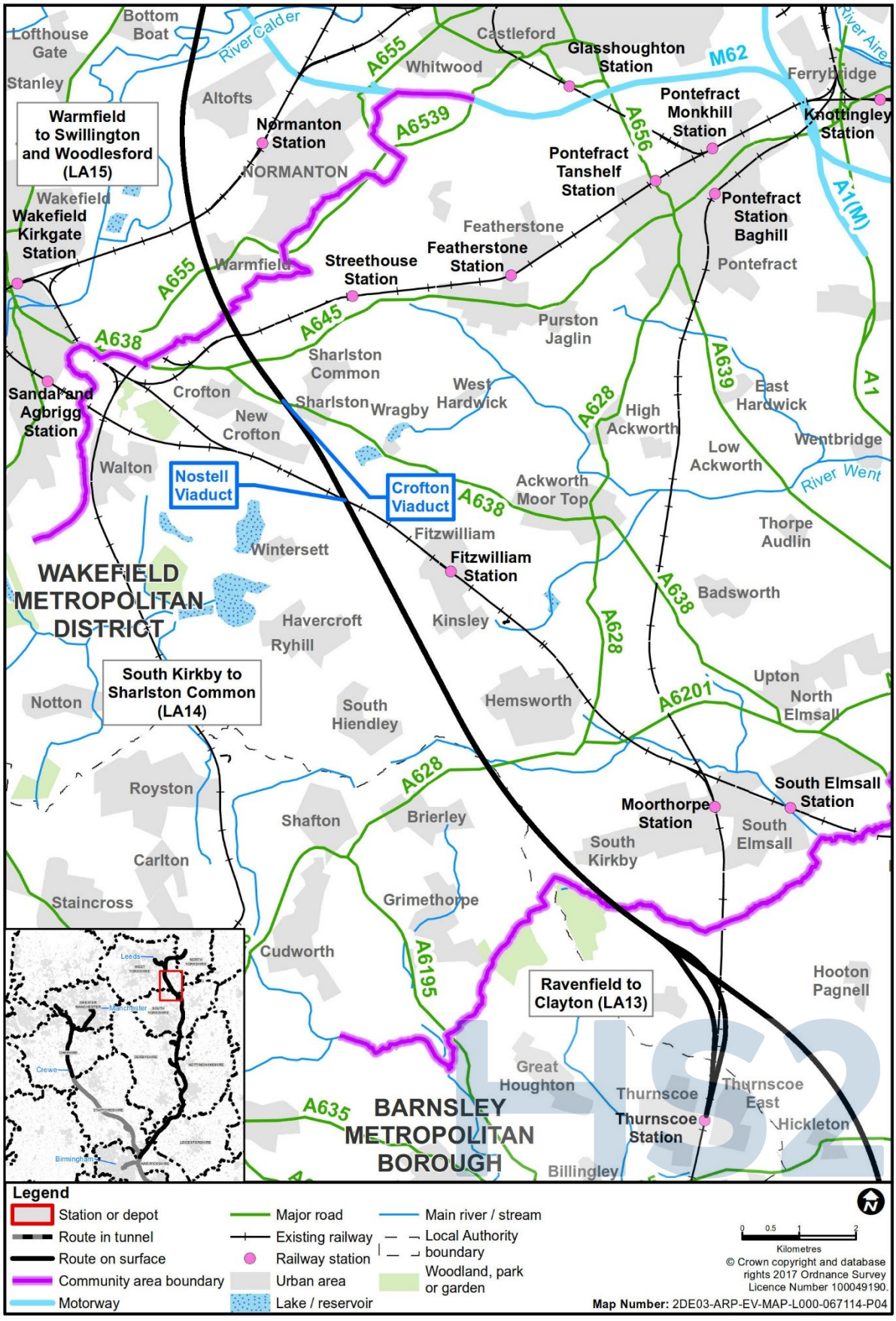
Settlement, land use and topography

2.1.4 The South Kirkby to Sharlston Common area is predominantly rural in character, with agriculture being the main land use. Historical land uses in the area included coal mining and historical landfill areas.

2.1.5 The main settlements are South Kirkby and Hemsworth, with a number of small villages including Brierley, South Hiendley, Kinsley, Havercroft (including Newstead), Ryhill, Fitzwilliam, New Crofton, Crofton and Sharlston Common. These settlements are interspersed with occasional areas of woodland, isolated dwellings and farmsteads throughout the area.

2.1.6 The topography of the South Kirkby to Sharlston Common area is undulating, with the highest point located at Brierley Common (105m above Ordnance Datum (AOD)) in the south, and the lowest point located in Sharlston (45m AOD) in the north.

Figure 3: Community area context map



Key transport infrastructure

2.1.7 Principal highways that pass through the South Kirkby to Sharlston Common area include the A628 Hemsworth Bypass, connecting Pontefract to Greater Manchester, the A638 Doncaster Road, which links Wakefield with Doncaster via Crofton, and the A645 Weeland Road, connecting Crofton with Goole. Local roads include Common Road, Holmsley Lane, the B6273 Southmoor Road, Barnsley Road, the B6428 Newstead Lane, Swine Lane, and the B6378 Pontefract Road.

2.1.8 The South Kirkby to Sharlston Common area is crossed by the Doncaster to Wakefield Line existing railway from east to north-west, with the north of the area transversely crossed by the Pontefract to Wakefield Line existing railway.

2.1.9 Within the area there are a number of public rights of way (PRoW) including local access roads, bridleways, public footpaths, and two promoted routes[4] (the Wakefield Way and the South Yorkshire Way). Some of the PRoW and bridleways also form part of the wider local cycle network, including the Wakefield Wheel and the Wonders of Wakefield Trail. National Route 67, which is part of the National Cycle Network, passes through the area to the west of South Hiendley, Havercroft and Crofton.

Socio-economic profile

2.1.10 Within the WMDC area, retail and construction account for the largest proportion of businesses (12% respectively), with professional, scientific and technical (10%) sectors also accounting for relatively large numbers of businesses within the district. In the BMBC area, construction accounts for the largest proportion of businesses (15%), followed by retail (11%) and professional, scientific and technical sectors (10%)[5].

2.1.11 According to the Annual Population Survey (2016)[6], the employment rate[7] within the WMDC area was 73% (152,000 people) and 71% (108,000 people) in the BMBC area. In 2017, the unemployment rate[8] in both the WMDC and BMBC areas was 5%.

2.1.12 According to the Annual Population Survey (2016)[9], 25% of WMDC and 27% of BMBC residents aged 16-64 were qualified to National Vocational Qualification Level 4 (NVQ4) and above. In both WMDC and BMBC areas 11% of residents had no qualifications.

Notable community facilities

2.1.13 The main concentrations of community facilities, in the South Kirkby to Sharlston Common area, are within the larger settlements of South Kirkby, Hemsworth,

[4] Promoted route refers to those PRoW which are "promoted" destinations in their own right as a recreational resource.
[5] Office for National Statistics (ONS) (2015) *Business Register and Employment Survey*. Available online at: http://www.nomisweb.co.uk
[6] Office for National Statistics (ONS) (2016) *Annual Population Survey, NOMIS*. Available online at: http://www.nomisweb.co.uk
[7] The proportion of working age (16-64 year olds) residents that is in employment.
[8] Refers to people without a job who were available to start work in the two weeks following their interview and who had either looked for work in the four weeks prior to interview or were waiting to start a job they had already obtained. As the unemployed form a small percentage of the population, the APS unemployed estimates within local authorities are based on very small samples so for many areas would be unreliable. To overcome this ONS has developed a statistical model that provides better estimates of total unemployed for unitary authorities and local authority districts (unemployment estimates for counties are direct survey estimates), NOMIS.
[9] Office for National Statistics (ONS) (2016) *Annual Population Survey, NOMIS*. Available online at: http://www.nomisweb.co.uk

and Crofton. Smaller villages, including Kinsley, Fitzwilliam, Havercroft, Ryhill, Nostell and Sharlston, provide a smaller number of local services.

2.1.14 South Kirkby is located approximately 10km to the north-east of Barnsley, and to the east of the route of the Proposed Scheme. Community facilities include: Common Road Infant and Nursery School; Stockingate Mill Junior School; South Kirkby Miners Welfare Club; a social club; and allotments.

2.1.15 The town of Hemsworth is located approximately 1.7km to the north of South Kirkby. Community facilities include: St. Helen's Church of England Primary School; Cedars Children's Centre; Hemsworth United Junior Football Club; and allotments. To the north of Hemsworth, the villages of Kinsley and Fitzwilliam offer a number of community facilities including: Kinsley Football Club; Our Lady of Graces Church; Kinsley Medical Centre and Autism Service; Red Roof Children's Day Nursery; the Church of the Resurrection; and allotments.

2.1.16 Approximately 1.3km west of Fitzwilliam, the adjacent villages of Ryhill and Havercroft contain a small number of community facilities, including: St. James Church; Living Hope Church; Ryhill Liberal Club; Ryhill Village Social Club; and allotments. The Yorkshire Air Ambulance Nostell Air Support Unit is based in the village of Nostell, to the north of Fitzwilliam.

2.1.17 The village of Crofton is located approximately 5km south-east of Wakefield. Community facilities present in the village include: Crofton Community Centre; Nostell Miners Welfare Football Club; Crofton Community Library; Crofton Youth Centre; and a number of schools, which includes The Priory Centre; a pupil referral unit for children aged 11 to 14 who have been excluded from mainstream school. The village of Sharlston, 750m north-east of Crofton, includes the Parish Church of Saint Luke, Crofton and Sharlston Medical Centre, and allotments.

Recreation, leisure and open space

2.1.18 The South Kirkby to Sharlston Common area is predominantly rural. Recreational and leisure facilities in the area include several sports pitches; Burntwood Court (hotel, health and fitness centre); Hemsworth Water Park and Playworld; and Crofton Riding and Livery Stables.

2.1.19 The National Trust owned Grade I Listed Nostell Priory and associated Grade II* Registered Park and Garden are located to the south-east of Crofton.

2.1.20 Other open spaces within the area include: Howell Wood, Fitzwilliam and Anglers country parks; and Dam Head Wood in Sharlston.

Policy and planning context

Planning framework

2.1.21 Volume 1 provides an overview of the policy case for HS2. Relevant development plan documents and policies have been considered in relation to environmental topics, as part of considering the Proposed Scheme in the local context.

2.1.22 The following local policy documents have been considered and referred to where appropriate to the assessment:

- WMDC Local Development Framework Core Strategy (2009)[10];
- WMDC Local Development Framework Development Policies Development Plan Document (2009)[11];
- WMDC Local Development Framework Waste Development Plan Document (2009)[12];
- WMDC Local Development Framework Site Specific Policies Local Plan (2012)[13];
- WMDC Policies Map (latest version adopted 18 January 2017)[14];
- WMDC Central Wakefield Area Action Plan Development Plan Document (2009)[15];
- WMDC Leisure, Recreation and Open Space Local Plan (2017)[16];
- WMDC Retail and Town Centre Local Plan (2017)[17];
- Barnsley Core Strategy (2011)[18];
- Saved policies of the Barnsley Unitary Development Plan (2000)[19];
- Barnsley, Doncaster and Rotherham Joint Waste Plan (2012)[20];
- Barnsley Education Sites Development Plan Document (2009)[21];
- Walton Neighbourhood Development Plan (2016)[22]; and
- West Yorkshire Local Transport Strategy (2017)[23].

[10] WMDC (2009) *Wakefield District Local Development Framework Core Strategy*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/core-strategy
[11] WMDC (2009) *Wakefield District Local Development Framework Development Policies Development Plan Document*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/development-policies
[12] WMDC, (2009) *Wakefield District Local Development Framework Waste Development Plan Document*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/waste-our-local-plan
[13] WMDC (2012) *Wakefield District Local Development Framework Site Specific Policies Local Plan*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/site-specific-policies
[14] WMDC (2017) Policies Map. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/site-specific-policies
[15] WMDC (2009) *Central Wakefield Area Action Plan Development Plan Document*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/central-wakefield
[16] WMDC (2017) *Leisure, Recreation and Open Space Local Plan*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/leisure-recreation-open-spaces
[17] WMDC (2017) *Retail and Town Centre Local Plan*. Available online at: http://www.wakefield.gov.uk/planning/policy/local-plan/retail-town-centres
[18] BMBC (2011) *Barnsley Core Strategy*. Available online at: https://www.barnsley.gov.uk/media/3093/core-strategy.pdf
[19] BMBC (2000) *Saved policies of the Barnsley Unitary Development Plan*. Available online at: https://www.barnsley.gov.uk/services/planning-and-buildings/local-planning-and-development/our-current-statutory-development-plan/the-unitary-development-plan/
[20] BMBC (2012) *Barnsley, Doncaster and Rotherham Joint Waste Plan*. Available online at: https://www.barnsley.gov.uk/media/3096/adopted-barnsley-doncaster-and-rotherham-joint-waste-plan.pdf
[21] BMBC (2009) *Barnsley Education Sites Development Plan Document*. Available online at: https://www.barnsley.gov.uk/media/4070/education-sites-dpd-adoption-version.pdf
[22] Walton Neighbourhood Plan Steering Group (2016) *Walton Neighbourhood Plan*. Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/neighbourhood-planning/walton/walton-neighbourhood-development-plan.pdf

2.1.23 Emerging policies are not generally included within this report unless a document has been submitted for examination to the Secretary of State. This is the case with the Barnsley Local Plan[24], which was submitted to the Secretary of State on 23 December 2016.

Committed development

2.1.24 Committed developments are defined as developments with planning permission and sites allocated for development, or safeguarded for minerals in adopted development plans, on or close to the land required for the Proposed Scheme.

2.1.25 Where it is likely that committed developments will have been completed by 2023, these will be identified as 'future baseline' schemes and taken into account in the formal ES.

2.1.26 Where there are committed developments that are considered likely to be constructed between 2023 and 2033, i.e. at the same time as the Proposed Scheme, they would be considered as receptors for the operation of HS2, but also potentially to give rise to cumulative impacts with the Proposed Scheme during construction. Any cumulative impacts and likely significant effects will be reported in the formal ES.

2.1.27 Planning applications yet to be determined at the time of the formal ES and sites that are proposed allocations in development plans that have yet to be adopted, on or close to the Proposed Scheme, are termed 'proposed developments'. These will not be included in the assessment in the formal ES.

Ongoing design development

2.1.28 Design development continues on this section of route as further engineering and environmental baseline is collated, including from field surveys, and as part of ongoing consultation and stakeholder engagement. Any further changes resulting from this will be reported in the formal ES. The main areas of design development being considered include:

- review of the proposed lengths and heights of viaducts and other crossing structures and associated replacement floodplain storage areas;
- review of the horizontal alignment of the route of the Proposed Scheme where it would pass South Kirkby, Brierley and Hemsworth;
- review of the vertical alignment of the Proposed Scheme, and the resulting heights of embankments and structures and depths of cuttings;
- development of proposed temporary and permanent utility diversions;
- refinement of the realignment of roads and PRoW crossing the Proposed Scheme;

[23] West Yorkshire Combined Authority (2017) *Transport Strategy 2040*. Available online at: https://www.westyorks-ca.gov.uk/transport/transport-strategy/
[24] BMBC (2016) *Barnsley Local Plan Publication Draft*. Available online at: https://www.barnsley.gov.uk/services/planning-and-buildings/local-planning-and-development/our-new-local-plan/barnsleys-local-plan/

- review of the requirement for modifications to the junction of the A638 Doncaster Road with the A645 Weeland Road;
- review of structural types and assumed construction methods for certain major structures;
- refinement of drainage features required for the Proposed Scheme and associated modified highways;
- refinement of maintenance access routes and access to balancing ponds;
- additional environmental features required to mitigate likely significant environmental effects;
- accommodation works and crossings of the route for private means of access;
- refinement of construction compound locations and site haul routes; and
- refinement of auto-transformer station locations.

2.2 Description of the Proposed Scheme

2.2.1 The following section describes the main features of the Proposed Scheme in the South Kirkby to Sharlston Common area, including the proposed environmental mitigation measures that have been identified to date. Further general information on typical permanent features is provided in Volume 1, Section 5. Similarly, a general description of the approach to mitigation is explained in Volume 1, Section 9.

2.2.2 Land required for operation of the Proposed Scheme is described in this section and is shown on Volume 2: Map Series CT-06. Land also required for construction is described in Section 2.3 and shown on Volume 2: Map Series CT-05.

2.2.3 In general, features are described from south to north along the route, and east to west for features that cross the Proposed Scheme.

Overview

2.2.4 The Proposed Scheme through the South Kirkby to Sharlston Common area would be approximately 12.6km in length. The route would extend from South Kirkby in the south and travel northwards towards Hemsworth, Crofton and Sharlston Common.

2.2.5 This section of route is illustrated on maps CT-06-478b to CT-06-486a-R1 in the Volume 2: LA14 Map Book.

2.2.6 All dimensions in the sections below are approximate.

2.2.7 In the South Kirkby to Sharlston Common area, the route of the Proposed Scheme would be carried on the following features:

- viaducts for a total length of 590m (Nostell and Crofton viaducts);
- cuttings for a total length of 5.7km (Howell Wood, Hemsworth, Havercroft, Crofton and New Sharlston cuttings); and
- embankments for a total length of 6.3km (Clayton North, Brierley, Kinsley,

New Crofton South, New Crofton North, Crofton South and Crofton North embankments).

2.2.8 The Proposed Scheme is described in four separate sections below.

2.2.9 In general, features are described along the route of the Proposed Scheme from south to north and to the eastern and western sides of the route as they cross the Proposed Scheme, as shown on Map Series CT-06 in the Volume 2: LA14 Map Book.

Clayton North embankment to Brierley embankment

2.2.10 The route of the Proposed Scheme would continue from the Ravenfield to Clayton area (LA13) north-west towards South Kirkby on Clayton North embankment. It would continue northwards into Howell Wood cutting, passing under the realigned Common Road and the B6273 Southmoor Road. The route would then pass onto Brierley embankment, crossing over the A628 Hemsworth Bypass.

2.2.11 This section of route is illustrated on maps CT-06-478b to CT-06-480 in the Volume 2: LA14 Map Book.

2.2.12 Key features of this 3.6km section would include:

- a section of Clayton North embankment, 240m in length and 9m in height, continuing from the Ravenfield to Clayton area (LA13), with landscape mitigation planting on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-478b, C6 to D5);
- a balancing pond for railway drainage from the Proposed Scheme on the eastern side of the route of the Proposed Scheme. Access would be provided via an access road from Broad Lane (see Volume 2: Map CT-06-478b, B7 to C9);
- an area of woodland habitat creation to the west of the route of the Proposed Scheme to provide replacement habitat (see Volume 2: Map CT-06-478b, C5 to I3);
- Howell Wood cutting, 2.3km in length, up to 20m in depth and 135m in width, with landscape mitigation planting adjacent to the cutting on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape. A noise fence barrier, 630m in length and up to 3m in height above rail, would be located at the base of the cutting on the eastern side of the route, to provide acoustic screening for properties in South Kirkby (see Volume 2: Map CT-06-478b, D5 to I5 and Map CT-06-479, B5 to H6);
- Howell Wood overbridge, 70m in length, to provide accommodation access for Avenue Farm across the route of the Proposed Scheme (see Volume 2: Map CT-06-478b, G5);
- realignment of Common Road, 15m to the south of its existing alignment for 605m, crossing the route of the Proposed Scheme via Common Road overbridge. The realignment of Common Road would result in the modification of the private access to the Grade II Listed South Kirkby Common

Farmhouse on the northern side of Common Road, to the east of the route of the Proposed Scheme (see Volume 2: Map CT-06-478b, I6 to I5 and Map CT-06-479, B5 to C4);

- Common Road overbridge, 136m in length, up to 4m above ground level and 12m above track level (see Volume 2: Map CT-06-478b, I5 to I6);
- diversion of Burntwood Lane, 40m west of its existing alignment for 120m, to join the realigned Common Road (see Volume 2: Map CT-06-478b, I4 and Map CT-06-479, B5);
- an area of landscape mitigation planting and grassland habitat creation to the west of the route of the Proposed Scheme, to help integrate the Proposed Scheme into the surrounding landscape and provide replacement habitat (see Volume 2: Map CT-06-479, B5 to D4);
- closure of Holmsley Lane where it would cross the route of the Proposed Scheme, with access to properties retained on the eastern side of the route and access to a historical landfill site retained on the western side of the route. On both sides of the route, a turning head would be provided on the retained sections of Holmsley Lane to facilitate vehicle access (see Volume 2: Map CT-06-479, C5 to D6);
- realignment of the B6273 Southmoor Road, 320m east of its existing alignment for 1.4km, crossing the route of the Proposed Scheme on the B6273 Southmoor Road overbridge. Landscape mitigation planting would be located on both sides of the realigned B6273 Southmoor Road, to help integrate the Proposed Scheme into the surrounding landscape. The existing B6273 Southmoor Road would be closed where it would cross the route of the Proposed Scheme. On the eastern side of the route, access to properties would be retained from the realigned B6273 Southmoor Road, with a turning head provided to facilitate vehicle access. On the western side of the route, the existing B6723 Southmoor Road would not be accessible from the realigned B6273 Southmoor Road (see Volume 2: Map CT-06-479, E2 to G8 and Map CT-06-479-R1 G3 to I4);
- the B6273 Southmoor Road overbridge, 60m in length, up to 8m above existing ground level and 12m above track level (see Volume 2: Map CT-06-479, F5 to G6);
- three ecological mitigation ponds adjacent to the realigned B6273 Southmoor Road, two to the west of the route of the Proposed Scheme and one to the east, to provide replacement habitat for great crested newt (see Volume 2: Map CT-06-479, F5, G5 and G9 to H9);
- a balancing pond for highway drainage, to the east of the realigned B6273 Southmoor Road, on the eastern side of the route of the Proposed Scheme. Access would be provided from the realigned B6273 Southmoor Road (see

Volume 2: Map CT-06-479-R1, I4);

- Dunsley drop inlet culvert[25], 90m north-west of the B6273 Southmoor Road overbridge, for realignment of Tributary of Hague Hall Beck 3 under the route of the Proposed Scheme. Access would be provided from the realigned B6273 Southmoor Road (see Volume 2: Map CT-06-479, G5 to G6);
- Hemsworth Gate drop inlet culvert, 230m north-west of the B6273 Southmoor Road overbridge, for surface water drainage under the route of the Proposed Scheme. Access would be provided from the realigned B6273 Southmoor Road (see Volume 2: Map CT-06-479, H5 to H6);
- Brierley embankment, 1km in length and up to 18m in height, with landscape mitigation planting and landscape earthworks on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-479, H5 to I6 and to Map CT-06-480, B6 to F5);
- realignment of Hemsworth Footpath 24, 125m south of its existing alignment for 450m, crossing under the route of the Proposed Scheme via the Hemsworth Footpath 24 underbridge, which would be 8m in length (see Volume 2: Map CT-06-480, B5 to C7);
- South Moor South culvert, 10m north-west of the Hemsworth Footpath 24 underbridge, for surface water drainage under the route of the Proposed Scheme (see Volume 2: Map CT-06-480, B5 to C6);
- South Moor North culvert, 160m north-west of the Hemsworth Footpath 24 underbridge, for surface water drainage under the route of the Proposed Scheme (see Volume 2: Map CT-06-480, C5 to C6);
- the A628 Hemsworth Bypass underbridge, 50m in length and up to 18m above ground level. The route of the Proposed Scheme would cross over the A628 Hemsworth Bypass, which would remain on its existing alignment (see Volume 2: Map CT-06-480, E6);
- Brierley culvert, 60m north-west of the A628 Hemsworth Bypass underbridge, for surface water drainage under the route of the Proposed Scheme (see Volume 2: Map CT-06-480, E5 to E6); and
- an area of landscape mitigation planting to the east of the route of the Proposed Scheme to provide visual screening for properties in Hemsworth (see Volume 2: Map CT-06-480, E10 to G9).

2.2.13 This section of the route would include two maintenance access points allowing vehicle access to the route of the Proposed Scheme. There would also be maintenance access routes, hedgerow planting and minor utilities works within this

[25] A drop inlet culvert comprises a circular pipe or rectangular box culvert, usually with an inlet weir and open stepped 'cascade' on the upstream side to dissipate energy. Drop inlet culverts are used when a watercourse (or dry valley) crosses the route or road in cutting or close to existing ground level.

section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.14 Construction of this section would be managed from the Clayton cutting satellite compound (located in the Ravenfield to Clayton area (LA13), see Volume 2, Community area LA13, Ravenfield to Clayton), Howell Wood cutting satellite compound, Common Road overbridge satellite compound and Brierley embankment main compound, which are described in Section 2.3, and shown on maps CT-05-478b to CT-05-480 in the Volume 2: LA14 Map Book.

Brierley embankment to Kinsley embankment

2.2.15 The route would continue into Hemsworth cutting, passing under the realigned Barnsley Road. The route would continue north-west, passing the town of Hemsworth on the eastern side of the Proposed Scheme, before continuing on to Kinsley embankment.

2.2.16 This section of route is illustrated on maps CT-06-480 to CT-06-482 in the Volume 2: LA14 Map Book.

2.2.17 Key features of this 3km section would include:

- Hemsworth cutting, 1.1km in length, up to 13m in depth and 100m in width, with engineering earthworks on the western side of the route of the Proposed Scheme. There would be associated landscape mitigation planting adjacent to the cutting on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-480, F5 to I6 and Map CT-06-481, B5 to D6);
- realignment of Hemsworth Footpath 23, 25m south-east of its current alignment for 210m, crossing the route of the Proposed Scheme on the Hemsworth Footpath 23 overbridge, which would be 76m in length (see Volume 2: Map CT-06-480, G5 to G7);
- Hemsworth auto-transformer station, 49m by 24m, on the western side of the route of the Proposed Scheme, 40m north of the Hemsworth Footpath 23 overbridge. Access would be provided from Barnsley Road (see Volume 2: Map CT-06-480, G5);
- realignment of Barnsley Road for 390m, crossing the route of the Proposed Scheme on the Barnsley Road overbridge. The Barnsley Road overbridge would be 98m in length, 1m above existing ground level and 12m above track level (see Volume 2: Map CT-06-480, H4 to H7);
- diversion of Robin Lane, 270m south-west of its existing alignment and 925m in length. The existing Robin Lane would be closed at the junction with Barnsley Road and retained as access to properties to the west of the route of the Proposed Scheme, with a turning head provided to facilitate vehicle access (see Volume 2: Map CT-06-480, G3 to I2 and Map CT-06-481, B1 to B2);
- two ecological mitigation ponds to the west of the route of the Proposed Scheme, one to the east and one to the west of the Robin Lane diversion, to

provide replacement habitat for great crested newt (see Volume 2: Map CT-06-480, I2 and Map CT-06-481, B1);

- realignment of Hemsworth Footpath 22 over the route of the Proposed Scheme on its existing alignment via the Hemsworth Footpath 22 overbridge, which would be 67m in length (see Volume 2: Map CT-06-480, I6);
- Kinsley embankment, 1.9km in length and up to 14m in height, with landscape mitigation planting, landscape earthworks and grassland habitat creation on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape and provide replacement habitat. A noise fence barrier, 560m in length and up to 2m in height above rail, would be located on the eastern side of the route to provide acoustic screening for properties in Kinsley (see Volume 2: Map CT-06-481, D5 to I6 and Map CT-06-482, B6 to F5);
- Rushworth Wood culvert, 230m to the north-west of Barnsley Road, for the realignment of Tributary of River Went 1 under the route of the Proposed Scheme (see Volume 2: Map CT-06-481, E5 to E6);
- two ecological mitigation ponds to the east of the route of the Proposed Scheme, to provide replacement habitat for great crested newt (see Volume 2: Map CT-06-481, E9 and Map CT-06-481-R, D2);
- West End culvert, 950m north-west of Hemsworth Footpath 22 overbridge, for surface water drainage under the route of the Proposed Scheme (see Volume 2: Map CT-06-481, F5 to F6);
- a balancing pond for railway drainage, 700m north-west of the Grade II Listed Vissitt Manor, to the west of the route of the Proposed Scheme. Access would be provided via an existing private access track which extends from Vissitt Lane to the west of Vissitt Manor Farm. The alignment of the private access track would be modified to enable access for maintenance vehicles to the balancing pond (see Volume 2: Map CT-06-481, F4 to G5);
- realignment of Hemsworth Bridleway 8, 60m south-east of its existing alignment for 420m, crossing the route of the Proposed Scheme on the Hemsworth Bridleway 8 accommodation overbridge, which would be 30m in length. The overbridge would provide accommodation access for Vissitt Manor Farm across the route of the Proposed Scheme (see Volume 2: Map CT-06-481, H4 to I7);
- realignment of Hemsworth Footpath 5, 95m north-west of its existing alignment for 330m, crossing the route of the Proposed Scheme via the Hemsworth Footpath 5 accommodation underbridge, which would be 13m in length. The underbridge would provide accommodation access for Newstead Grange Farm under the route of the Proposed Scheme. The northern branch of Hemsworth Footpath 5, connecting to Hemsworth Footpath 7, would be closed for 80m in length where it would cross the route of the Proposed Scheme (see Volume 2: Map CT-06-482, D4 to D6);
- diversion of Hemsworth Footpath 7, 130m north-east of its existing alignment

for 125m, to join the realigned Hemsworth Footpath 5 to the east of the route of the Proposed Scheme (see Volume 2: Map CT-06-482, D4 to D6);

- Kinsley culvert, 25m north-west of the Hemsworth Footpath 5 accommodation underbridge, for the realignment of Tributary of River Went 3 under the route of the Proposed Scheme (see Volume 2: Map CT-06-482, D5 to D6);
- an ecological mitigation pond to the east of the route of the Proposed Scheme, to provide replacement habitat for great crested newt (see Volume 2: Map CT-06-482, D6 to E6); and
- an ecological mitigation pond to the west of the route of the Proposed Scheme, to provide replacement habitat for great crested newt (see Volume 2: Map CT-06-482, F4).

2.2.18 This section of the route would include two maintenance access points allowing vehicle access to the route of the Proposed Scheme. There would also be maintenance access routes, hedgerow planting and minor utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.19 Construction of this section would be managed from the Hemsworth cutting satellite compound and Kinsley embankment satellite compound which are described in Section 2.3, and shown on maps CT-05-480 to CT-05-482 in the Volume 2: LA14 Map Book.

Kinsley embankment to New Crofton North embankment

2.2.20 The route would continue into Havercroft cutting, passing under the realigned B6428 Newstead Lane and Swine Lane. It would continue on to New Crofton South embankment, before passing onto Nostell viaduct to cross the Doncaster to Wakefield Line. The route would continue on New Crofton North embankment to the south-east of New Crofton.

2.2.21 This section of route is illustrated on maps CT-06-482 to CT-06-484 in the Volume 2: LA14 Map Book.

2.2.22 Key features of this 3.7km section would include:

- Havercroft cutting, 1.7km in length, up to 16m in depth and 117m in width, with associated landscape mitigation planting adjacent to the cutting on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-482 F5 to I5 to Map CT-06-483, B6 to G5);
- realignment of the B6428 Newstead Lane, 85m north-west of its existing alignment for 1.2km, crossing the route of the Proposed Scheme on the B6428 Newstead Lane overbridge. There would be an area of landscape mitigation planting to the north-east of the realigned B6428 Newstead Lane to help integrate the Proposed Scheme into the surrounding landscape. The existing B6428 Newstead Lane would be closed where it would cross the route of the Proposed Scheme. On the western side of the route, access to properties

would be retained from the realigned B6428 Newstead Lane, with a turning head provided to facilitate vehicle access (see Volume 2: Map CT-06-482, H1 to I9);

- the B6428 Newstead Lane overbridge, 83m in length, 5m above existing ground level and 12m above track level (see Volume 2: Map CT-06-482, H5 to H6);
- diversion of Carr Lane, 45m north-west of its existing alignment for 45m, to join the realigned B6428 Newstead Lane (see Volume 2: Map CT-06-482, H8 to I7);
- a balancing pond for highway drainage to the west of the realigned B6428 Newstead Lane on the eastern side of the route of the Proposed Scheme. Access would be provided from the realigned B6428 Newstead Lane (see Volume 2: Map CT-06-483, B9);
- a balancing pond for railway drainage to the east of the route of the Proposed Scheme, with access provided via the realigned B6428 Newstead Lane (see Volume 2: Map CT-06-483-R1, B3 to C4);
- Horncastle Hill inverted siphon[26], 400m north-west of the B6428 Newstead Lane overbridge, for the realignment of Tributary of Hessle Beck 1 under the route of the Proposed Scheme. On both sides of the route of the Proposed Scheme, access to the inverted siphon would be provided from the realigned B6428 Newstead Lane, with turning heads to facilitate vehicle access (see Volume 2: Map CT-06-483, C5 to C6);
- diversion of Hemsworth Footpath 4, 190m north-west of its existing alignment for 165m (see Volume 2: Map CT-06-483, E5 to F4);
- realignment of Swine Lane, 35m to the south-east of its existing alignment for 985m, to cross the route of the Proposed Scheme on the Swine Lane overbridge. The existing Swine Lane would be closed where it would cross the route of the Proposed Scheme. On the western side of the route, access to properties would be retained from the realigned Swine Lane, with a turning head provided to facilitate vehicular access. On the eastern side of the route, the existing Swine Lane would not be accessible from the realigned Swine Lane. The realignment of Swine Lane would result in the modification of private access to Horncastle Farm (Metcalfe) to the east of the route. Access to Station Cottages would be provided from the realigned Swine Lane (see Volume 2: Map CT-06-483, F3 to H10);
- Swine Lane overbridge 90m in length, up to 2m above existing ground level and 11m above track level (see Volume 2: Map CT-06-483, F5 to G6);
- a balancing pond for highway drainage to the south of the realigned Swine

[26] A form of culvert used on level ground where the water level has to be lowered to pass under the Proposed Scheme, other railways or a road access.

Lane on the western side of the route of the Proposed Scheme, with access provided from the realigned Swine Lane (see Volume 2: Map CT-06-483, F3 to F4);

- a balancing pond and associated pumping station for highway drainage to the east of the realigned Swine Lane on the eastern side of the route of the Proposed Scheme, with access provided from the realigned Swine Lane (see Volume 2: Map CT-06-483-R1, G3 to H2);
- diversion of Huntwick-with-Foulby and Nostell Footpath 1, 165m south-west of its existing alignment for 650m (see Volume 2: Map CT-06-483, F4 to I5);
- Doncaster to Wakefield Line underbridge, 9m above Network Rail track level, to accommodate the realignment of Swine Lane. The Doncaster to Wakefield Line underbridge would replace an existing Network Rail overbridge, which carries the existing Swine Line over the Doncaster to Wakefield Line. The route of the Proposed Scheme would pass to the south-west of the Doncaster to Wakefield Line underbridge (see Volume 2: Map CT-06-483, G8);
- an area of landscape mitigation planting on the western side of the route of the Proposed Scheme to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-483, G4 to I5);
- Crofton auto-transformer station, 49m by 24m, 100m north-west of Swine Lane overbridge on the western side of the route of the Proposed Scheme. Access would be provided from Swine Lane (see Volume 2: Map CT-06-483, G5);
- an area of woodland habitat creation to the west of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-483, G5 to I3);
- New Crofton South embankment, 255m in length and up to 12m in height (see Volume 2: Map CT-06-483, G5 to I6);
- Nostell viaduct, 210m in length and up to 21m in height, to cross over the Doncaster to Wakefield Line (see Volume 2: Map CT-06-483, I6);
- realignment of tributary of Hardwick Beck 1 under Nostell viaduct (see Volume 2: Map CT-06-483, I6);
- an area of wetland habitat creation to the west of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-483, I2 to I5 and CT-06-483-L1, I8 to I9);
- realignment of Huntwick-with-Foulby and Nostell Footpath 1, 35m east of its existing alignment for 215m, to cross under Nostell viaduct (see Volume 2: Map CT-06-483, I5 to I6 and Map CT-06-484, B6);
- New Crofton North embankment, 1.5km in length and up to 20m in height, with associated landscape earthworks and landscape mitigation planting on both sides of the route to help integrate the Proposed Scheme into the

surrounding landscape. A noise fence barrier, 870m in length and up to 3m in height above rail, would be located on the western side of the route to provide acoustic screening for properties in New Crofton. A noise fence barrier, 310m in length and up to 3m in height above rail, would be located on the eastern side of the route to provide acoustic screening for properties in Crofton (see Volume 2: Map CT-06-484, B5 to I6);

- an area of wetland habitat creation to the west of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-484, C3 to C4);
- an area of woodland habitat creation to the west of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-484, C3 to D5);
- an area of grassland habitat creation on the eastern side of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-484, C6 to D6);
- an area of grassland habitat creation on the western side of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-484, D4 to D5);
- realignment of Crofton Footpath 11, 165m south-east of its existing alignment for 510m, crossing the route of the Proposed Scheme via the Crofton Footpath 11 accommodation underbridge, which would be 8m in length. The underbridge would provide accommodation access for Horncastle Farm under the route of the Proposed Scheme (see Volume 2: Map CT-06-484, D7 to E4);
- three ecological mitigation ponds to the east of the route of the Proposed Scheme to provide replacement habitat for great crested newt (see Volume 2: Map CT-06-484, D8 and E7 to E9);
- an area of landscape mitigation planting to the west of the route of the Proposed Scheme to provide visual screening for properties in Crofton (see Volume 2: Map CT-06-484, F2 to F3 and Map CT-06-484-L1, F9 to G8);
- Crofton retaining wall, 50m in length and up to 10m in height, along the western side of the New Crofton North embankment. The retaining wall would reduce the amount of land required for the Proposed Scheme in proximity to Nostell Miners Welfare Football Club and Crofton Community Centre (see Volume 2: Map CT-06-484, F5 to G5);
- an area of wetland habitat creation on the eastern side of the route of the Proposed Scheme, to provide replacement habitat (see Volume 2: Map CT-06-484,G6);
- New Crofton culvert, 540m north-west of the Crofton Footpath 11 accommodation overbridge, for the realignment of Tributary of Hardwick Beck 3 and Tributary of Hardwick Beck 4 under the route of the Proposed Scheme (see Volume 2: Map CT-06-484, G5 to G7);

- realignment of Sharlston Footpath 12, 65m north-west of its existing alignment for 250m, to cross under the route of the Proposed Scheme via the Sharlston Footpath 12 underbridge, which would be 8m in length (see Volume 2: Map CT-06-484, G5 to G7); and
- three ecological mitigation ponds to the west of the route of the Proposed Scheme, one with an area of surrounding wetland habitat creation, to provide replacement habitat for great crested newt (see Volume 2: Map CT-06-484, G5 to I4).

2.2.23 This section of the route would include two maintenance access points, allowing vehicle access to the route of the Proposed Scheme. There would also be maintenance access routes, hedgerow planting and minor utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.24 Construction of this section would be managed from the Havercroft cutting satellite compound and New Crofton South embankment satellite compound, which are described in Section 2.3, and shown on maps CT-05-482 to CT-05-484 in the Volume 2: LA14 Map Book.

New Crofton North embankment to New Sharlston cutting

2.2.25 The route would continue north-west in Crofton cutting, before transferring onto Crofton South embankment. The route would cross over the A638 Doncaster Road on Crofton viaduct, continuing onto the Crofton North embankment and passing over the A645 Weeland Road and Pontefract to Wakefield Line. The route would transfer into New Sharlston cutting to continue to the end of the South Kirkby to Sharlston Common area.

2.2.26 This section of route is illustrated on maps CT-06-485 to CT-06-486a-R1 in the Volume 2: LA14 Map Book.

2.2.27 Key features of this 2.3km section would include:

- Crofton cutting, 280m in length, up to 10m in depth and 75m in width, with landscape mitigation planting adjacent to the cutting on both sides of the route of the Proposed Scheme to provide visual screening for properties in Crofton and help integrate the Proposed Scheme into the surrounding landscape. There would be noise fence barriers, up to 3m in height above rail, at the base of the cutting on both sides of the route to provide acoustic screening for properties in Crofton (see Volume 2: Map CT-06-485, B5 to C6);
- realignment of Crofton Footpath 9, 220m to the north-west of its existing alignment for 525m, with users diverted via the A638 Doncaster Road and Towers Lane (see Volume 2: Map CT-06-485, B5 to D6);
- Crofton South embankment, 45m in length and up to 3m in height, with landscape mitigation planting on both sides of the route of the Proposed Scheme to provide visual screening for properties in Crofton and help integrate the Proposed Scheme into the surrounding landscape. There would be noise fence barriers, up to 3m in height above rail, on both sides of the route to

provide acoustic screening for properties in Crofton (see Volume 2: Map CT-06-485, C5 to D6);

- a balancing pond for railway drainage from the Proposed Scheme, to the west of the route of the Proposed Scheme. Access would be provided from the A638 Doncaster Road (see Volume 2: Map CT-06-485, C5 to D5);
- closure of Towers Lane at its western end, to the east of the route of the Proposed Scheme, with access to properties retained. A turning head would be provided to facilitate vehicular access (see Volume 2: Map CT-06-485, C6);
- Crofton viaduct, 380m in length and up to 24m in height, crossing over the A638 Doncaster Road. There would be noise fence barriers, up to 3m in height above rail, on both sides of the viaduct to provide acoustic screening for properties in Crofton on the western side of the route and provide acoustic screening for properties in Sharlston on the eastern side of the route (see Volume 2: Map CT-06-485, D6 to E5);
- areas of landscape mitigation planting on both sides of the route of the Proposed Scheme, to provide visual screening for properties in Crofton and Sharlston and to help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-485, D5 to E4 and D6);
- replacement floodplain storage area on the western side of the route of the Proposed Scheme between Crofton viaduct and the A638 Doncaster Road. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-485, E4 to E5);
- an ecological mitigation pond to the east of the route of the Proposed Scheme, to provide replacement habitat great crested newt (see Volume 2: Map CT-06-484, D7 to E6);
- closure of Crofton Footpath 6 where it would cross the replacement floodplain storage area on the western side of the route of the Proposed Scheme. Users would be diverted to the realigned Crofton Footpath 5 (see Volume 2: Map CT-06-485, E4 to E5);
- realignment of Crofton Footpath 5, 125m south-east of its existing alignment for 325m, passing under Crofton viaduct (see Volume 2: Map CT-06-485, E5 to F6);
- Crofton North embankment, 1.3km in length and up to 23m in height, with landscape mitigation planting on both sides of the route to help integrate the Proposed Scheme into the surrounding landscape. A noise fence barrier, 1km in length and up to 3m in height above rail, would be located on the western side of the route to provide acoustic screening for properties in Crofton. A noise fence barrier, 600m in length and up to 2m in height above rail, would be located on the eastern side of the route to provide acoustic screening for properties in Sharlston Common (see Volume 2: Map CT-06-485 E5 to I6 and Map CT-06-486a, B5 to E6);

- an area of landscape mitigation planting to the west of the route of the Proposed Scheme to provide visual screening for properties in Crofton and help integrate the Proposed Scheme into the surrounding landscape (see Volume 2: Map CT-06-485, I4 to I3 and Map CT-06-486a, B3 to B2);
- Spring Hill culvert, 470m north-west of the A638 Doncaster Road, for surface water drainage under the route of the Proposed Scheme (see Volume 2: Map CT-06-485, F5 to F6);
- closure of the B6378 Pontefract Road where it would cross the route of the Proposed Scheme, with access to properties retained on both sides of the route. On both sides of the route, a turning head would be provided on the retained sections of the B6378 Pontefract Road to facilitate vehicle access (see Volume 2: Map CT-06-485, H5 to H6);
- the A645 Weeland Road underbridge, 42m in length and up to 13m above ground level. The route of the Proposed Scheme would cross over the A645 Weeland Road, which would remain on its existing alignment (see Volume 2: Map CT-06-485, H6 to I5);
- modifications to the junction of the A645 Weeland Road with the A638 Doncaster Road (see Volume 2: Map CT-06-485, J1);
- replacement floodplain storage area on the eastern side of the route of the Proposed Scheme, 205m to the north of the A645 Weeland Road underbridge. Following excavation, the area would be re-graded back to tie into the existing ground level (see Volume 2: Map CT-06-486a, B7 and C6 to C8);
- Sharlston culvert, 430m north-west of the A645 Weeland Road underbridge, for the realignment of Tributary of Red Beck 1 and Tributary of Red Beck 2 under the route of the Proposed Scheme (see Volume 2: Map CT-06-486a, C5 to C6);
- Pontefract to Wakefield Line underbridge, 11m above Network Rail track level, to carry the route of the Proposed Scheme over the Pontefract to Wakefield Line (see Volume 2: Map CT-06-486a, D6);
- realignment of tributary of Red Beck 2 under the Pontefract to Wakefield Line underbridge (see Volume 2: Map CT-06-486a, D6 to D5); and
- a section of New Sharlston cutting, 250m in length, up to 10m in depth and 90m in width in the South Kirkby to Sharlston Common area, continuing into the Warmfield to Swillington and Woodlesford area (LA15) (see Volume 2: Map CT-06-486a, E5 to F6).

2.2.28 This section of the route would not include any maintenance access points allowing vehicle access to the route of the Proposed Scheme. There would be maintenance access routes, hedgerow planting and minor utilities works within this section, which may include works to low voltage overhead or underground lines, gas pipes, sewers and telecommunication cables.

2.2.29 Construction of this section would be managed from the Crofton cutting satellite compound, Crofton viaduct satellite compound and Crofton North embankment main compound, which are described in Section 2.3, and shown on map CT-05-485 and map CT-05-486a in the Volume 2: LA14 Map Book.

Demolitions

2.2.30 As set out in Volume 1, as the design develops, it is likely that not all the properties reported within the assessment would need to be demolished, for example where not all of the land is required for permanent works.

2.2.31 At this stage of the design development, it is anticipated that demolition of two existing residential properties, two commercial/business properties (including farm outbuildings) and one other structure would be required to construct the permanent features in the South Kirkby to Sharlston Common area. These could be needed for construction of the permanent features or, in some cases, to enable the construction works for the Proposed Scheme. Demolitions would be managed from the same construction compounds as the permanent features with which they are associated. The identified demolitions are listed in Section 2.3 under the relevant construction compounds.

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the key construction activities that are envisaged to build the Proposed Scheme in the South Kirkby to Sharlston Common area. The construction arrangements described in this section provide the basis for the assessment presented in this working draft ES.

2.3.2 Land used only for construction purposes would be restored as agreed with the owner of the land and the relevant planning authority once the construction works in that area are complete.

2.3.3 Land would be required permanently for the key features of the Proposed Scheme described in Section 2.2.

2.3.4 During the construction phase, public roads and PRoW routes would remain open for public use wherever reasonably practicable. Where such routes would cross the Proposed Scheme and require diversion, the alternative road or PRoW crossing the Proposed Scheme would be constructed prior to any closure of existing roads or PRoW wherever reasonably practicable. Where they would cross the Proposed Scheme in proximity to their existing alignment, a temporary alternative alignment may be required. In some instances, diverted or realigned roads or PRoW may need to pass through areas required for construction of the Proposed Scheme. Routes through these areas would be provided where it is safe and reasonably practicable to do so.

2.3.5 Volume 1, Section 5 and Section 6 provide details of the permanent features of the Proposed Scheme and typical construction techniques. For the purposes of the environmental assessment, standard construction techniques as provided in Volume 1, Section 6 have been assumed.

Code of Construction Practice

2.3.6 All contractors will be required to comply with a Code of Construction Practice (CoCP). In addition, Local Environmental Management Plans (LEMPs) will be produced for each local authority area. The CoCP and LEMPs will be the means of controlling the construction works associated with the Proposed Scheme, and set out monitoring requirements, with the objective of ensuring that the effects of the works on people and the natural environment are reduced as far as reasonably practicable. The CoCP will contain generic control measures and standards to be implemented throughout the construction process. The LEMPs will set out how the project will adapt and deliver the required environmental and community protection measures within each area through the implementation of specific measures required to control dust and other emissions from activities in the area.

2.3.7 In addition, HS2 Ltd has produced a Community Engagement Framework[27] which sets out how HS2 Ltd and its contractors, as well as their sub-contractors, would undertake community engagement during the construction of the HS2 project. The framework is being implemented on Phase One of HS2 and is applicable to all phases of HS2.

2.3.8 The objectives of the framework include:

- to set out how HS2 Ltd and its contractors would undertake community engagement during the construction of the project;
- to provide clarity and reassurance to HS2 Ltd's stakeholders about how community engagement activity would be managed; and
- to help HS2 Ltd be a good neighbour to local communities, including by providing accurate and timely information about construction works and offering opportunities to influence them, where appropriate.

2.3.9 A draft CoCP has been prepared and is published alongside this document, in Supporting document: Draft Code of Construction Practice. It will remain a draft document through the Parliamentary process and the CoCP will be finalised by Royal Assent. The CoCP sets out measures to be implemented by the appointed construction contractor.

Overview of the construction process

2.3.10 Building and preparing the Proposed Scheme for operation will comprise the following general stages:

- advance works including: site investigations further to those already undertaken; preliminary mitigation works; preliminary enabling works;
- civil engineering works including: establishment of construction compounds; haul routes, site preparation and enabling works; main earthworks and

[27] HS2 Ltd (2017) Community Engagement Framework. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/625971/hs2_community_engagement_framework.pdf

structure works; site restoration; removal of construction compounds where the compound is not required for railway installation works; and associated utility diversions;

- railway installation works including: establishment of construction compounds; infrastructure installation; connections to utilities; changes to the existing rail network; and removal of construction compounds;
- site finalisation works; and
- systems testing and commissioning.

2.3.11 General information about the construction process is set out in more detail in Volume 1, Section 6, and the draft CoCP including:

- the approach to environmental management during construction and the role of the CoCP (Section 2);
- working hours (Section 5);
- management of construction traffic (Section 14); and
- handling of construction materials (Section 15).

Advance works

2.3.12 General information about advance works can be found in Volume 1, Section 6. Advance works will be required before the main construction works commence and typically include:

- further detailed site investigations and surveys for proposed construction compounds;
- further detailed environmental surveys;
- advance mitigation works including, where appropriate, contamination remediation, habitat creation and translocation, landscape planting and built heritage survey and investigation;
- advance site access works;
- site establishment with temporary fence construction; along with soil stripping and vegetation removal; and
- utility diversions and new utility connections for facilities associated with the Proposed Scheme.

Engineering works

Introduction

2.3.13 Construction of the Proposed Scheme would require the following broad types of engineering works along the entire length of the route, and within land adjacent to the route:

- civil engineering works, including earthworks such as embankments and

cuttings and erection of bridges and viaducts; and

- works to install, test and commission railway systems, including track, overhead line equipment, communications and signalling equipment and traction power supply.

2.3.14 The construction of track and railway systems works in open areas would include the installation of track form, rails, infill material, minor drainage works, and installation of electrification, signalling and communication equipment.

2.3.15 The construction of the Proposed Scheme would be divided into sections, each of which would be managed from compounds. The compounds would act as the main interface between the construction work sites and the public highway, as well as performing other functions as described below. Compounds would either be main compounds or satellite compounds. Satellite compounds are generally smaller than main compounds. Compounds would either be used for civil engineering works, for railway installation works, or for both.

General overview of construction compounds

2.3.16 Main compounds would be used for core project management staff (i.e. engineering, planning and construction delivery) and commercial and administrative staff. These teams would directly manage some works and coordinate the works at the satellite compounds. In general, a main compound would include:

- space for the storage of bulk materials;
- space for the receipt, storage and loading and unloading of excavated material;
- an area for the fabrication of temporary works equipment and finished goods;
- fuel storage;
- plant and equipment storage including plant maintenance facilities; and
- office space for management staff, limited car parking for staff and site operatives, and welfare facilities.

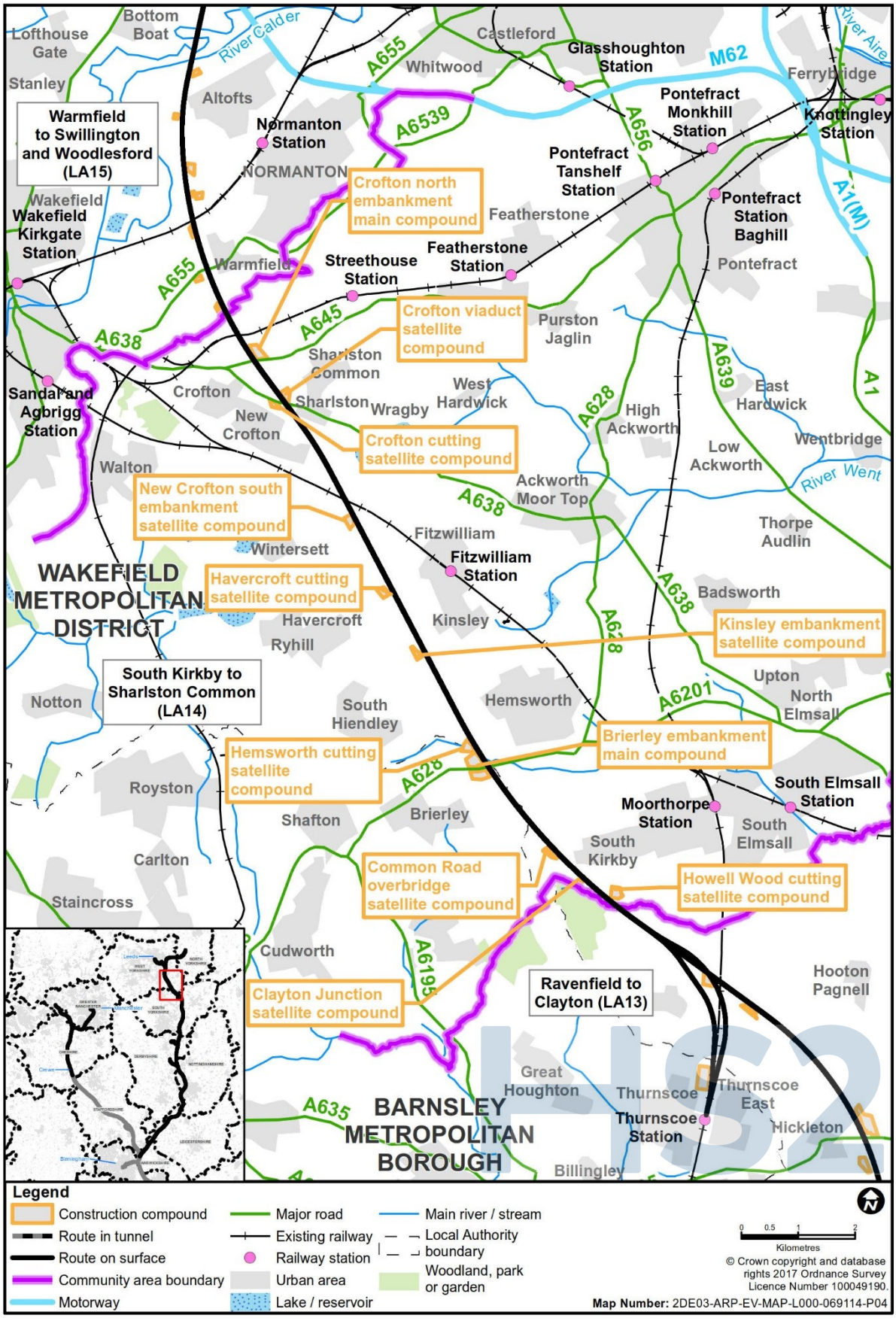
2.3.17 Satellite compounds would be used as the base to manage specific works along a section of the route. Depending on the nature and extent of the works to be managed, these satellite compounds could include office accommodation for staff, local storage for plant and materials, car parking for staff and site operatives, and welfare facilities.

2.3.18 Two main civil engineering compounds, the Brierley embankment main compound and Crofton North embankment main compound, would be located in the South Kirkby to Sharlston Common area. The two main compounds would manage eight civil engineering satellite compounds in the South Kirkby to Sharlston Common area.

2.3.19 Following the completion of civil engineering works, two civil engineering compounds would continue to be used for railway systems installation works. In addition, there would be one further satellite compound used for railway systems works only.

2.3.20 The location of construction compounds in the South Kirkby to Sharlston Common area is shown on Figure 4: Map Series CT-05 (in the Volume 2: LA14 Map Book) show in detail the locations of the construction compounds described below.

Figure 4: Location of construction compounds in the South Kirkby to Sharlston Common area



2.3.21 Figure 5 shows the management relationship for civil engineering works compounds and Figure 6 for the railway installation works. Details of the works associated with individual compounds are provided in subsequent sections of this report.

2.3.22 In the South Kirkby to Sharlston Common area there would be worker accommodation at Brierley embankment main compound for the construction workforce. Details of the location and duration of worker accommodation are provided in the description of the compound.

2.3.23 Soil stripped as part of the works, prior to it being used when the land is reinstated, would be stored for the duration of construction. The location of topsoil and subsoil storage areas would generally be adjacent to compounds and areas of construction activity. These areas are referred to as material stockpiles and those adjacent to compounds are shown on maps CT-05-478b to CT-05-486a-R1, in the Volume 2: LA14 Map Book.

2.3.24 Further information on the function of compounds is provided in Section 6 of Volume 1 and Section 5 of the draft CoCP. This includes general provisions for the operation of compounds, such as security fencing, lighting, utilities supply, site drainage and codes of worker behaviour.

Construction traffic routes, site haul routes and transfer nodes

2.3.25 The movement of construction vehicles, whether to carry materials, plant, other equipment and workforce, or moving empty, would take place within the construction compounds, on public roads and between the compounds and working areas. Where reasonably practicable, movements between the construction compounds and the working areas would be on designated haul routes within the construction site, often along the line of the route of the Proposed Scheme or running parallel to it.

2.3.26 The construction compounds would provide the interface between the construction works and the public road or railway network. The likely road routes to access compounds in the South Kirkby to Sharlston Common area are described in the subsequent sections of this report.

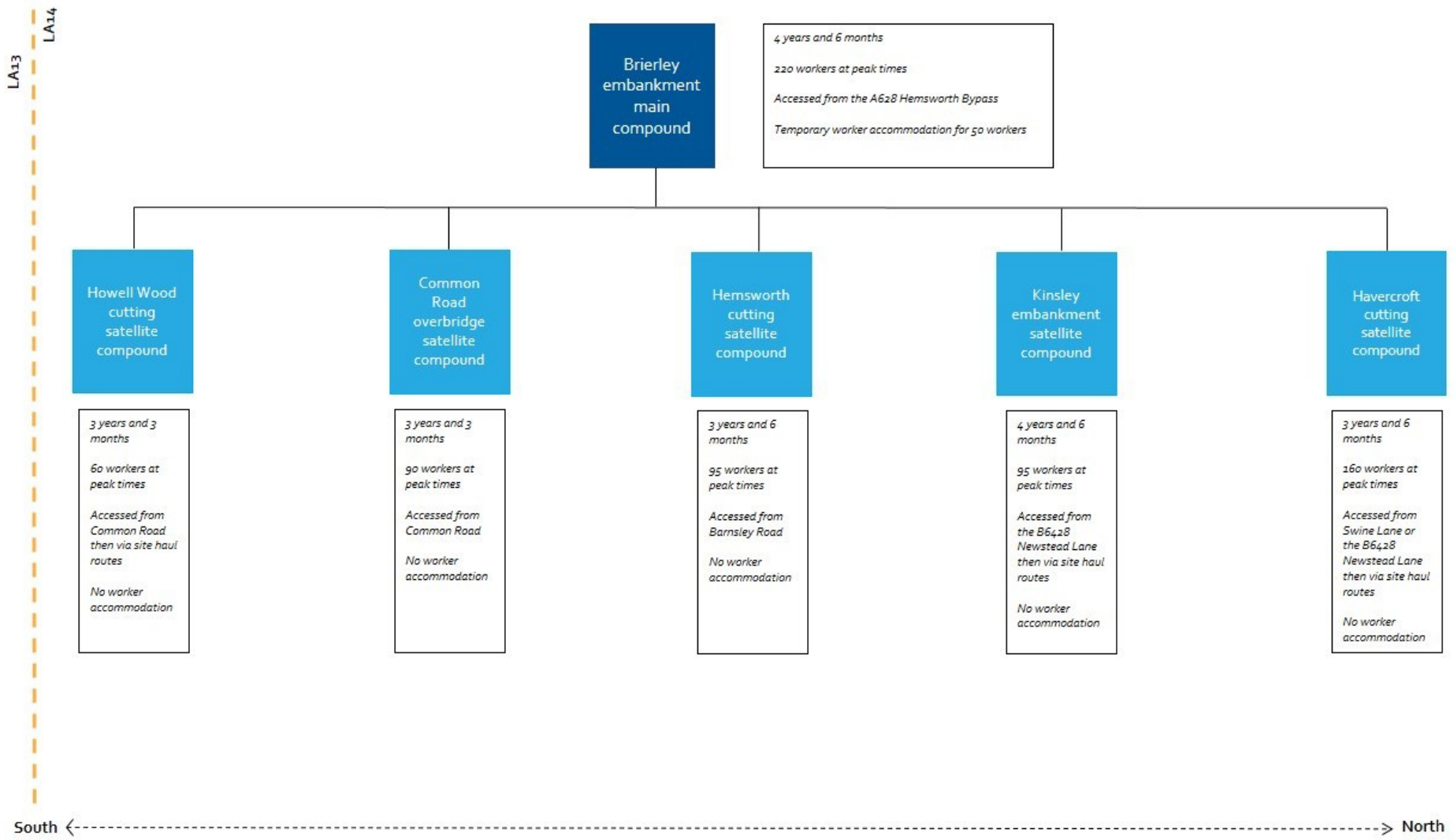
2.3.27 It may be necessary to undertake minor works including a number of minor highways and junction improvements along public roads that would be used as construction traffic routes but are at a distance from the route of Proposed Scheme. These minor works will be reported in the formal ES.

2.3.28 Areas of land are also required for the storage, loading and unloading of bulk earthworks materials that are moved to and from the site on public roads. These areas would allow transfer of material between road vehicles and site vehicles during construction to balance traffic movements on the road network. These areas are referred to as transfer nodes and are shown on Map CT-05-480 in the Volume 2: LA14 Map Book.

Construction compounds

2.3.29 This section provides a summary of the civil engineering works to be managed from the construction compounds in the South Kirkby to Sharlston Common area, as illustrated in Figure 5, and railway systems works as illustrated in Figure 6. All dates and durations of activities and number of workers are indicative. All compounds would undertake initial site set-up works and, at the end of its use, finalisation works including site reinstatement, landscaping and planting (as necessary).

Figure 5: Construction compounds for civil engineering works



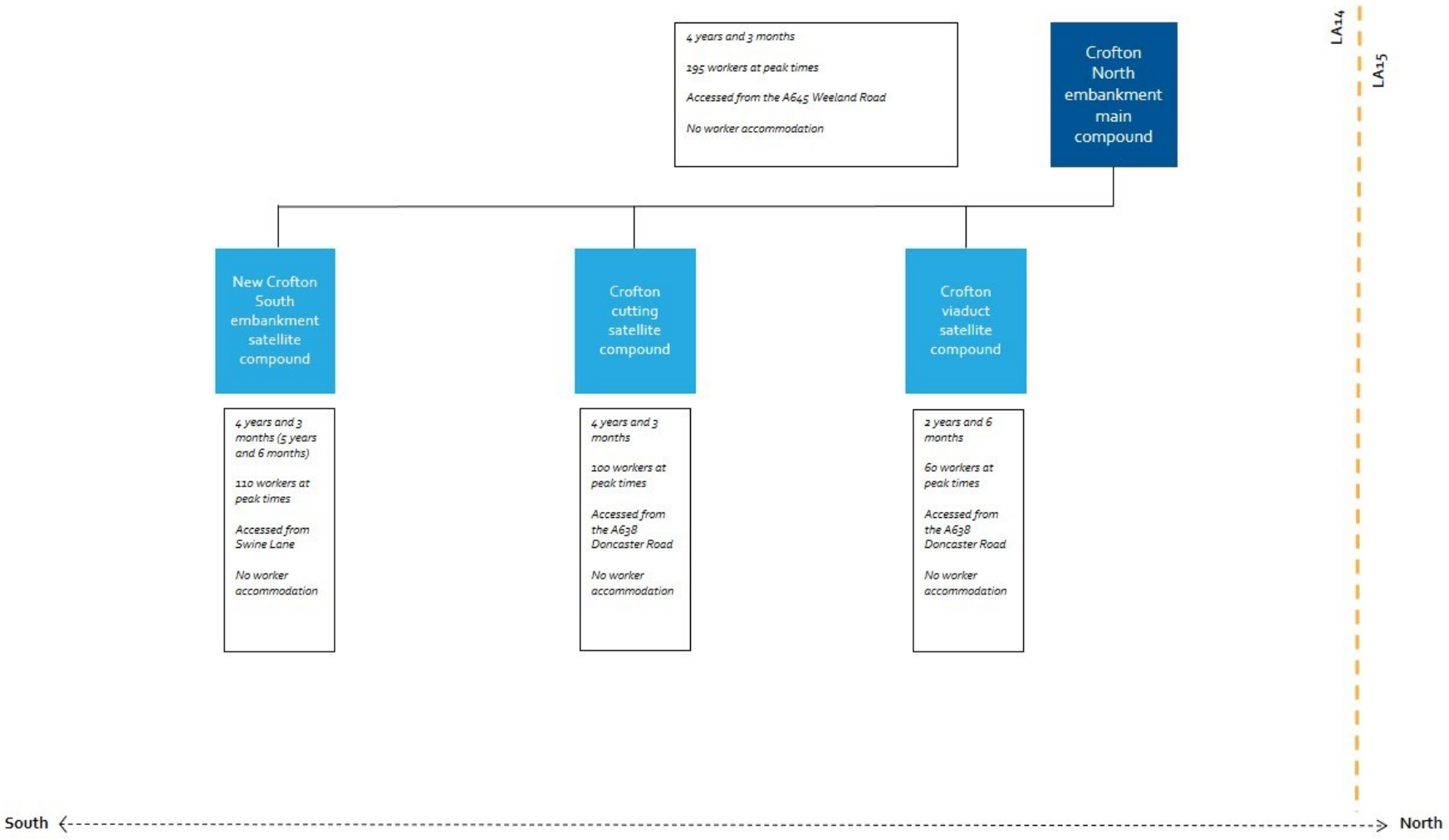
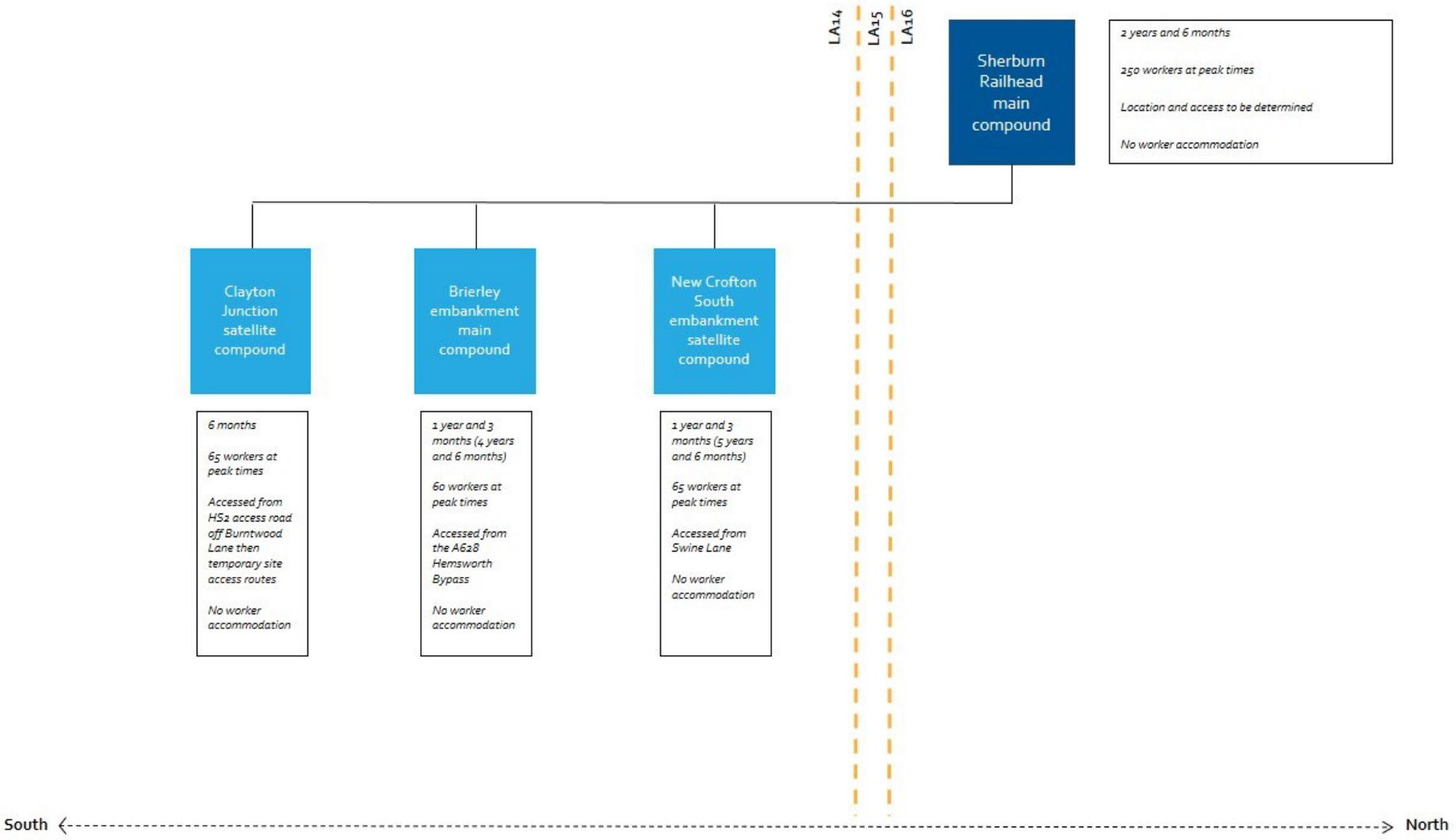

4 years and 3 months
195 workers at peak times
Accessed from the A645 Weeland Road
No worker accommodation
Crofton North embankment main compound
LA14
LA15
New Crofton South embankment satellite compound
4 years and 3 months (5 years and 6 months)
110 workers at peak times
Accessed from Swine Lane
No worker accommodation
Crofton cutting satellite compound
4 years and 3 months
100 workers at peak times
Accessed from the A638 Doncaster Road
No worker accommodation
Crofton viaduct satellite compound
2 years and 6 months
60 workers at peak times
Accessed from the A638 Doncaster Road
No worker accommodation
South
North

Figure 6: Construction compounds for railway systems installation works



Brierley embankment main compound

2.3.30 This compound would be used to manage civil engineering works and provide main compound support to five satellite compounds in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-480, D5 to E3). The compound would be used for four years and six months. Concurrently, the compound would be used as a satellite compound for railway systems installation works for a period of one year and three months, as illustrated in Figure 6.

2.3.31 No demolitions would be required as a result of the works to be managed from this compound.

2.3.32 The compound would provide temporary workers accommodation for up to 50 workers. This would provide accommodation and welfare facilities for the construction workforce for up to four years and six months.

2.3.33 The compound would be used to manage the construction of the following bridges:

- Hemsworth Footpath 24 underbridge, which would take nine months to complete; and
- the A628 Hemsworth Bypass underbridge, which would take one year to complete.

2.3.34 The compound would be used to manage the construction of Brierley embankment, which would take one year and six months to complete.

2.3.35 The compound would be used to manage a concrete batching plant to provide concrete supply for construction works across the Proposed Scheme.

2.3.36 The compound would be used to manage a transfer node for the storage and loading and unloading of bulk earthworks material, which would be moved to and from the site on public roads. The transfer node would be accessed from the A628 Hemsworth Bypass.

2.3.37 There would be five temporary material stockpile areas associated with this compound.

2.3.38 The works to be managed from this compound would require short-term overnight and/or weekend closures and temporary lane closures of the A628 Hemsworth Bypass for the construction of the A628 Hemsworth Bypass underbridge.

2.3.39 The works to be managed from this compound would require the permanent realignment of Hemsworth Footpath 24. The construction of the Hemsworth Footpath 24 underbridge, on which the footpath would be realigned, would be completed prior to the closure of the existing footpath alignment.

2.3.40 The works to be managed from this compound would require the following drainage works:

- South Moor South culvert, to convey surface water under the route of the Proposed Scheme, which would take six months to complete;
- South Moor North culvert, to convey surface water under the route of the

Proposed Scheme, which would take six months to complete; and

- Brierley culvert, to convey surface water under the route of the Proposed Scheme, which would take six months to complete.

2.3.41 Key railway systems works to be managed from this compound would include installation of the Hemsworth auto-transformer station, which would take one year and three months to complete.

2.3.42 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Howell Wood cutting satellite compound

2.3.43 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-478b, C7 to D6).

2.3.44 No demolitions would be required as a result of the works to be managed from this compound.

2.3.45 The compound would be used to manage the construction of Howell Wood overbridge, which would take one year and three months to complete.

2.3.46 The compound would be used to manage the construction of Howell Wood cutting, which would take two years and three months to complete.

2.3.47 There would be one temporary material stockpile area associated with this compound in the Ravenfield to Clayton area (LA13) and two temporary material stockpile areas associated with this compound in the South Kirkby to Sharlston Common area.

2.3.48 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Clayton Junction satellite compound

2.3.49 This compound would be used to manage rail systems installation works in the South Kirkby to Sharlston Common area (LA14) and Ravenfield to Clayton area (LA13), as illustrated in Figure 5 (see Volume 2: Map CT-05-478b, G4 to G5).

2.3.50 No demolitions would be required as a result of the works to be managed from this compound.

2.3.51 Key railway systems works to be managed from this compound would include connection to the existing Dearne Valley Line railway at the Sheffield Northern Spur in the Ravenfield to Clayton area (LA13).

Common Road overbridge satellite compound

2.3.52 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-479, B5 to D4).

2.3.53 No demolitions would be required as a result of the works to be managed from this compound.

2.3.54 The compound would be used to manage the construction of the following bridges:

- Common Road overbridge, which would take one year and three months to complete; and
- the B6273 Southmoor Road overbridge, which would take one year and six months to complete.

2.3.55 The compound would be used to manage the construction of Brierley embankment, which would take two years and three months to complete.

2.3.56 There would be two temporary material stockpile areas associated with this compound.

2.3.57 The works to be managed from this compound would require the following works to public roads:

- permanent diversion of Burntwood Lane, which would take one year and three months to complete. On completion of construction, traffic management measures would be implemented to enable connection between the diverted Burntwood Lane and the realigned Common Road;
- temporary closure of Common Road during construction for a period of one year and three months, with a temporary diversion along Holmsley Lane. During this time, the permanent realignment of Common Road would be constructed;
- permanent closure of Holmsley Lane where it would be crossed by the route of the Proposed Scheme following the construction of the realignment of Common Road; and
- permanent realignment of the B6273 Southmoor Road, which would take one year and six months to complete and would be constructed offline[28]. On completion of construction, traffic management measures would be implemented to enable connection between the realigned road and the existing road.

2.3.58 The works to be managed from this compound would require the following works to watercourses and drainage works:

- Dunsley drop inlet culvert, for the realignment of Tributary of Hague Hall Beck 3 under the route of the Proposed Scheme, which would take six months to complete; and
- Hemsworth Gate drop inlet culvert, 230m north-west of the Southmoor Road overbridge, to convey surface water under the route of the Proposed Scheme, which would take six months to complete.

[28] Offline works are works which are generally constructed along or nearby existing routes, which will remain open during construction.

2.3.59 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Hemsworth cutting satellite compound

2.3.60 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-480, G5 to H4).

2.3.61 No demolitions would be required as a result of the works to be managed from this compound.

2.3.62 The compound would be used to manage the construction of the following bridges:

- Hemsworth Footpath 23 overbridge, which would take six months to complete;
- Barnsley Road overbridge, which would take one year to complete;
- Hemsworth Footpath 22 overbridge, which would take nine months to complete; and
- Hemsworth Bridleway 8 accommodation overbridge, which would take nine months to complete.

2.3.63 The compound would be used to manage the construction of Hemsworth cutting, which would take two years to complete.

2.3.64 There would be two temporary material stockpile areas associated with this compound.

2.3.65 The works to be managed from this compound would require the following works to public roads:

- temporary closure of Barnsley Road during construction for a period of one year, with a temporary diversion along local roads, the A628 Hemsworth Bypass and the B6273 Southmoor Road. During this time, the permanent realignment of Barnsley Road would be constructed;
- permanent diversion of Robin Lane, which would take nine months to complete. On completion of construction, traffic management measures would be implemented to enable connection between the diverted Robin Lane and the existing road alignment; and
- permanent closure of the existing Robin Lane upon completion of the construction of the permanent diversion of Robin Lane.

2.3.66 The works to be managed from this compound would require the following works to PRoW:

- temporary closure of Hemsworth Footpath 23 with users diverted via Moorshutt Road and Barnsley Road for a period of one year. On completion of the construction of the Hemsworth Footpath 23 overbridge, a local temporary diversion around the land required for construction on the western side of the

Proposed Scheme would be required for two years. On completion of construction, Hemsworth Footpath 23 would be permanently realigned to cross the route of the Proposed Scheme via the Hemsworth Footpath 23 overbridge;

- temporary closure of Hemsworth Footpath 22 with users diverted via Robin Lane and Barnsley Road for a period of one year. On completion of construction, Hemsworth Footpath 22 would be permanently realigned to cross the route of the Proposed Scheme via the Hemsworth Footpath 23 overbridge; and
- permanent realignment of Hemsworth Bridleway 8, crossing under the route of the Proposed Scheme via the Hemsworth Bridleway 8 accommodation overbridge. The construction of the realignment would be completed prior to the closure of the existing alignment.

2.3.67 The works to be managed from this compound would require the following works to watercourses and drainage works:

- Rushworth Wood culvert, 230m to the north-west of Barnsley Road, for the realignment of Tributary of the River Went 1 under the route of the Proposed Scheme, which would take six months to complete; and
- West End culvert, 950m north-west of Hemsworth Footpath 22 overbridge, to convey surface water under the route of the Proposed Scheme, which would take six months to complete.

2.3.68 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Kinsley embankment satellite compound

2.3.69 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-481, I5 to J4).

2.3.70 No demolitions would be required as a result of the works to be managed from this compound.

2.3.71 The compound would be used to manage the construction of the Hemsworth Footpath 5 accommodation underbridge, which would take six months to complete.

2.3.72 The compound would be used to manage the construction of the Kinsley embankment, which would take two years and nine months to complete.

2.3.73 There would be seven temporary material stockpile areas associated with this compound.

2.3.74 The works to be managed from this compound would require the following works to PRoW:

- permanent realignment of Hemsworth Footpath 5, to cross the route of the Proposed Scheme via the Hemsworth Footpath 5 accommodation

underbridge. The construction of the Hemsworth Footpath 5 realignment would be completed prior to the closure of the existing footpath alignment. A temporary diversion around the land required for construction on the western side of the Proposed Scheme would be required for a period of six months; and

- permanent diversion of Hemsworth Footpath 7 to the realigned Hemsworth Footpath 5, to cross the route of the Proposed Scheme via Hemsworth Footpath 5 accommodation underbridge. The construction of the Hemsworth Footpath 5 realignment would be completed prior to the diversion of Hemsworth Footpath 7.

2.3.75 The compound would be used to manage the construction of Kinsley culvert, for the diversion of Tributary of River Went 3 under the route of the Proposed Scheme, which would take six months to complete.

2.3.76 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Havercroft cutting satellite compound

2.3.77 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-482, G5 to H3).

2.3.78 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 1.

Table 1: Demolitions required as a result of the works to be managed from the Havercroft cutting satellite compound

Description	Location	Feature resulting in the demolition
Other		
Water tower and associated pumping station	East of Swine Lane, to the south-west of Nostell	Havercroft cutting

2.3.79 The compound would be used to manage the construction of the following bridges:

- B6428 Newstead Lane overbridge, which would take nine months to complete;
- Swine Lane overbridge, which would take one year to complete; and
- Doncaster to Wakefield Line underbridge, which would take one year to complete.

2.3.80 The compound would be used to manage the construction of the Havercroft cutting, which would take two years to complete.

2.3.81 There would be six temporary material stockpile areas associated with this compound.

2.3.82 The works to be managed from this compound would require the following works to public roads:

- permanent realignment of the B6428 Newstead Lane, which would take nine months to complete and would be constructed offline. On completion of construction, traffic management measures would be implemented to enable connection between the realigned road and the existing road;
- permanent diversion of Carr Lane which would take six months to complete. On completion of construction, traffic management measures would be implemented to enable connection between the realigned road and the realigned B6428 Newstead Lane; and
- permanent realignment of Swine Lane, which would take nine months to complete and would be constructed offline. On completion of construction, traffic management measures would be implemented to enable connection between the realigned road and the existing road.

2.3.83 The works to be managed from this compound would require the following works to PRoW:

- permanent diversion of Hemsworth Footpath 4, which would take three months to complete. The construction of the Hemsworth Footpath 4 diversion would be completed prior to the closure of the existing footpath alignment;
- temporary diversion of Huntwick-with-Foulby and Nostell Footpath 1 via a local temporary diversion around the land required for construction on the western side of the route of the Proposed Scheme for a period of one year. On completion of construction, Huntwick–with-Foulby and Nostell Footpath 1 would be permanently diverted to the south-west of its existing alignment; and
- temporary diversion of Huntwick-with-Foulby and Nostell Footpath 1 via a local temporary diversion around the land required for construction on the eastern side of the route of the Proposed Scheme for a period of one year. On completion of construction, Huntwick-with-Foulby and Nostell Footpath 1 would be permanently realigned to cross under the route of the Proposed Scheme around a pier of the Nostell viaduct.

2.3.84 The compound would be used to manage the construction of Horncastle Hill inverted siphon, for the diversion of Tributary of Hessle Beck 1 under the route of the Proposed Scheme, which would take six months to complete.

2.3.85 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Crofton North embankment main compound

2.3.86 This compound would be used to manage civil engineering works and provide main compound support to three satellite compounds in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-485, H7 to J6).

2.3.87 The works to be managed from this compound would require demolition of the following buildings and structures, as described in Table 2.

Table 2: Demolitions required as a result of the works to be managed from the Crofton North embankment main compound

Description	Location	Feature resulting in the demolition
Residential		
Two residential properties on Pontefract Road	Pontefract Road, Crofton	Crofton North embankment
Commercial		
Riding and Livery Stables	Pontefract Road, Crofton	Crofton North embankment
Farm outbuildings	Holme Bank Farm, Pontefract Road, Crofton	Crofton North embankment

2.3.88 The compound would be used to manage the construction of the following bridges:

- the A645 Weeland Road underbridge, which would take one year to complete; and
- Pontefract to Wakefield Line underbridge, which would take one year to complete.

2.3.89 The compound would be used to manage the construction of the following earthworks:

- Crofton North embankment, which would take three years and six months to complete; and
- New Sharlston cutting, which would take one year to complete.

2.3.90 There would be one temporary material stockpile area associated with this compound.

2.3.91 The works to be managed from this compound would require the following works to public roads:

- permanent closure of the B6378 Pontefract Road where it is crossed by the route of the Proposed Scheme following the construction of the A645 Weeland Road underbridge;
- short-term overnight and/or weekend closures and temporary lane closures of the A645 Weeland Road and/or the A638 Doncaster Road for junction modification works; and
- short-term overnight and/or weekend closures and temporary lane closures of the A645 Weeland Road for the construction of the A645 Weeland Road underbridge.

2.3.92 The works from this compound would require the following works to watercourses and drainage works:

- Spring Hill culvert, 470m north-west of the A638 Doncaster Road, to convey surface under the route of the Proposed Scheme, which would take six months to complete; and
- Sharlston culvert, 430m north-west of the A645 Weeland Road, for the realignment of Tributary of Red Beck 1 and Tributary of Red Beck 2 under the route of the Proposed Scheme, which would take six months to complete.

2.3.93 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

New Crofton South embankment satellite compound

2.3.94 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-483, F4 to H5), for a period of four years and three months. On completion of civil engineering works, the compound would remain as a satellite compound for railway systems installations works for a period of one year and three months, as illustrated in Figure 6.

2.3.95 No demolitions would be required as a result of the works to be managed from this compound.

2.3.96 The compound would be used to manage the construction of the following bridges and viaducts:

- Nostell viaduct, which would take two years and nine months to complete;
- Crofton Footpath 11 accommodation underbridge, which would take six months to complete; and
- Sharlston Footpath 12 underbridge, which would take six months to complete.

2.3.97 The compound would be used to manage the construction of the following earthworks:

- New Crofton South embankment, which would take three years and six months to complete; and
- New Crofton North embankment, which would take three years and six months to complete.

2.3.98 The compound would be used to manage the construction of Crofton retaining wall, which would take six months to complete.

2.3.99 There would be two temporary material stockpile areas associated with this compound.

2.3.100 The works to be managed from this compound would require the following works to PRoW:

- temporary diversion of Huntwick-with-Foulby and Nostell Footpath 4 to Huntwick-with-Foulby and Nostell Footpath 1 via a local temporary diversion around the land required for construction of the Proposed Scheme for a period of one year;
- temporary diversion of Crofton Footpath 11 via a local temporary diversion around the land required for construction on both sides of the route of the Proposed Scheme to Sharlston Footpath 12 for a period of one year. On completion of construction, Crofton Footpath 11 would be permanently realigned to cross under the route of the Proposed Scheme via the Crofton Footpath 11 accommodation underbridge; and
- temporary diversion of Sharlston Footpath 12 via a local temporary diversion around the land required for construction on both sides of the route of the Proposed Scheme to the realigned Crofton Footpath 11 for a period of one year. On completion of construction, Sharlston Footpath 12 would be permanently realigned to cross under the route of the Proposed Scheme via the Sharlston Footpath 12 underbridge.

2.3.101 The compound would be used to manage the construction of New Crofton culvert, 540m north-west of Crofton footpath 11 accommodation underbridge, for the realignment of Tributary of Hardwick Beck 3 and Tributary of Hardwick Beck 4 under the route of the Proposed Scheme, which would take six months to complete.

2.3.102 Key railway systems installations works to be managed from this compound would include:

- installation of the Crofton auto-transformer station, which would take one year and three months to complete; and
- track installation works, including build-up and installation of crossovers, which would take six months to complete.

2.3.103 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Crofton cutting satellite compound

2.3.104 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-485, D5 to E4).

2.3.105 No demolitions would be required as a result of the works to be managed from this compound.

2.3.106 The compound would be used to manage the construction of the Crofton viaduct, which would take one year and nine months to complete.

2.3.107 The compound would be used to manage the construction of the following earthworks:

- Crofton cutting, which would take three months to complete; and
- Crofton South embankment, which would take three years and six months to complete.

2.3.108 There would be three temporary material stockpile areas associated with this compound.

2.3.109 The works to be managed from this compound would require the following works to public roads:

- permanent closure of Towers Lane at its western junction with the A638 Doncaster Road where it intersects with the Proposed Scheme; and
- short-term overnight and/or weekend closures of the A638 Doncaster Road for the construction of Crofton viaduct.

2.3.110 The works to be managed from this compound would require the temporary diversion of Crofton Footpath 9 to the realigned Sharlston Footpath 12 and a local temporary diversion on the western side of the route of the Proposed Scheme for a period of three years and six months. On completion of construction, Crofton Footpath 9 would be permanently realigned to the north-west of its existing alignment, with users diverted via the A638 Doncaster Road and Towers Lane.

2.3.111 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Crofton viaduct satellite compound

2.3.112 This compound would be used to manage civil engineering works in the South Kirkby to Sharlston Common area, as illustrated in Figure 5 (see Volume 2: Map CT-05-485, D6 to E7).

2.3.113 No demolitions would be required as a result of the works to be managed from this compound.

2.3.114 The compound would be used to manage the construction of the Crofton viaduct, which would take one year and nine months to complete.

2.3.115 There would be one temporary material stockpile area associated with this compound.

2.3.116 The works to be managed from this compound would require the following works to PRoW:

- permanent closure of a section of Crofton Footpath 6 where it crosses the Proposed Scheme; and
- temporary diversion of Crofton Footpath 5 via a local temporary diversion on the eastern side of the route of the Proposed Scheme to the A638 Doncaster Road for a period of three years. On completion of construction, Crofton Footpath 5 would be permanently realigned around a pier of Crofton viaduct.

2.3.117 Permanent and temporary utility diversions are anticipated to be required as a result of the works to be managed from this compound.

Construction waste and material resources

2.3.118 Excavated material (defined as excluding topsoil and subsoil) generated across the Proposed Scheme would be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, where suitable and reasonably practicable, either with or without treatment.

2.3.119 Forecasts of the amount of construction, demolition and excavation waste that would be produced during construction of the Proposed Scheme are reported in Volume 3: Route-wide effects.

2.3.120 Local excess or shortfall of excavated material within the South Kirkby to Sharlston Common area would be managed through the integrated design approach adopted for the Proposed Scheme, with the aim of contributing to an overall balance of excavated material on a route-wide basis. The overall balance of excavated material will be presented in Volume 3 of the Final ES.

2.3.121 Forecasts of the amount of waste generated at temporary worker accommodation sites will be reported in the formal ES.

Commissioning of the railway

2.3.122 Commissioning is the process of testing the infrastructure to ensure that it operates as expected. It would be carried out in the period prior to opening. Further details are provided in Volume 1, Section 6.

Construction programme

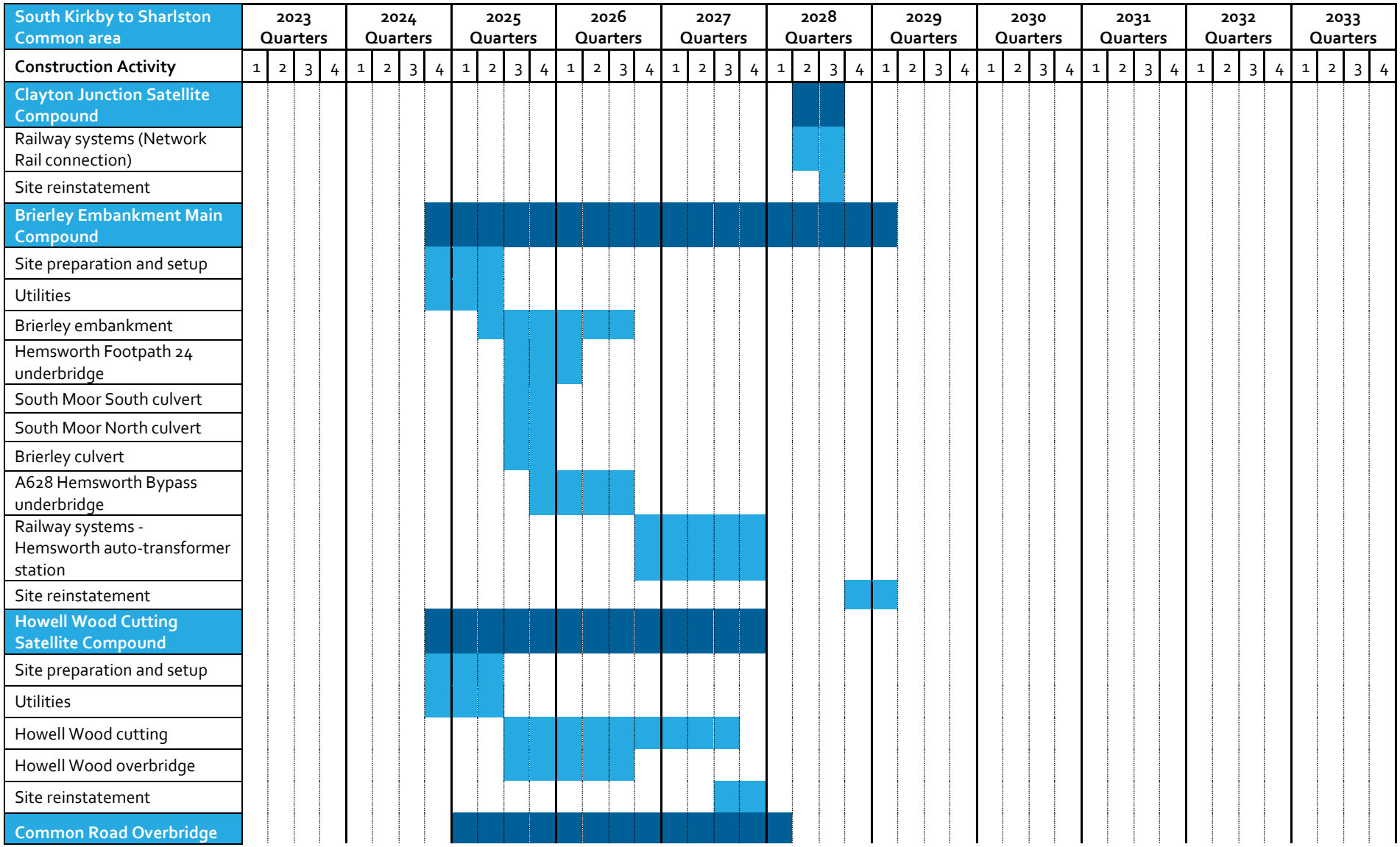
2.3.123 A construction programme illustrating indicative periods for each of the core construction activities described above is provided in Figure 7. Construction durations referred to in the following sections of this report are based on the indicative programme.

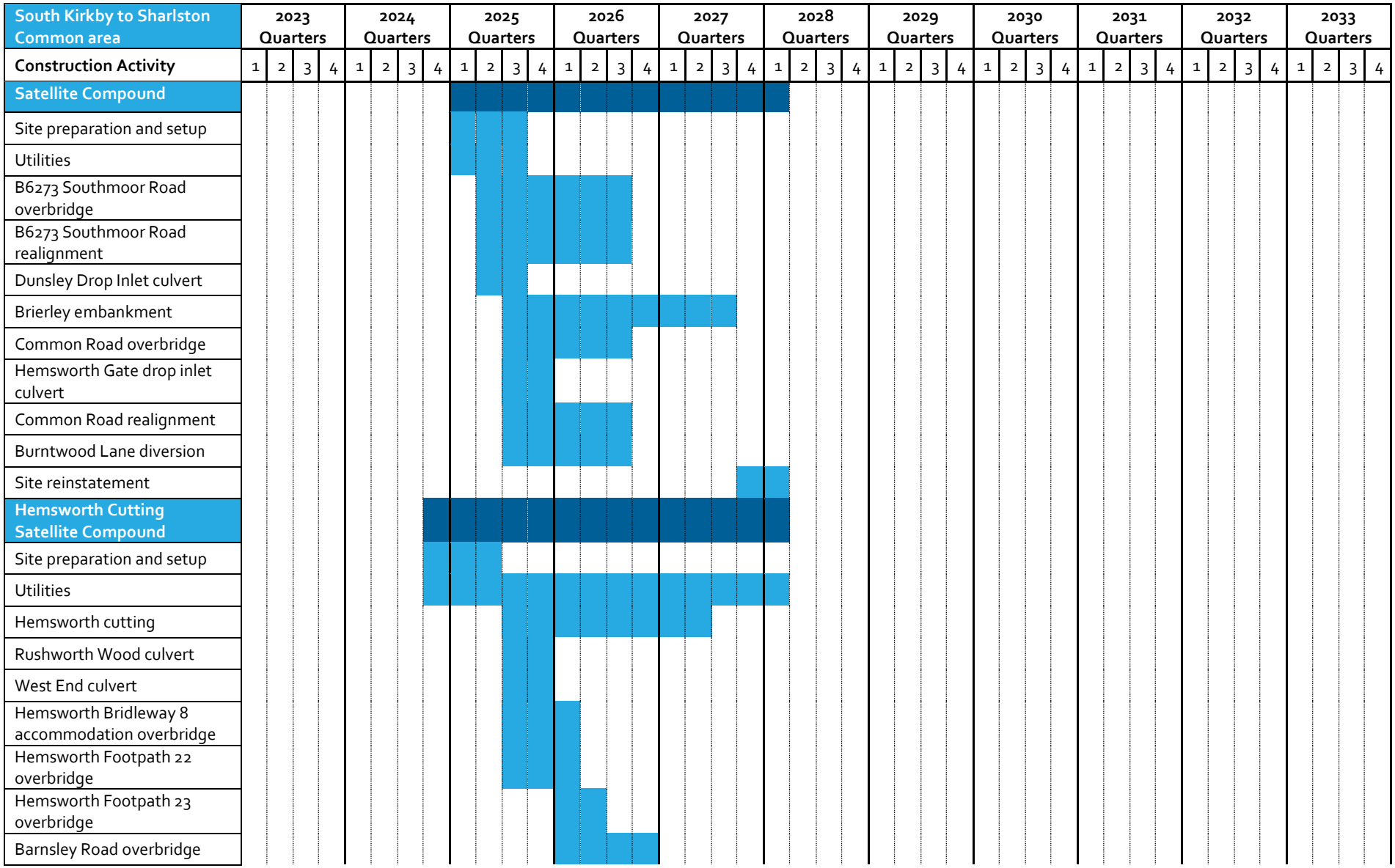
Monitoring during construction

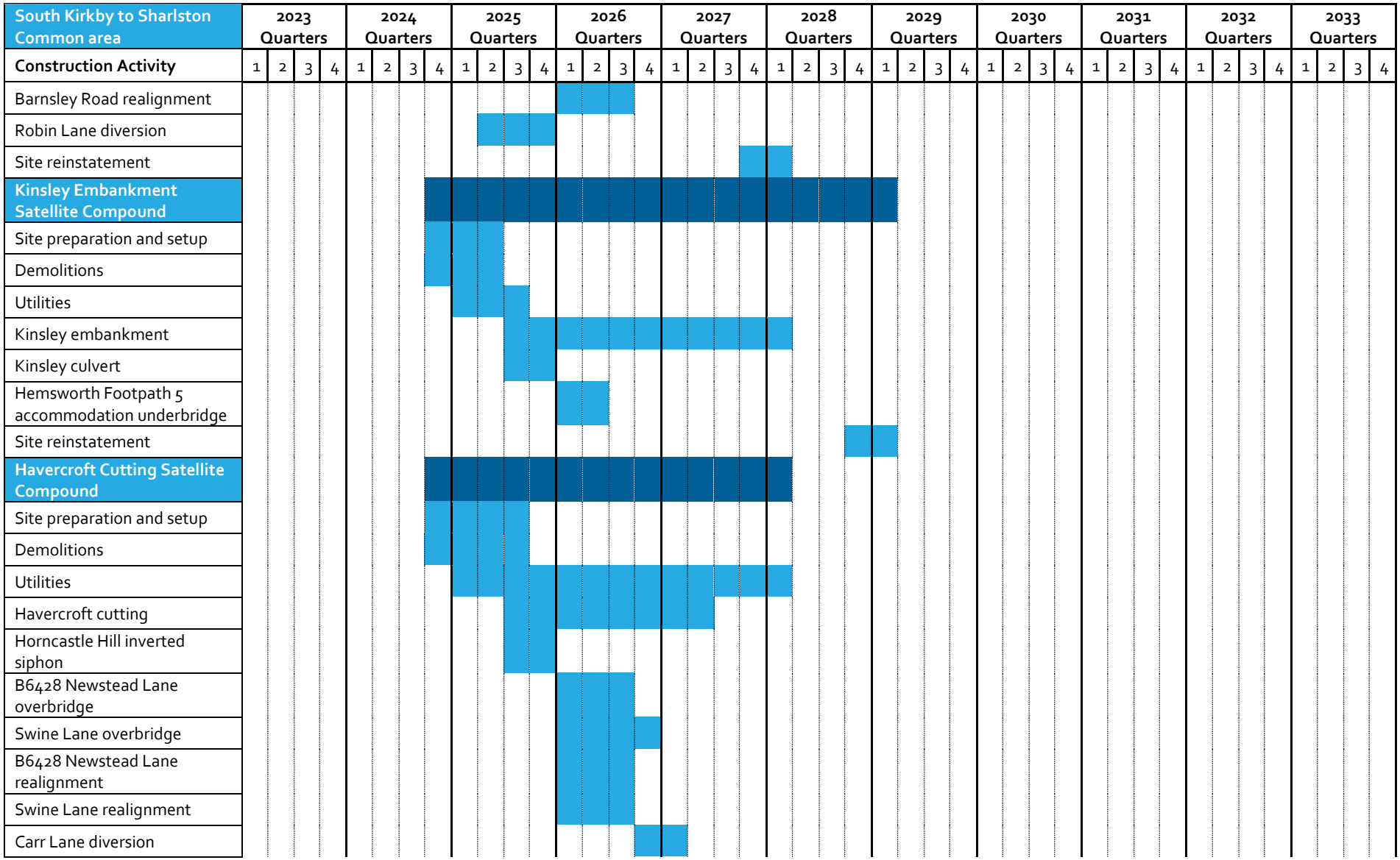
2.3.124 The appointed contractor would be required to undertake the necessary monitoring for each environmental topic to comply with the requirements of the CoCP, the relevant LEMP and any additional consent requirements. Any actions that may be necessary for compliance would be reported to the nominated undertaker and remedial action identified.

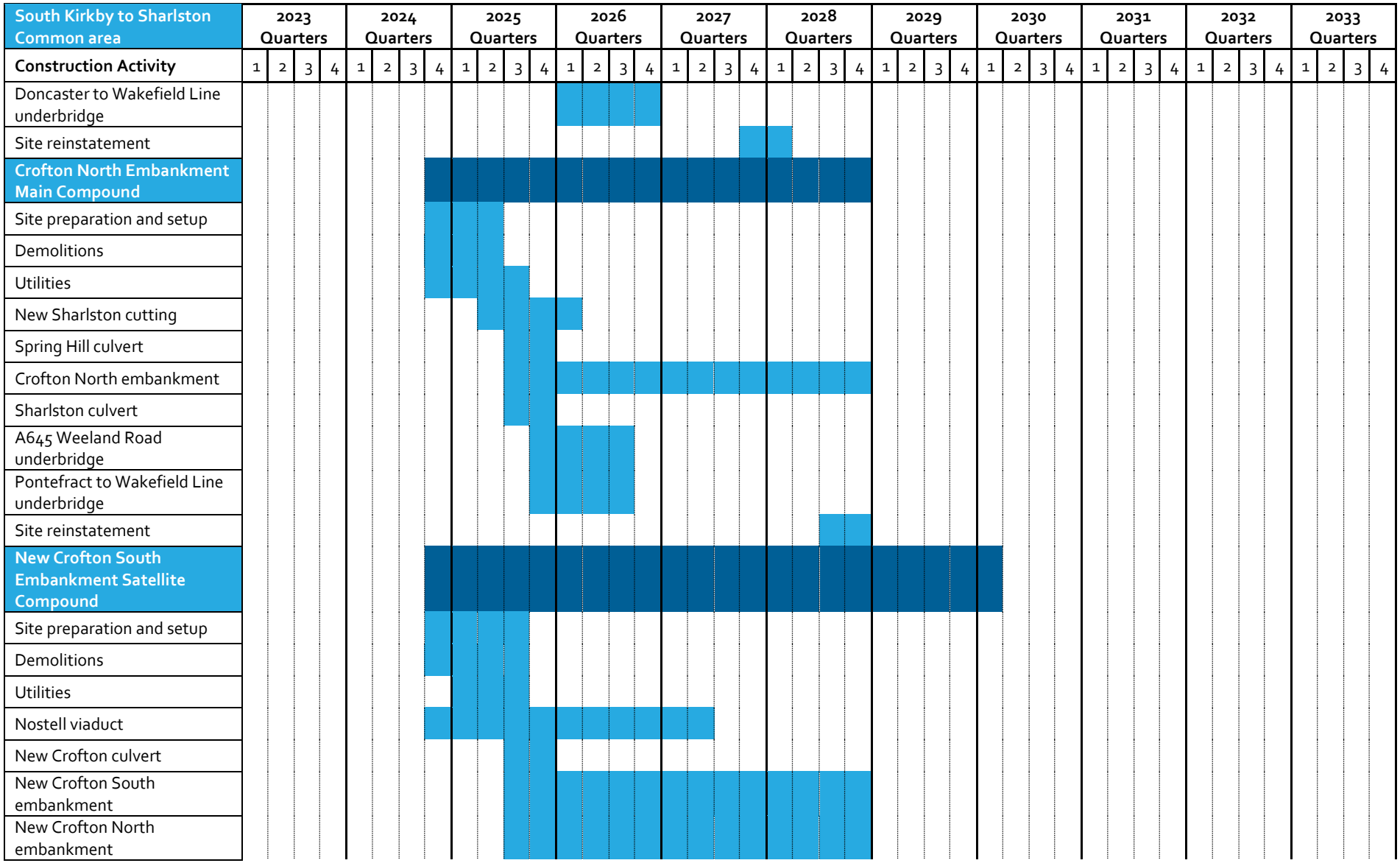
2.3.125 The CoCP and the relevant LEMP would set out inspection and monitoring procedures to assess the effectiveness of measures to prevent or reduce environmental effects during construction. Relevant local authorities and consenting authorities, such as the Environment Agency, would be consulted on the monitoring procedures to be implemented prior to construction commencement.

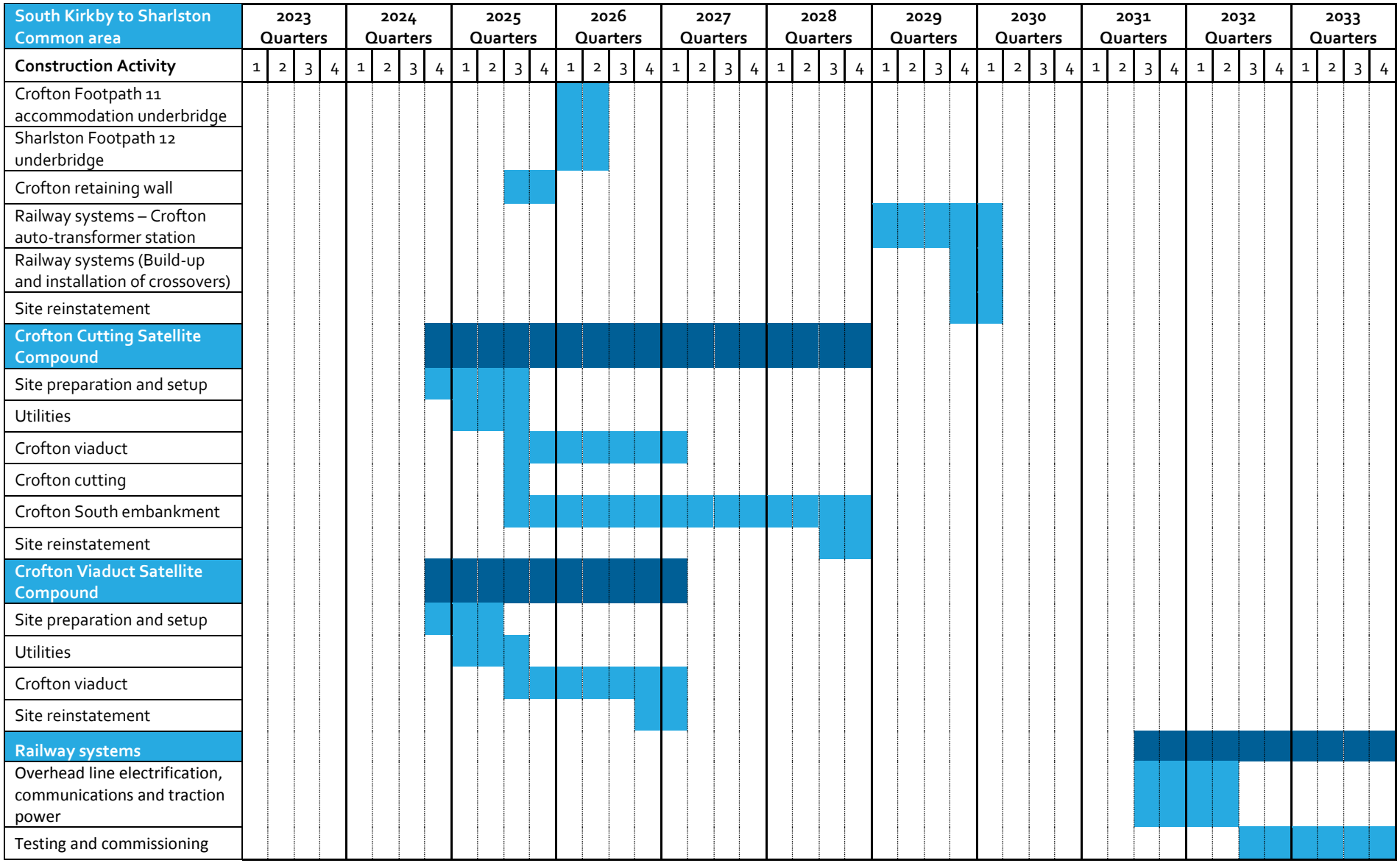
Figure 7: Indicative construction programme between 2023 and 2033




South Kirkby to Sharlston Common area
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
2028 Quarters
2029 Quarters
2030 Quarters
2031 Quarters
2032 Quarters
2033 Quarters
1 2 3 4
Construction Activity
Satellite Compound
Site preparation and setup
Utilities
B6273 Southmoor Road overbridge
B6273 Southmoor Road realignment
Dunsley Drop Inlet culvert
Brierley embankment
Common Road overbridge
Hemsworth Gate drop inlet culvert
Common Road realignment
Burntwood Lane diversion
Site reinstatement
Hemsworth Cutting Satellite Compound
Site preparation and setup
Utilities
Hemsworth cutting
Rushworth Wood culvert
West End culvert
Hemsworth Bridleway 8 accommodation overbridge
Hemsworth Footpath 22 overbridge
Hemsworth Footpath 23 overbridge
Barnsley Road overbridge


South Kirkby to Sharlston Common area
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
2028 Quarters
2029 Quarters
2030 Quarters
2031 Quarters
2032 Quarters
2033 Quarters
1 2 3 4
Construction Activity
Barnsley Road realignment
Robin Lane diversion
Site reinstatement
Kinsley Embankment Satellite Compound
Site preparation and setup
Demolitions
Utilities
Kinsley embankment
Kinsley culvert
Hemsworth Footpath 5 accommodation underbridge
Site reinstatement
Havercroft Cutting Satellite Compound
Site preparation and setup
Demolitions
Utilities
Havercroft cutting
Horncastle Hill inverted siphon
B6428 Newstead Lane overbridge
Swine Lane overbridge
B6428 Newstead Lane realignment
Swine Lane realignment
Carr Lane diversion


South Kirkby to Sharlston Common area
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
2028 Quarters
2029 Quarters
2030 Quarters
2031 Quarters
2032 Quarters
2033 Quarters
1 2 3 4
Construction Activity
Doncaster to Wakefield Line underbridge
Site reinstatement
Crofton North Embankment Main Compound
Site preparation and setup
Demolitions
Utilities
New Sharlston cutting
Spring Hill culvert
Crofton North embankment
Sharlston culvert
A645 Weeland Road underbridge
Pontefract to Wakefield Line underbridge
Site reinstatement
New Crofton South Embankment Satellite Compound
Site preparation and setup
Demolitions
Utilities
Nostell viaduct
New Crofton culvert
New Crofton South embankment
New Crofton North embankment


South Kirkby to Sharlston Common area
2023 Quarters
2024 Quarters
2025 Quarters
2026 Quarters
2027 Quarters
2028 Quarters
2029 Quarters
2030 Quarters
2031 Quarters
2032 Quarters
2033 Quarters
1 2 3 4
Construction Activity
Crofton Footpath 11 accommodation underbridge
Sharlston Footpath 12 underbridge
Crofton retaining wall
Railway systems – Crofton auto-transformer station
Railway systems (Build-up and installation of crossovers)
Site reinstatement
Crofton Cutting Satellite Compound
Site preparation and setup
Utilities
Crofton viaduct
Crofton cutting
Crofton South embankment
Site reinstatement
Crofton Viaduct Satellite Compound
Site preparation and setup
Utilities
Crofton viaduct
Site reinstatement
Railway systems
Overhead line electrification, communications and traction power
Testing and commissioning

2.4 Operation of the Proposed Scheme

Introduction

2.4.1 This section describes the operational characteristics of the Proposed Scheme in the South Kirkby to Sharlston Common area. Volume 1, Section 4 describes the envisaged operational characteristics of the Proposed Scheme as a whole, including Phase One, Phase 2a and Phase 2b.

HS2 services

2.4.2 It is anticipated that there would be up to nine trains per hour each way passing through the South Kirkby to Sharlston Common area. Services are expected to operate between 05:00 and midnight from Monday to Saturday and 08:00 and midnight on Sunday.

2.4.3 In this area, trains would run at speeds of up to 225mph (360kph). The trains would be either single 200m trains or two 200m trains coupled together, depending on demand and time of day.

Maintenance

2.4.4 Volume 1, Section 4 describes the maintenance regime for the Proposed Scheme.

2.4.5 Asset performance and condition monitoring would be undertaken using asset condition monitoring and unattended measurement systems fitted to the HS2 passenger rolling stock. Intrusive inspections would be carried out during the maintenance period. The maintenance approach would be a combination of risk based, preventative and reactive maintenance.

2.4.6 Provision for railway maintenance vehicles along the eastern leg of the route of the Proposed Scheme would be made at the Staveley infrastructure maintenance depot (IMD) in the Staveley to Aston area (LA11). Further information on the Staveley IMD can be found in Volume 2: Community area report LA11: Staveley to Aston.

Operational waste and material resources

2.4.7 The assessment of the likely significant environmental effects associated with the disposal of operational waste will be undertaken for the Proposed Scheme as a whole and reported in Volume 3: Route-wide effects of the formal ES.

2.4.8 Forecasts of the amount of waste arising from track maintenance and ancillary infrastructure and the associated potential significant environmental effects will also be reported in the formal ES.

Monitoring during operation

2.4.9 The nominated undertaker would be responsible for monitoring during operation of the Proposed Scheme. Proposed indicative area-specific monitoring measures for each environmental topic area are presented in Sections 4 to 15 of this report based on the current level of assessment.

2.4.10 Relevant local authorities and consenting authorities, such as the Environment Agency, will be consulted on the monitoring procedures to be implemented during operation prior to construction commencement.

2.5 Route section alternatives

2.5.1 The strategic, route-wide and route corridor alternatives to the Proposed Scheme and local alternatives considered prior to July 2017 are presented in Volume 1, Introduction and methodology and in the Alternatives report as a supporting document to the working draft ES. The local alternatives considered for the Proposed Scheme within the South Kirkby to Sharlston Common area since the route announcement in July 2017 are described in this section.

2.5.2 In this area, the route of the Proposed Scheme would be carried on viaduct, embankments, and in cuttings.

2.5.3 As part of the design development process since July 2017, consideration has been given to the impact of the Proposed Scheme on local residents of the South Kirkby to Sharlston Common area, and environmental receptors including: Anglers Country Park Local Nature Reserve; Manface Quarry Local Wildlife Site; Sharlston Common Local Wildlife Site; Nostell Priory Farm Scheduled Monument; Sharlston Common coal and ironstone workings Scheduled Monument; Grade I listed Church of All Saints in South Kirkby; and Wragby Conservation Area.

2.5.4 Further consideration will be given to the construction and engineering options in this area, design and construction methods, and alternative engineering options. Further studies are ongoing and will be reported in the formal ES.

3 Stakeholder engagement and consultation

3.1 Introduction

3.1.1 HS2 Ltd's approach to stakeholder engagement and consultation on the Proposed Scheme is set out in Volume 1, Section 3.

3.1.2 Since the initial preferred route announcement in November 2016, HS2 Ltd has carried out a programme of informal stakeholder engagement and formal consultation with a broad range of stakeholders.

3.1.3 A variety of mechanisms have been used to enable an open and inclusive approach to engagement and consultation, reflecting the differing requirements and expectations of stakeholders.

3.1.4 Whilst stakeholders have informed the design and assessment of the Proposed Scheme to date, it is important to note that this is an ongoing process. Feedback from the consultation on the working draft ES and emerging scheme design and ongoing engagement will continue to be considered as part of the ongoing design and assessment of the Proposed Scheme ultimately presented in the formal ES. There will be further consultation undertaken on the formal ES by Parliament following deposit of the hybrid Bill.

3.2 Key stages of Phase 2b engagement and consultation

3.2.1 The process of engagement remains ongoing. A summary of engagement undertaken or underway since the initial preferred route announcement in November 2016 is provided in Table 3.

Table 3: Mechanisms and timeline of stakeholder engagement since route announcement

Engagement and consultation activity and mechanisms	Date
Phase 2b initial preferred route announcement	15 November 2016
Phase 2b route refinement and property consultations	15 November 2016 – 9 March 2017
Phase 2b information events to support the route refinement and property consultations	January -February 2017
Confirmation of Phase 2b route announcement	17 July 2017
Start date of engagement with local communities and stakeholders on the confirmed Phase 2b route	July 2017
Consultation on the draft EIA and Equality Impact Assessment (EQIA) Scope and Methodology Report (SMR) to inform the EIA and EQIA and the proposed relocation of the Eastern Leg Rolling Stock Depot	17 July 2017 – 29 September 2017
Phase 2b information events to support SMR and Eastern Leg Rolling Stock Depot consultations	September 2017

Phase 2b information events to provide update on design development	June – July 2018
Phase 2b consultation on the working draft ES and working draft EQIA	October – December 2018

Draft EIA SMR consultation

3.2.2 The draft EIA SMR was formally consulted on between July and September 2017 and was issued to statutory bodies, non-government organisations and local authorities. It was also available on the Government's website, allowing comment by local interest groups and the public. One hundred and seven responses to the draft SMR were received, as a result of which changes were made to the SMR. These are set out in the SMR Consultation Summary Report published alongside this working draft ES, and will be used to inform the assessment methodologies applied for the formal ES.

Consultation on the working draft ES and ongoing engagement

3.2.3 As set out in Volume 1, the working draft ES is being formally consulted upon. The consultation is taking place during October 2018 to December 2018. A parallel consultation on the working draft EQIA is also being undertaken during this period. As part of the process of consultation, stakeholders are invited to comment on the Proposed Scheme and the working draft ES and EQIA Reports which inform it.

3.2.4 These consultations and wider feedback from ongoing stakeholder engagement will continue to be considered as part of the ongoing design of the Proposed Scheme and the assessment and identification of mitigation opportunities for the South Kirkby to Sharlston Common area. A consultation summary report will be published with the formal ES explaining how the responses have been taken into consideration.

3.3 Informing the Proposed Scheme

3.3.1 The main purpose of stakeholder engagement and consultation at this early stage is to inform the Proposed Scheme. Volume 1 details the engagement and consultation undertaken prior to initial preferred route announcement in November 2016.

3.3.2 The main themes to emerge from stakeholder engagement in the South Kirkby to Sharlston Common area since the initial preferred route announcement in November 2016, and which are informing the Proposed Scheme are:

- land required temporarily and permanently during construction and operation;
- refining the location of balancing ponds and environmental mitigation to reduce the loss of agricultural land;
- provision of access to severed agricultural land, including access under viaducts and the provision of farm access tracks;
- retention or realignment of Public Rights of Way (PRoW);
- concern about temporary and permanent changes to road access, including Common Road, Holmsley Lane, the B6273 Southmoor Road, Barnsley Road and Robin Lane;

- concerns around traffic on Common Road, Holmsley Lane, the A628 Hemsworth Bypass, Barnsley Road, the A638 Doncaster Road, the B6378 Pontefract Lane and the A645 Weeland Road, during construction;
- impacts on access to local community, educational, care, sporting, leisure, and cultural facilities, including Howell Wood Country Park and The Priory Centre Pupil Referral Unit (PRU);
- impacts to local businesses;
- visual impacts, including the height of embankments in Crofton and the cutting at South Kirkby;
- the potential impact on ecology and biodiversity and opportunities for environmental mitigation, including at Crofton and at Anglers Country Park;
- the potential severance of communities during construction and operation, including at South Kirkby and Brierley;
- the potential impact on heritage assets, including the Grade II Listed Kirkby Common Farmhouse; South Kirkby Camp Scheduled Monument; the Grade II Listed Vissitt Manor House; and Kinsley moat and fishpond Scheduled Monument; and
- the consideration of mining and geotechnical factors within design development.

3.3.3 Stakeholder feedback will continue to be considered as part of the ongoing design of the Proposed Scheme and will be reported in the formal ES.

3.4 Engagement and consultation with stakeholder groups

Communities

3.4.1 Community stakeholders in the South Kirkby to Sharlston Common area include a range of local interest groups, local facility and service providers, schools and educational establishments, cultural, leisure and sports stakeholders. Engagement on the Proposed Scheme has been undertaken with the residents of Robin Lane, Wakefield Local Access Forum, Crofton Against HS2, The Priory Centre PRU, Wakefield District Biodiversity Group and Wakefield District Cycle Network.

3.4.2 The purpose of this engagement has been to give affected communities the opportunity to raise issues in relation to the Proposed Scheme. Community stakeholders have been provided with information on the development of the Proposed Scheme, as a basis from which to identify potential impacts and opportunities for mitigation within the local area, reflecting local conditions and issues.

3.4.3 Engagement has been, and will continue to be, undertaken with schools and educational establishments, in particular, with those within close proximity to the Proposed Scheme and those with specialist interests or catering to the needs of vulnerable people within the community. This has informed the assessment of

community and health in the working draft ES, whilst also informing the separate EQIA being undertaken in parallel to the EIA.

3.4.4 As part of the consultation process for this working draft ES, public events are being held in communities across the route of the Proposed Scheme. Communities have been notified of these events through a range of publicity in the community area and also through the www.gov.uk/hs2 website. Documents have been made available online and in community libraries. Members of local communities and other interested parties have been invited to engage on issues pertinent to the working draft ES and the development of the Proposed Scheme design.

3.4.5 Table 4 summarises key engagement undertaken with community stakeholders to date, including the focus of the engagement and how this has informed the design of the Proposed Scheme.

Table 4: Engagement to date with community stakeholders

Stakeholder	Area of focus
Residents of Robin Lane	Engagement to discuss concerns of residents in respect of the construction and operation of the Proposed Scheme
Crofton Against HS2	Engagement to discuss specific queries asked by the action group on the construction and operation of the Proposed Scheme
Crofton Riding and Livery Stables	To discuss profile/composition of users of the centre
The Priory Centre PRU	Meeting to discuss proximity of Proposed Scheme to the PRU, access safety for pupils, and potential noise disruption during construction and operation
Wakefield District Cycle Network	Meeting to discuss impact of the Proposed Scheme on the designated cycle network
Wakefield District Biodiversity Group	Meeting to discuss impact of the Proposed Scheme on local biodiversity and options for mitigation
Wakefield Local Access Forum	Meeting to discuss impact of the Proposed Scheme on the designated PRoW and cycle network

Local authorities and parish councils

3.4.6 Direct engagement has been undertaken with county, borough, district and parish councils within the South Kirkby to Sharlston Common area. The purpose of this engagement is to collate local baseline information and knowledge to inform the design and assessment, identify and understand local issues and concerns, provide access to wider stakeholders and communities and provide a mechanism for ongoing dialogue and discussion on the assessment and design development.

3.4.7 Engagement has focused on the technical areas which inform the assessment, including, landscape and visual, sound, noise and vibration and traffic and transport, amongst other topics.

3.4.8 Key issues identified during engagement with local authorities and parish councils include those summarised in Table 5.

Table 5: Engagement to date with local authorities and parish councils

Stakeholder	Area of focus
West Yorkshire Combined Authority (WYCA)	Meeting to discuss Transport Assessment Scoping and Autumn Traffic Surveys, and the Transport Assessment Modelling Working Group
Sheffield City Region	
Wakefield Metropolitan District Council (WMDC)	General introductory and project update meetings, including briefings to the Leaders, Chief Executives and technical directors. Discussion on needs of LA, including approach to engagement with stakeholders
	Meetings with technical leads to collate data and discuss key assessment topics including: air quality; community and equality issues; ecology; flood risk, drainage and water; historic environment; landscape and visual issues; land quality; road diversions and realignments; socio-economics; sound, noise and vibration; traffic and transport; utilities; and waste and material resources
Barnsley Metropolitan Borough Council (BMBC)	General introductory and project update meetings, including briefings to the Leaders and Chief Executives. Discussion on needs of LA, including approach to engagement with stakeholders
	Meetings with technical leads to collate data and discuss key assessment topics including: air quality; community and equality issues; ecology; flood risk, drainage and water; historic environment; landscape and visual issues; land quality; road diversions and realignments; socio-economics; sound, noise and vibration; traffic and transport; utilities; and waste and material resources
	Geotechnical and mining constraints through affiliated South Yorkshire Mining Advisory Service
Hemsworth Town Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
Crofton Parish Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
Ryhill Parish Council	To discuss on–going design and construction planning including environmental impact assessment
South Kirkby and Moorthorpe Town Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
Sharlston Parish Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
South Hiendley Parish Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
Havercroft with Cold Hiendley Parish Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
Huntwick with Foulby and Nostell Parish Council	Engagement to understand local concerns, to discuss the design processes, and establish a schedule for focused engagement on environmental and engineering issues.
Wintersett Parish Council	To provide an overview of HS2 programme, impact mitigation, environmental assessment and receive feedback form the community

3.4.9 Councils will continue to be engaged as part of the design development of the Proposed Scheme with ongoing dialogue on key topics such as highways, PRoW and the draft Code of Construction Practice (CoCP)[29].

Expert, technical and specialist groups

3.4.10 Engagement has also been undertaken with expert, technical and specialist groups to provide appropriate specialist input, as and where appropriate. Stakeholders engaged to date include:

- Animal and Plant Health Agency;
- Barnsley Clinical Commissioning Group;
- Barnsley Hospital NHS Foundation Trust;
- British Geological Survey;
- Campaign to Protect Rural England;
- Canal & River Trust;
- Coal Authority;
- Country Land and Business Association;
- Department of Environment, Food and Rural Affairs;
- English Heritage;
- Environment Agency;
- Fera Science Ltd;
- Forestry Commission;
- Highways England;
- Historic England;
- Inland Waterways Association;
- Leeds City Region Local Enterprise Partnership;
- Mid Yorkshire Chambers of Commerce;
- Mid Yorkshire Hospitals NHS Foundation Trust;
- National Farmers Union;
- National Trust;
- Natural England;

[29] Supporting document: Draft Code of Construction Practice

- Network Rail;
- Public Health England;
- Ramblers Association;
- Royal Agricultural Society;
- Royal Society for the Protection of Birds;
- Royal Society of Wildlife Trusts/The Wildlife Trusts (Yorkshire Wildlife Trust);
- South Yorkshire Health Protection Scheme;
- South Yorkshire Mining Advisory Service;
- Trans Pennine Trail;
- Wakefield Clinical Commissioning Group;
- West Yorkshire Archaeology Advisory Service;
- West Yorkshire Health Protection Team;
- Woodland Trust; and
- Yorkshire Ambulance, West Yorkshire Fire & Rescue and West Yorkshire Police local representatives.

3.4.11 A key purpose of this engagement has been to obtain detailed specialist baseline information to inform the working draft ES and the design development of the Proposed Scheme.

3.4.12 Organisations with a specialist interest have informed individual technical assessments, such as the geotechnical assessment.

3.4.13 Further information about topic-specific engagement is provided in Sections 4 to 15, where relevant.

Utilities

3.4.14 Engagement is also ongoing with utility companies and statutory stakeholders such as Network Rail, National Grid Transmission (electric), Northern Gas Networks , Northern Powergrid, Yorkshire Water, Cadent Gas, BT Openreach and Instalcom to establish what infrastructure exists in the South Kirkby to Sharlston Common area and how it may need to be modified as part of the Proposed Scheme.

Directly affected individuals, major asset owners and businesses

3.4.15 This group includes those with property potentially affected by the Proposed Scheme, including individuals, major asset owners and businesses within the South Kirkby to Sharlston Common area.

3.4.16 Engagement is ongoing with farmers and growers whose land or property would be directly affected by the Proposed Scheme whether permanently or temporarily. The purpose of this engagement has been to obtain baseline information and provide

them with the opportunity to raise issues and discuss mitigation in relation to the Proposed Scheme. For example, the location of environmental mitigation will seek to reduce the loss of agricultural land and the location of accommodation bridges across the route will be considered to better reflect the needs of farmers.

3.4.17 Information gathered from 11 farm visits have informed the assessment presented in this working draft ES. Farm visits are ongoing and engagement will continue as the design and assessment develops.

3.4.18 Engagement is also continuing with key representatives for the farmers and growers industry, in particular with the National Farmers Union and Country Land and Business Association.

3.4.19 A route-wide programme of engagement is ongoing, in parallel to the working draft ES process. This engagement provides affected individuals, major asset owners and businesses the opportunity to raise issues and opportunities in relation to the Proposed Scheme and to gain an understanding of compensation and assistance available for property owners. Within the South Kirkby to Sharlston Common area, information events were held at Hemsworth Community Centre on 21 June 2018 and Crofton Academy on 14 July 2018. Facilities were available at the events for affected individuals, major asset owners and businesses to have private meetings with HS2 staff.

3.4.20 Engagement has been undertaken with local businesses.

3.4.21 HS2 Ltd is continuing to engage with directly affected individuals, major asset owners and businesses, as the design and assessment develops.

4 Agriculture, forestry and soils

4.1 Introduction

4.1.1 This section provides a description of the current baseline for agriculture, forestry and soils and the likely impacts and significant effects of the construction and operation of the Proposed Scheme within the South Kirkby to Sharlston Common area. Consideration is given to the extent and quality of the soil and land resources underpinning the primary land use activities of farming and forestry, and the physical and operational characteristics of enterprises engaged in these activities. Consideration is also given to diversification associated with the primary land uses, and to related land-based enterprises, notably equestrian activities.

4.1.2 Engagement with farmers and landowners has commenced and is ongoing. The purpose of the engagement has been to obtain baseline information on the scale and nature of the farm and forestry operations and related farm-based uses, and to provide farmers and landowners with the opportunity to raise issues and discuss mitigation in relation to the Proposed Scheme. Engagement undertaken with farmers and landowners will be documented in a farm pack for each farm holding within a Phase 2b Farmers and Growers Guide[30].

4.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book.

4.2 Scope, assumptions and limitations

4.2.1 The assessment scope, key assumptions and limitations for the agriculture, forestry and soils assessment are set out in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[31].

4.2.2 The study area for the agriculture, forestry and soils assessment covers all land required for the construction and operation of the Proposed Scheme. The resources and receptors that are assessed within this area are agricultural land, forestry land and soils, together with farm and rural holdings. The assessments of the impacts on agricultural land quality and forestry land are made with reference to the prevalence of best and most versatile (BMV) land and forestry land in the general locality, taken as a 4km corridor centred on the route of the Proposed Scheme.

4.2.3 The quality of agricultural land in England and Wales is assessed according to the Agricultural Land Classification (ALC)[32] system, which classifies agricultural land into five grades from excellent quality Grade 1 land to very poor quality Grade 5 land. Grade 3 is subdivided into Subgrades 3a and 3b. The main issue in the assessment of

[30] To be prepared for Phase 2b in due course, as per previous Phases found here: https://www.gov.uk/government/publications/hs2-guide-for-farmers-and-growers
[31] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report
[32] Ministry of Agriculture, Fisheries and Food (MAFF), (1988), *Agricultural Land Classification of England and Wales – Revised guidelines and criteria for grading the quality of agricultural land*.

the impacts on agricultural land is the extent to which land of BMV agricultural quality (Grades 1, 2 and 3a) is affected by the Proposed Scheme.

4.2.4 Forestry is considered as a commercial land use feature providing resources such as timber or fuel. The impacts on this feature have been calculated quantitatively in terms of the physical extent of commercial forestry land required. The qualitative effects on forestry land and woodland are addressed principally in Section 7, Ecology and biodiversity and Section 11, Landscape and visual.

4.2.5 The primary functions provided by soils other than for food and biomass production, such as flood water attenuation, carbon storage or the support of ecological habitats, are identified in this section and the ability of the soils to fulfil their primary functions after construction of the Proposed Scheme is assessed. Soil attributes, other than for food and biomass production, are identified in this section, but the resulting function or service provided is assessed in other sections, notably Section 7, Ecology and biodiversity; Section 9, Historic environment; Section 11, Landscape and visual; and Section 15, Water resources and flood risk.

4.2.6 The main issue for farm holdings is disruption by the Proposed Scheme of the physical structure of agricultural holdings and the operations taking place upon them, during both construction and operational phases. Where any part of a farm or rural holding is required for the construction and operation of the Proposed Scheme, the whole land holding is part of the study area for impacts on this receptor.

4.2.7 Common assumptions that have been used in assessing the effects of the Proposed Scheme are set out in Volume 1, Section 8. These assumptions include the restoration of agricultural land that is required temporarily for construction to agricultural use, and the handing back of land used temporarily to the original landowner. It is also assumed that buildings and other farm infrastructure on the land holding will not be replaced as this would ultimately be at the discretion of the landowner. For this reason, financial compensation is not a consideration in the assessment of effects on farm holdings, as set out under Impacts on holdings below. In the majority of cases, the details of land use have been obtained from face-to-face interviews. Where this has not been possible, holding data has been obtained from publicly available sources.

4.3 Environmental baseline

Existing baseline

4.3.1 This section sets out the main baseline features that influence the agricultural and forestry use of land within the South Kirkby to Sharlston Common area. These include the underlying soil resources that are used for food and biomass production, as well as providing other services and functions for society, and the associated pattern of agricultural and other rural land uses.

Soil and land resources

Geology and soil parent materials

4.3.2 A full description of the geological characteristics of the South Kirkby to Sharlston Common area is provided in Section 10, Land quality and Section 15, Water resources and flood risk. The underlying geology of the study area is mapped by the British

Geological Survey (BGS)[33]. Superficial deposits mapped in this study area are confined to a narrow valley to the south of Kinsley and comprise peat.

4.3.3 The bedrock geology is of Carboniferous-age, of the Pennine Coal Measures Group. The Pennine Coal Measures Group (of which the Pennine Upper and Middle Coal Measures Formations are components) includes interbedded grey mudstones, siltstones and pale grey sandstones which developed in fluvial, marsh or shallow-marine environments. Coal seams are common.

4.3.4 The Pennine Upper Coal Measures Formation is mapped between South Kirkby and north-east of Ryhill. Large outcrops of sandstone are mapped in the study area, representing a variant within the Pennine Upper Coal Measures Formation. These include Ravenfield Rock, to the west of South Kirkby, and Newstead Rock, to the west of Hemsworth and at Fitzwilliam and Ryhill, where Ackworth Rock sandstone is also present.

4.3.5 To the north of Ryhill is an abrupt boundary between the Pennine Upper Coal Measures and the Pennine Middle Coal Measures Formations, which continue northward to Sharlston Common, and which are distinguished by the presence of marine fossils within the mudstones.

4.3.6 The Pennine Middle Coal Measures Formation also has a sandstone-dominant variant, which is present in elongated seams aligned roughly north-west to south-east. An outcrop of Ackworth Rock, also comprising sandstone, though of fluvial origin, underlies higher ground to the south of Sharlston.

Topography and drainage

4.3.7 Topography in this study area is characterised by a series of outcrops and valleys, with largely irregular slopes of variable steepness. The steepest slopes are at South Moor, east of Brierley, and exceed 7 degrees in places (which precludes this land from being BMV land). The highest altitudes are in the south of the study area, to the west of South Kirkby, where altitudes are up to around 100m above Ordnance Datum (AOD). Further north, at Hemsworth and Sharlston, hilltops are at around 80m to 90m AOD.

4.3.8 In the south of the South Kirkby to Sharlston Common area, at South Kirkby, slopes are moderate and generally east-facing, falling in altitude from around 100m to 70m AOD. Within the valley of Howell Beck, at Howell Wood, the slopes are likely to exceed 7 degrees. At South Moor, the valleys of Hague Hall Beck and of a smaller tributary are cut into underlying mudstone, siltstone and sandstone. The valley sides are irregular and complex, falling to around 50m AOD. Slopes are moderate to steeply sloping and are also likely to exceed 7 degrees.

4.3.9 To the west of Hemsworth, broader, shallower valleys are cut into an east-facing outcrop of the underlying sandstone. The highest altitude of the outcrop is around 90m AOD, falling to around 55m AOD, though the route of the Proposed Scheme passes mostly across the mid-slopes, which are below 7 degrees.

[33] British Geological Survey (2018) Geology of Britain viewer. Available online at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html

4.3.10 The valleys become broader again west of Fitzwilliam where valley sides are generally shallow and undulating. Altitudes fall to the east from around 85m to 70m AOD.

4.3.11 Another sandstone outcrop at Foulby and Crofton forms an elongated hilltop at an altitude of around 90m AOD, falling in all directions to 55m to 65m AOD. To the west of Sharlston Common, a shallow valley drains the land westward via a small unnamed tributary of Red Beck.

4.3.12 A number of small watercourses (including Howell Beck and Hague Hall Beck) traverse the study area and generally form tributaries, which in the south of the study area, drain the land eastward toward the River Don, and in the north of the study area, drain the land eastward to the River Went. A number of man-made lakes and ponds are present to the south of Foulby.

4.3.13 The Environment Agency's Flood Map for Planning (rivers and sea)[34] has been used to scope the baseline flood risk for flooding from main rivers and ordinary watercourses. All of the land within the study area is classed as Flood Zone 1 and as such, agricultural land is not anticipated to be notably affected by flooding.

Description and distribution of soil types

4.3.14 The broad characteristics of the soils likely to be present in the study area are described by the Soil Survey of England and Wales[35] and their general distribution is shown on the National Soil Map[36]. Soils possessing similar characteristics are amalgamated into associations.

4.3.15 There are three known soil associations mapped in this area. The presence of each association has been confirmed in parts of the study area using published survey data. The Bardsey and Dale associations form the most extensive soil types, with the most prevalent being Bardsey soils which are generally mapped throughout the study area. The second most prevalent soils are of the Dale association which is mapped predominantly over the Pennine Middle Coal Measures, between Ryhill and Crofton.

4.3.16 Bardsey soils are characterised by stoneless clay loam or sandy clay loam topsoils overlying grey clay or silty clay subsoils. Profiles are affected by wetness and workability and are commonly of Wetness Class[37] (WC) III or IV. Profiles of the Dale association are characterised by stoneless clay or clay loam topsoil over slowly permeable grey clay subsoil and are typically poorly drained, of WC IV. Profiles comprising poorly drained heavy clay loam over clay have been identified in a survey undertaken to the south-west of Hemsworth[38].

4.3.17 The least extensive soils of the study area are of the Rivington 1 association, mapped to the west of South Kirkby, to the west of Hemsworth and between Fitzwilliam and

[34] Environment Agency (2018). Flood Map for Planning. Available online at: https://flood-map-for-planning.service.gov.uk/
[35] Soil Survey of England and Wales (1984), *Soils and their use in Midland and Western England*, Soil Survey of England and Wales, Bulletin No. 12, Harpenden.
[36] Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale.* Cranfield University: National Soil Resources Institute.
[37] The wetness class of a soil is classified according to the depth and duration of waterlogging in the soil profile and has six bands.
[38] MAFF (1990), *Proposed Hemsworth Bypass – Northern and Southern Options. Ref 4776 12/90*.

Crofton. This association comprises sandy loam or sandy silt loam topsoil overlying sandstone or extremely stony sandy loam. The profiles are well drained (WC I).

4.3.18 The detailed ALC survey[38] undertaken to the south-west of Hemsworth also identified these soils, noting sandy loam topsoils over similar or lighter subsoils, passing to sandstone at moderate depth.

Soil and land use interactions

Agricultural land quality

4.3.19 The principal soil/land use interaction is the quality of the agricultural land resource. The ALC is based on the identification of physical limitations to the agricultural capability of land resulting from the interactions of soil, climate, topography and drainage.

4.3.20 The main soil properties that affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility.

4.3.21 Climate within this area does not, in itself, place any limitation on agricultural land quality. However, the interactions of climate with soil characteristics are important in determining the wetness and droughtiness[39] limitations of the land.

4.3.22 The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point dataset[40] for three points within the area. The data show climate in the study area to be moderately cool and dry. The number of field capacity days[41] (FCDs), when the moisture deficit[42] is zero, ranges from 140 to 143 days per annum. This is slightly lower than average for lowland England (150 days) and generally favourable for providing opportunities for agricultural cultivations and soil handling. Moisture deficits, which give an indication of the liability of soils to droughtiness in summer, are moderate to moderately large.

4.3.23 Site factors such as gradient and microrelief[43] are likely to be limiting in some areas, particularly in the south around Howell Wood, at South Moor and potentially within some of the other valleys. Slopes are likely to be between 7 degrees and 11 degrees, limiting land quality to Subgrade 3b. Slopes of between 11 degrees and 18 degrees will be more severely limiting, reducing land quality to Grade 4.

4.3.24 The main physical limitations that result from interactions between soil, climate and site factors are soil wetness, soil droughtiness and a localised susceptibility to erosion. For soil wetness, each soil can be allocated a Wetness Class based on soil structure, evidence of waterlogging and the number of FCDs. The topsoil texture then

[39] A measure of the likely moisture stress in a crop arising from the crop's requirement for water exceeding the available water capacity in the soil
[40] Meteorological Office (1989), *Gridpoint Meteorological data for Agricultural Land Classification of England and Wales and other Climatological Investigations*.
[41] Field Capacity Days (FCD) is a meteorological parameter which estimates the duration of the period when the soil moisture deficit is zero. Soils usually return to field capacity (zero deficit) during the autumn or early winter and the field capacity period, measured in days, ends in the spring when evapotranspiration exceeds rainfall and a moisture deficit begins to accumulate.
[42] The moisture deficit is a crop-related meteorological variable which represents the balance between rainfall and potential evapotranspiration calculated over a critical portion of the growing season.
[43] Microrelief is the complex change of slope angle and direction over short distances, or the presence of boulders or rock outcrops, which can severely limit the use of agricultural machinery.

determines its ALC grade. Soil droughtiness is determined by the moisture retention of different soil textures and thicknesses of each soil horizon, soil structures, stone content and moisture deficits.

4.3.25 Soils of the Bardsey and Dale associations, which respectively represent the two most extensive soil types within the study area, are most affected by wetness and workability. Under the climatic conditions of the area, profiles of WC IV with heavy textured topsoils are limited to Subgrade 3b, as confirmed by the MAFF survey[38] undertaken in this soil type to the south-west of Hemsworth. Bardsey soils of WC III are less severely limited, to Subgrade 3a.

4.3.26 The least extensive, well-drained, sandy soil profiles of the Rivington 1 association are most likely to be affected by soil droughtiness, the severity of which will be determined by such factors as set out above. As crop moisture deficits are moderate to moderately large, droughtiness limitations are likely to be slight to moderate, to ALC Grade 2 or Subgrade 3a.

4.3.27 The survey at Hemsworth[38] classified this soil type as Subgrade 3a. Soil profiles comprise slightly stony medium sandy loam topsoils over similar or more sandy subsoils. Weathered sandstone is encountered at moderate depth. The profiles are well-drained, of WC I. Due to coarse textures and the presence of sandstone in the subsoil, there is restricted capacity for water storage, resulting in a droughtiness limitation to ALC Subgrade 3a.

4.3.28 As set out in the SMR, the sensitivity of BMV land in the area is determined relative to the abundance of such land in the area, set as a 4km corridor centred on the route of the Proposed Scheme. Department for Environment, Food and Rural Affairs (Defra) predictive mapping[44] shows that there is a moderate likelihood of encountering BMV agricultural land in the locality, which makes such land a resource of medium sensitivity in this study area.

4.3.29 The preceding assessment of agricultural land quality attributed to the soil associations is based on interpretation of publicly available data and will be confirmed by detailed soil survey, as will be the detailed distribution of soil types and land in the various grades of the ALC. The results will be reported in the formal ES.

Other soil interactions

4.3.30 Soil fulfils a number of functions and services for society in addition to those of food and biomass production, which are central to social, economic and environmental sustainability. These are outlined in sources such as the Soil Strategy for England[45] and the Government's White Paper, The Natural Choice: securing the value of nature[46], and include:

- the storage, filtration and transformation of water, carbon and nitrogen in the biosphere;

[44] Defra (2005), *Likelihood of Best and Most Versatile Agricultural Land*.
[45] Defra (2009), *Soil Strategy for England.*
[46] HM Government (2011), *The Natural Choice: securing the value of nature.*

- the support of ecological habitats, biodiversity and gene pools;
- support for the landscape;
- the protection of cultural heritage;
- the provision of raw materials; and
- the provision of a platform for human activities, such as construction and recreation.

4.3.31 Forestry resources represent a potentially multifunctional source of productive timber, landscape amenity, biodiversity and carbon storage capacity. An assessment of the value and sensitivity of woodland resources is reported in Section 7, Ecology and biodiversity and Section 11, Landscape and visual.

4.3.32 The channels of Howell Beck, Langthwaite Beck and Hague Hall Beck, and the ponds and lakes to the south of Foulby, occupy land where water has to either flow or be stored in times of flood, as set out in Section 15, Water resources and flood risk. The clayey soils in this area function as surface water stores facilitating flood attenuation, as well as providing ecological habitat.

Land use

Land use description

4.3.33 Large-scale arable agriculture is the predominant rural land use in the South Kirkby to Sharlston Common area, with nearly all of the land used to grow arable crops in medium to large regularly-shaped fields. There are three small areas of pasture, two of which are close to South Kirkby and the third to the north of Crofton.

4.3.34 The South Kirkby to Sharlston Common area is sparsely wooded, with the only woodlands found in the north. These include one broadleaved woodland west of Hemsworth; two broadleaved woodlands south of New Crofton; one broadleaved woodland south-east of New Crofton; and one broadleaved woodland north-east of Crofton. There are also a number of unnamed coniferous plantations south-east and east of Crofton. It is not yet known whether any of the woodlands affected by the Proposed Scheme are managed commercially.

4.3.35 A number of environmental designations influence land use within the study area. The whole area is a nitrate vulnerable zone where statutory land management measures apply, limiting the average amount of nitrogen from manufactured fertiliser and organic manures that can be applied to agricultural land in order to reduce nitrogen losses from agricultural sources to the natural water environment.

4.3.36 Some agricultural land is also subject to agri-environment management prescriptions that seek to retain and enhance the landscape and biodiversity qualities and features of farmland. These are associated with the Environmental Stewardship Scheme (the Entry Level Scheme (ELS) or Higher Level Scheme (HLS)), or the Countryside Stewardship Scheme (CSS), which has been the main agri-environment scheme in England since 2015. The CSS incorporates elements of Environmental Stewardship, the England Woodland Grant scheme and Catchment Sensitive Farming grants.

4.3.37 Most Environmental Stewardship agreements, which were extensive and covered approximately 70% of agricultural land in England, have now ended although existing agreements will continue to run their course. The higher and mid-tier options in the CSS are more focussed than Environmental Stewardship, with applications for funding being competitive and the area covered by the scheme less than that covered under Environmental Stewardship. However, four new simpler non-competitive offers have been introduced in 2018 to complement the higher tier and mid-tier options and open up the scheme to more farmers and land managers. Holdings that have land entered into an agri-environment scheme are identified in Table 1.

Number, type and size of holdings

4.3.38 Table 6 sets out the current understanding of main farm holdings within this study area. The details of holdings have been obtained from face-to-face interviews with farm owners and occupiers. Publicly-available sources have been used to obtain information about other farm holdings where it has not yet been possible to arrange interviews, and this information will be validated as survey work continues. Other farm holdings may be identified as survey work continues and the design develops. Effects on these farm holdings will be reported in the formal ES.

4.3.39 Table 6 also sets out the sensitivity of individual holdings to change. This is determined by the extent to which they have the capacity to absorb or adapt to impacts, which in turn is determined primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, can better absorb impacts and are less sensitive. Units that rely on the use of buildings (such as intensive livestock and dairy farms, and horticultural units) are less able to accommodate change and have a higher sensitivity. Non-commercial land uses and units, such as pony paddocks associated with residential properties, have a low sensitivity.

Table 6: Summary of characteristics of holdings

Holding name	Holding type	Holding size (ha)	Diversification	Agri-environment scheme	Sensitivity to change
Broad Lane Farm*	Arable	43	Not known	None	Medium
Land south of Broad Lane*	Arable	25	Not known	None	Medium
Avenue Farm	Arable	157	Grain drying/storage, caravan site	None	Medium
Land at Montrose*	Equestrian (non-commercial)	5	Not known	None	Low
Manor Farm*	Arable	54	Not known	None	Medium
Land north of Common Road*	Grassland	11	Not known	None	Medium
Kennels Farm	Arable	930	Grain storage	None	Medium
Hall Farm*	Arable	6	Not known	None	Medium

Holding name	Holding type	Holding size (ha)	Diversification	Agri-environment scheme	Sensitivity to change
Folly Hall Farm	Arable and equestrian	38	Boarding kennels	None	Medium
Vissitt Manor Farm	Arable	445	None	None	Medium
Newstead Grange Farm	Arable	121	None	None	Medium
Horncastle Farm (Welburn)	Arable	77	Agricultural contracting	None	Medium
Horncastle Farm (Metcalfe)	Arable	914	Fishing lakes let	None	Medium
Huntwick Grange*	Arable and beef cattle	200	Not known	None	Medium
Forbes Farm	Arable and woodland	107	Caravan storage and game shoot	None	Medium
Birkwood House Farm*	Grassland, equestrian (non-commercial)	18	Caravan storage, plant machinery training centre and fishing lake	None	Medium
Holme Bank Farm	Beef cattle	12	Garden landscaping and commercial let	None	Medium
Crofton Riding and Livery Stables	Equestrian (commercial)	6	None	None	Medium
Fairleigh Farm	Arable	283	Not known	None	Medium
Land north of A645 Weeland Road*	Arable	7	Not known	None	Medium
West End Farm*	Arable, sheep	40	Synthetic grass business	None	Medium

* It has not yet been possible to arrange farm impact assessment interviews with these holdings. Publicly-available sources have been used to obtain the information presented.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 In addition to design features that would be included in the Proposed Scheme to mitigate the impacts on farm holdings, there is a need to avoid or reduce environmental impacts to soils during construction. Soil resources from the areas required temporarily and permanently for the Proposed Scheme would be stripped and stored. This would enable agricultural land that is required temporarily for construction to be returned to agricultural use. It would also enable soils to be returned to other uses, such as to support landscape planting and biodiversity, and to a suitable condition whereby they would be able to fulfil the identified function.

4.4.2 Compliance with the Code of Construction Practice (CoCP)[47] will avoid or reduce environmental impacts during construction. Those measures that are particularly relevant to agriculture, forestry and soils are set out in the draft CoCP and relate to:

- the reinstatement of agricultural land that is used temporarily during construction to agriculture, where this is the agreed end use (Section 6);
- the provision of a method statement within the farm pack for stripping, handling, storing and replacing agricultural and woodland soils to reduce risks associated with soil degradation on areas of land to be returned to agriculture and woodland following construction, based on detailed soil survey work to be undertaken prior to construction. This would include any remediation measures necessary following the completion of works. Where they occur, there will be special provisions for handling peat and peaty soils (Section 6);
- a requirement for contractors to monitor and manage flood risk and other extreme weather events, insofar as reasonably practicable, that may affect agriculture, forestry and soil resources during construction (Sections 5 and 16);
- arrangements for the maintenance of farm and field accesses affected by construction (Section 6);
- the protection and maintenance of existing land drainage and livestock water supply systems, where reasonably practicable (Sections 6 and 16);
- the protection of agricultural land adjacent to the construction site, including the provision and maintenance of appropriate stock-proof fencing (Sections 5, 6, 9 and 12);
- the adoption of measures to control the deposition of dust on adjacent agricultural crops (Section 7);
- the control of invasive and non-native species; and the prevention of the spread of weeds generally from the construction site to adjacent agricultural land (Section 9);
- the adoption of measures to prevent, insofar as reasonably practicable, the spread of soil-borne, tree, crop and animal diseases from the construction area (Sections 6 and 9); and
- liaison and advisory arrangements with affected landowners, occupiers and agents, as appropriate (Sections 5 and 6).

4.4.3 As part of the ongoing development of the design, the following measures have been incorporated at this stage to avoid or mitigate adverse impacts on agriculture, forestry or soils:

- Howell Wood overbridge to mitigate severance of agricultural land at Avenue Farm (CT-06-478b);

[47] Supporting document: Draft Code of Construction Practice

- Hemsworth Bridleway 8 accommodation overbridge to mitigate severance of agricultural land at Vissitt Manor Farm (CT-06-481);
- Hemsworth Footpath 5 accommodation underbridge to mitigate severance of agricultural land at Newstead Grange Farm (CT-06-482); and
- Crofton Footpath 11 accommodation underbridge to mitigate severance of agricultural land at Horncastle Farm (Metcalfe) (CT-06-484).

4.4.4 As the design develops it will be necessary to continue to assess the requirement for access to severed parcels of agricultural land.

4.4.5 Upon completion of construction, it is currently anticipated that soils replaced for agricultural, forestry or landscape uses would be monitored to identify any unsatisfactory growing conditions during the five-year aftercare period.

4.4.6 Where agricultural uses are to be resumed on land disturbed during the construction of the Proposed 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. Some poorly or very poorly drained land or land with heavier textured soils (such as the Dale and some Bardsey association soils) may also require particularly careful management, such as the timing of cultivation and livestock grazing, during the aftercare period to ensure this outcome.

Assessment of impacts and effects

4.4.7 The acquisition and use of land for the Proposed Scheme would interfere with existing uses of that land and, in some locations, preclude existing land uses or sever and fragment individual fields and operational units of agricultural and forestry land. This could result in potential effects associated with the ability of affected agricultural and forestry interests to access and effectively use residual parcels of land. There may also be the loss of, or disruption to, buildings and operational infrastructure such as drainage. The Proposed Scheme seeks to reduce this disruption and, where appropriate and reasonably practicable, incorporate residual parcels of land no longer effective for agricultural use due to their size and/or shape as part of environmental mitigation works, such as ecological habitat creation.

4.4.8 Land used to construct the Proposed Scheme would fall into the following main categories when work is complete:

- part of the operational railway or associated infrastructure and kept under the control of the operator;
- returned to agricultural use (with aftercare management to ensure stabilisation of the soil structure);
- used for drainage or replacement floodplain storage areas, which may also retain some agricultural use; or
- used for ecological and/or landscape mitigation.

Temporary effects during construction

Impacts on agricultural land

4.4.9 Interpretation of publicly available data shows that the Proposed Scheme would be likely to require approximately 380ha of agricultural land within the South Kirkby to Sharlston Common area during the construction phase, of which approximately 90ha (24%) is likely to be classified as BMV land (predominantly of Subgrade 3a). This is a medium magnitude of impact on BMV land.

4.4.10 As BMV land in this local area is a receptor of medium sensitivity, it is currently anticipated that the likely effect of the Proposed Scheme on BMV land during the construction phase would be moderate adverse, which would be significant.

4.4.11 Following completion of construction, temporary facilities would be removed and the topsoil and subsoil reinstated in accordance with the agreed end use for the land. Some permanently displaced soils may be used to restore land to agriculture or other uses with slightly deeper topsoil and subsoil layers, where appropriate.

Nature of the soil to be disturbed

4.4.12 The sensitivity of the soils disturbed by construction activity reflects their textural characteristics, in the light of local FCDs, as set out in the SMR. In areas with the highest number of FCDs, and during the wettest times of the year, soils with high clay and silt fractions are most susceptible to the effects of handling during construction and the re-instatement of land; whereas soils with a high sand fraction in areas with the fewest number of FCDs and during the driest times of the year are the least susceptible.

4.4.13 Successful soil handling is dependent upon movements being undertaken under appropriate weather and ground conditions using the appropriate equipment. The principles of soil handling are well established and set out in advisory material such as Defra's Code of Practice for the Sustainable Use of Soils[48]. These principles would be followed throughout the construction period.

4.4.14 Clayey and seasonally waterlogged soils (including the Bardsey and Dale associations) are least able to remain structurally stable if moved in wet conditions or by inappropriate equipment. They are susceptible to compaction and smearing, which could affect successful reinstatement.

4.4.15 Implementation of the measures set out in the draft CoCP would reduce the magnitude of impact on soil. The detailed soil survey data will define the sensitivity of soil, and the assessment of the effects on soils to be disturbed will be reported in the formal ES.

Impacts on holdings

4.4.16 Land may be required for the Proposed Scheme from holdings temporarily, during the construction period, or permanently. In most cases, the temporary and permanent

[48] Department for Environment, Food and Rural Affairs (2009), *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.*

land requirement would occur simultaneously at the start of the construction period and it is the combined effect of both that would have the most impact on the holding. During the construction period, some agricultural land would be restored and the impact on individual holdings would reduce.

4.4.17 The effects of the Proposed Scheme on individual agricultural and related interests during the construction period will be reported in the formal ES. The formal ES will present the total area of land required on a particular holding during the construction period in absolute terms and as a percentage of the total area farmed. It will also show the area of land that would be returned to the holding following the construction period. The disruptive effects, principally of construction noise and dust, will be reported in the formal ES and assessed according to their effects on land uses and enterprises.

4.4.18 The potential temporary effects from the construction of the Proposed Scheme on individual agricultural and related interests are summarised in Table 7 for those holdings currently identified. The scale of the impact of land required to construct the Proposed Scheme is based on the likely proportion of land required from the holding during construction. The effects of severance will be judged on the ease and availability of access to severed land. With the implementation of the measures set out in the draft CoCP, these would generally be the same during and post-construction.

4.4.19 The potential scale of effect is determined by combining the highest impact on the farm holding with the sensitivity of that holding, as set out in the SMR.

Table 7: Summary of temporary effects on holdings from construction

Holding name/ Sensitivity to change	**Land potentially required**	**Potential severance impact**	**Potential scale of effect**
Broad Lane Farm Medium sensitivity	Medium	Negligible	Moderate adverse
Land south of Broad Lane Medium sensitivity	High	Negligible	Major/moderate adverse
Avenue Farm Medium sensitivity	High	High	Major/moderate adverse
Land at Montrose Low sensitivity	High	Negligible	Moderate adverse
Manor Farm Medium sensitivity	Negligible	Negligible	Negligible
Land north of Common Road Medium sensitivity	Medium	Negligible	Moderate adverse
Kennels Farm Medium sensitivity	Low	Negligible	Minor adverse

Holding name/ Sensitivity to change	**Land potentially required**	**Potential severance impact**	**Potential scale of effect**
Hall Farm Medium sensitivity	High	Negligible	Major/moderate adverse
Folly Hall Farm Medium sensitivity	Negligible	Medium	Moderate adverse
Vissitt Manor Farm Medium sensitivity	Low	Medium	Moderate adverse
Newstead Grange Farm Medium sensitivity	High	Medium	Major/moderate adverse
Horncastle Farm (Welburn) Medium sensitivity	High	High	Major/moderate adverse
Horncastle Farm (Metcalfe) Medium sensitivity	Low	Medium	Moderate adverse
Huntwick Grange Medium sensitivity	Medium	Negligible	Moderate adverse
Forbes Farm Medium sensitivity	Low	High	Major/moderate adverse
Birkwood House Farm Medium sensitivity	Medium	High	Major/moderate adverse
Holme Bank Farm Medium sensitivity	Low	Negligible	Minor adverse
Crofton Riding and Livery Stables Medium sensitivity	High	High	Major/moderate adverse
Fairleigh Farm Medium sensitivity	Low	Negligible	Minor adverse
Land north of A645 Weeland Road Medium sensitivity	High	Negligible	Major/moderate adverse
West End Farm Medium sensitivity	Medium	Negligible	Moderate adverse

4.4.20 Overall, the construction of the Proposed Scheme would potentially affect 21 agricultural holdings in the South Kirkby to Sharlston Common area temporarily. On the basis of information currently available, 17 holdings would experience moderate or

major/moderate adverse temporary effects from construction, which would be significant for each holding.

4.4.21 It is anticipated that nine farms would experience major/moderate adverse temporary effects from construction. The majority of these would be medium sensitivity arable holdings, which would have a high proportion of land acquired. The following three holdings would also experience a high severance impact: Avenue Farm, Horncastle Farm (Welburn) and Crofton Riding and Livery Stables. For Forbes Farm and Birkwood House Farm, severance would be the greatest impact.

4.4.22 It is currently anticipated that seven arable farms would experience moderate adverse effects due to the proportion of land required for construction of the Proposed Scheme. A low sensitivity holding at Land at Montrose would also experience a moderate adverse effect due to a high proportion of land required.

4.4.23 Although financial compensation would be available under existing statutory arrangements to offset these impacts, it is not a consideration in the assessment of effects on farm holdings.

Permanent effects of construction

Impacts on agricultural land

4.4.24 Interpretation of publicly available data shows that the Proposed Scheme would be likely to require approximately 220ha of agricultural land permanently within the South Kirkby to Sharlston Common area, of which approximately 60ha (27%) are likely to be classified as BMV land (predominantly of Subgrade 3a). This is a medium magnitude of impact on BMV land.

4.4.25 As BMV land in the South Kirkby to Sharlston Common area is a receptor of medium sensitivity, it is currently anticipated that the likely effect of the Proposed Scheme on BMV land following construction would be moderate adverse, which would be significant.

Impacts on forestry land

4.4.26 Based on baseline information currently available, it is anticipated that no areas of commercial forestry land would be required for the Proposed Scheme in this study area. The effects on forestry land will be reported in the formal ES. The qualitative assessment of loss of woodland is presented in Section 7, Ecology and biodiversity.

Impacts on holdings

4.4.27 The potential permanent effects from the construction of the Proposed Scheme on individual agricultural and related interests are summarised in Table 8 for those holdings currently identified. The scale of the impact of land required to operate the Proposed Scheme is based on the likely proportion of land required from the holding. The potential effects of severance are judged on the ease and availability of access to severed land once construction is completed. The impact on farm infrastructure refers mainly to the potential loss of or damage to farm capital, such as property, buildings and structures, and the consequential effects on land uses and enterprises.

4.4.28 The potential scale of effect is determined by combining the highest impact on the farm holding with the sensitivity of that holding, as set out in the SMR.

Table 8: Summary of permanent effects on holdings from construction

Holding name/ Sensitivity to change	**Land potentially required**	**Potential severance impact**	**Potential impact on farm infrastructure**	**Potential scale of effect**
Broad Lane Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Land south of Broad Lane Medium sensitivity	High	Negligible	Negligible	Major/moderate adverse
Avenue Farm Medium sensitivity	High	High	Negligible	Major/moderate adverse
Land at Montrose Low sensitivity	High	Negligible	Negligible	Moderate adverse
Manor Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Land north of Common Road Medium sensitivity	Medium	Negligible	Negligible	Moderate adverse
Kennels Farm Medium sensitivity	Negligible	Medium	Negligible	Moderate adverse
Hall Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Folly Hall Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Vissitt Manor Farm Medium sensitivity	Negligible	Low	Negligible	Minor adverse
Newstead Grange Farm Medium sensitivity	Medium	Low	Negligible	Moderate adverse
Horncastle Farm (Welburn) Medium sensitivity	Medium	Medium	Negligible	Moderate adverse
Horncastle Farm (Metcalfe) Medium sensitivity	Low	Low	Low	Minor adverse
Huntwick Grange	Low	Negligible	Negligible	Minor adverse

Holding name/ Sensitivity to change	Land potentially required	Potential severance impact	Potential impact on farm infrastructure	Potential scale of effect
Medium sensitivity				
Forbes Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Birkwood House Farm Medium sensitivity	Medium	High	Medium	Major/moderate adverse
Holme Bank Farm Medium sensitivity	Negligible	Negligible	High	Major/moderate adverse
Crofton Riding and Livery Stables Medium sensitivity	High	Negligible	High	Major/moderate adverse
Fairleigh Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible
Land north of A645 Weeland Road Medium sensitivity	Negligible	Negligible	Negligible	Negligible
West End Farm Medium sensitivity	Negligible	Negligible	Negligible	Negligible

4.4.29 Overall, the construction of the Proposed Scheme could potentially affect 20 holdings in the South Kirkby to Sharlston Common area permanently. On the basis of information currently available, ten holdings could experience moderate or major/moderate adverse permanent effects from construction, which would be significant for each holding. One holding at Hall Farm would not experience any permanent effects from construction.

4.4.30 It is anticipated that five farms would experience major/moderate adverse permanent effects. Two arable holdings (land south of Broad Lane and Avenue Farm) would have a high proportion of land required. Avenue Farm and Birkwood House Farm would experience a high severance impact. Holme Bank Farm and Crofton Riding and Livery Stables would have buildings demolished, and impacts from loss of land. Crofton Riding and Livery Stables is unlikely to be able to continue operating at the current site.

4.4.31 The following four farms would experience moderate adverse permanent effects due to medium land required/severance impacts on medium sensitivity holdings: Horncastle Farm (Welburn), land north of Common Road, Kennels Farm and Newstead Grange Farm. The non-commercial equestrian unit at land at Montrose would also experience a moderate adverse permanent effect due to the high proportion of land required.

4.4.32 Although financial compensation will be available under existing statutory arrangements, there can be no certainty that this would be used to reduce the above adverse effects by the purchase of replacement land or the construction of replacement buildings. Therefore, the above assessment should be seen as the worst case, which could be reduced if the owner and/or occupier is able, and chooses, to use compensation payments to replace assets.

Other mitigation measures

4.4.33 Other mitigation would incorporate climate change adaptation and resilience measures, insofar as reasonably practicable. For example, restored soils in areas that could be prone to drought with climate change could potentially be replaced at greater depths than at present to make them resilient to drought.

4.4.34 A farm pack within the Phase 2b Farmers and Growers Guide would be provided to all farmers and landowners, setting out baseline conditions on the farm and the assurances and obligations that HS2 Ltd would accept upon entering the land. This would include advice and appropriate assistance where there is a need for the landowner to relocate or re-provide agricultural buildings displaced by the Proposed Scheme.

Summary of likely residual significant effects

4.4.35 Although the extent of land required permanently by ALC grade is not yet known in the South Kirkby to Sharlston Common area, current indications based on publicly available information are that the effect on BMV agricultural land would be moderate adverse temporarily during construction, which would be significant, and moderate adverse permanently from construction, which would be significant. The amount of land required by ALC grade will be assessed and reported in the formal ES.

4.4.36 Seventeen of the 21 farm holdings identified are anticipated to experience moderate or major/moderate adverse temporary effects during construction; with ten anticipated to experience moderate or major/moderate adverse permanent effects of construction, which would be significant for each holding.

4.4.37 Effects on forestry land and soils to be disturbed will be reported in the formal ES.

4.5 Effects arising from operation

Avoidance and mitigation measures

4.5.1 No measures are currently anticipated to be required to mitigate the operational effects of the Proposed Scheme on agriculture, forestry and soils.

Assessment of impacts and effects

4.5.2 Potential impacts arising from the operation of the Proposed Scheme would include:

- noise emanating from moving trains; and
- the propensity of operational land to harbour noxious weeds.

4.5.3 One set of farm buildings at Birkwood House Farm lie within approximately 100m of the route of the Proposed Scheme. The potential for significant effects on sensitive livestock receptors from noise will be assessed and reported in the formal ES.

4.5.4 The propensity of linear transport infrastructure to harbour and spread noxious weeds is a consequence of:

- the management of the highway and railway land; and
- the propensity of the weeds to spread onto such land from adjoining land, which could be exacerbated by the effects of climate change.

4.5.5 The presence of noxious weeds (particularly ragwort) would be controlled using an appropriate management regime that identifies and remedies areas of weed growth that might threaten adjoining agricultural interests.

Other mitigation measures

4.5.6 No other mitigation measures have been identified at this stage.

Summary of likely residual significant effects

4.5.7 No residual significant effects on agriculture, forestry and soils have been identified at this stage as a result of the operation of the Proposed Scheme.

Monitoring

4.5.8 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

4.5.9 There are no area-specific requirements identified for monitoring agriculture, forestry and soil during the operation of the Proposed Scheme in the South Kirkby to Sharlston Common area.

5 Air quality

5.1 Introduction

5.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality identified to date arising from the construction and operation of the Proposed Scheme within the South Kirkby to Sharlston Common area. Oxides of nitrogen (NOx) including nitrogen dioxide (NO2), fine particulate matter[49] (PM10, PM2.5) and dust have been considered in the assessment. Emissions of all or some of these air pollutants are likely to arise from construction activities, demolition, site preparation works and the use of site haul routes. Emissions would also arise from road traffic during construction and operation of the Proposed Scheme.

5.1.2 Engagement with Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough Council (BMBC) has commenced and is ongoing. The purpose of this engagement has been to obtain relevant baseline information, which includes monitoring data in this area.

5.1.3 Maps showing the location of the key environmental features and the key construction and operational features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book.

5.2 Scope, assumptions and limitations

5.2.1 The scope, assumptions and limitations for the air quality assessment are set out in Volume 1 and the Scope and Methodology Report (SMR)[50].

5.2.2 The study areas for the air quality assessment have been determined on the basis of where impacts on local air quality may occur[51]:

- from construction activities;
- from changes in the nature of traffic during construction and operation; for example, increases in traffic flows during construction or where road closures or restrictions cause diversions and heavier traffic on adjacent roads;
- where road alignments have changed; or
- from the operation of combustion plant at buildings.

5.2.3 The assessment of construction traffic will be reported in the formal ES. The assessment will incorporate HS2 Ltd's policies on vehicle emissions. These include the use of Euro VI heavy goods vehicles (HGVs), Euro 4 petrol and Euro 6 diesel cars and light goods vehicles (LGVs) during construction of the Proposed Scheme.

[49] PM2.5 and PM10 describe two size fractions of airborne particles that can be inhaled and therefore are of concern for human health. The designations refer to particles of size less than 2.5 and 10 microns in diameter.
[50] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report
[51] The assessment of construction dust emissions has been undertaken where sensitive receptors are located up to a distance of 350m from dust generating activities. The assessment of traffic emissions will be undertaken where sensitive receptors are located up to a distance of 200m from roads screened in for further assessment.

5.2.4 The assessment of construction traffic impacts will use traffic data based on an estimate of the average daily flows in the peak year during the construction period (2023-2032). The assessment will assume vehicle emission rates and background pollutant concentrations from year 2023. As both pollutant emissions from vehicle exhausts and background pollutant concentrations are anticipated to reduce year by year as a result of vehicle emission controls, the year 2023 represents the worst case for the construction assessment.

5.3 Environmental baseline

Existing baseline

Background air quality

5.3.1 The main sources of air pollution in the South Kirkby to Sharlston Common area are emissions from road vehicles and agricultural activities. The main roads within the area are the A628 Hemsworth Bypass/Barnsley Road, the A6201 Sprockhovel Way/Wrangbrook Lane, the A638 Doncaster Road/Wakefield Road and the A645 Weeland Road/Wakefield Road.

5.3.2 There is one industrial installation (regulated by the Environment Agency) with a permit for emissions to air, namely the South Kirkby Waste Management Facility. The contribution of all industrial processes and other emission sources to local air quality is included within the background concentrations.

5.3.3 Estimates of background air quality have been obtained from the Department for Environment, Food and Rural Affairs (Defra)[52], for the baseline year of 2017. The data are estimated for 1km grid squares for NOx, NO2, PM10 and PM2.5. Background concentrations are within the air quality standards for all pollutants within the South Kirkby to Sharlston Common area.

Local monitoring data

5.3.4 There are currently five local authority diffusion tube sites located within the South Kirkby to Sharlston Common area for monitoring NO2 concentrations. These sites are located in Hemsworth, and along the A645 Weeland Road in Sharlston Common. Measured concentrations in 2016 were within the air quality standard at two sites (Hemsworth)[53]. The other three sites were installed towards the end of 2016 and therefore have no relevant data for this year.

Air quality management areas

5.3.5 There are two air quality management areas (AQMA) within the South Kirkby to Sharlston Common area, namely the Hemsworth AQMA and Wakefield City AQMA. Both AQMAs were designated for exceedances in the annual mean NO2 standard. Hemsworth AQMA covers an area encompassing properties at the Cross Hill junction in the town centre and was declared in May 2013. Wakefield City AQMA covers an

[52] Department for Environment, Food and Rural Affairs (Defra) Defra Background Pollutant Concentration Maps. Available online at; http://ukair.defra.gov.uk/data/laqm-background-maps?year=2015
[53] At the time of assessment, measurements for 2016 were the latest published annual monitoring baseline data.

area encompassing properties adjacent to main roads in the city, including the A638 Doncaster Road, and was declared in March 2016.

Receptors

5.3.6 Several locations have been identified in the area as sensitive receptors, which are considered to be susceptible to changes in air quality due to their proximity to dust generating activities or traffic routes during construction or operation of the Proposed Scheme.

5.3.7 Most of the receptors which may be affected by the Proposed Scheme are residential, in areas including South Kirkby, Ackworth Moor Top, Wragby, Crofton and Sharlston Common. Other receptors include schools and care homes.

5.3.8 There are no statutory designated ecological sites identified within the South Kirkby to Sharlston Common area. Non-statutory sensitive ecological sites identified close to the Proposed Scheme include South Kirkby Fort Local Wildlife Site (LWS), Manface Quarry LWS, Moorhouse Lane Ponds and Railway LWS and Nostell Priory Lakes LWS. Further details of ecological receptors are set out in Section 7, Ecology and biodiversity.

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 Emissions to the atmosphere will be controlled and managed during construction through the route-wide implementation of the Code of Construction Practice (CoCP)[54]. The draft CoCP includes a range of mitigation measures that are accepted by the Institute of Air Quality Management (IAQM) as being suitable to reduce impacts to as low a level as is reasonably practicable. These measures are generally sufficient to avoid any significant effects from dust during construction.

5.4.2 The assessment has assumed that the general measures detailed in Section 7 of the draft CoCP will be implemented. These include:

- contractors being required to manage dust, air pollution, odour and exhaust emissions during construction works;
- inspection and visual monitoring, undertaken in consultation with the local authorities, to assess the effectiveness of the measures taken to control dust and air pollutant emissions;
- cleaning (including watering) of vehicle routes and designated vehicle waiting areas to suppress dust;
- the use of water spray systems on demolition sites to dampen down fugitive dust;

[54] Supporting documents: Draft Code of Construction Practice.

- keeping soil stockpiles away from sensitive receptors where reasonably practicable, also taking into account the prevailing wind direction relative to sensitive receptors;
- the use of enclosures to contain dust emitted from construction activities; and
- soil spreading, seeding and planting of completed earthworks as soon as reasonably practicable following completion of earthworks.

5.4.3 The draft CoCP includes the requirement for site-specific traffic management measures, such as the use of site haul routes for construction vehicles to minimise the need to use public roads.

Assessment of impacts and effects

Temporary effects

5.4.4 Impacts from construction of the Proposed Scheme could arise from dust generating activities and emissions from construction traffic. As such, the assessment of construction impacts has been undertaken for dust and exposure to NO_2, PM10 and PM2.5 concentrations.

Construction dust effects

5.4.5 The risks of demolition of existing buildings, earthworks, construction of new structures and trackout[55], have been assessed for their effect on dust soiling, human health[56] and ecological sites. There are residential and ecological receptors located within the South Kirkby to Sharlston Common area.

5.4.6 It has been identified that there would be a low to medium risk of dust effects from demolition activities. The risk of human health effects would range from negligible to high risk depending on the location of sensitive receptors and the magnitude of the demolition activities. For earthworks, there would be a medium to high risk of dust effects and a high risk of human health effects. For construction, the risks of dust and human health effects would range from low to high risk, depending on the location of sensitive receptors and the magnitude of the activities. For trackout, there would be a high risk of dust and human health effects. The risk of ecological effects would range from low to high risk, depending on the location of sensitive receptors and the magnitude of the activities. No demolition activities would affect any ecological receptors.

5.4.7 With the application of the established national best practice mitigation measures contained in the draft CoCP, no significant effects are anticipated from the risks associated with the dust generating activities.

[55] Trackout refers to the transport of dust and dirt from the construction site(s) onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.
[56] Human health effects relate mainly to short-term exposure to particles of size between 2.5µm to 10µm, measured as PM10.

Construction traffic effects

5.4.8 Construction activity could also affect local air quality through the additional traffic generated on local roads as a result of construction vehicles and through changes to traffic patterns arising from temporary road diversions and realignments.

5.4.9 The A1/A1(M); Common Road; the B6273 Southmoor Road/Garmil Lane; the A628 Hemsworth Bypass/Barnsley Road; the A6201 Sprockhovel Way/Wrangbrook Lane; Barewell Hill/Barnsley Road; Robin Lane; the B6428 Newstead Lane/Hemsworth Lane; Swine Lane; the A638 Doncaster Road/Wakefield Road; the B6378 Pontefract Road; the A645 Weeland Road/Wakefield Road; and the B6133 Common Side Lane would likely provide the primary access for construction vehicles in this area. An increase in traffic flows as a result of construction traffic, temporary closures or diversions is anticipated on these roads. A detailed assessment of air quality impacts from traffic emissions in the area will be undertaken and reported in the formal ES.

5.4.10 Direct and indirect effects from changes in air quality, such as those arising from increased levels of construction traffic, will be considered for all sensitive receptors within 200m of construction routes. These will include human receptors and those ecological habitats considered to be sensitive to changes in air quality. These effects will be reported in the formal ES.

Permanent effects

5.4.11 No permanent effects on local air quality are likely to arise during construction of the Proposed Scheme.

Other mitigation measures

5.4.12 No other mitigation measures are proposed at this stage in relation to air quality during construction of the Proposed Scheme in this area.

Summary of likely residual significant effects

5.4.13 The methods outlined within the draft CoCP are considered effective at reducing dust and, therefore, no significant residual effects would be anticipated. Any significant residual effects from construction traffic emissions will be reported in the formal ES.

5.5 Effects arising from operation

Avoidance and mitigation measures

5.5.1 No specific mitigation measures for air quality are proposed during operation of the Proposed Scheme.

Assessment of impacts and effects

5.5.2 Impacts from the operation of the Proposed Scheme would relate to changes in the volume, composition and/or speed of road traffic and changes in road alignment.

5.5.3 There would be no direct atmospheric emissions that would cause an impact on air quality from the operation of trains, and, therefore, no assessment is required. Indirect emissions from sources such as rail wear and brakes have been assumed to be negligible.

Operational traffic effects

5.5.4 Direct and indirect effects from changes in air quality, such as those arising from increased levels of traffic, will be considered for all receptors within 200m of affected roads. These will include human receptors and those ecological habitats considered to be sensitive to changes in air quality. Any effects will be reported in the formal ES.

Other mitigation measures

5.5.5 No other mitigation measures are proposed at this stage in relation to air quality in this area during operation of the Proposed Scheme.

Summary of likely residual significant effects

5.5.6 Any significant residual effects for air quality from the operation of the Proposed Scheme will be reported in the formal ES.

Monitoring

5.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

5.5.8 Any area specific requirements for monitoring air quality effects during operation of the Proposed Scheme in this area will be reported in the formal ES.

6 Community

6.1 Introduction

6.1.1 This section of the report describes the impacts and likely significant effects identified to date on local communities resulting from the construction and operation of the Proposed Scheme in the South Kirkby to Sharlston Common area.

6.1.2 The assessment draws on information gathered from engagement with the users and operators of facilities including Wakefield Metropolitan District Council (WMDC), Crofton Parish Council, The Priory Centre Pupil Referral Unit (PRU), Crofton Against HS2, Wakefield Ramblers, Wakefield District Cycling Forum, Wakefield District Biodiversity Group, Wakefield Local Access Forum and residents of Robin Lane. The purpose of this engagement has been to understand how the facilities are used and to obtain relevant baseline information and inform the design development of the Proposed Scheme. Engagement will continue with these and other stakeholders and will be used to inform the formal ES.

6.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2, LA14 Map Book.

6.2 Scope, assumptions and limitations

6.2.1 The assessment scope, key assumptions and limitations for the community assessment are set out in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[57].

6.2.2 The assessment of in-combination effects will draw upon the findings of other technical disciplines (e.g. air quality, sound, noise and vibration, landscape and visual and traffic and transport). Likely significant in-combination effects on community facilities and resources will be reported in the formal ES.

6.2.3 Effects relating to the severance of public rights of way (PRoW) (public footpaths and bridleways) and highway and pedestrian diversions, are assessed in Section 14 Traffic and transport. However, where PRoW and other routes are a 'promoted' destination in their own right as a recreation resource, they will be considered within the community assessment. Where impacts on open space and PRoW are considered, these have been informed by open space and PRoW condition surveys, where it has been possible to undertake such surveys.

6.2.4 Where reasonably practicable, public footpaths and routes would be reinstated or convenient alternatives provided. HS2 Ltd will seek to provide a temporary or permanent alternative route in advance of a closure of a road or PRoW. No significant effects on these routes are likely once the mitigation measures have been implemented. Alternative temporary routes have not been defined in all cases due to

[57] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

the relatively early stage of design of the Proposed Scheme. Where this is the case they will be reported in the formal ES.

6.2.5 If a temporary or permanent alternative route cannot be provided in advance of any road or PRoW closure then this will be discussed with the relevant local authority and local groups and reported in the formal ES.

6.2.6 The assessment in the working draft ES is based on the design information, including demolitions as set out in Section 2 available at the time of the assessment. This is subject to change as a result of design changes confirmed in advance of the submission of the hybrid Bill.

6.2.7 The construction of the Proposed Scheme could lead to isolation effects in one or more communities in this area. These will be assessed in the formal ES.

6.2.8 Overall, the study area is taken as the area of land that encompasses the likely significant effects of the Proposed Scheme. The study area includes the area of land required both temporarily and permanently for the construction and operation of the Proposed Scheme. It also includes a wider corridor within which receptors or resources could be affected by a combination of significant residual effects arising from, for example, noise, vibration, poor air quality, HGV traffic and visual intrusion. These in-combination effects will be identified in the formal ES. In addition, the study area has regard to the proposed routes of construction traffic and takes account of catchment areas for community facilities that could be affected where intersected by the Proposed Scheme.

6.2.9 For the working draft ES the full details of construction traffic routes and geographical scope of likely in-combination (amenity) effects are yet to be determined. In the formal ES, the study area and associated baseline of community resources will be updated to take account of these.

6.3 Environmental baseline

6.3.1 The Proposed Scheme through the South Kirkby to Sharlston Common area would be approximately 12.6km in length and lie within the WMDC and Barnsley Metropolitan Borough Council (BMBC) areas. It would extend from South Kirkby, in the south, passing close to the settlements of Brierley, Hemsworth, South Hiendley, Kinsley, Fitzwilliam, Havercroft, Newstead, Ryhill, New Crofton, Crofton, Sharlston and Sharlston Common, and ending in New Sharlston in the north.

6.3.2 The South Kirkby to Sharlston Common area is predominantly rural in nature with a mix of settlements. In general, the majority of community facilities are located in the larger settlements of South Kirkby, Hemsworth and Crofton which are partially within the study area. Brierley, South Hiendley, Kinsley, Fitzwilliam, Ryhill, Havercroft, Newstead, New Crofton, Sharlston, Sharlston Common and New Sharlston are settlements which are also located partially within the study area. These settlements are predominantly residential in nature, although some provide a small number of local services. Outside of the main settlements the area is characterised by small clusters of dwellings, isolated dwellings and farmsteads within rural areas.

South Kirkby, Brierley and Hemsworth

6.3.3 This area covers the towns of South Kirkby, Brierley and Hemsworth.

6.3.4 South Kirkby is located to the east of the route of the Proposed Scheme and comprises approximately 5,000 residential properties. The nearest residential properties would be approximately 100m from the route of the Proposed Scheme. Within the study area, community facilities include: Conisborough Castle Archers; South Kirkby Miners Welfare Club; Common Road Social Club; Common Road Avenue allotments; Springfields Residential Care Home; Common Road Infant and Nursery School; and Stockingate Mill Junior School. Wakefield Way is a promoted PRoW, which runs to the west of South Kirkby and would be crossed by the route of the Proposed Scheme.

6.3.5 Brierley is located to the west of the route of the Proposed Scheme and comprises approximately 2,200 residential properties. The nearest residential properties would be approximately 700m from the route of the Proposed Scheme. Within the study area, community facilities and open spaces include: The Club at Burntwood Court Hotel; Brierley Playmates Pre-School Nursery; Brierley Park and Play Area; and public open space at Tanyard Croft. South Yorkshire Way promoted PRoW, which bisects Brierley, would be crossed by the route of the Proposed Scheme (Brierley Footpath 9 and 58).

6.3.6 Hemsworth is located to the east of the route of the Proposed Scheme and comprises approximately 9,000 residential properties. The nearest residential properties would be approximately 100m from the route of the Proposed Scheme. Within the study area, community facilities and open spaces include: Hemsworth United Junior Football Club; St. Helen's C of E Primary School; Cedars Children's Centre; and Cemetery Road allotments. Wakefield Way promoted PRoW continues from the south and runs to the south of Hemsworth along the A628 Hemsworth Bypass and would be crossed by the route of the Proposed Scheme.

South Hiendley, Havercroft, Ryhill and Newstead

6.3.7 This area covers the settlements of South Hiendley, Havercroft, Ryhill and Newstead.

6.3.8 South Hiendley is located to the west of the route of the Proposed Scheme and comprises approximately 1,600 residential properties. The nearest residential properties would be approximately 900m from the route of the Proposed Scheme. Within the study area, community facilities consist of South Hiendley Post Office.

6.3.9 Ryhill, Havercroft and Newstead are adjacent settlements located to the south-west of the route of the Proposed Scheme. Together, they comprise approximately 4,100 residential properties, the nearest of which would be located in Newstead, approximately 550m from the route of the Proposed Scheme. Within the study area, community facilities and open space in the village of Havercroft include the Living Hope Church, and in Newstead include common land at Upper Hatfield Place.

Kinsley and Fitzwilliam

6.3.10 This area covers the villages of Kinsley and Fitzwilliam.

6.3.11 Kinsley is located to the north-east of the route of the Proposed Scheme and comprises approximately 1,800 residential properties. The nearest residential properties would be approximately 300m from the route of the Proposed Scheme. Within the study area, community facilities include: Kinsley Football Club; Stoneybeck Nursing Home; Our Lady of Graces Church; Kinsley Medical Centre and Autism Service; and Red Roof Children's Day Nursery.

6.3.12 Fitzwilliam is located to the north-east of the route of the Proposed Scheme and comprises approximately 2,100 residential properties. The nearest residential properties would be approximately 600m from the route of the Proposed Scheme. Within the study area, community facilities in the village include the Church of the Resurrection; Fitzwilliam allotments; and Roof Cottage Care Home.

Crofton, New Crofton and surrounds

6.3.13 This area covers the villages of Crofton, New Crofton and surrounds. Crofton and New Crofton are two conjoined villages which contain approximately 4,500 residential properties.

6.3.14 Crofton and New Crofton are located to the south-west of the route of the Proposed Scheme. The nearest residential properties would be approximately 140m from the route of the Proposed Scheme. Community facilities and open space within the village include Crofton Community Centre; Nostell Miners Welfare Football Club; Middle Lane playing field; Crofton Wood; Oak Street allotments; Beech Avenue allotments; The Goose and Cowslip public house; New Crofton Post Office; Crofton Infants' School; Crofton Junior School; Crofton Working Men's Club; Crofton Health Centre; Crofton Post Office; Crofton Academy; Crofton Youth Centre; Crofton Academy Tennis Courts; Crofton Community Library; Royal Oak public house; All Saints Church; Shay Lane Primary School; Little Learners Day Nursery; The Priory Centre PRU; Crofton Riding and Livery Stables; and The Cock and Crown public house.

6.3.15 Nostell Miners Welfare Football Club is an association football club that has a clubhouse and its own football pitch on a site adjoining Crofton Community Centre on Middle Lane. The football pitch is adjacent to the route of the Proposed Scheme.

6.3.16 Crofton Riding and Livery Stables is a horse riding school and equestrian centre located on B6378 Pontefract Road, providing riding lessons, livery, show jumps, dressage arenas and saddlery. It would be located within land required to construct the Crofton North embankment.

6.3.17 The Priory Centre PRU is located on B6378 Pontefract Road and provides education for Key Stage 2 and 3 pupils who have been permanently excluded from mainstream school. The school is a mixed gender school for pupils aged 11-14. The school grounds would be adjacent to the route of the Proposed Scheme.

6.3.18 In the surrounding area, the Yorkshire Air Ambulance Nostell Air Support Unit is located on A638 Doncaster Road and would be approximately 850m north-east of the route of the Proposed Scheme. Nostell Priory (which includes a registered park and

garden) is also located on A638 Doncaster Road and would be approximately 1km north-east of the route of the Proposed Scheme.

Sharlston, Sharlston Common and New Sharlston

6.3.19 This area covers the villages of Sharlston, Sharlston Common and New Sharlston.

6.3.20 Sharlston is located to the north-east of the route of the Proposed Scheme and comprises approximately 150 residential properties. The nearest residential properties would be approximately 500m from the route of the Proposed Scheme. Community facilities in the village consist of the White Horse public house.

6.3.21 Sharlston Common is located to the north-east of the route of the Proposed Scheme and comprises approximately 1,900 residential properties. The nearest residential properties would be approximately 400m from the route of the Proposed Scheme. Community facilities and open space in the village include the Parish Church of Saint Luke; Sharlston Common Post Office; Sharlston Common allotments; common land at The Green; Sharlston Cemetery; and Crofton and Sharlston Medical Centre.

6.3.22 New Sharlston is located to the east of the route of the Proposed Scheme and comprises approximately 400 residential properties. The nearest residential properties would be approximately 550m from the route of the Proposed Scheme. Open space in the village consists of New Sharlston allotments.

6.4 Effects arising during construction

Avoidance and mitigation measures

6.4.1 The draft Code of Construction Practice (CoCP)[58] includes a range of provisions that would help mitigate community effects associated with construction within this area, including:

- implementation of a community engagement framework to provide appropriate information and resolve community issues (Section 5 of the COCP);
- sensitive layout of construction sites to reduce nuisance as far as possible (Section 5);
- maintenance of PRoW during construction where reasonably practicable (Section 14);
- monitoring and management of flood risk and other extreme weather events, where reasonable practicable, which may affect community resource during construction (Section 16); and
- specific measures in relation to air quality and noise will also serve to reduce impacts for the neighbouring communities including discretionary noise insulation for sensitive community resources and, in special circumstances,

[58] Supporting document: Draft Code of Construction Practice

temporary rehousing (Sections 7 and 13); and where practicable, the avoidance of HGVs operating adjacent to schools during drop off and pick up periods (Section 14).

Assessment of impacts and effects

Temporary effects

Residential properties

6.4.2 For construction of the Common Road overbridge, it would be necessary to carry out works within land which falls within the boundary of a residential property on Common Road, South Kirkby. An area of outside space would be temporarily lost to create a new access into the property. This would not impact on the ability of the residents to use their dwelling, and access would be maintained throughout construction. This is not considered to have a significant community effect.

6.4.3 For construction of the Barnsley Road overbridge, it would be necessary to carry out works within land which falls within the boundary of a residential property on Robin Lane, Hemsworth. An area of garden space would be temporarily lost. This would not impact on the ability of the residents to use their dwelling, and access would be maintained throughout construction. This is not considered to have a significant community effect.

6.4.4 For construction of the Swine Lane overbridge, it would be necessary to carry out works within land which falls within the boundaries of three residential properties on Swine Lane, Nostell. An area of outside space would be temporarily lost to create a new access into one of the properties. An area of garden space would be temporarily lost from two of the properties due to the construction of the overbridge. This would not impact on the ability of the residents to use their dwellings, and access would be maintained throughout construction. This is not considered to have a significant community effect.

6.4.5 For construction of the Crofton South embankment, it would be necessary to carry out works within land which falls within the boundary of a residential property on Towers Lane, Crofton. An area of garden space would be temporarily lost. This would not impact on the ability of the residents to use their dwelling, and access would be maintained throughout construction. This is not considered to have a significant community effect.

Community facilities

6.4.6 No temporary effects on community facilities have been identified as a result of the land required for construction of the Proposed Scheme.

Recreational facilities

6.4.7 The construction of the Crofton retaining wall at the New Crofton North embankment would require approximately 10% of land within the boundary of Nostell Miners Welfare Football Club, located off Middle Lane. The temporary loss of this small grassed area of land outside of the boundary of the football pitch would not impact on the ability of the club to use its facilities and access to the pitch would be maintained

throughout construction. This would result in a minor adverse effect, which would not be significant.

Open space and PRoW

6.4.8 No temporary effects on open space and promoted PRoW have been identified as a result of the land required for construction of the Proposed Scheme.

Permanent effects

Residential properties

6.4.9 The construction of Hemsworth cutting would require land that falls within the boundary of a property on Vissitt Lane. The loss of this land from the garden would not impact on the ability of the residents to use their dwelling and access would be maintained throughout construction. This is not considered to have a significant community effect.

6.4.10 The construction of the Crofton North embankment would require the demolition of two residential properties on the B6378 Pontefract Road. These two residential properties would be permanently lost.

6.4.11 The construction of the Crofton North embankment would require land that falls within the boundary of a property on the B6378 Pontefract Road. The southern corner of the garden would be lost. The loss of this area of outside space would not impact on the ability of the residents to use their dwelling and access would be maintained throughout construction. This is not considered to have a significant community effect.

Community facilities

6.4.12 No permanent effects on community facilities have been identified as a result of the land required for the Proposed Scheme.

Recreational facilities

6.4.13 Construction of the Crofton North embankment would require the demolition of Crofton Riding and Livery Stables. This facility would be unable to function in its existing arrangement and would be lost to the community. There are no other riding schools located in Crofton. The nearest riding school is located approximately 3km away in Walton. The permanent loss of Crofton Riding and Livery Stables would result in a major adverse effect, which would be significant.

Open space and PRoW

6.4.14 Construction of the Howell Wood cutting and the Brierley embankment would result in the severance of two promoted PRoW, the Wakefield Way and the South Yorkshire Way. Wakefield Way would be severed at two locations: at Holmsley Lane, due to the construction of Howell Wood cutting; and at the B6273 Southmoor Road, due to the construction of the Brierley embankment. The B6273 Southmoor Road overbridge would provide a permanent realignment for this section of Wakefield Way. South Yorkshire Way would be severed due to the construction of Brierley embankment near Hemsworth Gate (Brierley Footpath 9 and 58). Proposed mitigation and an

assessment of the likely effects on these promoted PRoW will be reported in the formal ES.

Other mitigation measures

6.4.15 HS2 Ltd will continue to engage with owners/operators to identify reasonably practicable measures to help mitigate potential significant effects identified in this assessment.

6.4.16 Any other mitigation measures will be described in the formal ES.

Summary of likely residual significant effects

6.4.17 Land required for the construction of the Proposed Scheme is likely to result in permanent residual significant adverse effects on Crofton Riding and Livery Stables.

Cumulative effects

6.4.18 Community wide effects occur where a number of individual impacts on resources come together within a location and have a wider impact on community, such that they change the experience of a considerable proportion of people within that community.

6.4.19 No cumulative effects have been identified at this time. Any combined effects on a community during construction of the Proposed Scheme, which would result in cumulative community effects, will be reported in the formal ES.

6.5 Effects arising from operation

Avoidance and mitigation measures

6.5.1 Avoidance and mitigation measures for effects arising from operation will be reported in the formal ES.

Assessment of impacts and effects

6.5.2 Operation of the Proposed Scheme could lead to in-combination effects on the community in this area which will be reported in the formal ES.

Other mitigation measures

6.5.3 Any other mitigation measures will be described in the formal ES.

Summary of likely residual significant effects

6.5.4 A summary of the likely residual significant effects will be reported in the formal ES.

Cumulative effects

6.5.5 Community wide effects occur where a number of individual impacts on resources come together within a location and have a wider impact on the community, such that they change the experience of a considerable proportion of people within that community.

6.5.6 No cumulative effects have been identified at this time. Any combined effects on a community during operation of the Proposed Scheme, which would result in cumulative effects, will be reported in the formal ES.

Monitoring

6.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

6.5.8 There are no area-specific community monitoring requirements during operation of the Proposed Scheme. Any area-specific operational monitoring requirements in relation to air quality effects, noise and vibration effects, traffic effects and visual effects that would contribute to the in-combination assessments, will be described in the relevant topic sections of the formal ES.

7 Ecology and biodiversity

7.1 Introduction

7.1.1 This section of the report identifies the predicted impacts and likely significant effects on species and habitats identified to date in the South Kirkby to Sharlston Common area as a consequence of the construction and operation of the Proposed Scheme. This includes effects on sites recognised or designated on the basis of their importance for nature conservation.

7.1.2 Engagement with stakeholders including, Natural England, the Forestry Commission, Sheffield and Rotherham Wildlife Trust, Yorkshire Wildlife Trust, Wakefield Metropolitan District Council (WMDC), Wakefield District Biodiversity Group and Barnsley Metropolitan Borough Council (BMBC) has commenced and is ongoing. The purpose of this engagement has been to discuss the Proposed Scheme and potential effects, obtain relevant baseline information and consider alternative locations for environmental mitigation. Engagement with these stakeholders and other local groups will continue as part of the development of the Proposed Scheme and inform the formal ES.

7.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme are provided in the Volume 2, LA14 Map Book.

7.1.4 All distances and area measurements in this section are approximate.

7.2 Scope, assumptions and limitations

7.2.1 The scope, assumptions and limitations for the ecological assessment are set out in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[59].

7.2.2 In the absence of field surveys and fully developed mitigation, the assessment has been undertaken on a realistic precautionary approach.

7.2.3 Field surveys are ongoing, but are limited to locations where landowner permission has been obtained and to areas accessible to the public. The surveys include (but are not limited to) broad habitat and detailed plant surveys, great crested newt surveys, wintering and breeding bird surveys, bat surveys, otter and water vole surveys. The findings from these ongoing surveys will be taken into account in the formal ES.

7.3 Environmental baseline

Existing baseline

Introduction

7.3.1 This section describes the ecological baseline relevant to the assessment: the designated sites, habitats and species recorded in this area as known at this time.

[59] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

7.3.2 The land required for the Proposed Scheme, and the adjacent areas, consists mainly of agricultural land (largely arable) interspersed with occasional areas of woodland, small settlements, isolated dwellings and farmsteads. The topography is undulating throughout this section of the route of the Proposed Scheme. The Doncaster to Wakefield Line runs parallel with and increasingly close to the route of the Proposed Scheme north of Hemsworth. The Doncaster to Wakefield Line would be crossed by the route near Nostell.

7.3.3 Statutory and non-statutory designated sites are shown on Map Series CT-10, Volume 2: LA14 Map Book.

Designated sites

7.3.4 This section describes the ecological baseline relevant to the assessment, including designated sites, habitats and species.

7.3.5 There are no statutory sites of international or national importance that are relevant to the assessment in the South Kirkby to Sharlston Common area.

7.3.6 There is one local nature reserve (LNR), which is also one of six local wildlife sites (LWS)[60], of potential relevance to the assessment in the South Kirkby to Sharlston Common area. The LNR and the LWS are of county/metropolitan value. Citations provided by relevant organisations have been used in the descriptions below, and where citations are outstanding, publicly available sources of information have been used. Details of site interest[61] features and reasons for designation will be updated in the formal ES. The LWS are:

- South Kirkby Fort LWS, covering an area of 3.7ha, is designated for its rough grass and scrub species and supports water vole. The LWS lies 55m north-east of the land required for the Proposed Scheme;
- Manface Quarry LWS, covering an area of 2.6ha. The LWS is designated for its rich diversity of habitats, including wetland, rough grass, woodland and seeded wildflower meadow, which supports brown argus, a local Biodiversity Action Plan (BAP)62 butterfly species. The LWS is located partially within the land required for the Proposed Scheme;
- Anglers Country Park LNR covers an area of 62.4ha and Anglers Park LWS is an area of 43.1ha. The LWS is almost entirely contained within the LNR although small boundary variations are present between the two designations. Both sites are designated for their varied aquatic vegetation, supporting a regionally uncommon spike rush, a variety of breeding dragonflies and an amphibian

[60] Within the Wakefield Local Biodiversity Action Plan (LBAP) WMDC (2014) *Wakefield Local Biodiversity Action Plan (LBAP)*. Available online at: http://www.wakefield.gov.uk/Documents/sports-leisure/parks-countryside/biodiversity-action-plan.pdf) Anglers Country Park, Nostell Priory Lakes, Moorhouse Lane Ponds and Railway are referred to as Sites of Scientific Interest (SSIs). In desk study data/records received by Wakefield District Borough Council they are referred to as LWS (not SSIs). This Section therefore adopts the LWS reference.

[61] In addition to desk study data/records received by WMDC relating to non-statutory designated sites, Wakefield Local Biodiversity Action Plan place an additional Sites of Scientific Interest (SSI) citation on a selection of its LNR and LWS which has been used to inform this Section, WMDC (2014) *Wakefield Local Biodiversity Action Plan (LBAP)*. Available online at: http://www.wakefield.gov.uk/Documents/sports-leisure/parks-countryside/biodiversity-action-plan.pdf

[62] WMDC (2014) *Wakefield Local Biodiversity Action Plan (LBAP)*. Available online at: http://www.wakefield.gov.uk/Documents/sports-leisure/parks-countryside/biodiversity-action-plan.pdf

population that includes great crested newt. The LNR/LWS is important for wintering wildfowl and also supports breeding wildfowl. The LNR is located 630m south-west of the land required for the Proposed Scheme and the LWS is located 685m to the south-west;

- Moorhouse Lane Ponds and Railway LWS covers an area of 31.1ha. The LWS consists of ponds, marshy grassland, tall ruderal grassland and various broadleaved trees species. The site is designated for its range of aquatic and swamp communities that support: the regionally rare grey club-rush; four breeding amphibian species, including great crested newt; and breeding dragonfly species. The LWS lies partly within the land required for the Proposed Scheme;
- Nostell Priory Lakes LWS covers an area of 25.6ha. This LWS forms a diverse wetland habitat that supports a range of aquatic and swamp communities, including supporting regionally rare species such as a grey club rush and mare's-tail. The site also supports broad-leaved helleborine and shows excellent succession from open water and swamp vegetation through wet woodland to alder and oak woodland. The LWS lies 215m north-east of land required for the Proposed Scheme; and
- Sharlston Common LWS covers an area of 25ha. The LWS is designated for relic heathlands and wetlands and supports great crested newt. The LWS is situated 515m north-east of the land required for the Proposed Scheme.

7.3.7 There are no Ancient Woodland Inventory Sites (AWIS) of potential relevance to the assessment in the South Kirkby to Sharlston Common area.

7.3.8 A review is being undertaken to identify any additional woodlands that are not currently listed on the AWI but that may nevertheless be ancient. These will be identified and assessed in the formal ES.

Habitats

7.3.9 The following habitat types which occur in the South Kirkby to Sharlston Common area are relevant to the assessment.

Woodland

7.3.10 In addition to the aforementioned woodlands, there are five other areas of unnamed lowland deciduous woodland (likely to qualify as habitats of principal importance and Wakefield and Barnsley local BAP habitats[63]), which are within or partly within land required for the Proposed Scheme.

[63] Barnsley Biodiversity Trust (2009) *Barnsley Biodiversity Action Plan* (BMBC) Available online http://www.barnsleybiodiversity.org.uk/Barnsley%20BAP%202009.pdf

7.3.11 These woodland areas include:

- one broadleaved woodland west of Hemsworth (0.7ha);
- two broadleaved woodlands south of New Crofton that provide connectivity to Moorhouse Lane Ponds and Railway LWS (4.4ha);
- one broadleaved woodland south-east of New Crofton providing connectivity to Nostell Priory Lakes LWS (3.3ha); and
- one broadleaved woodland north-east of Crofton (0.4ha).

7.3.12 On a precautionary basis, pending the findings of field surveys, these woodlands are assumed to be of up to district/borough value.

Hedgerows

7.3.13 The land required for construction of the Proposed Scheme would result in the permanent loss of hedgerows, and would result in severance of the network in many places, adversely affecting connectivity with the surrounding area. The length of hedgerow loss will be reported in the formal ES. Many of the hedgerows are likely to qualify as a habitat of principal importance and as a Wakefield and Barnsley local BAP habitat. Some may also meet the wildlife and landscape criteria to be 'important' hedgerows as defined in the Hedgerows Regulations 1997[64]. In addition, they could also provide commuting corridors for wildlife, as well as nesting and feeding habitat. On a precautionary basis, pending the findings of field surveys, the hedgerow network is assumed to be of up to district/borough value.

Watercourses

7.3.14 No main rivers or secondary tributaries traverse the land required for the Proposed Scheme. All seven watercourses traversing the land required for the Proposed Scheme are tertiary tributaries and are typically agricultural drainage ditches with little flow. Consequently, all watercourses have been categorised as either moderate or low value at this stage within the Water Framework Directive assessment (WFD)[65], although several have been noted to support semi natural riparian habitats. On a precautionary basis, pending the findings of field surveys, these watercourses are assumed to be of up to district/borough value.

Water bodies

7.3.15 There are seven ponds located within, or partly within, land required for the Proposed Scheme. Some may qualify as habitats of principal importance[66], or Wakefield or Barnsley local BAP[67][68] habitats (e.g. if they support fauna species of high conservation

[64] The Hedgerow Regulations, (1997), No, 1160.
[65] Refer to Water resources and flood risk (Section 15)
[66] Natural Environment and Rural Communities Act, (2006), Section 41.
[67] WMDC (2014) *Wakefield Local Biodiversity Action Plan (LBAP)*. Available online at: http://www.wakefield.gov.uk/Documents/sports-leisure/parks-countryside/biodiversity-action-plan.pdf
[68] Barnsley Biodiversity Trust (2009) *Barnsley Biodiversity Action Plan* (BMBC) Available online at: http://www.barnsleybiodiversity.org.uk/Barnsley%20BAP%202009.pdf

value such as great crested newts). On a precautionary basis, pending the findings of field surveys, these ponds are assumed to be of up to county/metropolitan value.

Ancient and veteran trees

7.3.16 Pending the results of the field surveys, it is possible that ancient and veteran trees will be present within the land required for the Proposed Scheme. On a precautionary basis, pending the findings of field surveys, any such ancient and veteran trees are considered to be of up to county/metropolitan value.

Protected and notable species

7.3.17 A summary of the likely value of fauna species of relevance to the assessment (excluding any features of species interest for which the sites described above are designated), is provided in Table 9.

Table 9: Species potentially relevant to the assessment within the South Kirkby to Sharlston Common area

Resource/feature	Value	Rationale
Bats	Up to regional.	Field survey has identified a tree with a bat roost of unknown species north-east of Crofton (on the eastern boundary of land required for the Proposed Scheme). Desk study data/records indicate a large and regionally significant noctule roost located 500m to the east of land required for the Proposed Scheme within Nostell Priory lakes LWS[69]. Records confirm there are at least nine other species of bat throughout the area: brown long-eared bat, common pipistrelle, Leisler's bat, Nathusius' pipistrelle, soprano pipistrelle, Daubenton's bat, Natterer's bat, whiskered bat and Brandt's bat.
Otter	Up to county/metropolitan.	Large semi-natural water bodies have potential to support foraging otter including Nostell Priory Lakes LWS (located 215m from land required for the Proposed Scheme), Moorhouse Lane Ponds (part of Moorhouse Lane Ponds and Railway LWS located 400m from land required for the Proposed Scheme) and Anglers Country Park LNR/LWS (located 626m from land required for the Proposed Scheme). Watercourses traversing the land required for the Proposed Scheme with adjacent semi natural/wooded riparian habitat have the potential to support commuting otter, particularly where connecting to water bodies, for example tributary 1 and 2 of the Hardwick Beck, which are located downstream of the Nostell Priory Lakes LWS (connecting the route of the Proposed Scheme to Nostell Priory Lakes LWS).
Water vole	Up to county/metropolitan.	There are records of water vole presence at the South Kirkby Fort LWS[70] 55m north-east from land required for the Proposed Scheme and Fitzwilliam Country Park LWS 545m north-east from land required for the Proposed

[69] West, A., (2016), *Could this be the biggest noctule roost in the UK?*, Bat News, 111, 5.
[70] Listed in citation of Wakefield Local Biodiversity Action Plan (BAP) (date of record unknown)

Resource/feature	Value	Rationale
		Scheme. Suitable water vole habitat[71] is present along the watercourses and drainage ditches within the land required for the Proposed Scheme.
Great crested newt	Up to county/metropolitan.	Great crested newt presence has been established in the Crofton, Sharlston, Horncastle and Nostell areas through eDNA[72] results. Stakeholder engagement with both the Wakefield District Biodiversity Group in 2017 confirmed the presence of great crested newt and desk study data/records has identified recent mitigation licences in a series of ponds also within the Crofton area. Three LWS within the South Kirkby to Sharlston Common area are designated for great crested newt (paragraph 7.3.6).
Birds	Up to county/metropolitan.	Wintering bird surveys have identified farmland bird assemblages in the area in between South Kirkby and Hemsworth, including flocks of 30 tree sparrow and 37 yellow hammer; whilst breeding bird surveys have identified 150 golden plover around the Holmsley area. These are noteworthy bird assemblages in both the county context and particularly for the local area with golden plover a Schedule 2 bird species; therefore, these bird assemblages are of county/metropolitan value. In addition, winter bird surveys have recorded barn owl near South Kirkby, peregrine near South Kirkby and Crofton and hen harrier near Nostell Priory. The farmland and woodland is suitable for breeding and wintering birds. Species associated with these habitats include lapwing, barn owl, skylark, tree sparrow, yellow wagtail, linnet and yellowhammer, which breed in farmland habitats, and a range of typical common woodland breeding and wintering birds.
White-clawed crayfish	Up to country/metropolitan.	Suitable habitat with the potential to support white clawed crayfish exists at Frickley Dike near the proposed Robin Lane diversion (west of Hemsworth), unnamed tributary of River Went (west of Hemsworth) and unnamed tributary of Oakenshaw Beck at Crofton where consistent (albeit low) flow rates have been recorded[73].
Aquatic invertebrates	Up to county/metropolitan.	Suitable habitat for aquatic invertebrates is likely to be present in watercourses and in water bodies within the land required for the Proposed Scheme. Moorhouse Lane Ponds and Railway LWS identifies breeding dragonfly species supported by its diverse range of swamp and aquatic habitats. The ponds are located 400m to the west of land required for the Proposed Scheme.
Terrestrial invertebrates	Up to district/borough.	Desk based terrestrial invertebrate scoping identified suitable habitat within the land required for the Proposed Scheme around the New Crofton and South Kirkby areas (including Manface Quarry LWS). These broad habitats include ancient woodland margins, woodland, open mosaic of brownfield /scrub and land adjacent to railways and ditches.
Reptiles	Up to district/borough.	There are no desk-based records of reptiles within 2km of the land required for the Proposed Scheme in the Sharlston and New Crofton area. Initial field

[71] Strachan, R. and Moorhouse, T.P., (2006), *The Watervole Conservation Handbook: Wildlife Conservation Research Unit*, University of Oxford, Oxford.
[72] Biggs J, Ewald N, Valentini A, Gaboriaud C, Griffiths RA, Foster J, Wilkinson J, Arnett A, Williams P and Dunn F. 2014 Analytical and methodological development for improved surveillance of the great crested newt Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (*Triturus cristatus*) environmental DNA. Freshwater Habitats Trust, Oxford
[73] For further details on flow rates refer to Water resources and flood risk (Section 17).

Resource/feature	Value	Rationale
		surveys undertaken in 2018 have identified one grass snake in the Crofton area. Additional reptile scoping surveys have identified suitable habitat is present within the land required for the Proposed Scheme around Sharlston, Crofton and Nostell. This includes localised areas of poor semi-improved grassland, tall ruderal planting, woodland, wetland and land adjacent to live/ disused railways.

7.4 Effects arising during construction

Avoidance and mitigation measures

7.4.1 The following measures have been included as part of the design of the Proposed Scheme (in addition to the landscape planting shown on the Map Series CT-06 in the Volume 2: LA14 Map Book, along the rail corridor which would be largely a mixture of woodland/scrub and grassland), and would contribute towards mitigating the losses of habitat and effects on species:

- construction of two viaducts (Nostell viaduct over unnamed tributary of Hardwick Beck 1 and 2 and Crofton viaduct over unnamed tributary of Oakenshaw Beck 1) would avoid direct effects to these watercourses, and allow free passage for wildlife beneath them, including along watercourses and their banks;
- provision of new ecological ponds (ponds lost would be replaced on a minimum 1:1 basis);
- new woodland planting adjacent to Howell Wood, and within the areas of Wintersett, New Crofton, would contribute towards replacing the losses of non-ancient woodland, and towards enhancing connectivity between remaining woodlands;
- provision of some new species-rich hedgerows, using appropriate native species, to help maintain connectivity of the ecological network in the surrounding areas, including along the margins of the route of the Proposed Scheme and in specific areas such as South Kirkby, Brierley Common, Hemsworth, Kinsley, Newstead, Fitzwilliam, New Crofton, Foulby, Crofton and Sharlston Common; and
- provision of new grassland habitat creation areas including some species rich grasslands.

7.4.2 The assessment assumes implementation of the measures set out within the draft Code of Construction Practice (CoCP)[74], which includes translocation of protected species where appropriate.

7.4.3 Section 9 of the draft CoCP requires contractors to implement a range of measures to protect ecological receptors including the following:

- manage impacts from construction, including the timing of works, on

[74] Supporting document: Draft Code of Construction Practice

designated sites, protected and notable species and other features of ecological importance such as ancient woodlands and watercourses;

- reduce habitat loss by keeping the working area to the reasonable minimum;
- reinstatement of areas of temporary habitat loss;
- restoration and replacement planting;
- implement management measures for potential ecological impacts to control dust, water quality and flow, noise and vibration, and lighting;
- provision of a watching brief, where relevant;
- relocation or translocation of species, soil and/or plant material, as appropriate;
- consultation with Natural England, the Environment Agency, local wildlife trusts and relevant planning authorities prior to and during construction; and
- compliance with all wildlife licensing requirements, including those for protected and invasive species and designated sites.

Assessment of impacts and effects

7.4.4 The following section considers the impacts and effects on ecological features as a consequence of construction of the Proposed Scheme. All assessments have been undertaken on a precautionary basis, in the absence of survey information, and take account of the baseline value as presented in Section 7.3.

Designated sites

7.4.5 Engineering works associated with Howell Wood cutting immediately north of Holmsley Lane would result in the permanent loss of 0.6ha (23.7%) of Manface Quarry LWS and dewatering and drainage associated with the Howell Wood cutting may reduce groundwater flows. The LWS is designated for its rich diversity of habitats and supports the brown argus butterfly. This habitat loss would result in a permanent adverse effect on site integrity that would be significant at the county/metropolitan level.

7.4.6 The land required for the Proposed Scheme would result in the loss of <0.1ha (0.2%) of Moorhouse Lane Ponds and Railway LWS. Moorhouse Lane Ponds and Railway LWS is designated for its range of aquatic and swamp communities, amphibians including great crested newt, and dragonfly populations. The Proposed Scheme would also exacerbate existing disturbance and fragmentation effects associated with the Doncaster to Wakefield Line which abuts the northern boundary of Moorhouse Lane Ponds and Railway LWS and severs its connectivity to Nostell Priory LWS to the north-east. The habitat loss, disturbance and fragmentation of Moorhouse Lane Ponds and Railway LWS would result in a permanent adverse effect on site integrity that would be significant at the district/borough level.

Habitats

Woodland

7.4.7 Outside of the designated sites, the land required for the Proposed Scheme would result in the loss of 5.3ha of broadleaved woodland within the South Kirkby to Sharlston Common area. A review is being undertaken to identify any additional woodlands that are not currently listed on the Ancient Woodland Inventory but that may nevertheless be ancient. These will be identified and assessed in the formal ES. Given the extent, the permanent loss of these woodlands would result in an effect that would be significant up to the district/borough level. The woodland planting undertaken as part of the Proposed Scheme would reduce this effect to a level that is not significant, unless any of the woodlands are identified as ancient in the ongoing review.

Hedgerows

7.4.8 The Proposed Scheme would result in the permanent loss of hedgerows, and would result in severance of the network in many places, adversely affecting connectivity with the surrounding area. The effects of these losses will be fully assessed in the formal ES. The Proposed Scheme includes new hedgerow planting which would help offset losses. Further hedgerow planting would be proposed as part of the design development. In the absence of this additional mitigation, the loss of these hedgerows would result in a permanent adverse effect on the conservation status of the hedgerow network that would be significant at up to the district/borough level.

Watercourses

7.4.9 Land required for the Proposed Scheme would result in the loss of sections of small watercourses and severance of watercourses due to installation of culverts. In addition, Dunsley drop inlet culvert on Tributary 1 of the Hague Hall Beck and the Horncastle Hill inverted siphon on a tributary of Hessle Beck have the potential to sever connectivity along these watercourses. These permanent effects would be significant up to the district/borough level.

Water bodies

7.4.10 Seven ponds would be lost as a result of the land required for the Proposed Scheme. The permanent loss of these ponds could result in an impact that would be significant up to county/metropolitan level, if they support great crested newts or other priority species. The provision of replacement ponds would reduce this loss to a level that is not significant.

Ancient and veteran trees

7.4.11 It is assumed that any veteran trees recorded within the land required for the Proposed Scheme in the South Kirkby to Sharlston Common area would be permanently lost. Ancient and veteran trees are an irreplaceable resource and their potential loss would result in a permanent adverse effect that is significant at the county/metropolitan level in each case.

Species

Bats

7.4.12 The permanent removal of vegetation may have effects on bats. Habitat loss would reduce the availability of foraging resource, and potentially result in the loss of roosts and fragmentation of commuting routes. This could particularly affect breeding populations of up to ten bat species. Construction of the Nostell viaduct over the Doncaster to Wakefield Line and adjacent New Crofton North embankment has the potential to create a barrier for the movement of noctule and other bat species between Nostell Priory LWS and other areas of potentially good foraging habitat, including Anglers Country Park LNR/LWS. The existing ground level would be elevated up to 20m in this area. Bats may also be affected by lighting associated with construction works, although it is anticipated that this would be controlled through measures outlined in the draft CoCP. On a precautionary basis, with limited survey information available at this stage, it has been assumed that impacts would result in a permanent adverse effect on the conservation status of the bat populations that would be significant up to the regional level.

Otter

7.4.13 Nostell viaduct (over the unnamed tributary of Hardwick Beck 1 and 2) and Crofton viaduct (over the unnamed tributary of Oakenshaw Beck 1) would avoid loss of riparian habitat. Indirect effects from construction activities may result in disturbance to otter during the construction period, and adversely affect them moving through the area. However, it is anticipated that these indirect effects would be controlled through measures outlined in the draft CoCP. The Proposed Scheme crosses several small watercourses, which would result in localised habitat loss. Dunsley drop inlet culvert and Horncastle Hill inverted siphon would permanently sever connectivity of these watercourses. On a precautionary basis, in the absence of further survey information, it has been assumed that impacts to otter would result in an adverse effect on the conservation status of this species that would be significant up to the county/metropolitan level.

Water vole

7.4.14 Water vole has been recorded in South Kirkby Fort LWS, located 55m from the land required for the Proposed Scheme. Viaducts over the unnamed tributary of Hardwick Beck 1 and 2 and the unnamed tributary of Oakenshaw Beck would avoid loss of riparian habitat. Indirect effects from construction activities may result in disturbance to water vole during the construction period, and adversely affect them moving through the area. However, it is anticipated that these indirect effects would be controlled through measures outlined in the draft CoCP. The route of the Proposed Scheme would cross several small watercourses, which would result in localised habitat loss. Dunsley drop inlet culvert and Horncastle Hill inverted siphon would permanently sever connectivity of these watercourses. On a precautionary basis, in the absence of further survey information, it has been assumed that impacts to water vole would result in an adverse effect on the conservation status of these species that would be significant up to the county/metropolitan level.

Great crested newt

7.4.15 Ponds and suitable habitat to support great crested newt populations are known to be present in the Nostell, New Crofton and Crofton areas and, in the absence of further survey information , it has been assumed that all seven ponds within the land required for the Proposed Scheme may support breeding great crested newt. The loss of ponds supporting great crested newt could result in the isolation and severance of breeding populations across this area. Where great crested newt is shown to be present by survey, two new ecological mitigation ponds would be created for every pond lost to the land permanently required for the Proposed Scheme. The implementation of these measures would reduce the effect of loss of breeding habitat to not significant. Suitable terrestrial habitat would be required around new ponds with links to encourage dispersal (e.g. by incorporating existing habitat or creating new habitat). In the absence of the full mitigation proposals, it has been assumed that the loss of terrestrial habitat and potential severance of connectivity would result in a permanent adverse effect on the conservation status of great crested newts that would be significant up to the county/metropolitan level.

Birds

7.4.16 The land required for the Proposed Scheme would result in the loss of nesting and foraging habitat for a range of breeding and wintering birds, predominantly farmland and woodland species. These are likely to include barn owl, a Schedule 1 species, which has been recorded at South Kirkby within 500m of the land required for the Proposed Scheme and golden plover recorded at Holmsley. On a precautionary basis, in the absence of further survey information, it has been assumed that the land required for the Proposed Scheme would result in a permanent adverse effect that would be significant up to the county/ metropolitan level.

White-clawed crayfish

7.4.17 The Proposed Scheme would result in the permanent loss of potential white-clawed crayfish habitat in: Frickley Dike, west of Hemsworth; an unnamed tributary of the River Went, west of Hemsworth; and an unnamed tributary of Oakenshaw Beck, at Crofton, which support a consistent flow of water. On a precautionary basis, in the absence of further survey information, it has been assumed that the land required for the Proposed Scheme would result in a permanent adverse effect that would be significant up to the county/metropolitan level.

Aquatic invertebrates

7.4.18 The Proposed Scheme would result in loss of habitat suitable for aquatic invertebrates (including Section 41 species[75]). On a precautionary basis, in the absence of further survey information, it has been assumed that the land required for the Proposed Scheme would result in a permanent adverse effect that would be significant up to the district/borough level.

[75] Species of principal importance under the Natural Environment and Resources Act (2006), Section 41.

Terrestrial Invertebrates

7.4.19 The land required for the Proposed Scheme would result in loss of habitat suitable for terrestrial invertebrates (including Section 41 species[76]). These habitats include woodland, open mosaic of brownfield and scrub land adjacent to existing railways and land adjacent to ditches. On a precautionary basis, in the absence of further survey information, it has been assumed that the land required for the Proposed Scheme would result in permanent adverse effects that would be significant up to the district/borough level.

Reptiles

7.4.20 There are no records of common reptiles within 2km of the route of the Proposed Scheme. However, suitable habitat is likely to be present for reptiles, including localised areas of poor semi-improved grassland, tall ruderal planting, woodland, wetland and land adjacent to live and disused railways. On a precautionary basis, in the absence of further survey information, it has been assumed that the Proposed Scheme would result in permanent adverse effects that would be significant up to the district/borough level.

7.4.21 Effects on other habitats and species that would be significant up to local/parish level during construction will be reported in the formal ES.

7.4.22 Indirect effects from changes in air quality, such as that arising from increased levels of construction traffic, will be considered where appropriate. These effects will be reported in the formal ES.

Other mitigation measures

7.4.23 Further measures currently being considered, but which are not yet part of the design and will be informed by the findings of the ongoing field surveys and engagement with relevant stakeholders, include:

- options to mitigate the partial loss of non-statutory LWS at Manface Quarry LWS and Moorhouse Lane Ponds and Railway LWS. The options would include enhancement of retained habitats within these locally designated sites and/or additional habitat creation;
- provision of additional broadleaved woodland (non-ancient) to replace those lost, and/or enhancement of remaining woodlands;
- provision of additional hedgerows which would mitigate the losses and maintain the connectivity of the network;
- options to mitigate potential reduction in groundwater flow to Manface Quarry LWS;
- provision of additional measures to facilitate connectivity where significant foraging or commuting routes of fauna species would be affected;

[76] Species of principal importance under the Natural Environment and Resources Act (2006), Section 41.

- use of temporary fencing or retention of existing habitat links to reduce the risk of disturbance to otter during construction; design of watercourse culverts and underpasses to allow the free passage of wildlife;
- structures to reduce severance effects on bats, great crested newt, otter and water vole;
- provision of alternative roosting habitat for bats; and
- provision of additional ponds (on a two to one basis where existing ponds supporting great created newt are lost), outside the area required for the permanent works but within the land required for the Proposed Scheme, and suitable terrestrial habitat around these ponds with habitat links to allow dispersal.

7.4.24 Some of the above may also be achieved through strategic mitigation, which is currently being discussed with relevant stakeholders.

Summary of likely residual significant effects

7.4.25 Taking into account mitigation proposed in the design of the Proposed Scheme set out above, the anticipated significant residual ecological effects during construction are described in Table 10.

Table 10: Residual significant effects on ecological resources/features during construction

Resource/feature	Residual effect	Level at which the effect would be significant
Manface Quarry LWS	Permanent adverse effect on site integrity due to hydrological changes and loss of 0.6ha (23.76%) of diverse habitat including wetland, rough grass, woodland and wildflower meadow which supports brown argus.	Up to county/metropolitan.
Moorhouse Lane Ponds and Railway LWS	Permanent adverse effect on site integrity due to loss of <0.1ha (0.2%) of site and increased disturbance and fragmentation of habitat links to Nostell Priory LWS due to the Doncaster to Wakefield Line.	Up to district/borough.
Woodlands	Potential adverse effect on unidentified ancient woodland. A review is being undertaken to identify any additional woodlands that are not currently listed on the Ancient Woodland Inventory but that may nevertheless be ancient. These will be identified and assessed in the formal ES.	Up to county/metropolitan
Hedgerows	Permanent loss of hedgerows.	Up to district/borough
Watercourses	Loss of sections of small watercourses and severance of watercourses. Potential for further severance of both Tributary 1 of the Hague Hall Beck and	Up to district/borough

Resource/feature	Residual effect	Level at which the effect would be significant
	an unnamed tributary of Hessle Beck.	
Ancient and veteran trees	Permanent loss of individual trees.	Up to county/metropolitan.
Bats	Potential permanent adverse effect on conservation status due to loss of roosts, foraging habitat and fragmentation.	Up to regional.
Otter	Potential permanent adverse effect due to loss of habitat and fragmentation.	Up to county/metropolitan.
Water vole	Potential permanent adverse effect due to loss of habitat and fragmentation.	Up to county/metropolitan.
Great crested newt	Potential permanent adverse effect due to potential loss of seven breeding ponds, and surrounding terrestrial habitat, which may support great crested newt.	Up to county/metropolitan.
Birds	Potential permanent adverse effect due to loss of habitat and disturbance.	Up to county/metropolitan.
White-clawed crayfish	Potential permanent adverse effect due to loss of habitat and fragmentation.	Up to county/metropolitan.
Aquatic invertebrates	Potential permanent adverse effect due to loss of habitat and fragmentation.	Up to district/borough.
Terrestrial invertebrates	Potential permanent adverse effect due to loss of habitat and fragmentation.	Up to district/ borough.
Reptiles	Potential permanent adverse effect due to loss of habitat and fragmentation.	Up to district/borough.

7.5 Effects arising during operation

Avoidance and mitigation measures

7.5.1 There are no specific measures currently identified to avoid or mitigate ecological effects during operation of the Proposed Scheme within this section of the route.

Assessment of impacts and effects

7.5.2 This section considers the impacts and effects on ecological features during operation of the Proposed Scheme. All assessments are based on a precautionary basis, in the absence of survey information.

7.5.3 Bats are at risk of being struck by trains or possibly harmed by turbulence, particularly at frequently used commuting/foraging routes which cross the Proposed Scheme. This represents a potential permanent adverse effect on conservation status of the bat species concerned that would be significant at up to the county/metropolitan level.

7.5.4 Barn owls are at risk of colliding with trains, where there is suitable grassland foraging habitat. The grassland vegetation that would grow along the embankments of the Proposed Scheme may encourage barn owls to forage close to trains, with the risk

that they may be killed. Mortality, even if infrequent, could affect the conservation status of this Schedule 1 species and the ongoing reduction in numbers would result in a permanent adverse effect that would also be significant at up to county/metropolitan level. Effects on all other habitats and species would likely be significant at the local/parish level during operation. These effects will be assessed and reported in the formal ES.

Other mitigation measures

7.5.5 Additional mitigation measures currently being considered include:

- updating the HS2 barn owl mitigation plan[77] which has been developed to provide measures that will be implemented to reduce the effects of the Proposed Scheme to a level that is not significant. This is likely to include seeking opportunities to provide barn owl nest boxes and where feasible habitat enhancement opportunities at least 3km from the Proposed Scheme in consultation with landowners; and
- structures to reduce mortality to bats.

Summary of likely residual significant effects

7.5.6 Taking into account mitigation included as part of the Proposed Scheme design, the anticipated significant residual ecological effects during operation are detailed in Table 11.

Table 11: Residual significant effects on ecological resources/features during operation

Resource/feature	Residual effect	Level at which the effect would be significant
Bats	Potential permanent adverse effect on conservation status due to collision with trains.	Up to county/metropolitan.
Barn owl	Potential permanent adverse effect on conservation status due to collision with trains.	Up to county/metropolitan.

Monitoring

7.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

7.5.8 There are no area-specific requirements for monitoring ecology and biodiversity effects or mitigation during the operation of the Proposed Scheme in the South Kirkby to Sharlston Common area.

[77] Currently in development for Phase One of HS2

8 Health

8.1 Introduction

8.1.1 This section identifies the communities within the South Kirkby to Sharlston Common area that would be subject to impacts associated with the Proposed Scheme and describes the changes that are considered to be potentially important for the health and wellbeing of people within these communities, where these effects are considered to be consequential.

8.1.2 Engagement with key public health bodies is underway, including Public Health England, relevant directors of Public Health and Health and Wellbeing Boards, and relevant Clinical Commissioning Groups. The purpose of the engagement has been to understand the health issues in the South Kirkby to Sharlston Common area that may not be identified solely through a review of publicly available data. Engagement with key public health bodies will continue as part of the development of the Proposed Scheme.

8.1.3 This section deals specifically with impacts and effects at a local level within the South Kirkby to Sharlston Common area. Health effects across the Proposed Scheme as a whole are assessed in the route-wide health assessment contained in Volume 3: Route-wide effects.

8.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme are provided in the Volume 2: LA14 Map Book.

8.2 Scope, assumptions and limitations

8.2.1 The scope, assumptions and limitations for the health assessment are set out in Volume 1 and the Scope and Methodology Report (SMR)[78].

8.2.2 As set out in the SMR, the health assessment is based on a broad understanding of health, consistent with the World Health Organization (WHO) definition of health as 'a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity'. An individual's health is mostly determined by genetics and lifestyle factors, but for a large enough population many other factors, or 'health determinants', are known to be important, and these factors may be affected by the Proposed Scheme.

8.2.3 The assessment has considered the impacts of the Proposed Scheme on a range of environmental and socio-economic 'health determinants', which could result in adverse or beneficial effects on health and wellbeing.

[78] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

8.2.4 The health determinants of relevance within the South Kirkby to Sharlston Common area are:

- for impacts during construction (temporary and permanent):
  - neighbourhood quality;
  - access to services, health and social care;
  - access to green space, and space for recreation and physical activity;
  - education; and
  - social capital.
- for impacts during operation (permanent):
  - neighbourhood quality;
  - access to green space, and space for recreation and physical activity; and
  - education.

8.2.5 The geographic extent of the health assessment covers those areas where impacts on health determinants are predicted to occur.

8.2.6 The health assessment is based on a review of evidence linking changes in health determinants to potential health outcomes. This information will be presented in a concise review of the key literature and included in the formal ES. The evidence varies in its strength; for example, the evidence linking physical activity to health outcomes is strong, whereas the evidence linking social capital with health outcomes is moderate. The strength of evidence does not necessarily determine the importance of a health effect, but is an indication of the level of certainty in the assessment. Additionally, there is greater certainty in the prediction of an impact on a health determinant than the consequent effect on health.

8.2.7 There is no established or widely accepted framework for assessing the significant health effects of a development proposal. The SMR sets out a methodology for describing the impacts on health determinants in terms of the magnitude and duration of the change and the extent of the population exposed to this change. It also draws attention to the strength of evidence that links a change in health determinant with health effects. This framework permits the assessment to describe the impacts on determinants in a largely qualitative manner, with some structure to the relative scale of these impacts to give a sense of the importance of the potential health effects. This does not, however, provide a clear basis for drawing conclusions as to whether a health effect is likely to be 'significant'.

8.2.8 Potential health effects have been identified based on information that is available at this stage of the assessment. A full assessment of health effects, applying the assessment criteria set out in the SMR, will be provided in the formal ES.

8.3 Environmental baseline

Existing baseline

Description of communities in the South Kirkby to Sharlston Common area

8.3.1 The South Kirkby to Sharlston Common area is characterised by towns, villages and isolated dwellings and farmsteads set within a rural area. As reported in Section 14, Traffic and transport, there are a number of public rights of way (PRoW) within the vicinity of the Proposed Scheme, which provide access to the countryside and are considered important to health and wellbeing.

8.3.2 For the purposes of the health assessment, the study area is divided into the communities described below. A description of community facilities is provided in Section 6, Community.

South Kirkby, Brierley and Hemsworth

8.3.3 South Kirkby is a town to the east of the route of the Proposed Scheme comprising approximately 5,000 residential properties. The nearest residential properties would be approximately 100m from the route. Community facilities within South Kirkby include allotments, a social club, a care home, a children's nursery and primary schools.

8.3.4 Brierley is a town to the west of the route of the Proposed Scheme comprising approximately 2,200 residential properties. The nearest residential properties would be approximately 700m from the route. Community facilities within Brierley include a children's nursery. In addition, public open space at Tanyard Croft and Brierley Park and Play Area provide recreational opportunities for the public.

8.3.5 Hemsworth is a town to the east of the route of the Proposed Scheme comprising approximately 9,000 residential properties. The nearest residential properties would be approximately 100m from the route. Community facilities within Hemsworth include allotments, a junior football club, a primary school and a children's centre.

South Hiendley, Ryhill, Havercroft and Newstead

8.3.6 South Hiendley is located to the west of the route of the Proposed Scheme comprising approximately 1,600 residential properties. The nearest residential properties would be approximately 900m from the route.

8.3.7 Ryhill, Havercroft and Newstead are adjacent settlements located to the south-west of the route of the Proposed Scheme. Together, they comprise approximately 4,100 residential properties, the nearest of which would be located in Newstead, approximately 550m from the route.

8.3.8 Community facilities within these settlements include a church and a post office. In addition, common land at Upper Hatfield Place provide recreational opportunities for the public.

Kinsley and Fitzwilliam

8.3.9 Kinsley and Fitzwilliam are located to the north-east of the route of the Proposed Scheme, connected to Hemsworth and each other by the B6273 Wakefield Road.

Kinsley comprises approximately 1,800 residential properties and Fitzwilliam comprises approximately 2,100 residential properties. The nearest residential properties are located approximately 300m and 600m from the route respectively.

8.3.10 Community facilities within these settlements include allotments, a football club, care homes, churches, Kinsley Medical Centre and Autism Service and a children's nursery.

Crofton, New Crofton and surrounds

8.3.11 Crofton and New Crofton are two conjoined villages located to the south-west of the Proposed Scheme. Together, the villages comprise approximately 4,500 residential properties, the nearest of which would be approximately 140m from the route of the Proposed Scheme.

8.3.12 Community facilities within these settlements include allotments, a community centre, Nostell Miners Welfare Football Club and football pitches, a working men's club, a youth centre, public houses, post offices, a church, a library, a nursery, primary schools, a secondary school and The Priory Centre Pupil Referral Unit (PRU), which is an educational facility for students who have been permanently excluded from mainstream school. In addition, Crofton Wood, Crofton Academy Tennis Courts and Crofton Riding and Livery Stables provide recreational opportunities for the public.

Sharlston, Sharlston Common and New Sharlston

8.3.13 Sharlston is located to the north-east of the route of the Proposed Scheme and comprises approximately 150 residential properties. The nearest residential properties within Sharlston would be approximately 500m from the route.

8.3.14 Sharlston Common is located to the north-east of the route of the Proposed Scheme and comprises approximately 1,900 residential properties. The nearest residential properties within Sharlston Common would be approximately 400m from the route.

8.3.15 New Sharlston is located to the east of the route of the Proposed Scheme and comprises approximately 400 residential properties. The nearest residential properties within New Sharlston would be approximately 550m from the route.

8.3.16 Community facilities in these settlements include allotments, a post office, a public house, a church and a medical centre. In addition, common land at The Green in Sharlston Common provides recreational opportunities for the general public.

Demographic and health profile of the South Kirkby to Sharlston Common area

8.3.17 The local communities in the South Kirkby to Sharlston Common area have a relatively low population density, commensurate with the rural nature of the area.

8.3.18 Data provided by the Office for National Statistics[79] for the local authority areas of Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough

[79] The Office for National Statistics (ONS) provides spatial data on levels of deprivation, using indicators of: 'multiple deprivation', 'employment', 'education', 'barriers to housing and social services', 'crime' and 'living environment'. These data are available by Lower Super Output area.

Council (BMBC), shows that this population has a broadly similar health status compared with the national (England) averages.

8.3.19 The population has similar levels of deprivation to the national average, with regard to the combined indices of multiple deprivation[80], and the health domain (a sub-set of the indices of multiple deprivation).

8.3.20 The available data provide detail down to local authority level and enables a demographic and health profile to be made of the population within the South Kirkby to Sharlston Common area. The description of the whole population, and the populations within local authorities does not exclude the possibility that there will be some individuals or small groups of people who do not conform to the overall profile.

8.4 Effects arising during construction

Avoidance and mitigation measures

8.4.1 Consideration of potential health issues is an integral part of the planning and design of the Proposed Scheme, alongside consideration of other environmental, community and economic issues. As far as reasonably practicable, mitigation measures have been incorporated into the design of the Proposed Scheme with the aim of avoiding or reducing adverse health effects. Examples of the mitigation measures incorporated into the design of the Proposed Scheme include the following:

- reducing the loss of property and community assets, as far as reasonably practicable;
- reducing visual intrusion and noise, as far as reasonably practicable;
- incorporating landscape design and screening into the design; and
- permanent realignment and diversion of a number of PRoW and roads to maintain access (see Section 14, Traffic and transport for further detail).

8.4.2 In addition, the locations of construction compounds and site haul routes have been selected to reduce exposure to construction impacts as far as reasonably practicable.

8.4.3 HS2 Ltd would require its contractors to comply with the environmental management regime for the Proposed Scheme, which would include the measures set out in the draft Code of Construction Practice (CoCP)[81], which provides a general basis for route-wide construction environmental management. Contractors would also be required to comply with the measures in Local Environmental Management Plans (LEMP), which apply the environmental management strategies at a local level.

8.4.4 The CoCP will be the means of controlling the construction works associated with the Proposed Scheme to ensure that the effects of the works upon people and the natural environment are reduced or avoided so far as reasonably practicable.

[80] Department for Communities and Local Government (2015) English Indices of Deprivation 2015. Available online at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015
[81] Supporting document: Draft Code of Construction Practice

8.4.5 The CoCP will require the nominated undertaker and its contractors to: produce and implement a community engagement framework and provide appropriately experienced community relations personnel to implement the framework; provide appropriate information; and to be the first point of contact to resolve community issues. The nominated undertaker would be required to take reasonable steps to engage with the community, focusing on those who may be affected by construction impacts, including local residents, businesses, landowners and community resources, and the specific needs of protected groups (as defined in the Equality Act 2010).

8.4.6 In the event of any loss of a community facility, the options for mitigating significant community effects to be explored by HS2 Ltd would include:

- improving or altering the remaining portion of the community facility;
- improving other existing community facilities in the area that could reduce the effect;
- improving accessibility to other community facilities; and/or
- identifying land owned by the relevant local authority that could be brought into use as a community facility with its agreement.

Assessment of impacts and effects

Neighbourhood quality

8.4.7 The term 'neighbourhood quality' is used in this assessment to describe the combination of environmental factors that influence people's experience of, and feelings about, their local environment. When these factors are altered people's levels of satisfaction with their living environment may change. In turn, this could affect mental wellbeing or behaviours such as the use of outside space.

8.4.8 The construction of the Proposed Scheme would affect neighbourhood quality through impacts such as noise, air emissions, visual impacts and additional traffic, including heavy goods vehicles (HGV). These will be assessed in the relevant sections of the formal ES, with a focus on those receptors, or groups of receptors, that are most affected. The Community section of the formal ES will provide a combined assessment, which will identify locations that are subject to significant environmental effects on two or more topics (e.g. noise and visual).

8.4.9 In contrast, a qualitative approach is taken to assessing impacts on neighbourhood quality. The assessment looks at changes in character, tranquillity and amenity across the neighbourhood as a whole, including streets and other public and private outdoor areas. This is judged on a case-by-case basis, taking into account the characteristics of each neighbourhood. It will be informed by the findings from other assessments, but does not rely on the same significance thresholds, as it is not focused on individual receptors. The assessment of health and wellbeing effects considers issues such as people's feelings of attachment to, and pride in, their neighbourhood and enjoyment of outside space, and how these may change.

8.4.10 The sections most relevant to the neighbourhood quality assessment are: Section 5, Air quality; Section 11, Landscape and visual; Section 13, Sound, noise and vibration; and Section 14, Traffic and transport.

8.4.11 Dust emissions from construction activities are considered in Section 5, Air quality, which identifies no adverse effects with respect to the effects of construction activities on dust soiling and human health within the South Kirkby to Sharlston Common area, taking account of mitigation measures contained in the CoCP. Therefore, it is not expected that dust emissions around construction sites would contribute to adverse impacts on neighbourhood quality.

8.4.12 The construction of the Proposed Scheme would have temporary and permanent[82] impacts on neighbourhood quality in areas close to construction sites. Impacts on neighbourhood quality have the potential to affect the wellbeing of residents adversely during the construction phase, by giving rise to negative feelings in relation to quality of life and the local environment, and potentially changing behaviours, such as deterring the use of outdoor space.

8.4.13 Construction activities would have the potential to generate a noticeable change in noise at outdoor areas and at neighbourhoods in proximity to the route of the Proposed Scheme, as reported in Section 13, Sound, noise and vibration. It is currently expected that the construction of the Proposed Scheme may be visible from nearby neighbourhoods, as reported in Section 11, Landscape and visual. This has the potential to contribute to impacts on neighbourhood quality and will be assessed in the formal ES.

8.4.14 Traffic and transport impacts in the South Kirkby to Sharlston Common area would include:

- construction vehicle movements to and from the various construction compounds and sites;
- temporary and permanent road closures and associated diversions; and
- temporary and permanent alternative routes for PRoW.

8.4.15 Construction traffic, including HGV, would be present on a number of roads in this area, as reported in Section 14, Traffic and Transport. The link between health and the aesthetic value of the public realm is not well understood, but there is moderate evidence to suggest that an attractive environment can improve people's enjoyment and sense of wellbeing. Conversely, poor quality environments have been shown to have negative effects on people's health. There is moderate evidence that people have a preference for views of natural environments over man-made environments, and that exposure to views of natural environments is associated with increased wellbeing.

[82] The SMR defines temporary changes (impacts) to health determinants as short term (<6 months), medium term (6 months – 2 years), and long term (2 years +). Permanent impacts have not been defined in the SMR. A change in a health determinant lasting 4 years or more will be considered as a permanent impact. A professional judgement will be made as to when an impact would lead to a permanent effect on the health of the population.

8.4.16 Overall, it is considered that the construction of the Proposed Scheme has the potential to affect wellbeing through changes to neighbourhood quality. This will be assessed in the formal ES.

Access to services, health and social care

8.4.17 There is strong evidence linking access to healthcare facilities with health outcomes, and there is also weak to moderate evidence to suggest that transport problems are a key barrier to people's ability to access these services. There is moderate evidence to suggest that access to shops and other local services can affect health. This is based on a range of factors affecting quality of life, and includes issues such as reducing feelings of isolation and enabling participation in society, as well as accessing basic needs such as food shopping.

8.4.18 The South Kirkby to Sharlston Common area is predominantly rural in character. Typically, there is a reliance on a limited range of shops and services in nearby settlements within the area. To access alternative services and facilities it is necessary to travel longer distances. There is potential for communities to experience increased difficulty in accessing shops and community services (such as post offices, banks, libraries) as a result of increased journey times during construction. This will be assessed and reported in the formal ES.

Access to green space, recreation and physical activity

8.4.19 There is moderate evidence to show that access to green space contributes to good mental health. There is also moderate evidence that environmental factors such as access to high quality green space, safety and amenity, can influence participation in physical activity. Physical activity is strongly linked to health outcomes.

8.4.20 Construction of the Proposed Scheme may impact on levels of access to green space and physical activity, including:

- impacts on PRoW, including temporary closures, diversions and loss of amenity, which may deter the use of these routes by walkers, cyclists and equestrians;
- any loss of green space or facility used for physical activity; and
- the presence of construction traffic, including HGV, on the local road network, which may deter their use by walkers, cyclists and equestrians.

8.4.21 There would be direct impacts on access to green space, recreation and physical activity as a result of the demolition of Crofton Riding and Livery Stables, which is located within the land required to construct the Crofton North embankment.

8.4.22 As reported in Section 14, Traffic and transport, the route of the Proposed Scheme would intersect a number of PRoW in the South Kirkby to Sharlston Common area. The effects on amenity and recreational value of these footpath networks, and therefore levels of physical activity and associated health and wellbeing benefits, will be assessed in the formal ES.

8.4.23 Construction traffic would mainly use the site haul routes along the route of the Proposed Scheme. Some construction traffic, however, including HGV, would be

present on local roads. This could obstruct or deter pedestrians, cyclists and equestrians from using these routes. In the case of recreational users, it is considered that alternative routes would be available. For those using these routes for active travel to work or to access shops and services, there is the possibility that people would choose instead to travel by car, temporarily reducing levels of physical activity and associated health and wellbeing benefits.

Education

8.4.24 There is moderate evidence linking low levels of education with poor mental and physical health. The majority of evidence linking education with health outcomes looks at educational attainment in the context of broader socio-demographic status. Educational attainment influences socio-economic factors such as earnings and home ownership, as well as self-esteem and lifestyle choices.

8.4.25 Construction of the Proposed Scheme may impact on education through the provision of training and apprenticeship opportunities, and through impacts on educational resources along the route.

8.4.26 The only identified educational facility along the route of the Proposed Scheme that has the potential to experience significant adverse effects on health, as a result of construction, is The Priory Centre PRU in Crofton. This educational facility is attended by Key Stage 2 and Key Stage 3 pupils who have been permanently excluded from mainstream school. Pupils attending The Priory Centre PRU are considered particularly sensitive to any impacts that might impinge on learning and educational activities.

8.4.27 The route of the Proposed Scheme passes adjacent to the eastern boundary of The Priory Centre PRU's playing fields and, at its nearest point, the route of the Proposed Scheme is approximately 200m from The Priory Centre PRU's buildings. Key concerns include distraction of pupils, safety and security with regard to pupils entering construction areas, and noise levels.

8.4.28 Consideration of potential impacts and subsequent mitigation measures for The Priory Centre PRU is ongoing as further design and construction details for the Proposed Scheme emerge. The effects arising from the construction of the Proposed Scheme on The Priory Centre PRU will be assessed in the formal ES.

Social capital

8.4.29 The connections between individuals within communities, and the increased likelihood that arises through these networks for individuals to feel valued, to feel a sense of belonging, to have companionship and to support each other, is important for health and wellbeing. A measure of the effectiveness of these connections within communities is termed 'social capital' and is a recognised determinant of health. The Office for National Statistics defines social capital as follows:

'In general terms, social capital represents social connections and all the benefits they generate. Social capital is also associated with civic participation, civic-minded

attitudes and values which are important for people to cooperate, such as tolerance or trust'[83].

8.4.30 There is moderate evidence for a link between social capital and health and wellbeing outcomes. A decrease in social capital has the potential to reduce the beneficial health effects that are gained through social contact and support, social participation, reciprocity and trust. Adverse effects on health from changes in social capital could be experienced as a reduction in wellbeing or as physiological effects on the body's hormonal and immune systems, with increased susceptibility to mental and physical illness.

8.4.31 The settlements along the route of the Proposed Scheme support small, well-established communities. The size of the temporary construction workforce may be substantial relative to the size of these local communities. During the daytime, the workforce would be present on construction sites and compounds throughout the area, including main compounds and satellite compounds in the vicinity of the settlements of South Kirkby, Brierley, Hemsworth, Kinsley, Fitzwilliam, Havercroft and Newstead, Crofton, New Crofton, Sharlston and Sharlston Common. The duration of the works at each site ranges from approximately six months to five years and six months. The presence of construction workers is likely to be noticeable, with construction vehicles using local roads to access compounds and workers using facilities such as shops, restaurants and public houses within local settlements.

8.4.32 The introduction of a temporary construction workforce into communities could have the potential to alter people's perceptions and interactions within their communities, modifying behaviour and the value they place on social capital. Such a reduction in social capital has the potential to adversely affect wellbeing, and may influence behaviours that are beneficial to wellbeing such as the use of community facilities.

8.4.33 The draft CoCP includes a commitment to produce and implement a community engagement framework and provide appropriately experienced community relations personnel. HS2 Ltd will engage with local authorities and community representatives to identify measures aimed at fostering and maintaining good relationships between the workforce and local communities. Any measures identified will be included within the community engagement framework as appropriate.

8.4.34 The Community section of the ES will include an assessment of impacts resulting from the loss of residential properties. The loss of five properties is identified as the threshold for a significant Community effect. In some cases, the Community assessment may identify significant impacts below this threshold, for example where the demolitions make up a significant proportion of a very small community.

8.4.35 The health assessment considers changes to the social environment and loss of social networks experienced by the remaining community following the loss of residential properties. For this to have an adverse impact on overall levels of social capital,

[83] Office for National Statistics (ONS) (2014) Measuring Social Capital. Available online at: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171766_371693.pdf

the loss of homes would need to make up a sizeable proportion of the local community, with the potential to result in the direct loss of contacts in the local area and/or a noticeable reduction in the number of people using local facilities. This will be judged on a case-by-case basis, taking account of the size of the community and its characteristics. Therefore, not all of the significant effects identified in the Community section will result in adverse health and wellbeing effects.

8.4.36 In the South Kirkby to Sharlston Common area, where two residential properties would be demolished as a result of construction of the Proposed Scheme, no health effects are anticipated on the remaining community. Effects on residents directly impacted by demolitions are assessed in Volume 3, Section 7, Health.

8.4.37 Road closures and diversions required for the construction of the Proposed Scheme would have the potential to reduce community connectivity by increasing journey times between communities.

Other mitigation measures

8.4.38 Any other mitigation identified to reduce adverse impacts on health determinants during the construction of the Proposed Scheme will be described in the formal ES.

8.4.39 HS2 Ltd will engage with local authorities and community representatives to identify measures aimed at fostering positive relationships between local communities and the temporary construction workforce. Any measures identified will be included within the Community Engagement Framework.

8.4.40 HS2 Ltd will continue to engage with owners/operators to identify reasonably practicable measures to help mitigate potential adverse effects identified in this assessment. Any other mitigation measures will be described in the formal ES.

8.5 Effects arising from operation

Avoidance and mitigation measures

8.5.1 Adverse impacts on health determinants would be reduced insofar as reasonably practicable through mitigation measures incorporated into the design of the Proposed Scheme to reduce adverse effects on people. The mitigation measures incorporated into the design of the Proposed Scheme in the South Kirkby to Sharlston Common area will be reported in the formal ES.

Assessment of impacts and effects

Neighbourhood quality

8.5.2 Operational noise would have the potential to generate a noticeable change in noise at outdoor areas and at neighbourhoods in proximity to the route of the Proposed Scheme, as reported in Section 13, Sound, noise and vibration. The permanent features of the Proposed Scheme may be visible from nearby neighbourhoods, as reported in Section 11, Landscape and visual. This has the potential to contribute to impacts on neighbourhood quality and will be assessed in the formal ES.

Access to green space, recreation and physical activity

8.5.3 The potential impact on neighbourhood quality during operation, described above, could have the potential to change behaviours, such as reducing the use of outdoor spaces. The effects arising from the operation of the Proposed Scheme will be reported in the formal ES.

Education

8.5.4 The only identified educational facility along the route of the Proposed Scheme that has the potential to experience significant adverse effects on health as a result of the operation of the Proposed Scheme is The Priory Centre PRU. During operation, key concerns include distraction of pupils, safety and security with regard to pupils entering the active railway, and noise levels.

8.5.5 Consideration of potential impacts and subsequent mitigation measures for The Priory Centre PRU is ongoing as further design details for the Proposed Scheme emerge. The effects arising from the operation of the Proposed Scheme on The Priory Centre PRU will be assessed in the formal ES.

Other mitigation measures

8.5.6 If a need is identified for mitigation to reduce adverse impacts on health determinants during the operation of the Proposed Scheme in this area, the mitigation will be described in the formal ES.

Monitoring

8.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

8.5.8 No area-specific monitoring of health effects during the operation of the Proposed Scheme have been identified at this stage.

9 Historic environment

9.1 Introduction

9.1.1 This section of the report provides a description of the current baseline for heritage assets and the likely impacts and significant effects identified to date resulting from the construction and operation of the Proposed Scheme within the South Kirkby to Sharlston Common area. Consideration is given to the extent and value (significance) of heritage assets including archaeological and palaeo-environmental remains, historic buildings, the built environment and historic landscape.

9.1.2 Engagement has been undertaken with Historic England, the National Trust, Wakefield Metropolitan District Council (WMDC) and the West Yorkshire Archaeology Advisory Services (WYAAS). The purpose of this engagement has been to discuss the assessment approach, to obtain relevant baseline information and to inform the design development and assessment of the Proposed Scheme. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.

9.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book. Only designated heritage assets within the South Kirkby to Sharlston Common area are shown on maps CT-10-106b to CT-10-111a. Non-designated heritage assets have also been assessed as part of this work, although they are not illustrated on these maps.

9.1.4 A gazetteer of designated and non-designated heritage assets with accompanying maps will be included in the formal ES. The formal ES will also include a Historic Landscape Characterisation Report, which will identify historic landscape character areas potentially affected by the Proposed Scheme.

9.1.5 Assets have been identified in this section of the report using their National Heritage List for England (NHLE) or Historic Environment Record (HER) name and number. If no record number is known (e.g. an asset identified from historic mapping), then the asset is referred to by name. Project-specific asset identification numbers will be used for the formal ES.

9.2 Scope, assumptions and limitations

9.2.1 The scope, key assumptions and limitations for the historic environment assessment are set out in full in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[84], including the method for determining the value of a heritage asset and magnitude of impact (Tables 19 and 20 in the SMR, respectively).

[84] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

9.2.2 The assessment focuses on the extent to which the Proposed Scheme would affect designated and non-designated heritage assets. Impacts on assets as a result of the Proposed Scheme would occur largely through the physical removal and alteration of heritage assets and changes to their setting.

9.2.3 The study area within which a detailed assessment of all assets, designated and non-designated, has been carried out is defined as the land required for the Proposed Scheme plus 500m. This is referred to in the remainder of this assessment as the 500m study area.

9.2.4 The setting of all designated heritage assets within a study area of up to 2km from the land required for the Proposed Scheme has been considered. This is referred to in the remainder of this assessment as the 2km study area.

9.2.5 The historic environment methodology includes the consideration of the relevant intra-project effects. These interactions will be included in the assessment of impacts and effects in the formal ES.

9.2.6 Where noise is considered, this is within the context of the contribution that this makes to the heritage significance of the assets, and is not a reference to absolute noise levels or sound, or the noise or vibration impacts on the health and quality of life of people who live in or visit the area.

9.2.7 The baseline studies informing this assessment have been drawn from a wide and comprehensive range of information sources. These will be supported by a programme of non-intrusive survey, including geophysical survey, the results of which will be reported in the formal ES.

9.2.8 At this stage of the design development, heritage assets within the land required to construct the Proposed Scheme are assumed to require complete removal and the assessment has, in the main, been undertaken on that basis. However, in relation to Roman road 721 (route of), Crofton 1 (WYHER 3500), although the asset is within the land required for the construction of the Proposed Scheme and may be affected, any effect is unlikely to be significant. With respect to overhead line diversions/realignments in particular, it is likely that the majority of the heritage assets can in fact be retained, as the land is only required to allow for raising or lowering of pylons and/or re-stringing of cables, or to provide an access route to the works.

9.2.9 Common features of the historic landscape such as marl pits, field boundaries and former areas of ridge and furrow are not individually considered but have been included in the baseline, as part of the historic landscape character and will be considered as part of the overall assessment of impacts on historic landscape reported in the formal ES.

9.2.10 In undertaking the assessment, the following limitations were identified and assumptions made:

- field surveys are ongoing, and are subject to land access and site conditions. The result of field surveys will be reported within the formal ES;
- desk based assessment is ongoing, and data on non-designated heritage assets will be described more fully in the formal ES and accompanying technical appendices; and
- intra-project topic assessments are ongoing and will be considered as part of the assessment of historic environment effects within the formal ES.

9.3 Environmental baseline

Existing baseline

9.3.1 Baseline data was collated from a variety of sources, including:

- the NHLE (Historic England register of designated heritage assets);
- West Yorkshire HER;
- WMDC and Barnsley Metropolitan Borough Council (BMBC) websites for information on conservation areas;
- West Yorkshire Archive Service, Borthwick Institute and Thoresby Society library; and
- historic maps and aerial photography.

9.3.2 In addition to collating documentary baseline data, site visits have been undertaken.

Designated assets

9.3.3 There are no designated heritage assets located partially or wholly within the land required for the Proposed Scheme.

9.3.4 The following designated heritage assets (listed from south to north) are located partially or wholly within 2km of the land required, temporarily or permanently, for the construction and operation of the Proposed Scheme:

- eight scheduled monuments of high value: Hallsteads moated site, Grimethorpe (NHLE 1012457), Prehistoric enclosed settlement known as South Kirkby Camp (NHLE 1018818), Site of post-medieval tannery, Felkirk (NHLE 1005775), Deserted medieval village of Hodroyd, Felkirk (NHLE 1005778), Kinsley moat and fishpond (NHLE 1009932), Medieval buildings at Nostell Priory Farm (NHLE 1005781), Dovecote located 90m south of Hall Farm (NHLE 1016547) and Sharlston Common coal and ironstone workings (NHLE 1018399);

- four Grade I listed buildings of high value: Church of All Saints (in South Kirkby, NHLE 1227519), Church of St Michael and Our Lady (Wragby Parish Church) (NHLE 1253565), Stables at Nostell Priory (NHLE 1253558) and Nostell Priory (1262071);
- five Grade II* listed buildings of high value: Grimethorpe Hall (NHLE 1151202), Nostell Bridge (NHLE 1252808), Church of All Saints (in Crofton, NHLE 1199946), Obelisk Lodge and attached screen walls, at SE 406 18 (NHLE 1253564) and Sharlston Hall (NHLE 1253750);
- 78 Grade II listed buildings all of moderate value: these are predominantly residential and other buildings associated with the settlements of South Kirkby, Brierley, Hemsworth, Crofton and Sharlston. Examples include Kirkby Common Farmhouse (NHLE 1265328), Church of St Paul (in Brierley, NHLE 1314994), 51-59, High Street (in Crofton, NHLE 1135568), Lord of the Manor public house (in Crofton, NHLE 1313223) and Church of St Helen (in Hemsworth, NHLE 1265774). Farmhouses and associated agricultural buildings include the Barn approximately 5m west of Broad Lane Farm East Farmhouse (NHLE 1235352), Cart Shed and Granary approximately 5m north of Ball Park Farmhouse (NHLE 1235141), Vissitt Manor (NHLE 1227039), Barn Forming North Side of Farmyard at Horncastle Farm (NHLE 1261689), Farm buildings to south-west of Monk's Rectory in Nostell Priory Estate Yard (NHLE 1259950) and Brierley Manor Farmhouse (NHLE 1191141). Country houses include Hodroyd Hall (NHLE 1227514). Estates, garden buildings and garden ornaments associated with country houses include Foulby Lodge (NHLE 1262109), Wragby Lodge, with gateway and screen walls (NHLE 1262110) and Gazebo and boundary wall of garden to west of Sharlston Hall (NHLE 1253781);
- one conservation area of moderate value: Wragby Conservation Area; and
- one Grade II* registered park and garden (RPG) of high value: Nostell Priory (NHLE 1001224).

Non-designated assets

9.3.5 The following non-designated assets of moderate value lie wholly or partially within the land required for the Proposed Scheme:

- Large sub-circular, multi-ditched enclosure (cropmark), South Kirkby (WYHER 1281);
- Curvilinear enclosure (cropmark), South Kirkby (WYHER 10685);
- Possible ring ditch (cropmark), Dunsley, South Kirkby (WYHER 136);
- Enclosure (cropmark), Dunsley, South Kirkby (WYHER 799);
- Possible D-shaped enclosure (cropmark), Brierley (WYHER 790);

- Prehistoric/Roman enclosures and trackway (cropmark), Barnsley Road, Hemsworth (WYHER 6732);
- Possible D-shaped enclosure (cropmark), south-west of Kinsley Carr Farm, Hemsworth (WYHER 782);
- Enclosure (cropmark), south-east of Newstead Grange, Havercroft (WYHER 130);
- Prehistoric/Roman curvilinear enclosure (cropmark), Hemsworth (WYHER 15582);
- Possible enclosure and field boundaries (cropmarks), Hemsworth (WYHER 783);
- Prehistoric/Roman enclosures, field boundaries & pits, Horncastle Farm (cropmarks), Hemsworth (WYHER 522);
- Curvilinear enclosure (cropmark), Crofton (WYHER 519);
- Roman road 721 (route of), Crofton 1 (WYHER 3500)[85]; and
- Iron Age/Roman enclosure complex (cropmarks), north of A645 Weeland Road, Crofton (WYHER 511).

9.3.6 The following non-designated assets of low value lie wholly or partially within the land required for the Proposed Scheme:

- the Dearne Valley Line;
- Moorthorpe Station, Moorthorpe;
- Ploughed out field boundaries (cropmark), Hemsworth 2 (WYHER 780);
- Opencast mining (earthworks), Horncastle Wood, Huntwick (WYHER 3429);
- Ploughed out field boundary (cropmark), Huntwick 2 (WYHER 4486);
- Long Row (site of), Nostell (WYHER 9651);
- Linear Ditches (cropmark), south west of Foulby Farm, Crofton (WYHER 523); and
- Shelling Mill, east of Holme Bank Farm (WYHER 15966).

[85] Where there is more than one HER asset with the same title in the study area, numbers following the direction of travel enable readers to differentiate between them.

9.3.7 Non-designated heritage assets located partially or wholly within the 500m study area include:

- 46 assets of moderate value, including evidence for prehistoric and Roman activity; and
- 33 assets of low value, including archaeological remains and buildings predominantly of medieval or post-medieval date.

Historic environment overview

9.3.8 The geology of the South Kirkby to Sharlston Common area straddles the boundary between the Pennine Upper Coal Measures Formation in the south, and Pennine Middle Coal Measures Formation in the north. The soils of both these geologies have provided fertile farmland throughout history, and this has led to extensive farming, settlement and other human activity.

9.3.9 While no evidence of Palaeolithic activity has been identified in the region, limited evidence from the later Mesolithic and Neolithic periods is present, and is typically characterised by finds of stone or flint tools. Within the South Kirkby to Sharlston Common area, the Mesolithic period is represented by a single flint found near South Kirkby. Neolithic evidence across the region is characterised by the distribution of artefacts, in particular stone axes, of which an example has been found near South Kirkby, and smaller worked flints such as those found near Hemsworth. Both artefact types can indicate the presence of early human activity.

9.3.10 Unlike the Mesolithic and Neolithic periods, the Bronze Age is characterised by monuments and evidence for settled habitation. Examples of ring ditches and round barrows[86] in the study area are visible as cropmarks[87], whilst archaeological investigations on an industrial estate near South Elmsall have offered physical evidence for seasonal occupation and agricultural activities.

9.3.11 Settlement and landscape management continued into the Iron Age. The landscape of the Iron Age in the region is characterised by extensive rectilinear field systems, and enclosures like those at Dunsley, Brierley, Havercroft and Hemsworth within the South Kirkby to Sharlston Common area. Some of those excavated in the region have been found to contain contemporary roundhouses and other domestic structures. South Kirkby Camp is formed by a large oval enclosure surrounded by a bank and ditch, inside of which there is evidence for internal enclosures and further ditches. Aerial photography has revealed evidence of extensive Iron Age and Romano-British field systems in the area, including a number of enclosures, ditches and trackways.

[86] A round barrow is a mound of earth constructed over one or more burials. A ring ditch is a trench of circular or penannular (incomplete circle) plan. When excavated, ring ditches are usually found to be the ploughed-out remains of a round barrow where the barrow mound has completely disappeared, leaving only the infilled former quarry ditch

[87] The presence of buried walls and/or infilled ditches/pits can cause crops to grow and ripen at different rates. When viewed from above in the right conditions, this effect can reveal the presence of buried archaeological sites.

9.3.12 The medieval period is characterised largely by the continued development of established settlements and their surrounding farming landscapes. Villages such as South Kirkby, Hemsworth and Brierley are likely to have been founded prior to, or during, the Anglo-Saxon period. Moats, often allied to defended manorial farms, are typical of this period, and Hallsteads moated site and Kinsley moat and fishpond provide direct evidence and examples of these monument types.

9.3.13 The medieval period also saw the establishment of religious houses in the area. These included a 12th century Augustinian priory dedicated to Saint Oswald, the remains of which gave its name to the later Nostell Priory estate. Some elements of the earlier structure are believed to have been incorporated into buildings associated with the post-medieval country house.

9.3.14 The landscape of the post-medieval period is characterised by extensive farms such as Vissitt Manor, parliamentary enclosure fields[88] and country house estates. Large neoclassical and Gothic-style mansions surrounded by designed landscapes and equally ornate estate buildings, of which Nostell Priory is an example, were built as statements of economic prosperity.

9.3.15 Coal and ironstone workings at Sharlston Common provide local evidence of the exploitation of mineral resources, which began in the medieval period. As these industries grew, there was a rapid expansion of the canal, and later the rail network throughout the country, in order to transport coal and other materials to the growing industrial centres. The 20th century saw the most dramatic change to the landscape, with widespread open-cast and underground coal mining and clay extraction pits scattered throughout the area. Examples include the scheduled medieval and post-medieval coal workings at Sharlston Common, and non-designated mining earthworks at Horncastle Wood, Huntwick. As the focus of their economy changed from farming to industrial production, many rural villages grew into towns.

9.4 Effects arising during construction

Avoidance and mitigation measures

9.4.1 The design of the Proposed Scheme has sought to avoid impacts on heritage assets within the area as far as reasonably practicable.

9.4.2 Section 8 of the draft Code of Construction Practice (CoCP)[89] sets out the measures that will be adopted, insofar as reasonably practicable, to control effects on heritage assets. These include:

- management measures that will be implemented for heritage assets that are to be retained within the land required for the Proposed Scheme;

[88] The largely 18th and 19th century process whereby common land and other small landholdings were consolidated under the ownership of a single landlord by Act of Parliament.
[89] Supporting documents: Phase 2b Draft Code of Construction Practice.

- route-wide principles, standards and techniques for works affecting heritage assets; and
- a programme of historic environment investigation and recording (including archaeology and historic buildings) to be undertaken prior to or during construction works affecting the heritage assets.

Assessment of impacts and effects

Temporary effects

9.4.3 The construction works, comprising excavations and earthworks and including temporary works such as construction compounds, storage areas, and diversion of existing roads and services, have the potential to affect heritage assets during the construction period. Impacts would occur to assets both within the land required for the Proposed Scheme and to assets in the wider study area as a result of changes to their settings.

9.4.4 The following significant effects are expected to occur as a result of temporary impacts on designated or non-designated heritage assets due to changes to their settings.

9.4.5 Vissitt Manor (NHLE 1227039) is a Grade II listed building of moderate value located 20m east of the land required for the Proposed Scheme. It is a 17th century farmhouse, altered in the 18th century and built of coursed sandstone rubble, with ridge chimney stacks and a stone tile pitched roof. It is adjacent to modern farm outbuildings and surrounded by farmland, both of which contribute to its value by maintaining a strongly rural character to its setting. This setting would be temporarily affected by construction activities, including the excavation of Hemsworth cutting, and the use of Vissitt Lane as an access route during construction. Temporary construction activities would encircle Vissitt Manor severing the building from its attendant farmland and this would impact on the ability to fully appreciate the value of the asset. This would constitute a medium magnitude of impact and a moderate adverse effect.

9.4.6 Kinsley moat and fishpond (NHLE 1009932) is a scheduled monument of high value located 25m east of the land required for construction of the Proposed Scheme. It dates from the medieval period and comprises a water-filled moat measuring approximately 60m by 25m, and a fishpond located approximately 30m to the north-east of the moat. A thick stand of mature deciduous trees and hedgerows west and south of the moat filter views to and from the asset. Its setting comprises arable farmland associated with the adjacent 19th century Kinsley Carr Farm. Its value is mostly derived from its archaeological interest and the potential for its waterlogged deposits to preserve organic remains. Its continued relationship with a farmed landscape contributes a small amount to the value of the heritage asset by reinforcing its rural character and permitting an appreciation of the heritage asset in its wider landscape setting.

9.4.7 The archaeological remains associated with Kinsley moat and fishpond would not be affected by the construction of the Proposed Scheme. Kinsley moat and fishpond's setting would be temporarily affected by construction activities associated with Kinsley embankment, and the presence of Kinsley embankment satellite compound. These would sever the relationship between Kinsley moat and fishpond and the surrounding farmland, and introduce visual disturbance within its setting, affecting the ability to fully appreciate the value of the heritage asset. This would constitute a low magnitude of impact and a moderate adverse effect.

9.4.8 Nostell Priory (NHLE 1001224) is a Grade II* RPG of high value, the boundary of which is located 230m east of the land required for the Proposed Scheme. It was created in the early 18th century to a design by Stephen Switzer, and comprises gardens and pleasure grounds surrounding a contemporary house (Nostell Priory, a Grade I listed building, NHLE 1262071). The asset also includes nearby estate buildings, a number of which are individually scheduled, or listed at Grade II* and II, and wider parkland to the north, north-west and east of the house. The parkland to the east of the house forms a vista framed by a long avenue of trees, and to the west views take in the upper lake before being screened by mature plantation woodland on the western bank of the Upper Lake. Views from higher ground in Obelisk Park north of the house include glimpses of the Upper Lake and the surrounding countryside beyond. Despite the presence of traffic noise and movement on the A638 Doncaster Road, the enclosing plantation woodland around Upper Lake creates a sense of isolation from the working farmland and the village of Crofton, which lies just outside the park to the west. This contributes to the appreciation of the function of the asset as a landscape park, and therefore to its value.

9.4.9 None of the listed buildings within Nostell Priory would be affected by the construction of the Proposed Scheme. The sense of isolation of the area surrounding the Upper Lake would be temporarily affected by construction activities including the construction of New Crofton North embankment approximately 230m to the west. Construction activity associated with Kinsley embankment, Havercroft cutting, Nostell viaduct and New Crofton North embankment would possibly be visible from higher ground in Obelisk Park close to the north boundary of the RPG. This would result in visual disruption and movement of construction plant in views from the heritage asset. Planned tree-thinning within the RPG, in Priory Wood, Top Park Wood, and Foulby Park[90] would potentially increase the visibility of construction activities associated with the Proposed Scheme. This has the potential to adversely affect the ability to fully appreciate the design of the landscape park to include views towards the wider landscape, impacting the ability to appreciate its value. This would constitute a low magnitude impact and a moderate adverse effect.

[90] Forest Land Ltd., 2018, Nostell Priory Woodland Management Plan April 2018-March 2028. Available online at: www.forestplans.co.uk/nostell-prioiry.

Permanent effects

9.4.10 Permanent significant effects can occur either as a result of physical impacts on heritage assets within the land required for the Proposed Scheme, or through changes to the setting of heritage assets through the presence of the Proposed Scheme.

9.4.11 The following significant effects are currently expected to occur as a result of permanent physical impacts on heritage assets within the land required for the construction and operation of the Proposed Scheme.

9.4.12 A large, multi-ditched enclosure at South Kirkby (WYHER 1281), visible from the air as a cropmark and of moderate value, is located within land required for the Proposed Scheme. It is believed to be of Iron Age or Romano-British date. The value of this heritage asset is derived from its potential to contribute to our understanding of Iron Age and Romano-British settlement in the region. Construction of the Proposed Scheme would result in removal of archaeological remains associated with this enclosure. This would constitute a high magnitude of impact and a major adverse effect.

9.4.13 The following non-designated heritage assets are believed to date from the Iron Age or Romano-British periods. They are characteristic of late prehistoric rural settlement in the area and are of moderate value. Their removal during construction of the Proposed Scheme would constitute a high magnitude of impact and a major adverse effect:

- Curvilinear enclosure (cropmark), South Kirkby (WYHER 10685);
- Possible ring ditch (cropmark), Dunsley, South Kirkby (WYHER 136);
- Enclosure (cropmark), Dunsley, South Kirkby (WYHER 799);
- Possible D-shaped enclosure (cropmark), Brierley (WYHER 790);
- Prehistoric/Roman enclosures and trackway (cropmark), Barnsley Road, Hemsworth (WYHER 6732);
- Possible D-shaped enclosure (cropmark), south-west of Kinsley Carr Farm, Hemsworth (WYHER 782);
- Enclosure (cropmark), south-east of Newstead Grange, Havercroft (WYHER 130);
- Prehistoric/Roman curvilinear enclosure (cropmark), Hemsworth (WYHER 15582);
- Possible enclosure and field boundaries (cropmarks), Hemsworth (WYHER 783);
- Prehistoric/Roman enclosures, field boundaries & pits, Horncastle Farm (cropmarks), Hemsworth (WYHER 522);

- Curvilinear enclosure (cropmark), Crofton (WYHER 519); and
- Iron Age/Roman enclosure complex (cropmarks), north of A645 Weeland Road, Crofton (WYHER 511).

9.4.14 The following assets are either cropmarks of uncertain date, but which are considered likely to be prehistoric, or post-medieval heritage assets relating to railways, mining or other industrial activities of local interest. The value of these assets is low. Their removal during construction of the Proposed Scheme would constitute a high magnitude of impact and a moderate adverse effect:

- The Dearne Valley Line;
- Moorthorpe Station, Moorthorpe;
- Ploughed out field boundaries (cropmark), Hemsworth 2 (WYHER 780);
- Opencast mining (earthworks), Horncastle Wood, Huntwick (WYHER 3429);
- Ploughed out field boundary (cropmark), Huntwick 2 (WYHER 4486);
- Long Row (site of), Nostell (WYHER 9651);
- Linear ditches (cropmark), south-west of Foulby Farm, Crofton (WYHER 523); and
- Shelling Mill, east of Holme Bank Farm (WYHER 15966).

9.4.15 The following significant effects are currently expected to occur as a result of permanent impact on the setting of designated or non-designated heritage assets:

9.4.16 The setting of Kinsley moat and fishpond (NHLE 1009932), a scheduled monument of high value located 25m east of land required for the Proposed Scheme, would be affected by the presence of Kinsley embankment. Kinsley embankment would form a dominant element of new railway infrastructure within the setting of the asset, particularly when viewed from higher ground to the east and north-west. This would affect the relationship between the asset and its surrounding rural landscape by screening elements of its setting, and therefore affect the ability to fully appreciate the heritage significance of the moat and fishpond. This would constitute a low magnitude impact and a moderate adverse effect.

9.4.17 The setting of Nostell Priory (NHLE 1001224), a Grade II* RPG of high value located approximately 240m north-east of the land required for the Proposed Scheme, would be affected by the presence of New Crofton North embankment. The embankment would be visible from higher ground in Obelisk Park close to the north boundary of the RPG. Planned tree-thinning within the RPG, in Priory Wood, Top Park Wood, and Foulby Park would potentially increase the visibility of the Proposed Scheme from Obelisk Park. This would affect views from the RPG and reduce the legibility of the differences between the designed landscape and the surrounding countryside. This impact has the potential to adversely affect the ability to appreciate the value of the

landscape park. This would constitute a low magnitude of impact and a moderate adverse effect.

Other mitigation measures

9.4.18 No additional construction phase mitigation measures beyond those included within the Proposed Scheme design have been identified at this stage, however potential opportunities for further mitigation measures will continue to be considered through detailed design. These may include the identification of:

- suitable locations for advance planting, to reduce impacts on the setting of heritage assets; and
- locations where the physical impacts on below ground heritage assets can be reduced through the design of earthworks.

Summary of likely residual significant effects

9.4.19 The temporary effects of construction activity on the setting of heritage assets have been considered. However, they are largely reversible in nature and would be restricted to the duration of the construction works.

9.4.20 As no specific mitigation measures have yet been identified in relation to the heritage assets described above, it is currently anticipated that the residual effects would be the same as those reported under permanent effects. Over time, the effect on the setting of some heritage assets could change as planting matures and the Proposed Scheme assimilates into the landscape.

9.5 Effects arising from operation

Avoidance and mitigation measures

9.5.1 The following measures have been incorporated into the design of the Proposed Scheme, which would reduce the impacts and effects on heritage assets as shown on the CT-06 Map Series within the Volume 2: LA14 Map Book:

- Noise mitigation measures have been included within the Proposed Scheme that could reduce potential impacts on some heritage assets; and
- landscape mitigation planting would increasingly reduce impacts on the setting of the designated assets within the study area as it matures.

Assessment of impacts and effects

9.5.2 The assessment considers the Proposed Scheme once operational and all effects are considered to be permanent.

9.5.3 During the operation of the Proposed Scheme no further ground works are anticipated, and as such there would be no further physical impacts on heritage assets arising from the operation of the Proposed Scheme.

9.5.4 Impacts on heritage assets due to changes in their settings arising from the presence of the Proposed Scheme are reported as permanent construction effects and are not

repeated in detail here, although they would continue throughout the operation of the Proposed Scheme.

9.5.5 Further effects could occur in relation to heritage assets during the operation of the Proposed Scheme where additional, permanent, changes to the asset's settings have an additional detrimental effect on the way that the asset is understood or appreciated, for example as a result of increased noise or the movement of the trains in combination with the effect of the presence of the Proposed Scheme.

9.5.6 It is currently anticipated that in relation to the following heritage assets there would be no significant effects as a result of the operation of the Proposed Scheme and that therefore the significance of effect would remain as described for the permanent construction phase effect:

- Kinsley moat and fishpond (NHLE 1009932); and
- Nostell Priory (NHLE 1001224).

Other mitigation measures

9.5.7 The Proposed Scheme includes a number of design measures to address potential impacts and significant effects. At this time, no additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified. Potential opportunities for further mitigation have not been identified, and will be considered as part of the detailed design process.

Summary of likely residual significant effects

9.5.8 As no specific mitigation measures have yet been identified in relation to the heritage assets described above, it is currently anticipated that the residual effects would be the same as those reported in the assessment of effects during operation.

Monitoring

9.5.9 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

9.5.10 No area-specific heritage monitoring requirements during operation of the Proposed Scheme have been identified at this stage.

10 Land quality

10.1 Introduction

10.1.1 This section of the report presents the baseline conditions that exist along the Proposed Scheme in the South Kirkby to Sharlston Common area in relation to land quality, and reports the likely impacts and significant effects identified to date resulting from construction and operation of the Proposed Scheme. Consideration is given to land that potentially contains contamination and land that has special geological significance, either from a scientific, historical, mineral exploitation or mineral resources point of view including geological sites of special scientific interest (SSSI) and local geological sites (LGS), areas of historical mining activity in the context of land quality and areas of designated mineral resources. Consideration is also given to petroleum (including gas) prospects and licensing.

10.1.2 Engagement has been undertaken with the British Geological Survey (BGS), Wakefield Metropolitan District Council (WMDC), Barnsley Metropolitan Borough Council (BMBC), the Coal Authority, the Environment Agency, Fera Science Ltd[91] and the Animal and Plant Health Agency (APHA). The purpose of this engagement has been to discuss the Proposed Scheme and potential effects, and obtain relevant baseline information. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.

10.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book.

10.1.4 Land contamination issues are closely linked with those involving water resources and waste. Issues regarding groundwater resources are addressed in Section 15, Water resources and flood risk. Issues regarding the disposal of waste materials, including contaminated soils, are addressed in Volume 3: Route-wide effects (Section 15).

10.2 Scope, assumptions and limitations

10.2.1 The scope, assumptions and limitations for the land quality assessment are set out in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[92].

10.2.2 In accordance with the SMR, a risk based approach was undertaken to identify contamination that may have an impact upon the construction of the Proposed Scheme. To support this, a desk based assessment has been undertaken for the study area, defined as the land required for construction of the Proposed Scheme plus a 250m buffer. In the case of groundwater abstractions, this buffer is increased up to 1km.

[91] Formerly known as the Food and Environment Research Agency
[92] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

10.2.3 The majority of new and diverted utilities would be laid in the boundaries of existing highways within normal road construction layers and natural soils below. These have been considered in the context of the conceptual site model (CSM) approach, and the lack of contact with nearby potentially contaminated sites, and the absence of sensitive receptors within the roadways reduces the risk of an impact occurring to very low levels. The impact of laying these new and diverted utilities has therefore been scoped out of the assessment as they are unlikely to cause any significant land quality effects.

10.2.4 Potentially contaminated areas of land have been identified that could affect, or be affected by, the construction of the Proposed Scheme (e.g. contaminated soils may need to be removed or construction may alter existing contamination pathways). Each of these areas has been studied to evaluate the scale of potential impacts caused by existing contamination (if present) and what needs to be done to avoid significant consequences to people and the wider environment.

10.2.5 The location of the Proposed Scheme was viewed from points of public access initially. In addition, visits to some key sites have been undertaken to verify desktop information.

10.2.6 A CSM approach has been used to provide an understanding of the types of contaminants that may be present, the likely sources and/or pathways by which contamination can spread and the potential receptors (i.e. people and the wider environment) that could be affected. It indicates the types of impacts that existing contamination may be having at present and may have during and after construction.

10.2.7 The minerals assessment is based upon the mineral resources[93] identified on published minerals plans, and existing planning or licensed areas. Any inference of minerals provided by geological maps/reports is excluded (except where these are covered by the Minerals Plan).

10.2.8 The geo-conservation assessment is based upon publicly available local geological trust records.

10.3 Environmental baseline

Existing baseline

10.3.1 Baseline data have been collected from a range of sources including Ordnance Survey mapping, the BGS, Coal Authority, WMDC, BMBC, Public Health England, the Environment Agency, Natural England, FLS and APHA records, as well as web sources such as local geological trusts.

[93] Defined in the draft SMR as "mineral body including aggregates, salt, coal and other hydrocarbons, Petroleum Extraction Development Licences (PEDLs), Shale Prospective Areas (SPAs)"

Geology

10.3.2 This section describes the underlying ground conditions within the South Kirkby to Sharlston Common area. Recent changes in lithostratigraphic classifications by the BGS have been incorporated where appropriate[94].

10.3.3 Table 12 provides a summary of the geology (made ground, superficial and bedrock units) underlying the Proposed Scheme in the study area.

Table 12: Summary of the geology underlying the land quality study area

Geology	Distribution	Formation description	Aquifer classification
Made Ground			
Made Ground	Significant deposits along the route of the Proposed Scheme, typically described by the BGS as "infilled ground" particularly within the area around New Crofton and Sharlston, which has been subject to extensive historical open cast coal extraction.	Artificial ground comprising variable deposits of reworked natural and man-made materials.	Not applicable
Superficial			
Peat	Approximately 1km north-west of Hemsworth as an elongated deposit.	Accumulation of partially decomposed vegetation.	Unproductive
Alluvium	Along Howell Beck and along a tributary of Oakenshaw Beck also likely to be associated with other streams within the study area.	Clay, silt, sand and gravel.	Secondary A
Bedrock			
Pennine Upper Coal Measures Formation	In the southern part of the study area, from South Kirkby to Horncastle Hill.	Interbedded mudstone, siltstone, sandstone with frequent coal seams and ironstone bands.	Secondary A
Pennine Middle Coal Measures Formation	In the northern part of the study area, from Horncastle Hill to Sharlston Common.	Interbedded mudstone, siltstone, sandstone with frequent coal seams and ironstone bands.	Secondary A

Made ground

10.3.4 Made ground is a term used to denote man-made deposits such as landfill, colliery spoil heaps or earthworks associated with construction or ground improvement. Such deposits may be poorly mapped and are often very variable in composition. Minor deposits of made ground may be encountered within this area, for example where ponds or quarries have been backfilled.

[94] Westphalian Coal Measures, Carboniferous, Northern England. From: Stone, P, Millward, D, Young, B, Merritt, JW, Clarke, SM, McCormac, M and Lawrence, DJD (2010) British Regional Geology: Northern England. Fifth Edition, Keyworth, Nottingham: British Geological Survey. http://earthwise.bgs.ac.uk/index.php/Westphalian_Coal_Measures,_Carboniferous,_Northern_England

10.3.5 There is evidence of historical and authorised landfilling within the area, which may comprise more significant deposits of made ground. Furthermore, there are significant deposits of made ground along the route of the Proposed Scheme, typically described by the BGS as "infilled ground" particularly within the area around New Crofton and Sharlston, where restored open cast coal workings are present. A colliery spoil heap is present in the south of the study area, associated with the former Frickley-South Elmsall colliery.

10.3.6 The APHA Foot and Mouth Disease (FMD) County Status maps show that the study area is located within the FMD free counties category. It is therefore unlikely that any burial or pyre sites associated with the 2001 FMD outbreak are present within the study area and no records of burial or pyre sites have been identified. In all cases, the records do not provide an exact location for the burial or pyre sites and other, unrecorded sites are likely to be present. However, older unrecorded sites may be present from the 1967 outbreak. Similarly, anthrax-infected cattle burials may be present, generally relating to burials 50 to 100 years ago. However, no records have been found of such burials.

Superficial geology

10.3.7 A linear deposit of peat trending south-west to north-east and measuring approximately 1km by 70m is located to the east of the route of the Proposed Scheme, approximately 350m north-west of Church Fields, Hemsworth.

10.3.8 Alluvial deposits variably comprising silty clay, silt, sand, peat and gravel occur along the courses of streams and rivers. A small area of alluvial deposits has been mapped within the study area along Howell Beck and a tributary of Oakenshaw Beck. Alluvium is likely to be present elsewhere within the study area associated with Frickley Dike and other, unnamed watercourses.

10.3.9 The BGS geological mapping does not show any head deposits or glacial deposits within the study area.

Bedrock geology

10.3.10 The bedrock geology comprises the Pennine Coal Measures Group, which underlies the whole of the Proposed Scheme in the South Kirkby to Sharlston Common study area. The Pennine Coal Measures typically comprise interbedded deposited mudstone, siltstone and sandstone, with frequent coal seams and ironstone bands.

10.3.11 The Coal Measures strata have been heavily folded and faulted. Fault lines orientated mainly in a south-west to north-easterly direction intersect the route of the Proposed Scheme throughout the study area. A geological fault to the south of Horncastle Hill marks the boundary between the Pennine Upper Coal Measures and Pennine Middle Coal Measures.

10.3.12 Rocks of the Pennine Upper Coal Measures outcrop in the southern part of the South Kirkby to Sharlston Common area, from South Kirkby to Horncastle Hill. There are numerous unnamed sandstone strata outcropping along the route of the Proposed Scheme and several named sandstone strata within the Pennine Upper Coal Measures Formation, notably (from south to north): the Ravensfield Rock; Brierley Rock;

Newstead Rock and Ackworth Rock. An outcrop of the Ackworth Rock sandstone of the Pennine Upper Coal Measures is also present at Windmill Hill and Towers Lane to the south of Sharlston.

10.3.13 Outcrops of Newstead Rock sandstone occur to the west of Hemsworth, at Kinsley Carr Farm west of Kinsley, at the B6428 Newstead Lane and Horncastle View. An outcrop of Brierley Rock sandstone is present to the south-east of Horncastle Hill and outcrops of Ravensfield Rock sandstone are present around Brierley Common.

10.3.14 There is one coal seam of the Pennine Upper Coal Measures which outcrops within the study area: the Brierley Coal, which outcrops to the south of Horncastle Hill. Coal seams of the Pennine Upper Coal Measures are generally unworked within the study area, with the exception of the Brierley Coal.

10.3.15 Rocks of the Pennine Middle Coal Measures are present at surface in the northern part of the study area, extending from Horncastle Hill to Sharlston Common and beyond. The Pennine Middle Coal Measures Formation is characterised by well-developed cyclothems[95], good quality economically important coal seams and thick sandstone beds. Coal seams of the Pennine Middle Coal Measures outcrop within an area extending from Horncastle Wood to Dean Field. The named coal outcrops within this area are: Shafton Coal, Sharlston Top, Sharlston Low and Sharlston Yard.

Radon

10.3.16 Radon is a radioactive gas formed by the radioactive decay of naturally occurring uranium in rocks and soils. The occurrence of radon gas is shown in the BGS Radon Potential Dataset[96].

10.3.17 The northern section of the route lies within a radon affected area, starting at Newstead and extending to Sharlston Common. This area is located within an intermediate probability radon area with between 5% and 10% of homes estimated to have radon levels at or above the action level of 200 becquerels per cubic metre of air (Bq/m3) for residential properties[97]. There are areas around Coalpit Field, Sharlston and Rushworth Wood off Robin Lane where between 3% and 5% of homes are estimated to have radon levels at or above the action level. The remainder of the South Kirkby to Sharlston Common area is a lower probability radon area, where less than 1% of homes are indicated to be at or above the action level.

10.3.18 The formal ES will include an assessment of areas where there are 5% of homes estimated to have radon levels at or above 200Bq/m^3.

[95] Coarsening-upward sequences of mudstone, siltstone and sandstone, often topped with seatearths and coal seams
[96] Available online at: http://www.bgs.ac.uk/radon/hpa-bgs.html. This dataset underpins Public Health England's Indicative Atlas of Radon in England and Wales (Miles J.C.H, Appleton J.D, Rees D.M, Green B.M.R, Adlam K.A.M and Myers, A.H. (2007). Indicative Atlas of Radon in England and Wales. Public Health England. ISBN: 978-0-85951-608-2. 29 pp) available at www.ukradon.org/information/ukmaps.
[97] Public Health England recommends that radon levels should be reduced in homes where the average is more than 200Bq m=3. This recommendation has been endorsed by the Government.

Groundwater

10.3.19 Two categories of aquifer have been identified within the study area, as defined by the Environment Agency:

- the Pennine Upper Coal Measures and Pennine Middle Coal Measures, together with any localised alluvium deposits, are designated as Secondary A aquifers; and
- the peat deposit at Hemsworth is designated as Unproductive strata.

10.3.20 The Environment Agency records show that there are is one groundwater abstraction licence located within the study area, which is used as part of a food and drink manufacturing process.

10.3.21 There are no groundwater abstractions licensed for public water supply and no groundwater source protection zones (SPZ)[98] identified within the study area.

10.3.22 Details of licensed abstractions are provided in Section 15, Water Resources and flood risk. It should be noted that all abstractions that are used directly or indirectly for human consumption are by default designated as SPZ. In such cases the abstraction point qualifies for a default 10m radius for SPZ1 and a default 250m radius for SPZ2. There is no default SPZ3 for total catchment with respect to this type of abstraction.

10.3.23 According to WMDC and BMBC records, there are no private groundwater abstractions that do not require a permit registered within the study area. There are no Drinking Water Safeguarding Zones within 250m of the Proposed Scheme within the South Kirkby to Sharlston Common area.

10.3.24 Further information on the groundwater in the South Kirkby to Sharlston Common area is provided in Section 15, Water resources and flood risk.

Surface water

10.3.25 The following watercourses are present within the study area. The WFD designation is given in brackets:

- Howell Beck (Ordinary Watercourse);
- Langthwaite Beck (Ordinary Watercourse);
- Tributary of Langthwaite Beck (Ordinary Watercourse);
- Tributary of Hague Hall Beck 1,2,3,4,5 (Ordinary Watercourse);
- Frickley Dike (Ordinary Watercourse);
- Tributary of Frickley Dike;
- Tributary of River Went 1,2,3 (Ordinary Watercourse);

[98] A groundwater SPZ is 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 to the potable source.

- Tributary of Hessle Beck 1,2 (Ordinary Watercourse);
- Swine Lane Drain;
- Drain Beck;
- Tributary of Hardwick Beck 1,2,3,4 (Ordinary Watercourse);
- Santingley Lane Drain;
- Oakenshaw Beck (Ordinary Watercourse);
- Tributary of Oakenshaw Beck 1,2 (Ordinary Watercourse);
- Tributary of Red Beck 1, 2 (Ordinary Watercourse);
- Red Beck (Ordinary Watercourse); and
- Hell Lane Drain 2 (Ordinary Watercourse).

10.3.26 Ponds and lakes within 250m of the route of the Proposed Scheme include man-made fishing ponds on the site of a former landfill to the east of the B6273 Southmoor Road, a moat and pond at Kinsley Carr Farm, a series of lakes at the restored Moorhouse open cast site and Upper Lake at Nostell Park. In addition, there are also a number of other ponds and lakes, as well as unnamed streams, tributaries, drains and culverts located within 250m of the route of the Proposed Scheme.

10.3.27 There are no licensed surface water abstractions located within the study area. There are no Surface Water Safeguard Zones within 250m of the route of the Proposed Scheme in the South Kirkby to Sharlston Common area.

10.3.28 No private water supplies from surface water sources have been identified within the study area.

10.3.29 Further information on surface water in the South Kirkby to Sharlston Common area is provided in Section 15, Water resources and flood risk.

Current and historical land use

10.3.30 Current potentially contaminative land uses within the study area include: two conventional railway lines (Doncaster to Wakefield Line and Pontefract to Wakefield Line), one petrol filling station, four garages/vehicle repair shops, a brickworks, a cemetery and several farms.

10.3.31 Historical land uses identified within the study area with the potential to have caused contamination include 11 landfill sites, a number of former mining sites, mine shafts, spoil mounds, historic hospitals, sewage works, depots, an industrial estate, clay extraction pit, general engineering works, shelling mill, coal disposal plant, garages/vehicle repair shops, a petrol filling station and dismantled railways.

10.3.32 The key historical potentially contaminative sites are: Manface HWS Quarry historical landfill near South Kirkby, historical tanks, historical landfill sites and several underground and open cast coal extraction sites, together with mine entries and adits.

10.3.33 Further details of these current and historical contaminative land uses within the study area are shown in Table 13, Table 14 and Table 15.

Table 13: Current and historical landfill sites located in the study area

Name and Area Reference	Location	Description
South Elmsall (historic landfill) (LA14-68)	Off Broad Lane, South Elmsall.	Disused quarry which accepted commercial waste. Dates of operation unknown. No record of licence or licence surrender.
Manface HWS Quarry Historic Landfill (LA14-157)	Holmsley Lane, between Brierley and South Kirkby. Crossed by land required for the Proposed Scheme.	Disused sandstone quarry operated by West Yorkshire Waste Disposal Authority between 1985 and 1989. Listed as having accepted inert, commercial and household wastes. Gas control system reported to be in place. Anecdotal information from WMDC suggests this quarry was infilled with ash and was later used for the deposit of road waste materials by the local authority.
South Moor Whin Historic Landfill (LA14-261)	Off the B6273 Southmoor Road, Hemsworth Gate.	Unknown date of first input of waste. Last input dated 1950. Listed as having accepted household waste, although anecdotal information from WMDC suggests it accepted ash in the 1930s which was later recovered for use in block making and the excavations filled with inert demolition waste.
Land off Southmoor Road Historic Landfill (LA14-156)	Off the B6273 Southmoor Road, Hemsworth Gate.	Unknown dates of operation. Unknown waste types. Operated by Burntwood Sports. No record of licence or licence surrender.
Land at Bellholme Historic Landfill/Brierley Railway Cutting (LA14-307 & LA14-309)	Off the A628 Hemsworth Bypass near Brierley Grove. Within land required for the Proposed Scheme.	Unknown dates of operation. Unknown waste types. No record of licence surrender.
Nostell Quarry Landfill (historic landfill) (LA14-09)	North of Swine Lane, Nostell.	Environment Agency recorded landfill site in former brickworks. Unknown dates of operation, unknown waste types. No record of licence or licence surrender.
Land to the Rear of Long Row (historic landfill) (LA14-24)	South of Swine Lane, Nostell. Intersected by land required for the Proposed Scheme.	Landfill licensed to, operated between 1984 and 1994 for the deposit of inert and commercial wastes. Licence surrendered in 1994.
Abbotts Tip Landfill (historic landfill) (LA14-81)	Crofton Towers, Towers Lane, Crofton.	Dates of operation and waste types accepted not recorded, but believed to have operated from 1970s to 1990s for the deposit of builder's rubble[99]. Information from planning records and historical mapping suggests that the area of landfilling was confined to the southern part of the site. The northern part of the licensed area has since been developed for housing. No record of licence surrender.
Vale Head Park Landfill (historic landfill) (LA14-322)	Shaw Hill, off the B6273 Wakefield Road, Hemsworth. Intersected by land required for Proposed Scheme.	WMDC recorded landfill site. Unknown dates of operation, unknown waste types. No record of licence or licence surrender.

[99] Fennell Green and Bates (2003) Phase 2 Environmental Report, Draft, Land at The Crofton Towers, Towers Lane (Report relating to WMDC planning application no. 02/99/30549/C). Available online at: https://planning.wakefield.gov.uk/online-applications/applicationDetails.do?keyVal=ZZZVQ6QQXC367&activeTab=summary

Name and Area Reference	Location	Description
Birkwood House Farm landfill (historic landfill) (LA14-27)	South of Birkwood House Farm off the B6378 Pontefract Road. Intersected by land required for the Proposed Scheme.	WMDC recorded landfill site. Unknown dates of operation, unknown waste types. No record of licence or licence surrender.
Landfill to west of Holme Bank Farm (historic landfill) (LA14-124)	West of Holme Bank Farm, off the B6378 Pontefract Road.	WMDC recorded landfill site. Unknown dates of operation, unknown waste types. No record of licence or licence surrender.

Table 14: Current and historical mining, mineral sites and colliery spoil sites located in the study area

Name and Area Reference	Location	Description
Disused tip off Broad Lane (LA14-122)	Broad Lane, South Kirkby.	WMDC recorded landfill site. Unknown dates of operation, unknown waste types. Possible colliery spoil tip associated with the former Frickley and South Elmsall Colliery.
Historical open cast mining sites (LA14-239, LA14-236, LA14-166, LA14-10, LA14-182, LA14-184, LA14-185, LA14-186, LA14-191, LA14-195, LA14-193, LA14-197, LA14-198, LA14-275, LA14-255, LA14-257, LA14-29, LA14-55, LA14-56, LA14-194, LA14-60, LA14-58, LA14-71, LA14-79 LA14-72, LA14-107, LA14-189, LA14-190, LA14-165, LA14-219, LA14-230, LA14-256, LA14-244, LA14-258, LA14-246, LA14-145)	From Horncastle Farm to New Crofton. Sharlston and Dean Field. A number of these sites are crossed by the Proposed Scheme.	Areas of open cast coal mining are where coal has been recorded as being worked in the past by open cast methods. A number of identified sites are located within the land required for the construction of the Proposed Scheme.
Historical shallow (up to 30m) mining sites Horncastle Bell Pits (LA14-52, LA14-205, LA14-235) Crofton Coal Pits (LA14-162, LA14-174, LA14-168, LA14-177, LA14-179 LA14-272, LA14-251, LA14-270, LA14-279) Spring Hill Coal Pits (LA14-178, LA14-142 CA-147 LA14-148)	Horncastle Wood, Swine Lane. South of the A638 Doncaster Road near Crofton. South of the A638 Doncaster Road near Spring Hill. Some of the identified sites are located within the land required for construction of the Proposed Scheme.	Areas of historical bell pits and coal pits for shallow coal extraction.
Nostell Colliery (LA14-141, LA14-152, LA14-170, LA14-183 LA14-225, LA14-232, LA14-270, LA14-252)	South of Swine Lane near Wragby. South of site intersects land required for construction of the Proposed Scheme.	Former deep coal colliery with three untreated mine shafts recorded. Later redeveloped into sewage works and landfill site near Long Row. Restored to undeveloped land.
Probable shallow coal mining areas	From Horncastle Hill to	Areas of probable shallow coal mining are recorded by the Coal Authority

Name and Area Reference	Location	Description
(LA14-169, LA14-10, LA14-144, LA14-305, LA14-169, LA14-191, LA14-192, LA14-184, LA14-195, LA14-186, LA14-214, LA14-213, LA14-212, LA14-208, LA14-207, LA14-210, LA14-209, LA14-202, LA14-200, LA14-201, LA14-231, LA14-316, LA14-235, LA14-260, LA14-253, LA14-273, LA14-276, LA14-277, LA14-301, LA14-262, LA14-302, LA14-181, LA14-204)	Sharlston Common. Areas of probable shallow mining are present within the land required for construction of the Proposed Scheme.	within the study area. Most areas coincide with recorded open cast workings at Moorhouse, Long Row, New Crofton, Crofton 1 OCCS and Birkwood Farm.
43 Historical mine entries (LA14-107, LA14-279, LA14-31, LA14-143, LA14- 32, LA14-33, LA14-34, LA14-35, LA14-36, LA14-37, LA14-38, LA14-39, LA14-40, LA14-41, LA14-42, LA14-150, LA14-149, LA14-148, LA14-147, LA14-142, LA14-43, LA14-146, LA14-153, LA14-152, LA14-141, LA14-44, LA14-161, LA14-163, LA14-164, LA14-158, LA14-176, LA14-177, LA14-159, LA14- LA14-165, LA14-160, LA14-167, LA14-168, LA14-183, LA14-58, LA14-238, LA14-296, LA14-313, LA14-314)	Various locations within an area from Horncastle Hill to Sharlston Common.	Historical mine entries comprising both shafts and adits. The mine entries were identified from historical Ordnance Survey maps and information obtained from the Coal Authority.

Table 15: Current and historical industrial sites located in the study area

Name and Area Reference	Location	Description
Evidence of fuel/ storage tanks (disused) (LA14-82, LA14-01, LA14-84, LA14-85, LA14-86, LA14-87, LA14-101, LA14-115, LA14-136, LA14-61, LA14-62, LA14-65, LA14-66, LA14-70, LA14-234, CA-172, CA-173, LA14-109, LA14-248)	One tank was located within land required for construction of the Proposed Scheme, at Vissitt Quarry.	Identified from historical mapping, mine abandonment plans of storage tanks/suspected storage within former open cast coal sites and brickworks. No information held on what the tanks may have contained, but assumed to have the potential for hydrocarbon and chemicals storage.
Brickworks and clay pits (LA14-01, LA14-09, LA14-107, LA14-146, LA14-153, LA14-180, LA14-181, LA14-193, LA14-194, LA14-199, LA14-220, LA14-221, LA14-228, LA14-229, LA14-230, LA14-84, LA14-85, LA14-82, LA14-86, LA14-256, LA14-58, LA14-60, LA14-71, LA14-72, LA14-79, LA14-87)	Nostell and at Vissett Cottage off Barnsley Road.	Historical brickworks and clay pits. Clay pit at Nostell is still shown on current OS mapping but believed to be no longer in use for extraction. Brickworks still operating at Nostell.
Dismantled Railways (LA14-63, LA14-73, LA14-53, LA14-54, LA14-63, LA14-319, LA14-352, LA14-278, LA14-286, LA14-311, LA14-312, LA14-306, LA14-344)	Various throughout the study area, four branch lines: Sections of dismantled railway near New Crofton – immediately adjacent to land required for Proposed Scheme New Sharlston – intersects land required for the Proposed Scheme	Identified from historical mapping. Most anticipated to be associated with former mineral railways.

Name and Area Reference	Location	Description
Existing Railways: Doncaster to Wakefield Line (LA14-223, LA14-206, LA14-203, LA14-222) Pontefract to Wakefield Line (LA14-259)	Around New Crofton and Sharlston.	Existing railway (Doncaster to Wakefield Line).
Garages and vehicle repair shops (disused) (LA14-106, LA14-08, LA14-11, LA14-20, LA14-117, LA14-118)	Off the B6428 Newstead Lane, Newstead, at New Crofton, Crofton, South Kirkby Common and Spring Hill.	Former garages and vehicle repair shops identified from historical mapping and spatial data provided by WMDC.
Garages, vehicle repair shops and depots (LA14-109, LA14-127, LA14-123, LA14-112, LA14-22, LA14-245, LA14-237)	Various throughout the study area.	Current garages and depots have been identified from historical mapping and WMDC spatial data.
Hill Top Service Station (disused) (LA14-121)	Near South Kirkby Common off Common Road.	Former filling station now used as car wash and garages identified from historical mapping and Wakefield spatial data. Shown on historic maps from 1988.
Unknown Works/ General Works/Industrial Estates/Engineering works (disused) (LA14-22, LA14-245, LA14-237,LA14-96, LA14-349, LA14-81, LA14-92, LA14-96, LA14-321)	Various throughout study area.	Former works within study area identified from historical mapping and Contemporary Trade Directory Entries. LA14-81 and LA14-96 are now open fields and LA14-81 and LA14-389 are residential use.
Sewage Works (disused) (LA14-83, LA14-99, LA14-225, LA14-232, LA14-240, LA14-100, LA14-89, LA14-90)	Off Swine Lane, New Crofton and Common Road. Some sites are present within the land required for the Proposed Scheme.	Former sewage works identified on historical OS mapping.
Hospitals (disused) (LA14-02, LA14-23, LA14-98)	Around South Kirkby and Brierley.	Historic hospitals believed to have been used for convalescence i.e. smallpox, alms hospice and a sanatorium (tuberculosis). Both sites are now used for residential purposes.
Cemetery (active) (LA14-4, LA14-45)	Off Weeland Road, Sharlston and at Church Field, Hemsworth.	Cemeteries have been identified from current OS mapping.

10.3.34 Contaminants commonly associated with sites in Table 13 could include metals, semi-metals, asbestos, organic and inorganic compounds. Additionally, infilled pits and landfills could also give rise to landfill gases such as methane or carbon dioxide and leachate.

10.3.35 Contaminants commonly associated with mining and mineral sites in Table 14 could include heavy metals, acid mine waters with low pH values and mine gases such as methane, carbon dioxide and hydrogen sulphide. Contamination could originate from oxidised colliery spoils, metalliferous materials or unknown waste materials deposited in voids. Contamination could be associated within ancillary or pit head activities such as electrical transformation, railway infrastructure, workshops or fuel storage.

10.3.36 Contaminants commonly associated with industrial sites in Table 15 include organic and inorganic contaminants including but not limited to: hydrocarbons including fuels and oils, solvents, paints/varnishes, polychlorinated biphenyls, heavy metals, ethylene, glycol, herbicides, ash and sulphate. Asbestos material may be present in soils from previously demolished structures. Pathogens may be present in soils associated with sewage works.

Other regulatory data

10.3.37 The regulatory data reviewed included pollution incidents (major, significant and minor categories), radioactive and hazardous substances consents and environmental permits (previously landfill, integrated pollution control and integrated pollution prevention and control licences). There were no major, four significant and six minor incidents reported over a 27 year period between 1990 and 2016.

10.3.38 There are four records of significant pollution incidents (Category 2) within the South Kirkby to Sharlston Common area. The first occurred in May 1992, to the north of the A638 Doncaster Road and involved the release of sewage to a tributary of Oakenshaw Beck. A second incident occurred in September 1992, involving the release of unknown sewage to into a tributary of Hessle Beck at the junction of Garmill Head Lane and the B6428 Newstead Lane. The third recorded significant incident within the South Kirkby to Sharlston Common area occurred in September 2007, involving the release of unknown pollutants to Langthwaite Beck. The fourth incident affected a lake to the west of The Willows near Foulby in April 2016; the pollutants released were not recorded.

10.3.39 There are no Control of Major Accident Hazards (COMAH) sites within the South Kirkby to Sharlston Common area.

10.3.40 The Environment Agency reports that there are four consented discharges to groundwater within the study area:

- Newstead Nurseries, Newstead;
- Catch Penny Farm, Fitzwilliam;
- Dwelling on Slack Lane, Crofton; and
- Crofton Towers, Crofton.

10.3.41 There are five discharge consents to surface water within the study area, two of which are within the area of land which would be required for the construction of the Proposed Scheme.

10.3.42 There are no nationally significant ecological designations as defined in the land quality section of the SMR[100] located within the study area. There are four locally significant ecological sites (local wildlife sites) within the study area: South Kirkby Fort; Manface Quarry; Moorhouse Lane Ponds and Railway, and Nostell Priory Lakes.

[100] Sensitive ecological receptors are defined as national designations such as SSSIs

10.3.43 Further information on ecology can be found in Section 7, Ecology and biodiversity.

Mining/mineral resources

10.3.44 There are a range of mining and mineral resources located within the study area that have the potential to be affected by the Proposed Scheme. These can include sand, gravel, clay, sandstone and coal, which can be protected via local or county level mineral plans and by the Coal Authority, as well as other forms of petroleum hydrocarbons such as shale gas and oil which are regulated by the Oil & Gas Authority (OGA) via the issue of Petroleum Exploration Development Licences (PEDLs).

Mineral plans

10.3.45 WMDC and BMBC are responsible for the overall mineral and waste local plans within the study area. The WMDC Local Development Framework[101] (LDF) was adopted in April 2009 and sets out the policies aimed at controlling mineral related developments within Wakefield Metropolitan District up to the year 2026. The Specific Policies Local Plan for Minerals[102] adopted in 2012 defines Mineral Safeguarding Areas (MSA) and Mineral Reserve areas.

10.3.46 BMBC published its Draft Local Plan in 2016[103] which is intended to provide local policy until 2033 and includes policies on mineral resources and safeguarding. The plan has been submitted to the Secretary of State for Communities and Local Government for examination and the policies therein have been considered as part of this assessment.

Sand, gravel and clay deposits

10.3.47 There are allocated mineral reserves of clay at Nostell Brickworks (north and south) near Wragby, which relates to WMDC minerals policies MR5 and MR6 as set out in the Specific Policies Local Plan for Minerals[104]. These reserves are located within the study area, but not within the area of land required for the Proposed Scheme. The BMBC Draft Local Plan mentions that reserves of fireclay and brick clay underlie virtually the whole borough and it is important that these minerals are safeguarded from sterilisation for future working.

Coal mining

10.3.48 Coal seams of the Pennine Middle Coal Measures outcrop within an area extending from Horncastle Hill to Dean Field. Coal seams of the Pennine Upper Coal Measures outcrop in an area from Vissitt Manor House to Horncastle Hill. The study area has been subject to extensive open cast and deep coal mining. It is also likely that unrecorded shallow workings are also present. Key coal seams outcropping in the study area are listed in Table 16, and it is likely that all these seams have been worked economically in the past.

[101] WMDC (2009) *Local Development Framework*. Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/local-plan/development-policies/development-policies.pdf
[102] WMDC (2009) *Specific Policies Local Plan for Minerals*. Available online at: https://wakefield.objective.co.uk/portal/spatial_policy/ssplp
[103] BMBC (2016) *Local Plan Publication Draft 2016.* Available online at: http://consult.barnsley.gov.uk/portal/development/planning/lppd2016
[104] WMDC; Interactive map viewer. Available online at: http://map.wakefield.gov.uk/connect/analyst/mobile/#/main?mapcfg=LDFadopted&zoom=7&x=437495&y=422564&overlays=WMDC_Boundary,Natural%20Environment%20and%20Open%20Land

Table 16: Coal Seams present within 50m depth within study area

Bedrock	Name	Thickness (m)	Depth (m bgl)	Comments
Pennine Upper Coal Measures	Brierley Coal	0.3-0.7	Outcrops within study area.	
Pennine Middle Coal Measures	Highgate Coal	Typically about 0.5 thick, ranges from 0-0.6	Possibly outcrops within study area to west of Horncastle Farm off Swine Lane.	
	Shafton Coal	0.6 -0.8	Outcrops within study area.	
	Sharlston Top Coal	0-0.6, up to 1m locally near Hemsworth[105]	Outcrops within study area.	Proposed to be worked at New Crofton Co-operative Colliery.
	Sharlston Muck Coal	0.2-0.4	Outcrops within study area.	Proposed to be worked at New Crofton Co-operative Colliery.
	Sharlston Low Coal	0.3-0.6	Outcrops within study area.	
	Sharlston Yard (First Wales Coal)	0.1-1.0	40 to 50m bgl	Proposed to be worked at New Crofton Co-operative Colliery.

Open cast coal mining

10.3.49 The South Kirkby to Sharlston Common area is within a MSA defined by WMDC, relating to shallow coal resources (MSA6). The MSA underlies the majority of the route of the Proposed Scheme except for a small area around the B6273 Southmoor Road which lies within BMBC area. The WMDC Core Strategy[106] states that "shallow coal extraction by opencast methods is most likely to occur before some other form of development takes place on a site."

10.3.50 The BMBC draft Local Plan states that shallow coal reserves underlie virtually the whole borough and that these minerals should be safeguarded from sterilisation for future working.

Deep coal mining

10.3.51 Geological mapping from the BGS shows that coal seams are present at depth beneath the entire study area and have the potential to be exploited in the future, for

[105] Lake, R.D. (2006) *The Pennine Lower and Middle Coal Measures formations of the Barnsley district. Geology & Landscape Southern Britain Programme. Internal Report IT/06/135 prepared for British Geological Survey*. Available online at: http://nora.nerc.ac.uk/id/eprint/7426/1/IR06135.pdf
[106] Wakefield Metropolitan District Council (WMDC), (2009), *Core Strategy*. Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/local-plan/core-strategy/core-strategy.pdf

both coal and coal bed methane. However, the WMDC Core Strategy states that deep mining for coal is unlikely to be a significant development in the future.

10.3.52 Planning permission was granted in May 2015 for the New Crofton Co-operative Colliery. The mine has been proposed as a Room and Pillar drift mine at depths of 45m to 100m in the Sharlston Top, Sharlston Muck and Sharlston Yard Coal seams. These would be mined to the south and south-west of the route of the Proposed Scheme.

Petroleum Exploration Development Licences/Hydrocarbons

10.3.53 The Local Plans recognise the potential for the future use of coal bed methane and underground gas resources. There is a current licence for onshore Petroleum Exploration and Development, PEDL273 (14th round), covering the entire South Kirkby to Sharlston Common study area, and another, PEDL37 (8th round)[107], at Nostell. Both areas are within the Carboniferous Bowland-Hodder Shale prospective area for shale gas.

Geo-conservation resources

10.3.54 One geological SSSI has been identified within the study area, at Nostell Brickyard Quarry, which was designated because of its geological features. However, a 2010 condition survey described this site as 'destroyed'[18] and, therefore, no assessment of geo-conservation resources has been undertaken.

Receptors

10.3.55 The sensitive receptors that have been identified within the study area are summarised in Table 17. A definition of receptor sensitivity is given in the SMR.

Table 17: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land contamination	People	Residents of existing properties and schools.	High
		Users of public open space, parks, playing fields and allotments.	High
		Employees and visitors at commercial areas and hotels.	Moderate
		Users of industrial land, including industrial estates and farm buildings.	Low
	Groundwater	Secondary A Aquifers (alluvium, Coal Measures bedrock).	Moderate
		Peat.	Low
	Surface waters	Howell Beck (moderate), Langthwaite Beck (moderate), Frickley Dike (poor), Swine Lane Drain (unclassified), Drain Beck (unclassified), Santingley Lane Drain (unclassified), Oakenshaw Beck (moderate)	Moderate

[107] Oil & Gas Authority; Onshore Oil and Gas Activity web viewer. Available online at: https://ogauthority.maps.arcgis.com/apps/webappviewer/index.html?id=29c31fa4b00248418e545d222e57ddaa

Issue	Receptor type	Receptor description	Receptor sensitivity
		and Red Beck (good). Unnamed tributaries of Langthwaite Beck (moderate), Hague Hall Beck (moderate), River Went (good), Hessle Beck (poor), Hardwick Beck (poor), Oakenshaw Beck (moderate), Red Beck (moderate) and Hell Lane Drain.	
	Built environment	Existing underground structures and buried services.	Low
	Natural environment	Nostell Brickyard Quarry SSSI.	Low[108]
		Manface Quarry LWS. South Kirkby Fort LWS. Moorhouse Lane Ponds and Railway LWS. Nostell Priory Lakes LWS.	Low
Impacts on mining/mineral and petroleum (gas) sites (severance and sterilisation)	Mining/mineral sites	MSA (shallow coal reserves within Wakefield Metropolitan District). Allocated reserves of brick clay at Nostell. Proposed future open cast coal extraction site at Dean Field and proposed underground coal mine at New Crofton.	Moderate
		Licensed shale gas exploration areas: PEDL273 and PEDL37.	High

10.4 Effects arising during construction

Avoidance and mitigation measures

10.4.1 The construction assessment takes into account the mitigation measures described in the draft Code of Construction Practice (CoCP)[109]. The draft CoCP sets out the measures and standards of work that would be applied to the construction of the Proposed Scheme and includes requirements to ensure the effective management and control of work in contaminated areas.

10.4.2 The requirements in the draft CoCP relating to work in contaminated areas would ensure the effective management and control of the work. These requirements include:

- methods to control noise, waste, dust, odour, gases and vapours (Sections 5, 7, 11, 13, 14 and 15);
- methods to control spillage and prevent contamination of adjacent areas

[108] The draft SMR states that the sensitivity of a SSSI should be 'high' but in this case, as evidence is available to suggest that the site has been destroyed. (https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S1000751&ReportTitle=Nostell%20Brickyard%20Quarry%20SSSI), 'low' sensitivity has been assigned.
[109] Supporting document: Draft Code of Construction Practice

(Sections 5, 11 and 16);

- the management of human exposure for both construction workers and people living and working nearby (Sections 5, 7, 11, 13 and 14);
- methods for the storage and handling of excavated materials (both contaminated and uncontaminated) (Sections 6, 7, 11 and 15);
- management of any unexpected contamination found during construction (Sections 11 and 15);
- a post-remediation permit to work system (Section 11);
- storage requirements for hazardous substances such as oil (Sections 5, 11 and 16);
- traffic management to ensure that there is a network of designated haul routes to reduce compaction/degradation of soils (Sections 5, 6 and 14);
- methods to monitor and manage flood risk and other extreme weather events which may affect land quality during construction (Sections 5 and 6); and
- methods to manage discovery of unknown animal burial pits (Section 6).

10.4.3 The draft CoCP would require that prior to and during construction, a programme of further detailed investigations, which may include both desk based and site based work, takes place in order to confirm the full extent of areas of contamination. It also requires a risk assessment to be undertaken to determine what, if any, site specific remediation measures are required to allow the Proposed Scheme to be constructed safely and to prevent harmful future migration of contaminants. The investigation and assessment of potentially contaminated sites would be undertaken in accordance with Environment Agency CLR11[110] and British Standards BS10175[111] and BS8576[112].

10.4.4 Where significant contamination is encountered, a remedial options appraisal would be undertaken to define the most appropriate remediation techniques. Where appropriate, this appraisal would be undertaken based on multi-criteria attribute analysis that considers environmental, resource, social and economic factors in line with the framework set out by the Sustainable Remediation Forum UK[113]. The preferred option would then be developed into a remediation strategy.

10.4.5 Contaminated soils excavated within the site, where practicable, would be treated to remove or render contamination inactive and reused within the Proposed Scheme where needed and suitable for use. Treatment techniques are likely to include stabilisation, soil washing and bio-remediation. Contaminated soil removed off-site would be taken to a soil treatment facility, another construction site (for treatment and reuse) or to an appropriately permitted landfill.

[110] Environment Agency, (2004) *CLR11 Model Procedures for the Management of Land Contamination*.
[111] British Standard (2017) *BS10175+A2:2017 Investigation of Potentially Contaminated Sites*.
[112] British Standard (2013) *BS8576 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).*
[113] Sustainable Remediation Forum UK, (2010), *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation,* Contaminated Land: Applications in Real Environments (CL:AIRE), London.

Assessment of impacts and effects

10.4.6 Construction of the Proposed Scheme in this area would require earthworks, utility diversions, deep foundations, grouting and ground stabilisation and other activities, including the construction of the various viaducts and road infrastructure works. These aspects of the Proposed Scheme, along with other construction features, are shown on the Map Series CT-05 in the Volume 2: LA14 Map Book.

Land contamination

10.4.7 In line with the assessment methodology, as set out in the SMR, an initial screening process has been undertaken to identify areas of current or historical contaminative use within the study area and to consider which of these areas might pose contaminative risks for the Proposed Scheme. Sites that present a low risk have not been taken further in the assessment. Any moderate to higher risk sites have been taken forward to more detailed risk assessments, in which the potential risks are assessed more fully. The majority of the areas that have undergone the more detailed risk assessments are historical landfills, industrial, mining and commercial sites.

10.4.8 CSMs have been produced for those areas taken to detailed risk assessments. The following factors determine the need for detailed risk assessments:

- whether the site is located on or off the route of the Proposed Scheme or associated offline works;
- the vertical profile of the route;
- the presence of underlying sensitive groundwater aquifers (Principal or Secondary A) or nearby watercourses; and
- the presence of adjacent residential properties or sensitive ecological receptors.

10.4.9 Clusters of potentially contaminated sites of a similar nature have been grouped, and assessed together, where appropriate.

10.4.10 A simple summary of the baseline CSM is provided in Table 18. The potential impacts and baseline risks quoted are those before any mitigation is applied. The assessed baseline risk is based on the information provided at the time of the assessment. Where limited information is available, the assessment is based on precautionary, worst case assumptions and may therefore report a higher risk than that which actually exists. A screening assessment of the effects of contamination has been completed by comparing the detailed CSM developed for potential contaminated areas at baseline with construction and post-construction stages.

Table 18: Summary of baseline CSM for sites which may pose a contaminative risk for the Proposed Scheme

Area reference[114]	Area name	Human health risk	Groundwater risk	Surface water risk	Ecosystem risk[115]	Buildings risk
On site[116]						
LA14-171, LA14-299, LA14-342, LA14-226, LA14-241 and LA14-242	Localised shallow mineral extraction and infilled ground >0.5ha (grouped).	Low to moderate/low	Low	Low	N/A	Low to moderate/low
LA14-53, LA14-54, LA14-63, LA14-319, LA14-259, LA14-206, LA14-223, LA14-73, LA14-311, LA14-312, LA14-187, LA14-306, LA14-203 and LA14-222	Railways and railway land (grouped).	Low to moderate/low	Low	Low	N/A	Very low
LA14-95, LA14-10, LA14-144, LA14-145, LA14-151, LA14-166, LA14-170, LA14-178, LA14-179, LA14-181, LA14-182, LA14-184, LA14-186, LA14-189, LA14-190, LA14-191, LA14-192, LA14-193, LA14-194, LA14-195, LA14-196, LA14-197, LA14-200, LA14-201, LA14-202, LA14-204, LA14-205, LA14-208, LA14-209, LA14-210, LA14-212, LA14-217, LA14-227, LA14-235, LA14-236, LA14-239, LA14-244, LA14-246, LA14-255, LA14-258, LA14-260, LA14-262, LA14-274, LA14-275, LA14-276, LA14-277, LA14-301, LA14-302, LA14-305, LA14-316, LA14-318, LA14-52, LA14-92	Coal mining pit heads and spoil heaps, including recorded open cast and probable shallow mining and mine entries (grouped).	Low to moderate	Moderate/low	Moderate/low	N/A	Moderate/low to moderate
LA14-157	Manface Quarry HWS Landfill	Low to moderate	Moderate	Low	Moderate/low	Low to moderate

[114] Each potentially contaminated site is allocated a unique reference number.
[115] The abbreviation 'N/A' has been used where there are no ecosystem receptors as defined by the SMR and therefore the risks are not applicable
[116] 'On site' is within the area of land required for construction of the Proposed Scheme.

Area reference[114]	Area name	Human health risk	Groundwater risk	Surface water risk	Ecosystem risk[115]	Buildings risk
	(historical).					
LA14-109, LA14-173	Garages, petrol filling stations and tanks (grouped).	Low to moderate/low	Low	Low	N/A	Very low
LA14-105, LA14-155, LA14-215, LA14-211, LA14-224,LA14-303,LA14-03,LA14-320,LA14-78,LA14-317,LA14-48 CA-14-80.	Farms (grouped).	Low to moderate	Moderate/low	Moderate/low	N/A	Low to moderate/low
LA14-100, LA14-232, LA14-240, LA14-225	Sewage works (grouped).	Very low to low	Moderate/low	Low	N/A	Low to moderate/low
LA14-02, LA14-23	Historic hospitals (grouped).	Very low to Moderate/low	Low	Low	N/A	Very low to moderate/low
LA14-24, LA14-27, LA14-156, LA14-67, LA14-322, LA14-114, LA14-307, LA14-308, LA14-309, LA14-315	Landfills (historic) (grouped).	Very low to moderate/low	Moderate/low	Low	N/A	Moderate/low to moderate
Off site[117]						
LA14-22, LA14-245, LA14-237	Depots (grouped).	Very low to moderate/low	Low	Low	N/A	Very low
LA14-53 and LA14-54	Railways and railway land (grouped).	Low to moderate/low	Low	Very low	N/A	Very low
LA14-178, LA14-184, LA14-195, LA14-194, LA14-193, LA14-181, LA14-210, LA14-204, LA14-255, LA14-277, LA14-305, LA14-236, LA14-302, LA14-166, LA14-186	Coal mining pit heads and spoil mounds, including recorded open cast and probable shallow mining (grouped).	Low to moderate	Moderate/low	Moderate/low	Moderate/low	Moderate/low to moderate
LA14-20, LA14-123, LA14-61, LA14-62, LA14-01, LA14-84, LA14-85, LA14-86,	Garages, petrol filling stations and tanks	Low	Very low	Low	N/A	Very low

[117] 'Off site' is beyond the land required for construction of the Proposed Scheme but within 250m of it.

Area reference[114]	Area name	Human health risk	Groundwater risk	Surface water risk	Ecosystem risk[115]	Buildings risk
LA14-11, LA14-112, LA14-127, LA14-136, LA14-106, LA14-115, LA14-121, LA14-172, LA14-65, LA14-66, LA14-70, LA14-234, LA14-248	(grouped).					
LA14-83, LA14-90, LA14-99	Sewage works (grouped).	Very low to low	Moderate/low	Low	N/A	Low to moderate/low
LA14-45	Hemsworth Cemetery.	Very low to moderate/low	Moderate/low	Very low	N/A	Very low to moderate/low
LA14-98	Historic hospital.	Very low to Moderate/low	Moderate/low	Moderate/low	N/A	Very low to Moderate/low
LA14-06, LA14-261	Landfills (historic) (grouped).	Very low to moderate/low	Moderate/low	Low	N/A	Moderate/low to moderate

Temporary effects

10.4.11 In order to identify potential temporary effects, the baseline and construction CSM have been compared to determine the change in level of risk at receptors during the construction stage, and thus to define the level of effect at the construction stage.

10.4.12 Where there is no change between the main baseline risk and the main construction risk, the temporary effect significance is deemed to be negligible even if the risk is deemed to be high. For example, this would be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the area required for construction.

10.4.13 A worsening risk at construction stage compared to baseline would result in a negative effect, and conversely, an improvement would result in a positive effect. The assessment assumes that contamination would be controlled through the general measures in the draft CoCP. Once updated this will also include mining related contamination risks.

10.4.14 All of the sites set out in Table 18 have been assessed for the change in impact associated with the construction stage of the work. Table 19 presents the summary of the resulting construction effects that have been found to be significant. All other sites referenced in Table 18 were found to have non-significant effects.

Table 19: Summary of construction CSM effects

Name and area ref[118]	Receptor	Main baseline risk	Main construction risk	Temporary effect
LA14-95, LA14-10, LA14-144, LA14-145, LA14-151, LA14-166, LA14-170, LA14-178, LA14-179, LA14-181, LA14-182, LA14-184, LA14-186, LA14-189, LA14-190, LA14-191, LA14-192, LA14-193, LA14-194, LA14-195, LA14-196, LA14-197, LA14-200, LA14-201, LA14-202, LA14-204, LA14-205, LA14-208, LA14-209, LA14-210, LA14-212, LA14-217, LA14-227, LA14-235, LA14-236, LA14-239, LA14-244, LA14-246, LA14-255, LA14-258, LA14-260, LA14-262, LA14-274, LA14-275, LA14-276, LA14-277, LA14-301, LA14-302, LA14-305, LA14-316, LA14-318, LA14-52, LA14-92 Coal mining pit heads and spoil mounds, including recorded open cast coal extraction sites and probable shallow mine workings (grouped), on site	Exposure to off-site human receptors to inhalation of gases and vapours.	Moderate/low	High	Moderate adverse (significant)
	Exposure of Secondary A aquifer to leaching, vertical migration through groundwater and direct runoff from site.	Moderate/low	High	Moderate adverse (significant)

10.4.15 In the event that unexpected contamination is encountered during the construction of the route in this area, this would be remediated as described in the draft CoCP resulting in an overall beneficial effect.

10.4.16 Table 19 indicates that there are several locations where there would be a potential significant adverse effect, relating to former coal mining sites along the route of the Proposed Scheme. For mining sites, a potential for significant adverse effects has been identified associated with the uncertainty around mine gas and mine water in historical workings. For the WDES, the CoCP does not address this in detail, but is being further developed in consultation with authoritative consultees to develop mechanisms for mitigating and significant adverse effects.

10.4.17 Construction compounds located in the study area could include the storage of potentially hazardous substances, such as fuels and lubricating oils and may also be used for temporary storage of potentially contaminated soils. Mitigation measures set out within the draft CoCP include management of risks from the storage of such materials resulting in no significant effects.

[118] Each potentially contaminated site is allocated a unique reference number. Note that these numbers will change in future drafts, as temporary reference numbers have been used for Draft 2.

Permanent effects

10.4.18 In order to identify potential permanent effects, a screening assessment has been undertaken comparing the baseline and post-construction CSM to assess the permanent (post-construction) effects.

10.4.19 The magnitude of the permanent effects and their significance have been determined by assessing the change in risk between the main baseline risk and the main post-construction risk. Therefore, where there is no change between the main baseline risk and the main post-construction risk, the permanent effect significance is deemed to be negligible even if the risk is assessed to remain as high. This would be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the construction boundary. As noted above, a worsening would result in negative effects and an improvement would result in positive effects.

10.4.20 In relation to the potential significant effects associated with mining sites at construction stage, there will be a greater level of knowledge and understanding of the mine workings ground model and the best means to mitigate the potential effects on a permanent basis.

10.4.21 All of the sites set out in Table 18 have been assessed for the change in impact associated with the permanent post-construction stage. Table 20 presents the summary of the resulting post-construction effects that have been found to be significant. All other sites referenced in Table 18 were found to have non-significant (neutral or minor beneficial) effects.

Table 20: Summary of permanent (post-construction) effects

Name and area ref	Receptor	Main baseline risk range	Main post-construction risk range	Post-construction effect
LA14-157 Manface Quarry HWS Landfill (historical)	Exposure of on-site human receptors to contamination by direct contact, ingestion and inhalation of dusts and vapours from contaminated soils.	Moderate	Low	Moderate beneficial (significant)

10.4.22 Additional site-specific permanent remediation measures, that could focus on source removal, pathway breakage or receptor protection, would be developed during the detailed design stage if required. These measures would ensure that risks would be controlled to an acceptable level.

Mining/mineral resources

10.4.23 Construction of the Proposed Scheme has the potential to affect existing mineral resources and proposed areas of mineral exploitation. This could occur by sterilisation of the resource through direct excavation during construction of the Proposed

Scheme or through temporary and/or permanent severance[119] or isolation that may occur during the construction phase of the Proposed Scheme, possibly continuing through to its operation.

10.4.24 The entire route of the Proposed Scheme through the South Kirkby to Sharlston Common area is within an MSA for shallow coal reserves.

Temporary effects

Coal mining – open cast

10.4.25 The effect of construction of the Proposed Scheme on the future open cast coal mining areas would be minor adverse. Temporary adverse effects may occur where construction compounds are proposed within these licensed areas. In such cases, there would be a temporary sterilisation of the resource during construction works, but this is not considered to represent a significant effect and the resource would not be lost permanently.

10.4.26 There are no proposed compounds which fall within the Licenced Future open cast areas.

Coal mining – deep

10.4.27 The effect of construction of the Proposed Scheme on the future deep coal mining area at New Crofton would be minor adverse. Temporary adverse effects may occur where construction compounds are proposed within this area that might impact on the proposed surface works associated with the new colliery. In such cases, there would be a temporary sterilisation of the resource during construction works, in that enabling works for the proposed colliery may be affected, but this is not considered to represent a significant effect and the resource would not be lost permanently.

10.4.28 The New Crofton South embankment satellite compound falls within the proposed New Crofton co-operative coal mining area.

Petroleum Exploration Development Licences

10.4.29 The route of the Proposed Scheme would cross an area underlain by two PEDLs of the Bowland Shale Prospective area, both licensed by the Oil and Gas Authority (OGA). The effect of construction of the Proposed Scheme on the identified PEDLs would be negligible. The PEDLs identify hydrocarbons resources present deep underground, specifically, potential sources of shale gas. The construction of the Proposed Scheme is unlikely to place a constraint on future exploitation of potential sources of shale gas.

Permanent effects

10.4.30 The majority of effects on mining and mineral sites would be permanent. There are no permitted mineral sites for coal, brick or fireclay extraction in the South Kirkby to Sharlston Common study area.

[119] In this context, severance refers to the Proposed Scheme splitting an actual or proposed mining/mineral site into two or more areas, such that separate accesses would be required to work the whole site.

Coal mining – open cast

10.4.31 The effect of construction of the Proposed Scheme on the proposed open cast coal mining areas in Deanfield would be permanent where they are present beneath the footprint of the permanent works, with a strip of mineral becoming sterilised. Mitigation measures (if any) would be discussed in advance of the works with the Mineral Planning Authority, the Coal Authority and the mineral owner.

Coal mining – deep

10.4.32 The effect of construction of the Proposed Scheme on the proposed deep coal mining at New Crofton and any other future proposed areas of deep coal mining within the South Yorkshire coalfield would be permanent where the proposed mining could have a potential impact on the stability of the ground surface beneath the footprint of the permanent works, with an area of mineral becoming sterilised. Mitigation measures would need to be discussed in advance of the works with the Mineral Planning Authority, the relevant local authority, the Coal Authority, and commercial mining companies with asset interests in the area.

Petroleum Exploration Development Licences

10.4.33 The effect of construction of the Proposed Scheme on the identified PEDLs would be negligible. The route of the Proposed Scheme would cross an area underlain by two PEDLs of the Bowland Shale Prospective area. The PEDLs identify the deep areas of hydrocarbon resources, specifically, potential sources of shale gas. Operation of the Proposed Scheme is unlikely to place a constraint on future exploitation of potential sources of shale gas.

10.4.34 Table 21 reports the assessment of permanent effects from construction on the mining and mineral resources identified.

Table 21: Summary of effects for mining and mineral resources

Site name	Status	Description	Sensitivity/ value	Magnitude of impact	Effect and significance (Y/N)
Brick clay and fireclay	Allocated mineral reserves MR5 and MR6 (Nostell brickworks).	Defined by WMDC.	Moderate	Minor	Negligible (N)
Shallow reserves of coal	MSA.	MSA defined by WMDC.	Moderate	Minor	Negligible (N)
Deep reserves of coal	Planning permission granted for extraction of coal at New Crofton[120].	Proposed New Colliery. Deep coal defined by Coal Authority as below 50m.	Moderate	Minor	Negligible (N)

[120] Planning consent ref. 13/03206/MIN accessible via WMDC planning portal. Available online at: https://planning.wakefield.gov.uk/online-applications/applicationDetails.do?previousCaseType=Application&previousKeyVal=O4JFQDQQ08600&activeTab=summary&previousCaseNumber=13%2F03206%2FSUB03&keyVal=MWI72RQQ08600

Site name	Status	Description	Sensitivity/ value	Magnitude of impact	Effect and significance (Y/N)
Carboniferous Bowland-Hodder Shale Prospective Area	PEDLs 273 and 37.	Extent of hydrocarbons with potential for exploitation for gas.	High	Negligible	Negligible (N)

10.4.35 There would be negligible effects on four mining, mineral and gas resources, which would not be significant.

Geo-conservation sites

10.4.36 One geo-conservation site (a SSSI) is present within the study area, at Nostell Brickyard Quarry, which was designated because of its geological features. However, a 2010 condition survey described this site as 'destroyed' and, therefore, no assessment of geo-conservation resources has been undertaken.

Other mitigation measures

10.4.37 At this stage, no additional measures are considered necessary to mitigate risks from land contamination during the construction stage beyond those that are set out in the draft CoCP and/or instigated as part of the site specific remediation strategies that would be developed at the detailed design stage if required. These measures would ensure that risks to people and property from contaminants in the ground would be controlled such that they would not be significant. For example, measures might include excavation and treatment of contaminated soils or controls to manage movement of landfill gas and leachate.

10.4.38 Mitigation of the effects within the existing MSA could include extraction of the resource in landscaping areas within the Proposed Scheme adjacent to, rather than beneath the structural footprint of the Proposed Scheme, which would require good founding conditions. A plan would be discussed in advance of the construction works with the landowner, the mineral planning departments at WMDC and BMBC, and any other relevant parties to assist in achieving an effective management of minerals within the affected location of the MSAs.

Summary of likely residual significant effects

10.4.39 Based on the information currently available and with the application of the mitigation measures detailed above, no likely significant residual effects are anticipated with respect to land quality.

10.5 Effects arising from operation

10.5.1 Users of the Proposed Scheme (i.e. rail passengers) are at all routine times within a controlled environment (i.e. within trains), and have therefore been scoped out of the assessment.

Avoidance and mitigation measures

10.5.2 Maintenance and operation of the Proposed Scheme would be in accordance with environmental legislation and good practice. Spillage and pollution response procedures similar to those to be outlined in the draft CoCP would be established for all high risk activities and employees would be trained in responding to such incidents.

Assessment of impacts and effects

10.5.3 The Proposed Scheme within this area would include two auto-transformer stations, to be located to the south of Barnsley Road and to the north of Swine Lane. Auto-transformer stations and sub-stations can, in principle, be a source of contamination through accidental discharge or leaks of coolant. However, in common with other modern sub-stations, secondary containment appropriate to the level of risk would be included in the installed design.

10.5.4 The operation of the trains may give rise to minor contamination through leakage of hydraulic or lubricating oils. However, such leakage or spillage is expected to be very small and unlikely to result in significant contamination.

Other mitigation measures

10.5.5 No other mitigation measures are expected to be required beyond what has already been outlined relating to land quality in the study area.

Summary of likely residual significant effects

10.5.6 No significant residual effects are anticipated associated with operation of the Proposed Scheme.

Monitoring

10.5.7 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme. Requirements for monitoring would be determined as part of the investigation, treatment and validation of contamination on a site specific basis as part of the detailed design process. Monitoring requirements may include water quality, air quality and/or (landfill bulk and trace gases), depending on the site being considered.

11 Landscape and visual

11.1 Introduction

11.1.1 This section of the report presents the assessment of the likely significant landscape and visual effects identified to date within the South Kirkby to Sharlston Common area. It summarises the baseline conditions found within and around the route of the Proposed Scheme and describes the likely impacts and significant effects during construction and operation on landscape and visual receptors.

11.1.2 The operational assessment section refers not just to the running of the trains, vehicles on roads and any associated lighting but also the presence of the new permanent infrastructure associated with the Proposed Scheme.

11.1.3 Engagement with Wakefield Metropolitan District Council (WMDC), Barnsley Metropolitan Borough Council (BMBC) and the Dearne Valley Landscape Partnership (DVLP) has commenced. The purpose of this engagement has been to discuss the assessment methodology, extent of the landscape and visual study area, and the locations of visual assessment and verifiable photomontage viewpoints. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.

11.1.4 The Volume 2: LA14 Map Book shows the locations of key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and operational (Map Series CT-06) features of the Proposed Scheme. It also shows the locations of landscape and visual impact measures (Map Series CT-06) and viewpoints that would potentially be significantly affected at the construction (Map Series LV-03) and operation (Map Series LV-04) phases and Landscape Character Areas (LCA) that would potentially be significantly affected at the construction and operation phases (Map Series LV-02).

11.1.5 A separate, but related, assessment of effects on the setting of heritage assets is reported in Section 9, Historic environment.

11.2 Scope, assumptions and limitations

11.2.1 The scope, key assumptions and limitations for the landscape and visual assessment are set out in full in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[121].

11.2.2 Summer surveys for the landscape and visual assessment were undertaken from August to September and winter surveys from October 2017 to March 2018 to inform the assessment. Further surveys will be undertaken to inform the assessment and will be reported in the formal ES.

11.2.3 At this stage it has not been possible to complete surveys of all publicly accessible land in this area; therefore, for the working draft ES an assumption has been made

[121] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

about the level of sensitivity and magnitude of change on a case by case basis using professional judgement. This will be adjusted, as appropriate, on the basis of survey results to inform the formal ES.

11.2.4 The extent of the study area has been informed by construction and operational phase zones of theoretical visibility (ZTV). The ZTVs have been produced in line with the methodology described in the SMR and are an indication of the theoretical visibility of the Proposed Scheme. In some locations, extensive vegetation cover would mean the actual extent of visibility is substantially less than that shown in the ZTVs, and professional judgement will be used to further refine the study area to focus on likely significant effects.

11.2.5 Tall construction plant (for example cranes and piling rigs) is excluded from the ZTVs for the construction phase, as there is a great degree of variability in the extent and timeframes of the visibility of construction activity and plant. Overhead line equipment rarely gives rise to significant effects if it is the only element visible and has, therefore, been excluded from the ZTVs to give a better indication of the possible spread of significant effects to aid the assessment.

11.2.6 Landscape and visual receptors within approximately 1.5km of the route of the Proposed Scheme have been assessed as part of the study area. Long distance views of up to 2km have been considered at settlement edges across the study area, including the towns of South Kirkby and Hemsworth and the villages of Brierley, South Hiendley, Kinsley, Ryhill, Havercroft (including Newstead), Fitzwilliam, Crofton and Sharlston. This assessment is based on preliminary design information and makes reasonable worst case assumptions on the nature of potentially significant effects where these can be substantiated. It is based on information known at present. The assessment of visual effects during construction covers the situation in winter of year 1. The assessment of operational visual effects covers the situation in winter and summer of year 1 and summer of year 15. The assessment of landscape effects is undertaken for the construction phase and for the operational phase at both year 1 and year 15. The landscape assessment does not consider seasonal variations e.g. winter/summer, since these do not affect character. Likely significant landscape and visual effects for year 30 will be reported in the formal ES.

11.2.7 Professional judgements on landscape value are summarised in the baseline descriptions and judgements on landscape susceptibility and sensitivity are summarised as part of the assessment of effects on each significantly affected LCA. Full judgements on value, susceptibility and sensitivity will be provided in the formal ES.

11.2.8 The assessment has been carried out on the basis that design of structures would, insofar as reasonably practicable, integrate with existing skyline features and would make use of a simple, clean and coherent palette of materials to help structures fit in the landscape.

11.3 Environmental baseline

Existing baseline

Landscape baseline

11.3.1 The South Kirkby to Sharlston Common area extends from South Kirkby in the south to Crofton and Sharlston in the north.

11.3.2 The area comprises a gently undulating and rolling landscape with local variation in landform provided by the tributaries of the Rivers Aire, Went, Don and Dearne. In places these tributaries have been straightened, such as Frickley Dike.

11.3.3 The underlying coal measure geology has given rise to relatively poor soils that are now intensively used as arable land. Across much of the study area, fields have been enlarged with many hedgerows, woodland, heathland, wetland and other traditional landscape features removed. Fields are typically medium to large with gappy and unmanaged hedgerows and are dominated by large-scale arable agriculture. Fragments of a smaller historic field pattern are found around Ryhill, with areas of pasture close to South Kirkby and Crofton. Woodland remains in only a few locations and, with the exception of areas around Nostell Priory, are mostly small and fragmented. Some pockets of ancient woodland remain near Hemsworth Marsh, Cold Hiendley Reservoir and at Nostell Priory. Elsewhere, linear tree belts are found along the stream valleys and transport corridors. Relic degraded heathland is found at South Hiendley Common and Sharlston Common.

11.3.4 Settlements comprise the former coal mining towns of South Kirkby and Hemsworth and the villages of Brierley, South Hiendley, Kinsley, Ryhill, Havercroft (including Newstead), Fitzwilliam, Crofton and Sharlston. To the east of the area is Nostell Priory, a Grade II* Registered Park and Garden that comprises 121ha of gardens and pleasure grounds surrounding a contemporary house (Nostell Priory, a Grade I listed building).

11.3.5 Linear transport corridors include the Doncaster to Wakefield Line, the A628 Hemsworth Bypass, the A638 Doncaster Road and the A645 Wakefield Road as well as a network of minor roads and farm access tracks. Pylon lines cross the study area south of Hemsworth and south of South Hiendley and there is a tall communications mast at Brierley Gap.

11.3.6 Overall the landscape is relatively scenic and rural in character and provides an important recreational resource with a public rights of way (PRoW) network that includes National Cycle Route 67, the Barnsley Boundary Walk, Wakefield Way and Wakefield Wheel cycleway route, which are all found to the west of the study area. There are also a number of recreational areas such as Hemsworth Water Park, Waterton Park, Anglers Country Park, Wintersett Reservoir, Fitzwilliam Country Park, Nostell Priory and Walton Colliery Nature Park.

11.3.7 None of the area has been identified as being of 'special' landscape value in the local plans for WMDC or BMBC.

11.3.8 The LCAs have been determined as part of an integrated process of environmental characterisation, informed by a review of historic landscape mapping and the outcome from other topics including ecological assessments. These LCAs will be

refined, as appropriate, upon review of available historic landscape characterisation data and will be included in the formal ES. Use has been made of published landscape character assessments and a wide range of supporting GIS data, aerial photography and Ordnance Survey mapping, plus desk study data/records and fieldwork. Landscape character assessments reviewed include the relevant National landscape character areas (LCAs)[122], Landscape Character Assessment of WMDC[123], BMBC Landscape Character Assessment[124] and the DVLP Landscape Character Assessment[125].

11.3.9 These published LCAs have been adapted for this assessment to provide project specific LCAs of an appropriate and consistent scale. Minor amendments have also been made to some published LCA boundaries to reflect existing conditions.

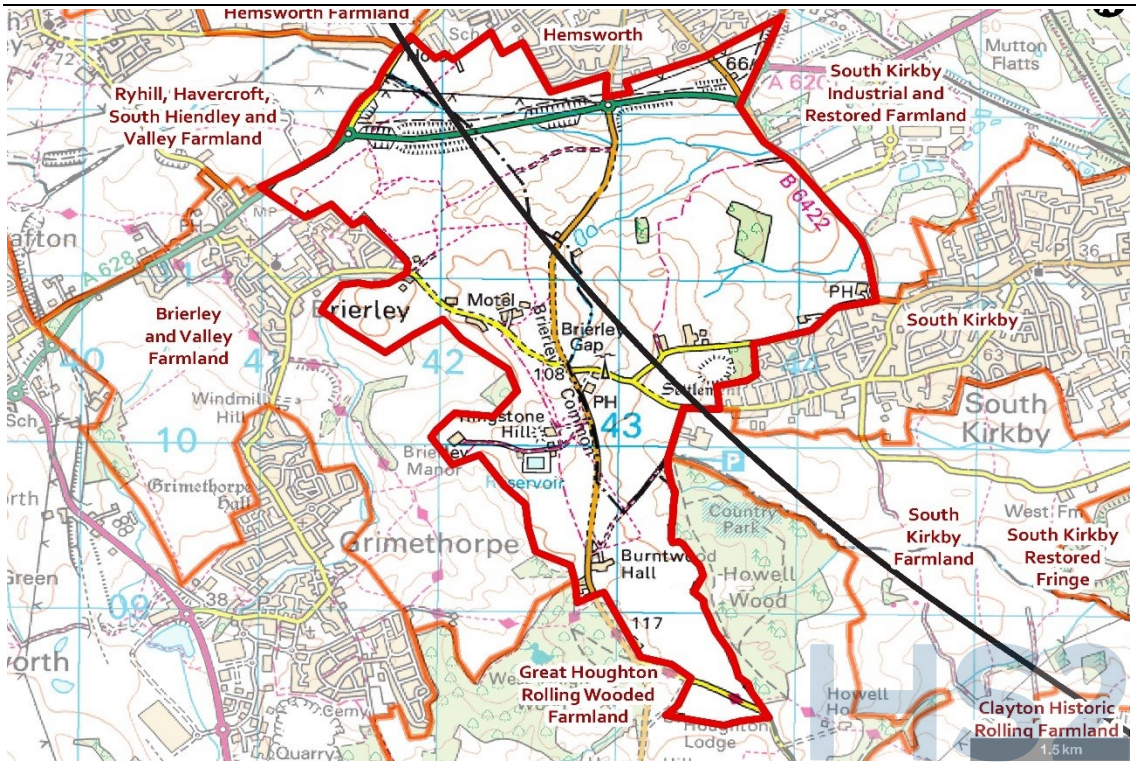
11.3.10 For the purposes of this assessment, the study area for the South Kirkby to Sharlston Common area has been subdivided into 15 LCAs. These LCAs are draft and subject to review in consultation with local planning authorities. Full descriptions of all LCAs will be provided in Volume 5 of the formal ES. Eleven of the 15 LCAs would not be significantly affected by the Proposed Scheme as there would be no physical changes to landscape characteristics and/or the LCAs would be at a distance from the Proposed Scheme.

11.3.11 The South Kirkby Farmland LCA and Sharlston Coalfield Farmland LCA would be significantly affected by the Proposed Scheme and are included in Volume 2, Community Area report LA13: Ravenfield to Clayton and Volume 2, Community Area Report LA15: Warmfield to Swillington and Woodlesford as they are located for the most part within these areas. A summary of the four LCAs that would be significantly affected by the Proposed Scheme within the LA14 South Kirkby to Sharlston Common area is provided in Table 22.

[122] Natural England, (2014), *National Character Area profiles*. Available online at: https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making/national-character-area-profiles
[123] WMDC, (2004), *Landscape Character Assessment of Wakefield Council.* Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/information-monitoring/ldf-landscape-assessment.pdf
[124] BMBC, (2002), *Barnsley Borough Landscape Character Assessment*. Available online at: https://www.barnsley.gov.uk/media/4585/eb86-barnsley-landscape-character-assessment.pdf
[125] DVLP, (2012), *Dearne Valley Landscape Character Assessment*. Available online at: http://discoverdearne.org.uk/story-of-the-dearne/nature/landscape-character/

Table 22: Summary of significantly affected LCAs

Southmoor and Brierley Farmland



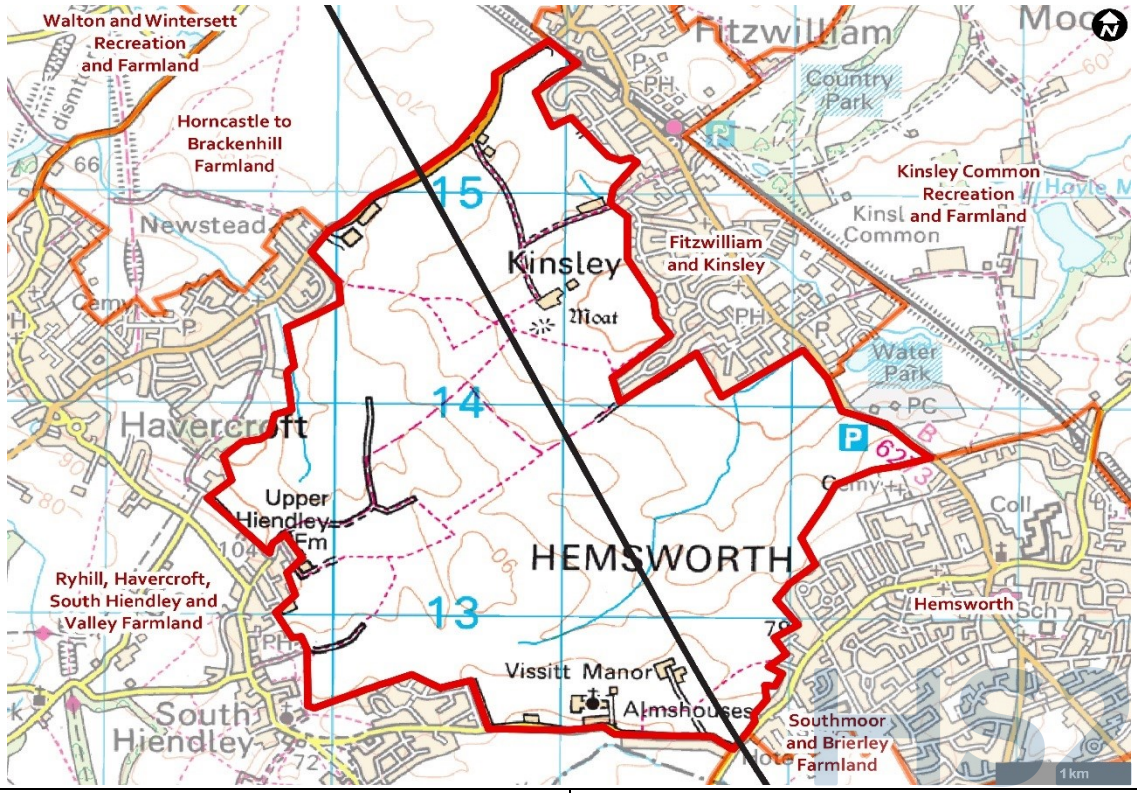
View from PRoW showing rolling farmland, panoramic views, poor hedgerows and trees along the A628 Hemsworth Bypass

View from PRoW showing large open fields, buildings on the ridgeline and remnant trees along watercourse

The Southmoor and Brierley Farmland LCA is an area of slightly elevated rolling farmland which is mostly in intensive arable cultivation. This has resulted in loss of hedgerows through field amalgamation, particularly in the central part of the LCA where medium to large or very large fields are bounded by fragmented hedgerows and remnant hedgerow trees. A more intact field pattern with smaller, irregular hedged fields and hedgerow trees is found to the east of the LCA and west of Common Road. To the south of the LCA, the land covered by the medieval Brierley Common, Kirkby Common and South Kirkby Common is still visible in the field pattern. Kirkby Common is the site of a pre-historic enclosed settlement known as South Kirkby Camp scheduled monument. South Kirkby, Brierley and Hemsworth lie just outside the LCA, with Hemsworth in particular exerting a visual influence on the landscape to the north of the LCA. Settlement within the LCA comprises the occasional scattered farms or commercial properties accessed by a network of small lanes and private tracks. The A628 Hemsworth Bypass broadly follows the route of a disused railway and a prominent pylon line crosses the northern part of the LCA just south of Hemsworth. The area includes local recreational resources, including the Burntwood Court Hotel, which is set in landscaped grounds and a small PRoW network. Despite being surrounded by settlement and experiencing a decline in scenic quality due to intensification of farming practices, much of the LCA has a rural and in places expansive, tranquil and remote quality.

The overall value of this LCA is medium-low due to the proximity of the landscape to nearby settlement and agricultural intensification which has led to loss of scenic quality and perceptual aspects such as remoteness and tranquillity.

Kinsley and Hemsworth Farmland



View from Hemsworth showing large open fields and buildings at South Hiendley and Havercroft on ridgeline

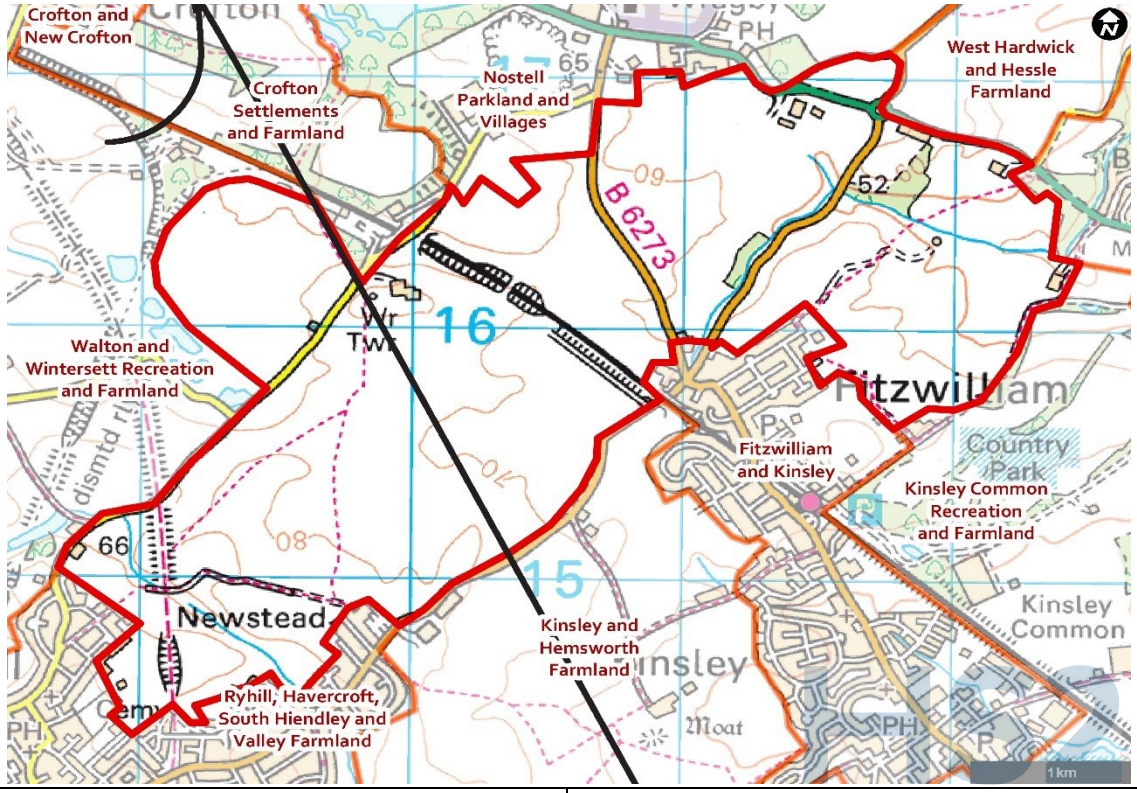
View from Hemsworth showing housing, conifers enclosing settlements and trees along B6428 Newstead Lane

The rolling farmland of the Kinsley and Hemsworth Farmland LCA forms a slightly elevated plateau that falls gently in an easterly direction. Although the field pattern becomes slightly smaller closer to the B6428 Newstead Lane, which forms the northern boundary of the LCA, fields are mostly large with few hedgerows or hedgerow trees to introduce a sense of enclosure. There is little woodland other than the immature woodland and scrub on the site of the former New Monckton Colliery. Springs are common and there are some drainage ditches and occasional field ponds. This is a rural and historic landscape although the field patterns seen today mostly result from the 20th century. Newstead Hall (formerly Grade II* listed) and Kinsley Moat and Fishpond scheduled monument, near Carr Farm, exert little influence on the wider landscape. Vissitt Manor and Holgate Hospital are both Grade II listed and set within landscapes that have an extensive covering of mature trees, which provides a sense of enclosure to the southern end of the LCA. The LCA has little settlement other than some isolated farms close to its boundary. Other than the B6428 Newstead Lane there are no roads or railways and only a limited PRoW network. The landscape has an expansive quality and there are some extensive panoramic views, particularly from the PRoW on the higher land to the west. On a clear day, up to four power stations can be seen on the horizon to the

east and north-east. These are Ferrybridge, now closed and due for demolition, Eggborough, Drax and Thorpe Marsh. These panoramic views impart a sense of remoteness and vastness to the perception of the landscape and tend to draw the eye more than the views of surrounding settlement, which impart a more urban fringe character.

The overall value of this LCA is medium-low due to this being a mostly large-scale and open arable farmland landscape with some urbanising influences including nearby settlements and multiple wood pole lines.

Horncastle to Brackenhill Farmland



View from PRoW at watercourse showing open arable fields, intermittent vegetation and recreational use

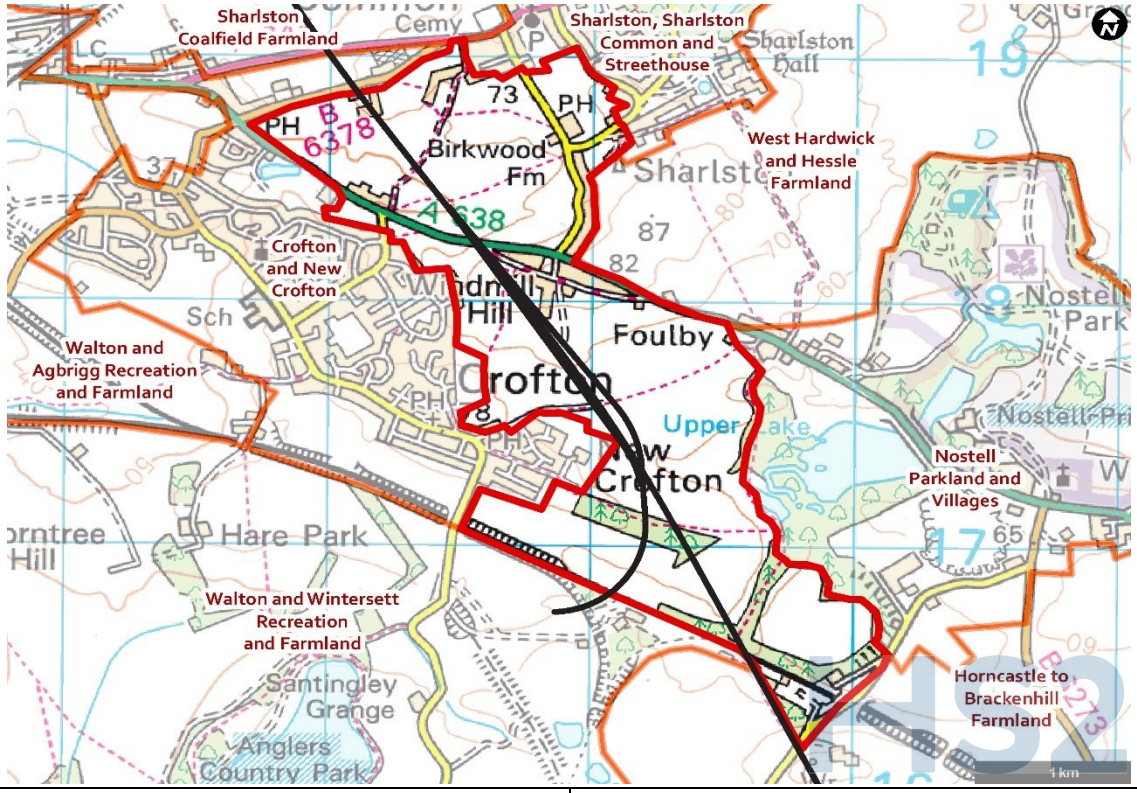
View across rolling farmland with open fields giving way to a smaller pattern of fields with hedgerows and hedgerow trees

The Horncastle to Brackenhill Farmland LCA is an area of relatively scenic undulating and rolling farmland which falls gently eastwards from a low sandstone ridgeline at Ryhill. Much of the LCA is intensively farmed with medium and large-scale irregular arable fields and pastures, and fragmented or absent hedgerows with scattered hedgerow trees. The exception is around Ryhill, Havercroft and Newstead where there is a pattern of smaller, rectilinear pastures bounded by more intact hedgerows. There are few woodland blocks but linear tree belts follow the transport corridors and stream valleys which are found to the west and east of the LCA and include Hessle Beck, which flows through Taylor Wood. To the north, developing scrub vegetation has colonised a disused tip and waste ground on the site of the former Nostell Long Row. There is little settlement within the LCA, but the former mining villages of Ryhill, Havercroft (including Newstead), Fitzwilliam and Brakenhill lie just outside to the west and east. The Doncaster to Wakefield Line bisects the LCA and the dismantled Dearne Valley Junction Railway crosses its western extent. There are few public roads and access is via the infrequent farm tracks

and the small PRoW network. Much of the central part of the LCA, with its large, gently undulating open fields and drainage ditches, is relatively inaccessible and has a remote, tranquil and expansive character.

The overall value of this LCA is medium due to this being a relatively scenic rural landscape, parts of which have a tranquil and remote character.

Crofton Settlements and Farmland



View from PRoW showing rolling fields, recreational use and woodland edge around Nostell Park and Gardens

View from PRoW showing rolling topography, medium sized open arable fields, intermittent trees and housing edge

The Crofton Settlements and Farmland LCA comprises a series of shallow undulations falling north and south from a ridgeline on the A638 Doncaster Road near Windmill Hill. Situated between the mining settlements of Crofton and Sharlston, there is little evidence of the coal mining activities around Nostell Colliery, which once heavily influenced the landscape. It is a rural landscape of medium to large-scale arable farmland, with some smaller, more intimate and irregular pastures close to the B6378 Pontefract Road in the north. Fields are defined by a relatively intact hedgerow pattern with hedgerow trees. Areas of scrub and woodland belts are associated with transport corridors, including the existing Doncaster to Wakefield Line, while developing woodland and scrub is a distinctive feature on restored former colliery land and south of the plant training centre at Sharlston Common. Along the eastern edge of the LCA, proximity to the parkland at Nostell Priory imparts a more attractive, enclosed and wooded character to the landscape. Settlement is focussed on the A638 Doncaster Road although the nearby villages locally impart a more rural fringe character to the landscape. The area is an

important local recreational resource with a well-defined PRoW network that connects to the edge of Nostell Priory and includes the Wakefield Wheel cycle route. This is a relatively scenic rural landscape, with some tranquil areas away from the roads and railway.

The overall value of this LCA is medium due to its being a rural landscape of important local recreational value.

Visual baseline

11.3.12 A summary description of the distribution and types of receptors most likely to be affected is provided below. The viewpoints are numbered to identify their locations and are shown on the viewpoint location maps (see Volume 2: LA14 Map Book, Map Series LV-03 and LV-04). In each case, the middle number (xxx.**xx.**xxx) identifies the type of receptor that is present in this area – 1: Protected views (none within this area), 2: Residential, 3: Recreational[126], 4: Transport, 5: Hotels/healthcare/education and 6: Employment (none within this area).

11.3.13 Views of the Proposed Scheme within the area would generally be gained from public highways, PRoW, settlements, residential properties and employment areas up to 1km distant.

11.3.14 Views within the study area are also obtained by residents located within and around the settlements of South Kirkby, Brierley, Hemsworth, South Hiendley, Kinsley, Ryhill, Havercroft, Newstead, Fitzwilliam, Crofton, Sharlston and New Sharlston. Linear developments along roads, such as the A638 Doncaster Road, the B6378 Pontefract Road and Robin Lane, also afford views of the local landscape. Residents are also found at the many dispersed properties and farmsteads. Views experienced are typically over agricultural land towards settlements and commercial areas to the east and west of the route of the Proposed Scheme. From elevated locations in the west, views frequently extend beyond immediate villages to the wider rural and industrial landscapes beyond.

11.3.15 Views from settlement edges are typically filtered and framed by intervening garden and field boundary vegetation, but there are some locations, for example on the western edge of Hemsworth, along the B6378 Pontefract Road and within Sharlston, where there are long views out across large-scale open farmland, towards neighbouring villages and the wider landscape beyond.

11.3.16 The PRoW network includes many footpaths, bridleways and cycleways. National Route 67 (part of the National Cycle Network), Barnsley Boundary Walk, Wakefield Way and Wakefield Wheel cycle route all cross the study area. Views from the PRoW network are variable depending on the local landscape and in many locations are restricted or filtered by landform or by hedgerows and trees. In places there are elevated panoramic views beyond the settlements to the west and south.

11.3.17 Key transport receptors within the area include users of Common Road, Holmsley Lane, the B6273 Southmoor Road, the A628 Hemsworth Bypass, Barnsley Road, the B6428 Newstead Lane, Swine Lane, the A638 Doncaster Road and the A645 Weeland

[126] Reference to specific civil parish numbers for footpaths is provided where available otherwise the adjacent road name is used as a reference to the footpath.

Road. Views from these roads are variable depending on the elevation and amount of roadside vegetation.

11.4 Temporary effects arising during construction

11.4.1 As is commonplace with major infrastructure works, the scale of the construction activities means that works would be visible from many locations and would have the potential to give rise to significant temporary effects that cannot practicably be mitigated. Such effects are temporary and would vary over the construction period depending on the intensity and scale of the works at the time. The assessment of landscape and visual effects has been based on the activities occurring during the peak construction phase, which is defined as the period during which the main construction works would take place, including the presence of compounds, main earthworks and structure works.

11.4.2 The effects associated with the peak construction stage in this area are generally considered to be medium-term, based on the indicative construction programme in Section 2.3. It is currently anticipated that the peak civil engineering stage in this area would be undertaken between the end of 2024 and start of 2029. Effects during other stages of works are likely to be less intensive due to less construction equipment being required at the time and a reduced intensity of construction activity.

11.4.3 Section 2.2 sets out the key permanent features of the Proposed Scheme and Section 2.3 describes the construction compounds and associated temporary works that have been considered in this assessment.

11.4.4 Measures that have been incorporated into Sections 12 and 14 of the draft Code of Construction Practice (CoCP)[127] to avoid or reduce landscape and visual effects, where reasonably practicable, during construction include the following:

- avoidance of unnecessary tree and vegetation removal, and protection of existing trees in accordance with BS 5837: Trees in relation to design, demolition and construction[128];
- use of well-maintained hoardings and fencing;
- prevention of damage to the landscape features adjacent to the construction sites due to movement of construction vehicles;
- designing lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses; and
- replacement of any trees intended to be retained which may die as a consequence of nearby construction works.

11.4.5 Implementation of these measures has been taken into account in the assessment of the construction effects.

[127] Supporting document: Draft Code of Construction Practice
[128] BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations, 2012, British Standard.

Assessment of temporary impacts and effects

11.4.6 The most apparent changes to the landscape and to the views experienced by visual receptors during construction would relate to the presence of construction plant, compounds and soils and material storage and stockpiling. Key construction activities that would give rise to the most apparent changes to landscape and visual receptors are: the removal of existing landscape elements, including trees and hedgerows; construction of viaducts, cuttings and embankments; the closure and diversion of existing roads and PRoW; the presence of construction plant; and the stockpiling of soils and materials. Other key changes include the construction of overbridges and underbridges; utility diversions; the presence of transfer nodes and concrete batching plant; and demolition of buildings and structures.

Landscape assessment

11.4.7 Based on the current design it is anticipated that the LCAs set out in Table 23 would be significantly affected during construction of the Proposed Scheme.

Table 23: Construction phase significant landscape effects

Southmoor and Brierley Farmland	**Medium-low susceptibility and sensitivity**
Susceptibility to change: There are some pockets of higher susceptibility around the historic features, but overall the undulating and gently rolling landform and intensive arable farmland has a medium-low susceptibility to change which would arise from the Proposed Scheme. The western and central part of this LCA would be affected by construction of Howell Wood cutting, Brierley embankment, Hemsworth cutting and realignment of the B6273 Southmoor Road, which would require construction of a new overbridge. The construction activity would substantially alter the character and appearance of the rural landscape, with a reduction in scenic quality and changes to the undulating and gently rolling landform and noticeable loss of hedgerows. Near the A628 Hemsworth Bypass, a group of mature trees would have to be removed. The associated earth moving equipment and material stockpiles would introduce further noise and visual disturbance while north of the bypass, construction compounds, a concrete batching plant and temporary workers accommodation would be at variance with existing landscape character. The construction activity would be noticeable across much of the western and central part of this LCA, but the eastern smaller scale and more scenic landscape would be relatively unaffected. Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Kinsley and Hemsworth Farmland	**Medium-low susceptibility and sensitivity**
Susceptibility to change: There are some pockets of higher susceptibility around the historic features, but overall the slightly elevated plateau landform and large-scale intensive arable farmland has a medium-low susceptibility to change which would arise from the Proposed Scheme. The prominence of the earthworks associated with construction of Hemsworth cutting, Kinsley embankment and Havercroft cutting would adversely affect this LCA through large-scale changes to the gently rolling landform and field pattern, and removal of trees and hedgerows. The landscape would be further impacted by the presence of a construction compound, construction vehicle movements and noise which would be at variance with the existing undeveloped character of the farmland and reduce the tranquillity and sense of remoteness currently experienced. Due to its proximity to the western edge of Hemsworth cutting, the effects on the well-treed landscape around Vissitt Manor, one of the few landscape features of note in this part of the LCA, would be particularly apparent in terms of reduction of	**Level of effect:** Moderate adverse (significant)

tranquillity and scenic quality through noise and visual disturbance. The large-scale earthworks and changes to the rolling landform would be very noticeable across the central part of this LCA, but much of the western and eastern parts would be unaffected. Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.	
Horncastle to Brackenhill Farmland	**Medium susceptibility and sensitivity**
Susceptibility to change: The undulating rolling landform, linear tree belts and in places remote, tranquil and expansive qualities of this LCA have a medium susceptibility to change which would arise from the Proposed Scheme. The nature and scale of the activity associated with construction of the Havercroft cutting and Nostell viaduct would create large-scale changes to the undulating landform. This would be particularly apparent at Horncastle Hill where Havercroft cutting would sever the crest of the hill. This activity and the presence of a construction compound, earth moving equipment and material stockpiles would be at variance with the existing undeveloped character of the farmland, while cranes used for constructing Nostell viaduct would be prominent and uncharacteristic skyline features. The visual and noise disturbance would reduce the tranquillity and sense of remoteness currently experienced. The impacts on the central part of the LCA would be high, but the more scenic western and eastern parts of the area would be largely unaffected. Construction of the Proposed Scheme would therefore result in a medium magnitude of change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Crofton Settlements and Farmland	**Medium susceptibility and sensitivity**
Susceptibility to change: The undulating landform (including Horncastle Hill), field pattern and relatively intact hedgerow network and rural qualities of this LCA have a medium susceptibility to change which would arise from the Proposed Scheme. Much of this relatively small and narrow LCA would be substantially altered by construction activity associated with Nostell viaduct and Crofton viaduct and a series of embankments and cuttings. The nature and scale of the works would substantially alter the rural farmland, with removal of trees and hedgerows, fragmentation of the farmland and large-scale changes to the undulating landform. Removal of trees within the southern part of the LCA, including along the edge of Horncastle Wood, would be very noticeable. The character of the landscape would be further diminished due to the presence of construction compounds, earth moving equipment and material stockpiles while cranes used for constructing the two viaducts would be prominent and uncharacteristic skyline features. The construction activity would add to the loss of tranquillity already experienced due to the presence of the A638 Doncaster Road and Doncaster to Wakefield Line. Construction of the Proposed Scheme would therefore result in a high magnitude of change and major adverse effect.	**Level of effect:** Major adverse (significant)

Visual assessment

Introduction

11.4.8 The following section describes the likely significant effects on visual receptors during construction. The construction assessment has been undertaken for the winter period, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of construction activities may be reduced during summer when vegetation, if present in a view, would be in leaf.

11.4.9 Where a viewpoint represents multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with lower sensitivity would be lower than those reported.

11.4.10 Night-time surveys will be undertaken to inform the assessment in the formal ES. Potential visual impacts arising from additional lighting at night during construction within the area may arise from continuous working and/or overnight working. Assessment of these effects will be reported in the formal ES on completion of the night time assessment.

11.4.11 Table 24 describes the construction phase potentially significant visual effects based on the current design of the Proposed Scheme. These are shown in Map Series LV-03 in the Volume 2: LA14 Map Book.

Table 24: Construction phase potentially significant visual effects

View west from a PRoW south of South Kirkby (VP416-03-005) (Map Number LV-03-416b)	**Medium-high sensitivity receptors**
Users of the footpath would experience a substantial alteration to existing near and middle distance views across small scale, rolling and well-treed farmland, including longer views towards the wooded horizon around Howell Wood Country Park due to the large-scale construction activity associated with Clayton North embankment and Howell Wood cutting, to the east of Howell Wood Country Park. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View east from Ringstone Hill Farm (VP417-02-003) (Map Number LV-03-417)	**High sensitivity receptors**
Residents of Ringstone House would experience changes to middle distance, slightly elevated views as a result of construction activity associated with Howell Wood cutting and associated earth moving equipment and material stockpiles. This activity would introduce new and uncharacteristic features into the sloping arable farmland and substantially alter the rolling landform and medium-scale landscape pattern with consequent effects on scenic quality. Construction activity around Common Road overbridge and B6273 Southmoor Road overbridge would further affect the views around the southern and northern end of the Howell Wood cutting respectively. Hedgerow removal along Common Road and Holmsley Lane would also be very noticeable. Views of the material stockpiles and B6273 Southmoor Road overbridge would however be partially screened and filtered by intervening vegetation which would lessen the overall effect of the construction activity in this location. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View east from a PRoW east of Common Road (VP 417-03-005) (Map Number LV-03-417	**Medium-high sensitivity receptors**
Users of the footpath would have near distance, slightly elevated views of construction activity associated with Brierley embankment, B6273 Southmoor Road overbridge and an accommodation underbridge. Movement of material to construct the embankment and an accommodation underbridge and the consequent changes to the rolling landform would be directly in the frame of view. The current outlook across gently rolling fields would be replaced by one of large-scale construction, which would extend across much of the view. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and	**Level of effect:** Major adverse (significant)

major adverse effect.	
View west from a PRoW to the south of the A628 Hemsworth Bypass and west of Southmoor Road (VP417-03-010) (Map Number LV-03-417)	**Medium-high sensitivity receptors**
Users of the footpath would have near distance views across rolling arable farmland towards construction activity associated with Brierley embankment and the A628 Hemsworth Bypass underbridge to the west and north-west, and of Hemsworth cutting and Barnsley Road overbridge visible on the hillside in the distance to the north-west. To the south there would be filtered views of the construction of the B6273 Southmoor Road overbridge diversion and tie in with the existing road. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Views north and east from Park View on edge of Brierley Park (VP 417-02-009, 418-03-002 and 418-03-001) (Map Number LV-03-417)	**High sensitivity receptors**
Residents on the edge of Brierley Park and users of the recreational footpaths in the area would experience a substantial alteration to near and middle distance panoramic views across gently rolling arable fields due to construction of Brierley embankment and Hemsworth cutting. Long views to distant settlement and wooded hills on the horizon would also be interrupted by the construction activity, which would be visible across much of the view. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View east from Frickley Bridge Lane near Brierley (VP418-02-003) (Map Number LV-03-418)	**High sensitivity receptors**
Residents and road users would have long distance views of construction activity and material stockpiles associated with Barnsley Road overbridge and Hemsworth cutting which would noticeably change the existing rural outlook over well-wooded rolling arable farmland. Construction of the Robin Lane diversion would also be visible to the north-east where it would intrude on skyline views of existing woodland and housing along Robin Lane. Construction compounds, a transfer node, workers' accommodation site and concrete batching plant would be partially visible and further add to the loss of scenic quality. Although the construction activity would be present across much of the field of view, it would not be visible at close range and in places would be screened and filtered by intervening field boundary vegetation and mature trees along the disused railway in the middle distance. This would lessen its overall effect. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View south and west from a bridleway south of Kennels Farm near Brierley (VP418-03-005) (Map Number LV-03-418)	**Medium-high sensitivity receptors**
Users of the bridleway would experience near distance and open views of construction activity associated with Brierley embankment, A628 Hemsworth Bypass underbridge and Hemsworth cutting. To the south, the loss of mature vegetation along both sides of the A628 Hemsworth Bypass would open up views of the bypass and passing vehicles. Overall the rural outlook across gently rolling arable farmland would be substantially altered. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)

Views from residences along Robin Lane and the residential edge of Hemsworth (VPs 418-03-007, 418-02-010, 418-03-012 and 418-02-013) (Map Number LV-03-418)	**High sensitivity receptors**
Residents of Robin Lane, road users and users of footpaths on the edge of Hemsworth would experience a substantial alteration to near distance views due to construction activity associated with Hemsworth cutting, Kinsley embankment and Robin Lane diversion. The rural outlook across gently rolling arable fields would be replaced by views of large-scale construction. Depending on the actual viewpoint location, there would be some screening and filtering by intervening vegetation, but residents and road users would typically have extensive views of the works Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View east from a PRoW in farmland between South Hiendley and Kinsley (VP 419-03-003) (Map Number LV-03-419)	**Medium-high sensitivity receptors**
Users of the footpath would experience a substantial alteration to their near and middle distance, slightly elevated views across open sloping arable farmland. This is due to construction activity associated with Kinsley embankment and associated earth moving equipment and material stockpiles. More distant views towards the edge of Kinsley and Fitzwilliam Country Park, which are a key characteristic of the view in this location, would be interrupted. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Views west from PRoW and residences on edge of Kinsley (VP 419-03-005 and 419-02-011) (Map Number LV-03-419)	**High sensitivity receptors**
Residents of Kinsley and users of the recreational footpaths would have extensive near and middle distance views of construction activity associated with Kinsley embankment and Hemsworth Bridleway 8 accommodation overbridge. The scenic quality of the rolling arable farmland which has already been diminished by agricultural intensification and loss of field boundary hedgerows would be further reduced. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View west from the east side of the B6273 Wakefield Road near Kinsley (VP419-02-009) (Map Number LV-03-419)	**High sensitivity receptors**
Residents, including those in Hemsworth Park Care Home, road users and visitors to Hemsworth Water Park and Vale Head Park would experience a noticeable alteration to middle distance views due to construction activity for Kinsley embankment, Hemsworth Bridleway 8 accommodation overbridge and associated earth moving equipment and material stockpiles. Although only part of the view would be affected due to the screening and filtering effect of vegetation along the B6273 Wakefield Road, this construction activity would be visible on the skyline and would alter the current outlook across arable farmland, which rises up away from the viewpoint. A construction access road to the Kinsley embankment from the B6273 Wakefield Road and moving vehicles would also be visible on the rising hillside in the near distance. The changes to the landform, loss of field boundary vegetation and the movement of vehicles would contribute to a reduction in scenic quality. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

View west from the edge of Fitzwilliam close to Newall Crescent (VP419-02-020) (Map Number LV-03-419)	**High sensitivity receptors**
Residents would experience a noticeable alteration to existing close and middle distance open views across large, gently rising arable fields. This is due to construction activity associated with Havercroft cutting, B6428 Newstead Lane realignment and B6428 Newstead Lane overbridge, although only part of the view would be affected due to the screening and filtering effect of intervening vegetation along Carr Lane, around Newstead Garden Centre and within private gardens. The changes to the landform and loss of field boundary vegetation would be very noticeable, while the presence of earth moving equipment and material stockpiles would also add to the loss of scenic quality and interrupt longer views to trees on the skyline near Horncastle Hill and Newstead. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View east from Brooklands Crescent and a PRoW in Newstead (VP419-02-024) (Map Number LV-03-419)	**High sensitivity receptors**
Residents of Newstead and users of the footpath would have slightly elevated, near to middle distance views of construction activity for Kinsley embankment and southern end of Havercroft cutting, and associated earth moving equipment and material stockpiles. The current rural outlook across open arable fields would be replaced by views of a large-scale and uncharacteristic construction activity and substantial changes to the rolling landform, although only part of the view would be affected due to the screening and filtering effect of vegetation within the hedgerow field boundary south of the footpath. Construction of Hemsworth Footpath 5 accommodation underbridge and the B6428 Newstead Lane overbridge would further contribute to the loss of scenic quality. The loss of field boundary hedgerows and trees would represent an alteration to one of the key characteristics of the view. More distant views towards the settlement edge of Fitzwilliam and Hemsworth would be interrupted. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View east from a PRoW in farmland south of Horncastle Farm (VP420-02-004) (Map Number LV-03-420)	**High sensitivity receptors**
Users of the footpath would have elevated, middle distance and panoramic views of construction activity for Havercroft cutting, the B6428 Newstead Lane overbridge, Swine Lane overbridge. This activity and the presence of earth moving equipment and material stockpiles would noticeably change the current outlook across well-treed arable farmland, although the rolling landform and intermittent field boundary trees would partially screen and filter some views. There would also be long distance views of construction activity associated with Nostell viaduct to the north-west, including cranes which would be seen against the skyline. The loss of mature trees along both sides of Swine Lane for construction of the Swine Lane overbridge would open up views of a construction compound. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

View west from a PRoW on the western side of Nostell Priory (VP420-03-014) (Map Number LV-03-421)	**Medium-high sensitivity receptors**
Users of the footpath would have slightly elevated and near distance views of the construction activity for the New Crofton North embankment and Crofton Footpath 11 accommodation underbridge. The presence of associated earth moving equipment and material stockpiles and the loss of an area of woodland would lead to a noticeable change in the existing views across the wooded and sloping farmland, although the works would be partially screened and filtered by the hedgerow on either side of the footpath which would lessen their overall effect. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View east from Wakefield Wheel cycle route between New Crofton and Fitzwilliam (VP420-03-012) (Map Number LV-03-420)	**Medium-high sensitivity receptors**
Users of the Wakefield Wheel cycle route would experience a substantial alteration to existing near distance views across woodland and scrub on a restored rail junction and coal disposal plant due to construction activity associated with New Crofton South embankment and New Crofton North embankment. To the east, removal of vegetation would open up views of construction of Nostell viaduct, including cranes which would be visible on the skyline. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View north and west from Horncastle Farm (VP420-02-005) (Map Number LV-03-420)	**High sensitivity receptors**
Residents of Horncastle Farm would experience a substantial change to existing near distance elevated, panoramic views across open rolling farmland due to construction activity associated with Havercroft cutting, Swine Lane overbridge and Swine Lane realignment. The scale and proximity of the works would dominate near distance views and interrupt longer views towards Wintersett. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View north and east from the Crofton Community Centre (VP421-03-005) (Map Number LV-03-421)	**Medium-high sensitivity receptors**
Users of Crofton Community Centre and the associated sports pitches would experience a substantial alteration to open views across sports pitches due to construction activity associated with New Crofton North embankment and Crofton retaining wall. The scale and proximity of the works would dominate near distance views and interrupt longer views towards Sharlston. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Views from residences and a PRoW on the edge of Crofton and Sharlston (VPs 421-02-007 and 421-02-013) (Map Number LV-03-417 and LV-03-021)	**High sensitivity receptors**
Residents of Crofton and Sharlston and users of the footpath would have middle distance slightly elevated and open views of construction activity associated with New Crofton North embankment. Although there would be some screening and filtering of views by intervening hedgerows and	**Level of effect:** Major adverse

occasional mature trees, the current outlook across arable farmland would be substantially altered. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	(significant)
View north and east from residences along the A638 Doncaster Road opposite Slack Lane and Pinfold Drive (VP421-02-021) (Map Number LV-03-421)	**High sensitivity receptors**
Residents and users of the A638 Doncaster Road and Towers Lane would have near to middle distance views of construction activity associated with Crofton viaduct, Crofton North embankment and associated earth moving equipment and material stockpiles. Cranes to construct the viaduct would be visible on the skyline. From the front of the properties and the A638 Doncaster Road, the Crofton cutting satellite compound would be an uncharacteristic new feature within what is currently a hedged field on the opposite side of the A638 Doncaster Road. To the rear of the properties, the construction would introduce new uncharacteristic features which would be visible from the upper storeys above the woodland to the south of the commercial facility. Construction of the Proposed Scheme would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View west from residences and a PRoW near the junction of The Green and West Lane (VP421-02-025) (Map Number LV-03-421)	**High sensitivity receptors**
Residents, users of the footpath and road users would have extensive middle distance and slightly elevated views of construction activity associated with Crofton cutting, Crofton viaduct, and Crofton North embankment. The current outlook across gently rolling open pastures towards the well-treed edge of New Crofton would be replaced by views of large-scale construction. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View south from a PRoW to the south of Sharlston Common (VP421-03-026) (Map Number LV-03-422a)	**Medium-high sensitivity receptors**
Users of the footpath would experience a substantial alteration to existing near to middle distance views across undulating, well-wooded arable farmland due to construction activity associated with Crofton viaduct and southern end of Crofton North embankment. Vegetation removal would be highly visible. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
View east from residences along the B6378 Pontefract Road close to The Priory Centre Pupil Referral Unit (PRU) (VP422-02-017) (Map Number LV-03-422a)	**High sensitivity receptors**
Residents along the B6378 Pontefract Road, road users and occupiers of The Priory Centre PRU would have near distance views of construction activities associated with Crofton North embankment. The current rural outlook across well-treed undulating fields would be replaced by large-scale construction. Demolition of buildings at Holme Bank Farm would open up more expansive views of the construction activity. Construction of the Proposed Scheme would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)

Other mitigation measures

11.4.12 To reduce the significant effects described above, consideration will be given during the detailed design stage to where planting can be established early in the construction programme to help achieve earlier landscape and visual integration. Early planting, including ecological mitigation sites, would have the benefit of providing some visual screening, however, not all landscape and visual effects can be mitigated due to the visibility of construction activity and the sensitivity of surrounding receptors. No other mitigation measures are considered practicable during construction.

Summary of likely residual significant effects

11.4.13 The temporary residual significant effects during construction remain as described above. These effects would be temporary and reversible in nature lasting only for the duration of the construction works. These residual effects would generally arise from the widespread presence of construction activity and construction plant within the landscape and viewed by surrounding residents, and users of PRoW, roads and recreational facilities within the study area.

11.4.14 The significant effects that would remain after implementation of construction phase mitigation are summarised below:

- major adverse effects in relation to one LCA;
- moderate adverse effects in relation to three LCAs;
- major adverse effects at nine residential viewpoint locations;
- major adverse effects at 13 recreational viewpoint locations;
- moderate adverse effects at six residential viewpoint locations; and
- moderate adverse effects at one recreational viewpoint location.

11.5 Permanent effects arising from operation

11.5.1 The permanent features of the Proposed Scheme that have been taken into account in determining the effects arising during operation on landscape and visual receptors are presented in Section 2.2 of this report.

Avoidance and mitigation measures

11.5.2 The operational assessment of impacts and effects is based on year 1 (2033) and year 15 (2048) of the Proposed Scheme, with Year 30 (2063) to be reported in the formal ES. A process of iterative design and assessment has been employed, and is ongoing, to avoid or reduce adverse effects during the operation of the Proposed Scheme. Measures that would be integrated into the design of the Proposed Scheme include:

- design of earthworks to tie the engineering earthworks for embankments (such as New Crofton North embankment) and cuttings (such as Havercroft cutting) into their wider landscape context and to mitigate views of structures, overhead line equipment and trains from sensitive receptors, where reasonably practicable. Earthworks design also takes account of the

relationship to surrounding land uses and management, such as agriculture;

- compensatory woodland planting in areas of loss, using the same species composition and planting types (and appropriate planting density), such as woodland planting to compensate for the partial loss of woodland at locations such as the B6273 Southmoor Road overbridge and Crofton, and to provide habitat connectivity, enhanced landscape/green infrastructure connectivity, as well as connectivity of historic landscape features, where reasonably practicable, and to soften the appearance of the embankments and viaduct abutments;
- hedgerow replacement and restoration in areas of loss to restore habitat connectivity and landscape pattern, where reasonably practicable, and using an appropriate palette of hedgerow types and species to tie the Proposed Scheme mitigation into the wider landscape character;
- compensation for loss of field ponds with new wetlands, ecological ponds and biodiversity wetland features and wetland enhancement at Nostell and Crofton; and
- provision of new areas of informal semi-natural greenspace at Crofton to compensate for loss of existing greenspace.

Assessment of impacts and effects

11.5.3 The likely effects on landscape and visual receptors during operation of the Proposed Scheme relate to the presence of new structures and elements in the landscape including viaducts, embankments, cuttings, overbridges, underbridges, road and PRoW realignments and diversions. Other aspects include the presence of overhead line equipment, noise fence barriers and the presence of moving trains. Landscape bunds and new planting would also influence how the Proposed Scheme affects landscape and visual receptors.

Landscape assessment

11.5.4 Based on the current design, it is currently anticipated that the LCAs described in Table 25 would be significantly affected during operation of the Proposed Scheme.

Table 25: Operation phase significant landscape effects

Southmoor and Brierley Farmland	**Medium susceptibility and sensitivity**
Susceptibility to change: There are some pockets of higher susceptibility around the historic features, but overall the undulating and gently rolling landform and intensive arable farmland has a medium-low susceptibility to change arising from the Proposed Scheme. **Year 1:** This LCA would be directly affected by Brierley embankment which would alter the existing landscape pattern through reduction in field size and permanent loss of arable farmland, hedgerows and mature trees. The slopes of the embankment would be reduced to help integrate it into the undulating and gently rolling farmland but it would remain a very noticeable feature and be at variance with existing landscape character. Scenic quality, which is already diminished due to intensive farming practices and the presence of a pylon line, would be further eroded. New cuttings, overbridges and underbridges would also be uncharacteristic landscape features which would be locally prominent but not completely out of context	**Level of effect:** Moderate adverse (significant)

given that this LCA lies close to settlement and has some similar features including the A628 Hemsworth Bypass. The landscape would be further affected by noise and visual disturbance from passing trains and vehicles on the Common Lane overbridge. The Proposed Scheme would be at variance with the existing landscape character of the western and central part of this LCA but much of the eastern, more scenic part of the LCA would be unaffected which would lessen its overall effect. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.	
Year 15: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
Kingsley and Hemsworth Farmland	**Medium-low susceptibility and sensitivity**
Susceptibility to change: There are some pockets of higher susceptibility around the historic features but overall the slightly elevated plateau landform and large-scale intensive arable farmland has a medium-low susceptibility to change arising from the Proposed Scheme. **Year 1:** The landscape within the central part of the LCA would be directly affected by severance due to the presence of Hemsworth cutting, Kinsley embankment and Havercroft cutting. These would all be uncharacteristic features in the gently rolling farmland although the slopes of the embankment would be reduced to provide some integration of the new landform into the wider landscape. Some arable fields would be reduced in size and shape and hedgerows and mature trees would be permanently lost. Scenic quality would be reduced and noise from passing trains would diminish the tranquillity currently experienced, including by the landscape around Vissitt Manor, one of the few landscape features of note in this part of the LCA. New overbridges and underbridges would also be uncharacteristic and prominent features in the rural landscape. A section of Robin Lane would be permanently diverted. The existing Robin Lane wold be closed at the junction with Barnsley Road and retained as access to properties, which would improve the character of the housing along the closed section of road through removal of traffic. The changes to the landscape of the LCA would be localised with much of the western and eastern parts unaffected. This would reduce the overall impact of the Proposed Scheme on the wider LCA. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
Horncastle to Brackenhill Farmland	**Medium susceptibility and sensitivity**
Susceptibility to change: The undulating rolling landform, linear tree belts and in places remote, tranquil and expansive qualities of this LCA have a medium susceptibility to change arising from the Proposed Scheme. **Year 1:** This LCA would be directly affected through severance of the farmland by Havercroft cutting and particularly New Crofton South embankment which would affect the openness of the arable farmland north of the realigned section of Swine Lane. The landscape pattern would be altered with field sizes reduced and permanent loss of arable farmland, trees and hedgerows. The area of farmland between the Doncaster to Wakefield Line (on low embankment) and the Proposed Scheme would be encircled by rail infrastructure with consequent effects on scenic quality. Havercroft cutting would alter the appearance of Horncastle Hill which is an area of localised high ground. New structures including the B6428 Newstead	**Level of effect:** Moderate adverse (significant)

Lane overbridge, Swine Lane overbridge, Doncaster to Wakefield Line underbridge and Nostell viaduct would be highly perceptible, with views of passing trains and vehicles reducing the sense of remoteness currently experienced. The changes introduced by the Proposed Scheme would be focussed on the central part of the LCA, but the more scenic western and eastern parts of the LCA would be largely unaffected which reduce their overall impact on the wider LCA. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of change and moderate adverse effect.	
Year 15: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
Crofton Settlements and Farmland	**Medium susceptibility and sensitivity**
Susceptibility to change: The undulating landform, field pattern, relatively intact hedgerow network, woodland and rural qualities of this LCA have a medium susceptibility to change arising from the Proposed Scheme. **Year 1:** A central swathe of this LCA would be directly affected by the presence of the Proposed Scheme, mainly through severance of the landscape and changes to the landform arising from the presence of the New Crofton South embankment, New Crofton North embankment, Crofton cutting and Crofton South embankment. Nostell viaduct and Crofton viaduct would also be new prominent features of the LCA and would result in a substantial alteration to the landscape which, although close to settlement and affected by coal mining and agricultural intensification, has been reclaimed and is now an area of relatively scenic rural farmland. The Proposed Scheme would affect much of the LCA, leading to a substantial reduction in scenic quality and be at considerable variance with existing landscape character. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15: The magnitude of change would reduce to medium and there would be a moderate adverse effect as the ecological mitigation woodland and hedgerow planting would provide some integration of the embankments and cuttings, but Nostell and Crofton viaducts would remain prominent and uncharacteristic features within the landscape.	**Level of effect:** Moderate adverse (significant)

Visual assessment

Introduction

11.5.5 The following section describes the likely significant effects on visual receptors during operation year 1 and year 15. Effects at operation year 60 will be reported in the formal ES. The assessment has been undertaken for the winter period, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of the operational Proposed Scheme may be reduced during summer when vegetation, if present in a view, would be in leaf.

11.5.6 Where a viewpoint represents multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with a lower sensitivity would be lower than those reported.

11.5.7 Table 26 identifies the locations where the operation of the Proposed Scheme would potentially result in significant effects. These are shown in Map Series LV-04 in the Volume 2: LA14 Map Book.

Table 26: Operation phase significant visual effects

View west from a PRoW south of South Kirkby (VP 416-03-005) (Map Number LV-04-416b)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the footpath would have middle distance open views of Clayton North embankment and more distant views of the top of Howell Wood cutting. The large embankment, moving trains and associated overhead line equipment would be a very noticeable feature cutting within the small-scale and relatively intact farmland which is characterised by robust hedgerows and mature hedgerow trees. The rolling landform would be altered and field sizes reduced and altered in shape. Existing views towards the wooded ridgeline at Howell Wood Country Park would be partially interrupted (although this higher ground would also provide a backdrop to the Proposed Scheme thereby reducing its perceptibility). In summer, existing vegetation in full leaf would provide some screening and filtering of views but the scale of the structures would still result in a noticeable change. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View east from a PRoW east of Common Road (VP417-03-005) (Map Number LV-04-417)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the footpath would experience a substantial alteration to existing near distance and slightly elevated views across rolling arable farmland due to the introduction of the prominent Brierley embankment and the B6273 Southmoor Road overbridge. Long views towards Hemsworth would also be interrupted. To the south-east the realigned section of the B6273 Southmoor Road and moving vehicles on the B6273 Southmoor Road overbridge would also be partially seen against the skyline. Existing vegetation would provide some additional screening and filtering of views in summer but the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15 – summer: Brierley embankment, and particularly the realigned section of the B6273 Southmoor Road and the B6273 Southmoor Road overbridge, would be partially screened by the maturing landscape mitigation planting, which would also help to visually integrate them into the landscape. The outlook would become more wooded but would remain rural in context. Brierley embankment, with its associated overhead line equipment and passing trains would, however, remain very apparent, which means there would still be a noticeable reduction in scenic quality compared to the existing view. The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

View west from a PRoW to the south of the A628 Hemsworth Bypass and west of Southmoor Road (VP417-03-010) (Map Number LV-04-417)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the footpath would experience a noticeable change in the view due to the introduction of Brierley embankment, the A628 Hemsworth Bypass underbridge and the associated overhead line equipment and moving trains in the near distance. These would be prominent and uncharacteristic new features within the arable farmland which, together with changes to the landform and permanent loss of vegetation, notably on both sides of the A628 Hemsworth Bypass, would reduce scenic quality. The B6273 Southmoor Road diversion, overbridge and tie in with the existing B6273 would be visible to the south and would add to the overall reduction in scenic quality. Existing vegetation would provide some screening and filtering of views in summer but the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. The Proposed Scheme would, however, be seen in the context of some large pylons which already diminish the quality of the view. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View south and west from a PRoW south of Kennels Farm near Brierley (VP418-03-005) (Map Number LV-04-418)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the bridleway would have near to middle distance open views of Brierley embankment and A628 Hemsworth Bypass underbridge with associated overhead line equipment, passing trains and traffic on the bypass. Overall the rural outlook across gently rolling arable farmland partially contained by hedgerows would be substantially altered. Existing vegetation would provide some additional screening and filtering of views in summer but the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect, which is significant.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View south-west from a PRoW along Highfield Lane near Kennels Farm (VP418-03-007) (Map Number LV-04-418)	**High sensitivity receptors**
Year 1 – winter and summer: Residents of Kennels Farm and users of the footpath would have panoramic and slightly elevated close and middle distance views of Brierley embankment and Hemsworth cutting, including moving trains as they enter and leave the cutting. The slopes of Brierley embankment would be reduced to provide some visual integration, but both the embankment and Hemsworth cutting would appear as artificial landforms, cutting uncharacteristically across the rolling farmland. Views of traffic on the A628 Hemsworth Bypass where existing vegetation would be removed for construction of the bypass underbridge would also add to the reduction in scenic quality. There is little intervening vegetation to provide additional screening or filtering of views in summer and the landscape mitigation woodland planting would provide minimal	**Level of effect:** Moderate adverse (significant)

screening or visual integration at this stage. The Proposed Scheme would, however, be seen in the context of some large pylons and would not be present across the full extent of the view which would slightly lessen its overall effect. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View north from a PRoW and residences along Robin Lane (VP418-02-010) (Map Number LV-04-418)	**High sensitivity receptors**
Year 1 – winter and summer: Residents of Robin Lane and users of the footpath would experience a noticeable alteration to existing views across the edge of Hemsworth due to the presence of Hemsworth cutting and Barnsley Road overbridge in the near distance. To the rear of the viewpoint, the Robin Lane diversion would also be apparent. Existing vegetation would provide some additional screening and filtering of views in summer but the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View west from Sandygate Lane near sports fields (VP 418-02-013) (Map Number LV-04-418)	**High sensitivity receptors**
Year 1 – winter and summer: Residents, road users and users of Sandygate Lane sports fields would have middle distance elevated views of Hemsworth cutting and Kinsley embankment. Overhead line equipment and passing trains would also be noticeable. The eastern slope of Kinsley embankment would be reduced to provide some visual integration, but both the embankment and Hemsworth cutting would appear as artificial landforms, cutting uncharacteristically across the undulating farmland and partly appearing on the skyline. Other than an intermittent hedgerow and some small roadside trees, there is little intervening vegetation to provide additional screening or filtering of views in summer and the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. While the Proposed Scheme would not be seen at close range and in places would obscured by the rolling landform and intermittent hedgerows, it would still affect much of the panoramic view across this open and expansive landscape. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: The mitigation planting in this area of open arable farmland would be mostly grassland. There would be few trees to provide additional screening or filtering of views and Hemsworth cutting and Kinsley embankment would continue to affect views and reduce scenic quality. The magnitude of visual change would remain medium and continue to be a moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

View east from a PRoW in farmland between South Hiendley and Kinsley (VP 419-03-003) (Map Number LV-04-419)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the footpath would have near distance, slightly elevated views of Kinsley embankment and Hemsworth Bridleway 8 accommodation overbridge, which would both be prominent and uncharacteristic features. A noise fence barrier, overhead line equipment and moving trains would also be very apparent. The western slope of Kinsley embankment would be reduced to provide some visual integration into the wider landscape but due to the size of the embankment there would still be a substantial alteration to the existing open and expansive views across arable fields towards the edge of Vale Head Park and Hemsworth Water Park. Other than an intermittent hedgerow and some hedgerow trees there is little intervening vegetation to provide additional screening or filtering of views in summer. Landscape mitigation hedgerow planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: The mitigation planting in this area of open arable farmland would be mostly grassland with some new field boundary hedgerows. This would provide little additional screening or filtering of views and Kinsley embankment would continue to be a prominent and uncharacteristic landscape feature with consequent effects on scenic quality. The magnitude of visual change would remain medium and there would continue to be a moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Views west from residences and PRoW on the edge of Kinsley (VP419-03-005 and 419-02-011) (Map Number LV-04-419)	**High sensitivity receptors**
Year 1 – winter and summer: Residents of Kinsley and users of the recreational footpaths would experience a substantial alteration to existing middle distance views across rolling arable farmland due to the presence of Kinsley embankment and Hemsworth Bridleway 8 accommodation overbridge. In summer, views would be slightly more screened and filtered by vegetation in full leaf, particularly from VP 419-02-011, but the landscape mitigation hedgerow planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15 – summer: Views of the Proposed Scheme would be partially screened and filtered by the reinstated field boundary hedgerows and maturing hedgerow trees. Due to the proximity and openness of the view, however, Kinsley embankment with its associated noise fence barrier, and Hemsworth Bridleway 8 accommodation overbridge would remain very noticeable, particularly from VP419-03-005. The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

View west from the edge of Fitzwilliam close to Newall Crescent VP419-02-020 (Map Number LV-04-419)	**High sensitivity receptors**
Year 1 – winter and summer: Residents would experience a noticeable alteration to close and middle distance rear elevation views across gently rising arable fields due to presence of the realigned B6428 Newstead Lane and B6428 Newstead Lane overbridge, which would appear uncharacteristic features within the rural landscape. The top of Hemsworth cutting would be noticeable but not prominent and due to the depth of the cutting, the overhead line equipment and moving trains would not be visible. In summer the effects would lessen as the intervening garden vegetation and occasional hedgerows and hedgerow trees would provide some additional screening and filtering of views, particularly from the rear of properties along Newall Crescent, but the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View east from Brooklands Crescent and a PRoW in Newstead (VP 419-02-024) (Map Number LV-04-419)	**High sensitivity receptors**
Year 1 – winter and summer: Residents of Newstead and footpath users would have slightly elevated, middle distance south-easterly views to Kinsley embankment with its associated overhead line equipment and passing trains. The top of Havercroft cutting would be a noticeable feature to the east. The western slope of the Kinsey embankment would be reduced and partially planted with woodland but at year 1 the scale and proximity of the embankment would substantially change the existing rural views across rolling arable farmland. The overhead line equipment and passing trains would be partially seen against the skyline which would further diminish scenic quality. In summer the effects would lessen as intervening vegetation would provide some additional screening and filtering of views, particularly from the rear of properties along Brooklands Crescent. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View north and west from Horncastle Farm (VP420-02-005) (Map Number LV-04-420)	**High sensitivity receptors**
Year 1 – winter and summer: Residents of Horncastle Farm would experience a noticeable change to existing near distance open views due to the introduction of the Swine Lane overbridge and the Swine Lane realignment to the north. The new section of road would be on low embankment and closer to the viewpoint than the existing route of Swine Lane and the overbridge would be an uncharacteristic new feature in the rural landscape. To the west, the deep Havercroft cutting would conceal views of moving trains but the overhead line equipment would be visible in the middle distance views where it would affect the longer panoramic outlook across	**Level of effect:** Moderate adverse (significant)

open rolling farmland. There is little existing vegetation to provide screening or visual integration in summer and the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View east from Wakefield Wheel cycle route between New Crofton and Fitzwilliam (VP 420-03-012) (Map Number LV-04-420)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the Wakefield Wheel cycle route would experience a substantial alteration to existing near distance views across the well-wooded farmland due to the presence of Nostell viaduct, New Crofton South embankment and New Crofton North embankment. Trees along the existing Doncaster to Wakefield Line would provide some filtering and screening of views, particularly in summer when the trees are in full leaf, but Nostell viaduct and New Crofton South embankment would be uncharacteristic skyline features and would interrupt views to Horncastle Hill and Horncastle Wood. Landscape mitigation planting and ecology woodland creation would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15 – summer: The landscape and ecological mitigation woodland planting on New Crofton South embankment, New Crofton North embankment and along the route of a dismantled railway to the south of New Crofton would partially screen and filter views and provide some visual integration of the new landform into the wider landscape. There would remain a noticeable reduction in scenic quality compared to the current outlook. The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
View west from a PRoW on the western side of Nostell Priory (VP420-03-014) (Map Number LV-04-421)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the footpath would have slightly elevated near distance views of New Crofton North embankment, which due to its scale and proximity would be a prominent and uncharacteristic feature in the well-wooded rolling arable farmland. Permanent loss of woodland would also be very apparent. The slopes of the embankment would be reduced and planted which would provide some visual integration of the landform. Existing hedgerows either side of the footpath would provide some screening and filtering of views particularly in summer when in full leaf but the ecological mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View north and east from the Crofton Community Centre (VP421-03-005) (Map Number LV-04-421)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of Crofton Community Centre would experience a substantial alteration to near distance open views across sports pitches due to the introduction of New Crofton North embankment and Crofton retaining wall. The associated noise fence barrier and overhead line equipment would be seen against the skyline where they would be prominent and uncharacteristic features. There is little intervening vegetation to provide additional screening or filtering of views in summer and the landscape and ecological mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View east from a PRoW near Priory Ridge, New Crofton (VP 421-02-007) (Map Number LV-04-421)	**High sensitivity receptors**
Year 1 – winter and summer: Residents at New Crofton and users of the footpath would have slightly elevated, near to middle distance views of New Crofton North embankment and top of Crofton cutting. The overhead line equipment would be partially visible above the noise fence barrier. The scale and proximity of the embankment would substantially change the existing rural views across an open arable field towards woodland close to Nostell Priory. The consequent reduction in scenic quality would be most noticeable from the upper storeys of the properties. Other than an area of shrubs and young trees close to the junction of Priory Ridge with Oakdene Drive there is little intervening vegetation to provide additional screening or filtering of views in summer. While extensive mitigation planting is proposed in this location, it would provide minimal screening or visual integration at this stage and the embankment would be a prominent and uncharacteristic feature which would extend across much of the view. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View south-west from residences along the A638 Doncaster Road near junction with Towers Lane (VP421-02-013) (Map Number LV-04-421)	**High sensitivity receptors**
Year 1 – winter and summer: Residents, road users and visitors to a local restaurant would have near to middle distance views of New Crofton North embankment and an area south of Towers Lane where scrub woodland would be permanently lost. The eastern slope of the embankment would be reduced and the slopes planted but it would still be a prominent and uncharacteristic feature, introducing large-scale changes to the gently	**Level of effect:** Moderate adverse (significant)

rolling landform and interrupting longer views towards the well-wooded edge of New Crofton. Noise fence barriers, overhead line equipment and moving trains on top of the embankment would be partially seen against the skyline, where they would contribute to the reduction in scenic quality and affect the current rural outlook across large-scale arable fields. Sharlston Footpath 12 underbridge would appear as an artificial break in the embankment. Intervening hedgerows and occasional mature trees would provide some screening and filtering of views, but landscape mitigation woodland and hedgerow planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View north and east from residences on the A638 Doncaster Road opposite Slack Lane and Pinfold Drive (VP 421-02-021) (Map Number LV-04-421)	**High sensitivity receptors**
Year 1 – winter and summer: Residents and road users would have near distance views of Crofton viaduct above the A638 Doncaster Road. The permanent closure of Towers Lane and loss of a section of woodland south of the plant training centre at Sharlston Common would also affect the outlook, which is currently relatively rural in character despite proximity to settlement. Crofton North embankment, noise fence barriers and the top of the overhead line equipment would be visible particularly from the upper storeys of the properties but affected views would be oblique and partially screened by garden and roadside vegetation. In summer this vegetation in full leaf would provide additional screening and filtering of views. Landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View west from residences and a PRoW near the junction of The Green and West Lane (VP421-02-025) (Map Number LV-03-421)	**High sensitivity receptors**
Year 1 – winter and summer: Residents, footpath and road users would have middle distance views of Crofton viaduct and Crofton North embankment which would substantially alter the current outlook across open and gently rolling pastures towards New Crofton. Views between New Crofton and Sharlston and long westerly views to well-wooded hills on the distant horizon would be interrupted. There is little intervening vegetation to provide additional screening or filtering of views in summer and the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15 - summer: Views of the Proposed Scheme would be partially screened by the extensive maturing landscape mitigation woodland planting proposed on either side of the route. This planting would also provide some integration of Crofton North embankment into the wider landscape and reduce the sense of visual	**Level of effect:** Moderate adverse (significant)

severance between New Crofton and Sharlston Common. The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.	
View south from a PRoW to the south of Sharlston Common (VP421-03-026) (Map Number LV-04-422a)	**Medium-high sensitivity receptors**
Year 1 – winter and summer: Users of the footpath would have views of Crofton viaduct and southern end of Crofton North embankment, which would noticeably alter the current outlook across undulating and well-wooded arable farmland. Overhead line equipment and moving trains on top of the viaduct would be uncharacteristic features which would affect skyline views, while permanent loss of woodland would further diminish scenic quality. The intervening vegetation in full leaf would provide some additional screening and filtering of views in summer but due to its size, the viaduct would remain prominent. The landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a medium magnitude of visual change and moderate adverse effect.	**Level of effect:** Moderate adverse (significant)
Year 15 – summer: Due to the maturing vegetation present in the view, effects would reduce to non-significant by year 15.	**Level of effect:** (non-significant)
View east from residences along the B6378 Pontefract Road close to the Priory Centre PRU (VP422-02-017) (Map Number LV-03-422a)	**High sensitivity receptor**
Year 1 – winter and summer: Residents along the B6378 Pontefract Road, road users and occupiers of The Priory Centre PRU would experience a substantial alteration to existing near distance views across the playing fields of the Priory Centre and relatively flat farmland beyond. This is due to the introduction of the large Crofton North embankment and the A645 Weeland Road underbridge. Permanent loss of buildings and vegetation at Holme Bank Farm would be very apparent. The roadside vegetation in full leaf would provide additional screening and filtering of views in summer but the landscape mitigation woodland planting would provide minimal screening or visual integration at this stage. Operation of the Proposed Scheme in year 1 would therefore result in a high magnitude of visual change and major adverse effect.	**Level of effect:** Major adverse (significant)
Year 15 - summer: The Proposed Scheme would become less apparent as the landscape mitigation woodland planting along and around Crofton North embankment began to screen and filter views, as well as visually integrate the new landform into the wider landscape. Views of the overhead line equipment would be mostly screened by the maturing vegetation. There would, however, be permanent physical and visual severance along the B6378 Pontefract Road and there would remain a noticeable reduction in scenic quality compared to the current outlook. The magnitude of visual change would reduce to medium and there would be a moderate adverse effect.	**Level of effect:** Moderate adverse (significant)

Other mitigation measures

11.5.8 The permanent effects of the Proposed Scheme on landscape and visual receptors have been reduced through integration of the measures described in this section. 'Effects in Year 1 may also be further reduced through establishing planting early or in advance of the main construction programme. Other features such as additional earthworks, planting or public greenspace, including use of materials, would be considered as part of the ongoing development of contextual design. These measures would potentially provide additional screening and/or greater integration of the Proposed Scheme into the landscape'.

Summary of likely residual significant effects

11.5.9 In many cases, significant effects would reduce over time as the proposed mitigation planting matures and reaches its designed intention. However, the following likely residual significant effects would remain following year 15 of operation:

- moderate adverse effects in relation to one LCA;
- major adverse effects at no residential viewpoint locations;
- major adverse effects at no recreational viewpoint locations;
- moderate adverse effects at four residential viewpoint locations; and
- moderate adverse effects at four recreational viewpoint locations.

Monitoring

11.5.10 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

12 Socio-economics

12.1 Introduction

12.1.1 This section reports on the environmental baseline, likely economic and employment impacts and significant effects identified to date during construction and operation of the Proposed Scheme within the South Kirkby to Sharlston Common area. The assessment considers existing businesses, community organisations, local employment and local economies, including planned growth and development.

12.1.2 Engagement with Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough Council (BMBC) has been undertaken as part of the development of the Proposed Scheme. The purpose of the engagement was to increase the understanding of socio-economic characteristics identified through a review of publicly available data. Engagement will continue as part of the development of the Proposed Scheme and to inform the formal assessment.

12.1.3 The socio-economic effects on employment at a route-wide level are reported in Volume 3: Route-wide effects.

12.1.4 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book.

12.2 Scope, assumptions and limitations

12.2.1 The scope, assumptions and limitations for the socio-economics assessment are set out in Volume 1,Section 8 and the Scope and Methodology Report (SMR)[129].

12.2.2 The assessment of in-combination effects will draw upon the findings of other technical disciplines (e.g. air quality, sound, noise and vibration, landscape and visual and traffic and transport). Likely significant in-combination effects on socio-economic receptors and resources will be reported in the formal ES.

12.2.3 Businesses may experience significant isolation effects as a result of the Proposed Scheme. Likely significant isolation effects will be reported in the formal ES.

12.3 Environmental baseline

Existing baseline

Study area description

12.3.1 The following provides a brief overview of employment, economic structure, labour market, and business premises availability within the South Kirkby to Sharlston Common area. It lies within the administrative area of WMDC and BMBC. It also falls

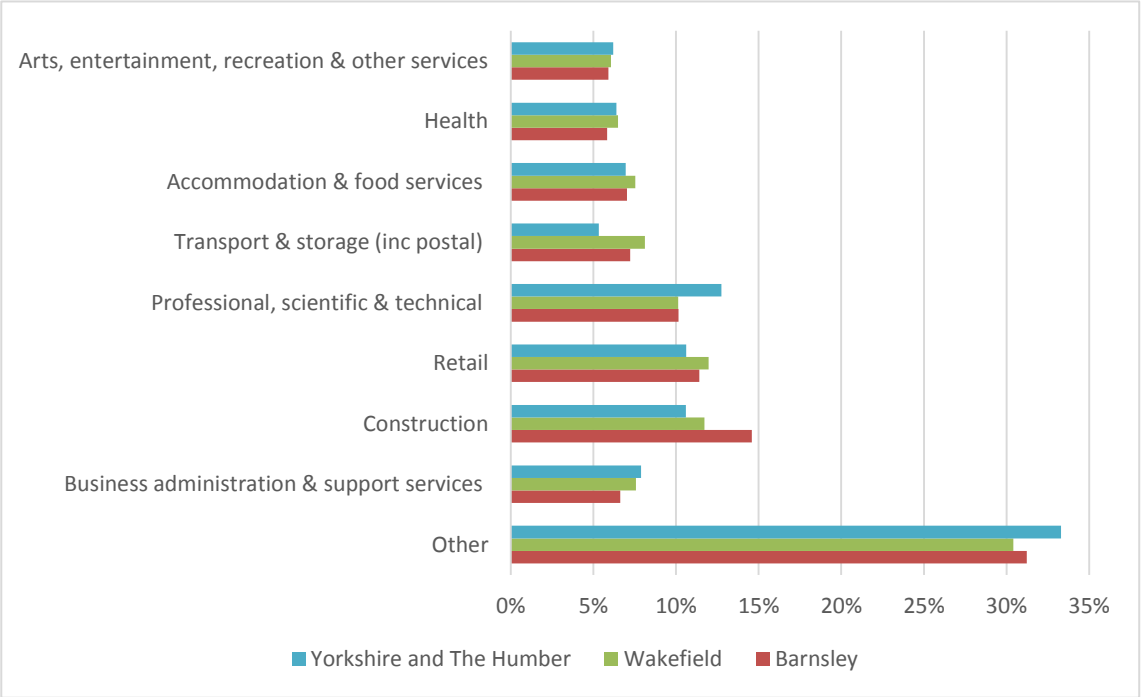
[129] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

entirely within the Leeds City Region Local Enterprise Partnership (LEP) area[130] and Yorkshire and the Humber region.

Business and labour market

12.3.2 Within the WMDC area, retail and construction account for the largest proportion of businesses (both 12%) with the professional, scientific and technical (10%) sector also accounting for relatively large numbers of businesses within the district. In BMBC, construction accounts for the largest proportion of businesses (15%), followed by retail (11%) and professional, scientific and technical (10%). This is shown below in Figure 8. For comparison, within the Yorkshire and the Humber region, professional, scientific and technical sector (13%) accounts for the largest number of businesses with retail and construction (both 11%) also accounting for relatively large numbers of businesses.

Figure 8: Business sector composition in the WMDC and BMBC areas and the Yorkshire and the Humber Region[131]

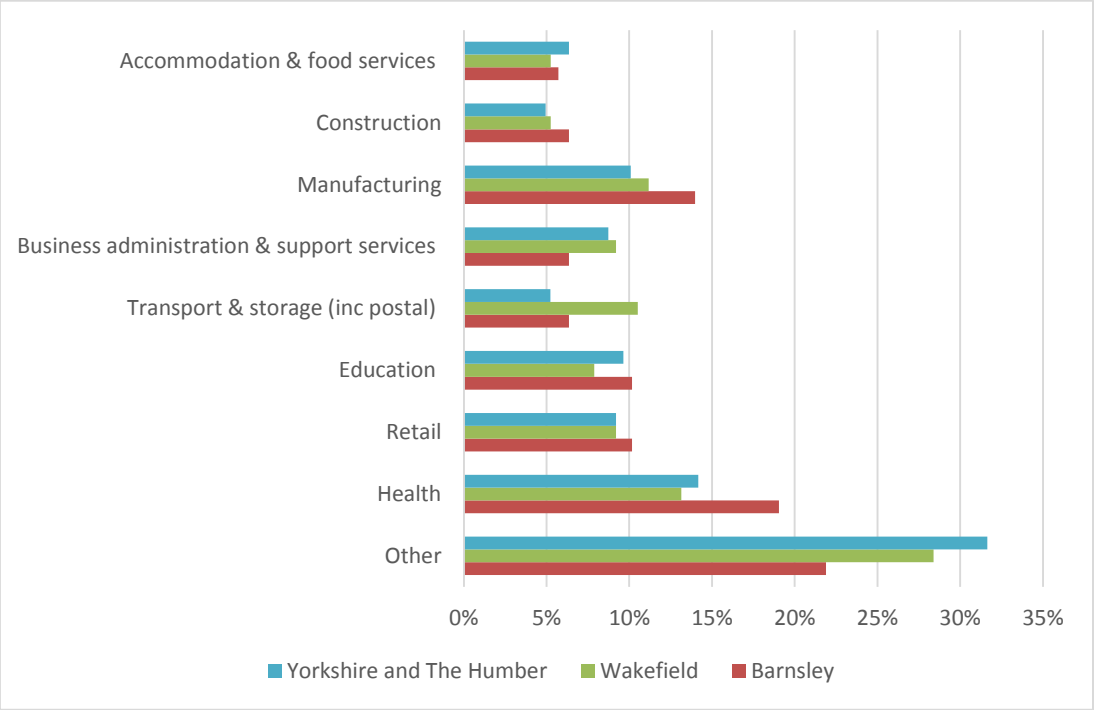


12.3.3 In 2016, approximately 151,000 people worked in the WMDC area and 79,000 people in the BMBC area[132]. According to the Office for National Statistics Business Register and Employment Survey 2016[133], the top five sectors in terms of share of employment in the WMDC area were: health (13%); manufacturing (11%); transport and storage (including postal services) (11%); retail (9%); and business administration and support

[130] Leeds City Region Local Enterprise Partnership, (2016), *Strategic Economic Plan Summary May 2016*.
[131] "Other" includes: Arts, entertainment, recreation and other services; Wholesale; Information and communication; Motor trades; Education; Public administration and defence;
[132] Office for National Statistics (2016) *Business Register and Employment Survey*. Available online at: http://www.nomisweb.co.uk. This number includes both residents and non-residents who work within the boundaries of these local authorities.
[133] Office for National Statistics (2016) *Business Register and Employment Survey*. This number includes both residents and non-residents who work within boundaries of these local authorities. Available online at: http://www.nomisweb.co.uk. This number includes both residents and non-residents who work within the boundaries of these local authorities.

services (9%). In the BMBC area, the top five sectors were: health (19%); manufacturing (14%); retail (10%); education (10%); and transport and storage (including postal services) (6%). These compare with the top five sectors for the Yorkshire and the Humber region, which were: health (14%); manufacturing (10%); education (10%); retail (9%); and business administration and support services (9%). This is shown in Figure 9.

Figure 9: Employment by Industrial Sector in the WMDC and BMBC areas and the Yorkshire and the Humber Region[134]



12.3.4 According to the 2016 Annual Population Survey[135], the employment rate[136] within the WMDC area was 73% (152,000 people), and 71% (108,000 people) in the BMBC area. This compares with an employment rate of 72% recorded for the Yorkshire and the Humber region and 74% for England. In 2017, the unemployment rate[137] in both the WMDC area and BMBC areas was 6%, which compares with 5% for both Yorkshire and the Humber region and England.

12.3.5 According to the 2016 Annual Population Survey[138], 25% of WMDC and 27% of BMBC residents aged 16-64 were qualified to National Vocational Qualification Level 4 (NVQ4) and above. This compares to 31% in the Yorkshire and Humber region and 38% in England. In both WMDC and BMBC areas, 11% of residents had no

[134] "Other" includes: Transport and storage (inc postal); Arts, entertainment, recreation and other services; Wholesale; Professional, scientific and technical; Motor trades; Information and communication; Mining, quarrying and utilities; Financial and insurance; Property; and Agriculture, forestry and fishing.
[135] Office for National Statistics (2016) *Annual Population Survey*. Available online at: http://www.nomisweb.co.uk
[136] The proportion of working age (16-64 year olds) residents that are in employment.
[137] Refers to people without a job who were available to start work in the two weeks following their interview and who had either looked for work in the four weeks prior to interview or were waiting to start a job they had already obtained. As the unemployed form a small percentage of the population, the APS unemployed estimates within local authorities are based on very small samples so for many areas would be unreliable. To overcome this, the Office for National Statistics has developed a statistical model that provides better estimates of total unemployed for unitary authorities and local authority districts (unemployment estimates for counties are direct survey estimates), NOMIS.
[138] Office for National Statistics, (2017) *Annual Population Survey*. Available online at: http://www.nomisweb.co.uk

qualifications, which was higher than that recorded both for the Yorkshire and the Humber region (10%) and England (8%).

Property

12.3.6 A review of employment land in 2016 identified a supply of 256ha[139] of available employment land in the WMDC area. This is set against a requirement of 350ha[140]. In 2016, the BMBC area identified an employment land requirement of 291ha, which could not be met within its own area (with an estimated employment land supply of 95ha). Access to more land over the study period to 2033 will be required in order to meet projected need[141].

12.3.7 The average vacancy rate for industrial and warehousing property in the WMDC area in December 2017 has been assessed as 13%, based on marketed space against known stock[142]. The average vacancy rate for industrial and warehousing property in the BMBC area in December 2017 has been assessed as 11%, based on marketed space against known stock.

12.4 Effects arising during construction

Avoidance and mitigation measures

12.4.1 The draft Code of Construction Practice (CoCP)[143] includes a range of provisions that would help mitigate socio-economic effects associated with construction within this area, including:

- reducing nuisance through sensitive layout of construction sites (Section 5);
- consulting businesses located close to hoardings on the design, materials used and construction of the hoarding, to reduce impacts on access to and visibility of their premises (Section 12);
- applying best practicable means (BPM) during construction works to reduce noise (including vibration) at sensitive receptors (including local businesses) (Section 13);
- site specific traffic management measures including requirements relating to the movement of traffic from business and commercial operators of road vehicles, including goods vehicles (Section 14);
- maintaining access to businesses for the duration of construction works where reasonably practicable (Section 14); and

[139] Wakefield Local Development Framework Annual Monitoring Report (2016) (page 36) Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/information-monitoring/annual-monitoring-reports/annual-monitoring-report-2016.pdf
[140] Wakefield Metropolitan District Council (2008) *Employment Land Technical Paper*. Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/local-plan/core-strategy/employment-land-technical-paper.pdf
[141] Barnsley Metropolitan Council (2016) *Employment Land Review*. Available online at: https://www.barnsley.gov.uk/media/4702/eb33-barnsley-employment-land-review-december-2016.pdf
[142] Vacant space is based on marketed space identified from Estates Gazette data (EGi); stock data are taken from information supplied by the valuation office (VOA).
[143] Supporting documents: Draft Code of Construction Practice

- monitor and manage flood risk and other extreme weather events that may affect socio-economic resources during construction (Section 15).

Assessment of impacts and effects

12.4.2 The proposed construction works are assessed for socio-economic effects in relation to:

- premises demolished with their occupants and employees needing to relocate to allow for construction of the Proposed Scheme;
- in-combination effects (e.g. air quality, noise, vibration, construction traffic and visual impacts) and isolation of an area, which could affect business operations, both will be reported in the formal ES. Any resulting effects on employment will be reported at a route-wide level (see Volume 3, Route-wide effects); and
- potential employment opportunities arising from construction in the local area (including in adjacent community areas).

Temporary effects

In-combination effects

12.4.3 Businesses within the South Kirkby to Sharlston Common area may experience air quality, noise and vibration or construction traffic impacts as a result of construction of the Proposed Scheme. Taken in combination, the residual effects from these other topic assessments may amount to a significant change in the environment. In-combination effects will be reported in the formal ES.

Isolation

12.4.4 Non-agricultural businesses may experience significant isolation effects as a result of the construction of the Proposed Scheme in the South Kirkby to Sharlston Common area. Isolation effects will be reported in the formal ES.

Construction employment

12.4.5 The two main compounds in the South Kirkby to Sharlston Common area are Brierley Embankment and Crofton North Embankment, along with nine satellite construction compounds. These sites could result in the creation of up to 2,140 person years of construction employment opportunities[144] broadly equivalent to 220 full-time jobs[145], which, depending on skill levels required and the skills of local people, are potentially accessible to residents in the locality and to others living further afield. The impact of the direct construction employment creation has been considered as part of the route-wide assessment (see Volume 3: Route-wide effects).

12.4.6 Direct construction employment would also lead to opportunities for local businesses to supply the construction of the Proposed Scheme or to benefit from expenditure of

[144] Construction labour is reported in construction person years, where one construction person year represents the work done by one person in a year composed of a standard number of working days.
[145] Based on the convention that 10 employment years is equivalent to one full time equivalent job.

construction workers. The impact of the indirect construction employment creation has been considered as part of the route-wide assessment (see Volume 3: Route-wide effects).

12.4.7 The resulting effects on employment are reported in aggregate at a route-wide level (see Volume 3: Route-wide effects).

Permanent effects

Businesses

12.4.8 Businesses directly affected, comprising those that lie within land required for the Proposed Scheme, are reported in groups, where possible, to form defined resources based on their location and operational characteristics. A group could contain either one or a number of businesses reflecting the fact that a building may have more than one occupier or that similar businesses and resources are clustered together.

12.4.9 One business accommodation unit or site (sports activities business) in the South Kirkby to Sharlston Common area would experience direct impacts as a result of the Proposed Scheme.

12.4.10 It is currently expected that no businesses in the area would experience significant permanent direct effects as a result of the land required for the operation of the Proposed Scheme. Across all the employment areas reviewed, an estimated ten jobs would either be displaced or possibly lost in the wider Yorkshire and the Humber region. There is a reasonable probability that businesses would be able to relocate to places that would still be accessible to residents within the travel to work areas due to the general availability of vacant premises. However, there could be cases where alternative locations are more problematic and the business may be unable to be relocate on a like-for-like basis within the area. The impact on the local economy from the relocation or loss of jobs is considered to be relatively modest when compared to the scale of economic activity and employment opportunity in the WMDC and BMBC areas (approximately 151,000 jobs in WMDC and 79,000 jobs in BMBC).

12.4.11 The resulting effects on employment are reported in aggregate at a route-wide level (see Volume 3: Route-wide effects).

Other mitigation measures

12.4.12 Businesses displaced by the Proposed Scheme would be compensated in accordance with the Compensation Code. HS2 Ltd recognises the importance of businesses, displaced from their existing premises, being able to relocate to suitable alternative premises and at this stage it assumes that it would, therefore, adopt a policy to offer additional support over and above statutory requirements to facilitate this process as it has done on Phases One and 2a.

12.4.13 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the route of the Proposed Scheme in terms of supplying goods and services and obtaining employment. HS2 Ltd at this stage assumes that it would, therefore, adopt a policy to work with its suppliers to build a skilled workforce that promotes further economic growth across the UK as it has done on Phases One and 2a.

Summary of likely residual significant effects

12.4.14 Any likely residual significant socio-economic effects will be reported in the formal ES.

12.5 Effects arising from operation

Avoidance and mitigation measures

12.5.1 No mitigation measures are proposed in relation to business resources during operation of the Proposed Scheme.

Assessment of impacts and effects

Resources with direct effects

12.5.2 It is currently expected that no resources would experience significant direct socio-economic effects during the operation of the Proposed Scheme.

In-combination effects

12.5.3 In-combination effects will be assessed and reported in the formal ES.

Operational employment

12.5.4 Direct operational employment created by the Proposed Scheme could lead to indirect employment opportunities for local businesses in terms of potentially supplying the Proposed Scheme or benefiting from expenditure of directly employed workers on goods and services.

12.5.5 The impact of operational employment creation will be assessed and reported at a route-wide level in Volume 3: Route-wide effects.

Other mitigation measures

12.5.6 No mitigation measures are proposed in relation to business resources during the operation of the Proposed Scheme.

Summary of likely residual significant effects

12.5.7 Any likely residual significant socio-economic effects will be reported in the formal ES.

Monitoring

12.5.8 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

12.5.9 There are no area-specific requirements for monitoring socio-economic effects during the operation of the Proposed Scheme in the South Kirkby to Sharlston Common area.

13 Sound, noise and vibration

13.1 Introduction

13.1.1 This section reports the initial assessment of the likely significant effects from sound, noise and vibration arising from the construction and operation of the Proposed Scheme within the South Kirkby to Sharlston Common area on:

- 'residential receptors'; people, primarily where they live, in terms of individual dwellings and on a wider community basis including any shared community open areas146; and
- 'non-residential receptors'[147] such as:
  - community facilities including schools, hospitals, places of worship and 'quiet areas'[148]; and
  - commercial properties such as hotels.

13.1.2 The methodology for the assessment of likely significant noise and vibration effects was developed in alignment with Government noise policy[149], planning policy, planning practice guidance on noise (PPGN)[150] and EIA Regulations as described in the Scope and Methodology Report[151] (SMR).

13.1.3 Engagement has been undertaken with Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough Council (BMBC) with respect to the sound, noise and vibration assessment. This engagement process will continue as part of the development of the Proposed Scheme. The purpose of this engagement has been twofold. Firstly, engagement has been undertaken on a route wide basis covering matters including process, scope, method and the approach to baseline and mitigation strategy. Secondly, local engagement has been undertaken to obtain relevant information regarding residential and non-residential receptors and existing baseline sound levels, and to discuss the development of the mitigation to be included in the Proposed Scheme. Officers from local and county authorities are invited to attend and witness baseline sound measurements.

13.1.4 Maps of the Proposed Scheme in the South Kirkby to Sharlston Common area showing the location of the key environmental features (Map Series CT-10), key construction features (Map Series CT-05), key operational features (Map Series CT-06) and operational sound, noise and / or vibration impacts and proposed noise mitigation

[146] 'Shared community open areas' are those that the Planning Practice Guidance identifies may partially offset a noise effect experienced by residents at their dwellings and are either a) relatively quiet nearby external amenity spaces for sole use by a limited group of residents as part of the amenity of their dwellings or b) a relatively quiet external publicly accessible amenity space (e.g. park or local green space) that is nearby.
[147] Non-residential receptors with multiple uses would be assessed either based on the most noise sensitive use or would be subject to multiple assessments as appropriate.
[148] 'quiet areas' are defined as either Quiet Areas as identified under the Environmental Noise Regulations 2007 (as amended) or are resources which are prized for providing tranquillity as noted in the NPPF and are therefore designated as such under the relevant local plan or are designated under local plans or neighbourhood development plans as local green spaces.
[149] Noise Policy Statement for England, (2015) Department for Environment, Food & Rural Affairs. (Defra)
[150] Department for Communities and Local Government (DCLG) (2014), Planning Practice Guidance – Noise. Available online at: https://www.gov.uk/guidance/noise--2
[151] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

(Map Series SV-01), can be found in the Volume 2: LA14 Map Book. Map Series SV-01 also presents key 'non-residential receptors'. These receptors will be reviewed and developed further to incorporate, where appropriate, consultation feedback and ongoing stakeholder engagement, and will be reported in the formal ES.

13.1.5 The assessment of noise and vibration likely significant effects on agricultural, heritage and ecological receptors and the assessment of tranquillity is ongoing and will be reported in the formal ES.

13.2 Scope, assumptions and limitations

13.2.1 The approach to assessing sound, noise and vibration and identifying envisaged mitigation is outlined in Volume 1 (Sections 8 and 9) and in the SMR.

13.2.2 In this assessment 'sound' is used to describe the acoustic conditions that people experience as a part of their everyday lives. Noise is taken as unwanted sound and hence adverse effects are noise effects and mitigation is, for example, by noise barriers.

13.2.3 Effects can either be temporary from construction or permanent from the operation of the Proposed Scheme. These effects may be direct, resulting from the construction or operation of the Proposed Scheme, and/or indirect, resulting from changes in traffic patterns on existing roads or railways that result from the construction or operation of the Proposed Scheme.

13.2.4 The effects of construction noise and vibration are assessed qualitatively, based on construction compound locations, construction routes, initial construction estimates and professional judgement. No quantitative assessment has been undertaken for the construction of the Proposed Scheme at this stage. The quantitative assessment will be reported in the formal ES.

13.2.5 The effects on operational noise and vibration are assessed quantitatively based on forecast noise emission from the Proposed Scheme combined with outline baseline information and professional judgement. As baseline information is limited at this stage the quantitative assessment including a full baseline will be reported in the formal ES.

13.3 Environmental baseline

13.3.1 The SMR describes the three rounds of baseline data collection covering existing sources, modelling and by targeted monitoring. Baseline sound levels will be published in the formal ES.

13.3.2 The South Kirkby to Sharlston Common area is characterised by towns, villages, isolated residential properties and agricultural land in a predominantly rural setting. The sound environment is generally dominated by local and distant road traffic, existing railways and local neighbourhood sources, with contributing natural sounds and agricultural activity.

13.3.3 The sound environment of the South Kirkby to Sharlston Common area is affected by several main roads: the A628 Hemsworth Bypass, which connects Cudworth, Shafton,

Brierley, Hemsworth and Ackworth Moor Top; the A638 Doncaster Road, which connects Agbrigg, Crofton and Ackworth Moor Top; and the A645 Weeland Road, which connects Crofton, Sharlston Common and Featherstone. Two railways also contribute to the local sound environment: the Doncaster to Wakefield Line, passing through South Elmsall and to the east of Hemsworth and Kinsley and south of New Crofton and Crofton; and the Pontefract to Wakefield Line, north of Sharlston Common and Crofton.

13.3.4 Sound levels close to these main transportation routes are high during the daytime, but are lower at night. Sound levels decrease with increasing distance from the main transportation routes.

13.3.5 The effects of vibration at all receptors are being initially assessed using specific thresholds, below which receptors would not generally be adversely affected by vibration. Further information is provided in Volume 1, Section 8.

13.3.6 The baseline assessment presented in the formal ES will consider current sound levels and how these may change in the future. This will include any changes firstly due to national trends such as road traffic growth and the progressive electrification of road vehicles and secondly due to area specific changes caused either by local committed development and / or noise reduction provided in Important Areas identified in Defra's Noise Action Plans for Agglomerations[152], Roads[153] or Railways[154]. HS2 Ltd will engage with the Competent Authorities responsible for the relevant Important Areas. Map Series SV-01 (Volume 2: LA14 Map Book) shows any noise Important Areas in the South Kirkby to Sharlston Common area.

13.4 Effects arising during construction

Assumptions and limitations

13.4.1 The construction arrangements that form the basis of the assessment are presented in Section 2.3 of this report, in Volume 1, Section 8 and in the draft Code of Construction Practice (CoCP)[155]. The assessment focuses on the initial identification of communities that may be affected by construction noise. The formal ES will include the assessment of likely significant effects from construction noise and / or vibration on individual receptors and communities.

13.4.2 The assessment takes account of people's sensitivity to noise during the day, evening and night. More stringent criteria are applied during evening and night-time periods, compared to the busier and more active daytime period.

[152] Noise Action Plan: Agglomerations (large urban areas) (2014) Department for Environment, Food & Rural Affairs
[153] Noise Action Plan: Roads (including major roads) (2014) Department for Environment, Food & Rural Affairs
[154] Noise Action Plan: Railways (including major railways) (2014) Department for Environment, Food & Rural Affairs
[155] Supporting document: Draft Code of Construction Practice

Avoidance and mitigation measures

13.4.3 The assessment assumes the implementation of the principles and management processes set out in the noise and vibration section of the draft CoCP (Section 13) would occur, which are:

- best practicable means (BPM) as defined by the Control of Pollution Act 1974 (CoPA) and Environmental Protection Act 1990 (EPA), would be applied during construction activities to minimise noise (including vibration) at neighbouring residential properties and other sensitive receptors[156];
- as part of BPM, mitigation measures would be applied in the following order:
  - noise and vibration control at source: for example, the selection of quiet and low vibration equipment, review of construction methodology to consider quieter methods, location of equipment on-site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings;
  - screening: for example, local screening of equipment or perimeter hoarding or the use of temporary stockpiles; and
  - where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary re-housing would be offered at qualifying properties.
- lead contractors would seek to obtain prior consent from the relevant local authority under Section 61 of the CoPA for the proposed construction works. The consent application would set out BPM measures to minimise construction noise and vibration, including control of working hours, and provide a further assessment of construction noise and vibration, including confirmation of noise insulation/temporary re-housing provision;
- contractors would undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data would be provided regularly to, and be reviewed by, the nominated undertaker and made available to the local authorities; and
- contractors would be required to comply with the terms of the CoCP and appropriate action would be taken by the nominated undertaker as required to ensure compliance.

13.4.4 Noise insulation or, where appropriate, temporary re-housing would avoid residents of qualifying properties being significantly affected by levels of construction noise inside their dwellings. Work is being undertaken to provide a reasonable worst case estimate of the buildings that are likely to qualify for such measures and the estimate will be reported in the formal ES.

[156] Including local businesses and quiet areas designated by the local authority.

13.4.5 Qualification for noise insulation and temporary re-housing would be confirmed as part of seeking prior consent from the local authority under Section 61 of the CoPA. Qualifying properties would be identified, as required in the draft CoCP so that noise insulation could be installed, or any temporary re-housing provided, before the start of the works predicted to exceed noise insulation or temporary re-housing criteria.

Assessment of impacts and effects

13.4.6 Potential construction airborne noise significant effects could occur at the communities, or those part of the communities, that are nearest to the Proposed Scheme in the following locations, as a result of the construction works illustrated on Map Series CT-05 (Volume 2: LA14 Map Book):

- South Kirkby, arising from construction activities such as cutting formation, embankment formation, overbridge construction, road realignment and landscape bund construction;
- Brierley, arising from construction activities such as use of transfer node;
- Hemsworth, arising from construction activities such as cutting formation, overbridge construction, road realignment and landscape bund construction;
- Kinsley, arising from construction activities such as embankment formation and landscape bund construction;
- Newstead, arising from construction activities such as road realignment and landscape bund construction;
- Fitzwilliam, arising from construction activities such as balancing pond construction, road realignment and landscape bund construction;
- New Crofton, arising from construction activities such as cutting formation, embankment formation, underbridge construction, viaduct construction, ecological pond construction and landscape bund construction;
- Foulby, arising from construction activities such as embankment formation, viaduct construction, road realignment and landscape bund construction;
- Crofton, arising from construction activities such as demolition, cutting formation, embankment formation, retaining wall, balancing pond construction, ecological pond construction and landscape bund construction;
- Sharlston, arising from construction activities such as embankment formation and ecological pond construction;
- Sharlston Common, arising from construction activities such as demolition, embankment formation and landscape bund construction; and
- New Sharlston, arising from construction activities such as embankment formation and landscape bund construction.

13.4.7 Map Series SV-01 (Volume 2: LA14 Map Book) shows key non-residential properties that have been identified within the study area as defined in the SMR. Of these, the following are likely to experience significant effects (to be confirmed in the formal ES):

- Burntwood Court Hotel, Brierley;
- Vissett Cottage Hotel, Hemsworth;
- Crofton Community Centre, New Crofton; and
- The Priory Centre PRU, Crofton.

13.4.8 The avoidance and mitigation measures to be implemented would avoid or reduce airborne construction noise adverse likely significant effects. Residual temporary noise or vibration likely significant effects will be reported in the formal ES.

13.4.9 Construction traffic on the following local roads has the potential, on a precautionary basis, to cause adverse noise or vibration effects on the nearest parts of residential communities and nearest noise sensitive non-residential receptors:

- Common Road, Holmsley Lane and the B6273 Southmoor Road, between Hemsworth Gate drop inlet culvert and the South Moor Roundabout;
- Robin Lane, between Barewell Hill and High Street in South Hiendley;
- the B6428 Newstead Lane, between Fitzwilliam and Havercroft;
- the B6273 Garmill Head Lane, between Fitzwilliam and the A638 Doncaster Road in Wragby;
- Swine Lane, between Swine Lane overbridge and the B6273 Garmill Lane; and
- the B6378 Pontefract Road, between A645 Weeland Road and A638 Doncaster Road.

13.4.10 The magnitude and extent of effect will depend on the level of construction traffic using the road. Any residual significant temporary noise or vibration effects will be reported in the formal ES.

Other mitigation measures

13.4.11 Further work is being undertaken to confirm the likely significant effects and identify any site-specific mitigation, or amendment to construction routes considered necessary in addition to the general measures set out in the draft CoCP. Any site-specific mitigation will be presented in the formal ES and would include an estimate of the number of properties that may qualify for noise insulation or temporary re-housing under provisions set out in the draft CoCP.

Summary of likely residual significant effects

13.4.12 Further work is being undertaken to confirm significant construction noise and vibration effects, including any temporary indirect effects from construction traffic.

13.4.13 Non-residential receptors identified at this stage as potentially subject to construction noise or vibration effects will be further considered, where necessary, on a receptor-by-receptor basis. Any likely significant effects will be reported in the formal ES.

13.5 Effects arising from operation

Assumptions and limitations

Local assumptions

13.5.1 The assessment of the effects of noise and vibration from the operation of the Proposed Scheme is based on the envisaged design as described in Section 2.2 of this report and in Volume 1 (Sections 4 and 8) and the highest likely train flows, assuming the service pattern including Phase One and Phase Two services. The expected passenger service frequency for Phase 2b is described in Volume 1 (Section 4) and as outlined below for the South Kirkby to Sharlston Common area.

13.5.2 Passenger services will start at or after 05:00 from the terminal stations. In this area, with Phase One and Phase Two in operation, after 05:00 services will progressively increase to nine trains per hour in each direction on the main lines with an operating speed of 330kph for 90% of services and 360kph for 10% of services. This number of services is assumed to operate every hour from 07:00 to 21:00. The number of services will progressively decrease after 21:00 and the last service will arrive at terminal stations by midnight. Further information is presented in Volume 1 (Section 4).

Avoidance and mitigation measures

13.5.3 The development of the Proposed Scheme alignment has sought to reduce noise impact as far as reasonably practicable.

13.5.4 Envisaged avoidance and mitigation measures that apply route-wide are described in Volume 1, Section 9.

Airborne noise

13.5.5 Through the procurement process for the trains and the track, the use of proven international technology will enable the railway to be quieter than implied by current minimum European standards. Details of operational train noise will be provided in the formal ES. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia where reasonably practicable. Overall it is assumed that proven international technology would reduce noise emissions by approximately 3dB at 360kph (225mph) compared to the current minimum European standards[157].

13.5.6 The Proposed Scheme would incorporate noise barriers to avoid or reduce significant adverse airborne noise effects. The assessment has been based on the assumption that noise fence barriers are acoustically absorbent on the railway side and are located 5m from the outer rail. The envisaged noise barrier locations based upon the currently

[157] Technical Specification for Interoperability (TSI) Noise – EU Commission Regulation No 1304/2014

available information are shown on Map Series SV-01 (Volume 2: LA14 Map Book) and described in Section 2.2.

13.5.7 In practice, barriers may differ from this description while maintaining the required acoustic performance. For example, where noise barriers are in the form of landscape earthworks, they would need to be higher above rail level to achieve similar noise attenuation to the noise fence barrier because the crest of the earthwork would be further than 5m from the outer rail.

13.5.8 Noise effects would also be reduced in other locations along the route by engineering structures and landscape earthworks provided to avoid or reduce significant visual effects.

13.5.9 As required by statute, noise insulation measures would be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 and the Noise Insulation Regulations 1975 ('the NI Regulations'). Additionally, HS2 Ltd will apply more onerous discretionary criteria, to provide the same mitigation as defined in 'the NI Regulations' at residential buildings where[158] noise from the use of the Proposed Scheme measured outside a dwelling exceeds the Interim Target defined by the World Health Organization's (WHO) Night Noise Guidelines for Europe[159] or the maximum noise level criteria[160] defined in the SMR. Noise insulation is designed to avoid residents experiencing any residual significant effect on health and quality of life from resulting noise inside their dwelling.

Ground-borne noise and vibration

13.5.10 Significant ground-borne noise or vibration effects would be avoided or reduced through the design of the track and track-bed.

Assessment of impacts and effects

13.5.11 Map Series SV-01 (Volume 2: LA14 Map Book) indicates the likely long-term daytime noise level (defined as the equivalent continuous sound level from 07:00 to 23:00 or $Lp_{Aeq,day}$) from HS2 operations alone. The contours are shown in 5dB steps from 50dB to 70dB. With the train flows described in Volume 1, the night-time noise level (defined as the equivalent continuous noise level from 23:00 to 07:00 or $Lp_{Aeq,night}$) from the Proposed Scheme would be approximately 10dB lower than the daytime sound level. The 50dB contour, therefore, indicates the distance from the Proposed Scheme at which the night time noise level would be 40dB. This contour represents where adverse noise effects may start to be observed during the day (with respect to annoyance) and night (with respect to sleep disturbance). With regard to sleep disturbance the assessment also takes account of the maximum noise levels generated by each train pass by as defined in the SMR.

[158] Following Government's National Planning Practice Guidance. Available online at: https://www.gov.uk/government/collections/planning-practice-guidance
[159] World Health Organization (2010), *Night time Noise Guidelines for Europe*.
[160] Dependent on the number of train passes.

13.5.12 The potential for noise effects that are considered significant on a community basis in areas between the 50dB and 65dB daytime noise contours, or 40dB and 55dB night-time contours, is dependent on the baseline in that area and the change in level brought about by the Proposed Scheme. Baseline information will be confirmed in the formal ES.

13.5.13 A summary of the likely significant effects identified on a precautionary basis is presented at the end of this section.

13.5.14 Likely significant airborne noise effects arising from permanent changes to existing roads, will be reported in the formal ES.

Other mitigation measures

13.5.15 Further work is being undertaken to confirm the extent, location and type of the noise mitigation to be included within the design of the Proposed Scheme, which will be reported in the formal ES.

Summary of likely residual significant effects

13.5.16 Mitigation, including landscape earthworks and noise fence barriers, described in Volume 1, Section 9, Section 2.2 and presented in Map Series SV-01 (Volume 2: LA14 Map Book) and Map Series CT-06 (Volume 2: LA14 Map Book), would substantially reduce the potential airborne noise effects that would otherwise arise from the Proposed Scheme. It is anticipated that the mitigation would avoid likely significant adverse effects due to airborne operational noise on the majority of receptors and communities.

13.5.17 Taking account of the avoidance and mitigation measures this initial assessment has identified effects on a precautionary basis with the potential to be considered significant on a community basis due to increased airborne noise levels in line with the SMR at or around:

- South Kirkby (western edge): occupants of residential properties on Common Road, Hilltop Estate and First Avenue, located closest to the route of the Proposed Scheme, identified by LA14-C01 on Map SV-01-393b;
- Hemsworth (southern end): occupants of residential properties on Burntwood Bank, Greenfield Road and Willow Drive, located closest to the route of the Proposed Scheme, identified by LA14-C02 on Map SV-01-394;
- Hemsworth (western edge): occupants of residential properties on Robin Lane and Barnsley Road, located closest to the route of the Proposed Scheme, identified by LA14-C03 on Map SV-01-394;
- Kinsley (western edge): occupants of residential properties on Tombridge Crescent, located closest to the route of the Scheme, identified by LA14-C04 on Map SV-01-395;
- Kinsley (western edge): occupants of residential properties on Chantry Croft, Common Road and Briar Bank, located closest to the route of the Proposed Scheme, identified by LA14-C05 on Map SV-01-395;

- New Crofton (eastern edge): occupants of residential properties on Greenside Park, Greenside Court, Greenview, Middle Lane and Beech Avenue, located closest to the route of the Proposed Scheme, identified by LA14-C06 on Map SV-01-396;
- Crofton (eastern edge): occupants of residential properties on Towers Lane and The Towers, located closest to the route of the Proposed Scheme, identified by LA14-C07 on Map SV-01-396;
- Crofton (eastern edge): occupants of residential properties on Dovedale Close, Wentworth Drive, Springhill Drive, Springhill Grove and Pinfold Drive, located closest to the route of the Proposed Scheme, identified by LA14-C08 on Map SV-01-396;
- Sharlston Common (western edge): occupants of residential properties on Birkwood Avenue and Weeland Road, located closest to the route of the Proposed Scheme, identified by LA14-C09 on Map SV-01-397a; and
- Crofton (eastern edge): occupants of residential properties on the B6378 Pontefract Road, located closest to the route of the Proposed Scheme, identified by LA14-C10 on Map SV-01-397a.

13.5.18 The initial assessment indicates that, the forecast noise from long-term railway operation may exceed the daytime threshold set by the Noise Insulation Regulations, the night-time Interim Target identified in the WHO Night Noise Guidelines for Europe 2009 or the maximum noise levels criteria set out in the SMR, at individual residential properties closest to the Proposed Scheme in:

- Hemsworth Gate, in the vicinity of the B6273 Southmoor Road (identified on Map SV-01-394 in Volume 2: LA14 Map Book);
- Vissitt Manor Farm, in the vicinity of Vissitt Lane (identified on Map SV-01-394 in Volume 2: LA14 Map Book);
- Kinsley Carr Farm, in the vicinity of Carr Lane (identified on Map SV-01-395 in Volume 2: LA14 Map Book);
- Station Cottages, in the vicinity of Swine Lane (identified on Map SV-01-396 in Volume 2: LA14 Map Book);
- The Towers, in the vicinity of Towers Lane (identified on Map SV-01-396 in Volume 2: LA14 Map Book); and
- Crofton, in the vicinity of Towers Lane (identified on Map SV-01-396 in Volume 2: LA14 Map Book).

13.5.19 Map Series SV01 (Volume 2: LA14 Map Book) shows key non-residential properties for the assessment of operational airborne noise impacts in the formal ES. Of these, the following are likely to experience significant effects:

- Burntwood Court Hotel, Brierley;
- Vissett Cottage Hotel, Hemsworth;

- Crofton Community Centre, New Crofton; and
- The Priory Centre PRU, Crofton.

13.5.20 Further assessment work is being undertaken to identify operational sound and vibration significant effects. This will be reported in the formal ES.

13.5.21 HS2 Ltd will continue to seek reasonably practicable measures to further reduce or avoid these significant effects. In doing so HS2 Ltd will continue to engage with stakeholders to fully understand the potentially affected receptor, its use and the benefit of the measures.

Monitoring

13.5.22 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

13.5.23 Operational noise and vibration monitoring would be carried out at different times during the lifetime of the Proposed Scheme at a combination of carefully selected monitoring locations including: adjacent or attached to moving vehicles; at fixed positions or in the vicinity of individual assets; and locations within the surrounding areas and communities alongside the route of the Proposed Scheme.

13.5.24 The expected noise and vibration performance of the Proposed Scheme, operational noise and vibration measurement data, associated asset information, description of corrective actions, results of measured performance compared to expected conditions, and monitoring reports would be shared with the relevant local authorities at appropriate intervals.

14 Traffic and transport

14.1 Introduction

14.1.1 This section considers the likely impacts on all forms of transport and the potential likely significant effects identified to date on transport users arising from the construction and operation of the Proposed Scheme through the South Kirkby to Sharlston Common area.

14.1.2 Engagement with Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough Council (BMBC) has been undertaken. An important focus of this engagement has been to obtain relevant baseline information and discuss transport survey requirements and assessment methodology. This engagement process will continue as part of the development of the Proposed Scheme.

14.1.3 Maps showing the location of the key environmental features (Map Series CT-10) and the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book.

14.2 Scope, assumptions and limitations

14.2.1 The scope, key assumptions and limitations for the traffic and transport assessment are set out in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[161].

14.2.2 The study area for traffic and transport includes the urban areas of South Kirkby, South Hiendley, Hemsworth, Kinsley, Fitzwilliam, Havercroft, Newstead, New Crofton, Crofton and Sharlston Common.

14.2.3 The study area includes all roads potentially affected by the Proposed Scheme including the A1(M)/A1, which is the only strategic route in the South Kirkby to Sharlston Common area. It also includes the following local roads: the A628 Hemsworth Bypass; the A638 Doncaster Road; the A645 Weeland Road/Wakefield Road; the A6201 Sprockhovel Way/Wrangbrook Lane; the B6133 Common Side Lane; the B6134 Havertop Lane; the B6273 Southmoor Road/Garmil Lane; the B6378 Pontefract Road; the B6428 Newstead Lane/Hemsworth Lane; Common Road; Burntwood Lane; Holmsley Lane; Barewell Hill/Barnsley Road; Robin Lane; Vissitt Lane; Carr Lane; Swine Lane; Towers Lane; and Common Side Lane/Sewerbridge Road.

14.2.4 The potential effects on traffic and transport have been assessed qualitatively, based on the Proposed Scheme design, proposed construction routes, initial estimates of construction traffic and professional judgement.

14.2.5 No quantitative assessment has been undertaken at this stage. A quantitative assessment will be presented in the formal ES.

[161] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

14.3 Environmental baseline

Existing baseline

14.3.1 Existing conditions in the study area have been determined through site visits, traffic and transport surveys, liaison with WMDC and BMBC (including provision of information on public transport, public rights of way (PRoW) and accident data) and desktop analysis.

Surveys

14.3.2 Traffic surveys, comprising junction turning counts and queue surveys and automatic traffic counts, were undertaken in June, July and November 2017. These data have been supplemented by existing traffic data from other sources where available, including from WMDC and BMBC. Assessment of existing data indicates that the peak hours in the area are 07:30-08:30 and 16:00-17:00. However, there are only small differences (4% to 6%) between the observed peak hours and the periods 08:00-09:00 and 17:00-18:00, which are the periods when HS2 construction traffic movements and workforce arrivals and departures would have the maximum impact. Consequently, the 08:00-09:00 and 17:00-18:00 periods have been used as the assessment hours representing a reasonable worst case.

14.3.3 PRoW surveys were undertaken in August and September 2017 and April 2018 to establish their nature and usage by non-motorised users (pedestrians, cyclists and equestrians). The surveys included PRoW and roads that would cross the route of the Proposed Scheme, and any additional PRoW and roads that may be affected by the Proposed Scheme. The majority of the PRoW surveys were undertaken during the weekend, at times when recreational use is expected to be highest, but where routes are likely to be used by non-leisure users such as commuting, surveys were also undertaken on a weekday.

Strategic and local highway network

14.3.4 The strategic routes that passes through the area are: the A1(M)/A1, which passes approximately 8km to the east of the route of the Proposed Scheme (at its nearest point); and the M1, which passes approximately 6.5km to the west of the route of the Proposed Scheme (at its nearest point). The strategic road network in and around the South Kirkby to Sharlston Common area is busy at peak times and delays can be experienced.

14.3.5 The local roads that could be affected by the Proposed Scheme include: the A628 Hemsworth Bypass/Barnsley Road; the A638 Doncaster Road/Wakefield Road; the A645 Weeland Road/Wakefield Road; the A6201 Sprockhovel Way/Wrangbrook Lane; the B6133 Common Side Lane; the B6134 Havertop Lane; the B6273 Southmoor Road/Garmil Lane; the B6378 Pontefract Road; the B6428 Newstead Lane/Hemsworth Lane; Common Road; Burntwood Lane; Holmsley Lane; Barewell Hill/Barnsley Road; Robin Lane; Vissitt Lane; Carr Lane; Swine Lane; Towers Lane; and Common Side Lane/Sewerbridge Road. The local road network in this area generally operates well although the area is busy at peak times and delays can be experienced, particularly on the A628 Hemsworth Bypass and on the A638 Doncaster Road/Wakefield Road.

14.3.6 Relevant accident data for the road network subject to assessment have been obtained from the Department for Transport[162]. Data for the three year period (mid-2014 to mid-2017) have been assessed and any identified clusters (i.e. where there are nine or more accidents in the three year period) have been examined. No accident clusters were identified within the South Kirkby to Sharlston Common area.

14.3.7 The route of the Proposed Scheme would cross seven roads with footways within the South Kirkby to Sharlston Common area. These are: the A638 Doncaster Road; the A645 Weeland Road; the B6378 Pontefract Road; the B6428 Newstead Lane; Barewell Hill/Barnsley Road; Robin Lane; and Towers Lane. In addition: the A628 Hemsworth Bypass; the B6273 Southmoor Road; Common Lane; Holmsley Lane; and Swine Lane have no footways where they cross the route of the Proposed Scheme, but were observed to be used by pedestrians.

Parking and loading

14.3.8 There is no parking or loading identified in the South Kirkby to Sharlston Common area that is expected to be impacted by the Proposed Scheme. Consequently, this topic is not considered further in this assessment.

Public transport network

14.3.9 Seventeen bus routes operate on eight roads that are crossed by the route of the Proposed Scheme in the South Kirkby to Sharlston Common area. The bus routes that could be affected by the Proposed Scheme include:

- Common Road: services 30 and 39 (Pontefract – South Elmsall – Hemsworth);
- the B6273 Southmoor Road: services 30 and 39 (Pontefract – South Elmsall – Hemsworth);
- Barewell Hill/Barnsley Road: services 28 and 28C (Pontefract – Hemsworth – Barnsley); service 29 (Barnsley – Grimethorpe – Hemsworth); service 29B (South Hiendley – Hemsworth – Pontefract); service 36 (South Elmsall – Hemsworth – Barnsley); and service 195 (Wakefield – New Crofton – Hemsworth);
- Robin Lane: service 29B (South Hiendley – Hemsworth – Pontefract); service 36 (South Elmsall – Hemsworth – Barnsley); and service 195 (Wakefield – New Crofton – Hemsworth);
- the B6428 Newstead Lane: service 196 (Wakefield – Newstead – Hemsworth); and service 197 (Hemsworth – Newstead – Ryhill (Havercroft Green);
- the A638 Doncaster Road: service 223 (Wakefield – Crofton – Hemsworth – South Elmsall); service 485 (Wakefield – Crofton – South Elmsall); service 496 (Wakefield – Hemsworth – Doncaster) and service 497 (Wakefield – Hemsworth – Upton);

[162] Department for Transport; Crashmap.co.uk; www.crashmap.co.uk. CrashMap provides accident data for the UK.

- the B6378 Pontefract Road: service P2 (Pontefract – Sharlston – Wakefield); and
- A645 Weeland Road: service 148 (Wakefield – New Sharlston – Knottingley); and service 148A (Wakefield - New Sharlston – Knottingley).

14.3.10 In the South Kirkby to Sharlston Common area, the Proposed Scheme would cross the Doncaster to Wakefield Line to the south-east of New Crofton and the Pontefract to Wakefield Line to the north of Crofton.

14.3.11 Local rail services are accessible via South Elmsall, Moorthorpe, Fitzwilliam and Streethouse railway stations. South Elmsall Station provides access to local services to Leeds and Doncaster. Moorthorpe provides access to local services to Leeds, Sheffield and York. Fitzwilliam Station provides access to local services to Leeds, Sheffield and Doncaster. Streethouse Station provides access to local services to Wakefield Kirkgate and Knottingley.

Non-motorised users

14.3.12 There are pedestrian footways adjacent to many of the roads in the built-up areas of South Kirkby, South Hiendley, Hemsworth, Kinsley, Fitzwilliam, Havercroft, Newstead, New Crofton, Crofton and Sharlston Common. The footways vary in width and condition within these locations. Where there is no formal footway provision adjacent to a road, non-motorised user numbers are generally low.

14.3.13 The route of the Proposed Scheme would cross the existing the route of 15 PRoW within the South Kirkby to Sharlston Common area that could be affected either temporarily or permanently due to, for example, temporary diversion of a PRoW during construction or permanent diversions or upgrades, including for maintenance access to the Proposed Scheme. The surveys undertaken to inform the assessment recorded fewer than 10 people a day on eight of the PRoW and roads with footways. The routes with the greatest usage during the survey day were: the A628 Hemsworth Bypass, used by 100 cyclists and 22 pedestrians; Barnsley Road, used by 62 cyclists, 22 pedestrians and eight equestrians; and Crofton Footpath 11, used by 40 pedestrians, 16 cyclists and two equestrians.

14.3.14 In the South Kirkby to Sharlston Common area, National Route 67 (part of the National Cycle Network) passes through the area to the west of the route of the Proposed Scheme. It does not, however, cross the route of the Proposed Scheme. Other cycle routes in the area include the Wakefield Wheel, which is a 40-mile circular cycle route around Wakefield and the Wonders of Wakefield Trail, which is a 21-mile circular cycle route around Wakefield. The route of the Proposed Scheme would cross the existing route of the Wakefield Wheel to the south-east of Crofton, where it runs along the route of Huntwick-with-Foulby and Nostell Footpath 1. The route of the Proposed Scheme would cross the existing route of the Wonders of Wakefield Trail to the east of Crofton, where it runs along the route of the Sharlston Footpath 12.

Waterways and canals

14.3.15 There are no navigable waterways in the South Kirkby to Sharlston Common area. Consequently, this topic is not considered further in this assessment.

Air transport

14.3.16 There is no relevant air transport in the South Kirkby to Sharlston Common area. Consequently, this topic is not considered further in this assessment.

14.4 Effects arising during construction

Avoidance and mitigation measures

14.4.1 The following measures are currently proposed to avoid or reduce effects on transport users:

- new highways (roads and PRoW) would be constructed and operational prior to the permanent closure of any existing highways, insofar as reasonably practicable;
- the majority of roads crossing the route of the Proposed Scheme would be maintained or locally diverted during construction to limit the need for diversion of traffic onto alternative routes;
- traffic management measures would be implemented to limit any disruption;
- road closures would be restricted to overnight and weekends, insofar as reasonably practicable;
- temporary alternative routes for PRoW would be provided during construction, insofar as reasonably practicable, where either the existing or final proposed route is not available;
- insofar as reasonably practicable, site haul routes would be created adjacent to the route of the Proposed Scheme to transport construction materials and equipment to reduce heavy goods vehicle (HGV) movements on public roads with access taken via the main road network;
- HGV would be routed, insofar as reasonably practicable, along the strategic and/or primary road network;
- the use of the local road network would, insofar as reasonably practicable, be limited to use for site set-up, access for surveys and ongoing servicing (including refuse collection and general deliveries to compounds) during construction;
- the reuse of excavated material along the route of the Proposed Scheme, insofar as reasonably practicable;
- highway measures including junction improvements, passing places and carriageway widening would be provided, as required, to manage the safe passing of construction vehicles on construction HGV routes; and
- on-site welfare facilities would be provided which would reduce daily travel by site workers.

14.4.2 Section 14 of the draft Code of Construction Practice (CoCP)[163] includes measures that aim to reduce the adverse impacts and effects on local communities and maintain public access. This includes the impacts of deliveries of construction materials and equipment.

14.4.3 The measures in the draft CoCP include controls on vehicle types, hours of site operation and routes for HGVs to reduce the impact of road-based construction traffic. In order to achieve this, general and site specific traffic management measures would be implemented during the construction of the Proposed Scheme on or adjacent to public roads and PRoW affected by the Proposed Scheme.

14.4.4 The draft CoCP includes the requirement to develop local traffic management plans in consultation with the highway and traffic authorities and the emergency services. These would consider the local traffic management strategy including consideration of sensitive receptors, such that adverse impacts would be reduced insofar as reasonably practicable and any effect on safety and accidents would not be significant.

14.4.5 Specific measures would include core site operating hours of 08:00 to 18:00 on weekdays and 08:00 to 13:00 on Saturdays with site staff and workers generally arriving before the morning peak hour and departing after the evening peak hour.

14.4.6 The number of private car trips to and from the construction compounds (both workforce and visitors) would be reduced by encouraging alternative sustainable modes of transport or vehicle sharing. This would be supported by an overarching framework travel plan that would require construction workforce travel plans[164] to be produced that would include a range of potential measures to mitigate the impacts of traffic and transport movements associated with construction of the Proposed Scheme.

14.4.7 Where works potentially affect Network Rail assets, disruption to travelling passengers and freight movements would be reduced insofar as reasonably practicable. This includes measures such as:

- programming the construction works to coincide with the possessions that are required and planned by Network Rail for the general maintenance of their railway;
- planning the required construction works so that they can be undertaken in short overnight stages so that passenger services are not disrupted; and
- programming longer closures at the weekend and on bank holidays to reduce insofar as reasonably practicable the number of passengers affected.

[163] Supporting documents: Draft Code of Construction Practice

[164] Construction and operational travel plans would promote the use of sustainable transport modes as appropriate to the location and types of trip. They would include measures such as: provision of information on and promotion of public transport services; provision of good cycle and pedestrian facilities; liaison with public transport operators; promotion of car sharing; and the appointment of a travel plan coordinator to ensure suitable measures are in place and are effective.

Assessment of impacts and effects

Temporary effects

14.4.8 The traffic and transport impacts during the construction period within the South Kirkby to Sharlston Common area are likely to include:

- construction vehicle movements to and from the various construction compounds;
- road closures and associated realignments and diversions;
- alternative routes for PRoW; and
- possessions on the conventional rail network.

14.4.9 The construction assessment has also considered any impacts in the South Kirkby to Sharlston Common area that may arise from construction of the Proposed Scheme in the adjoining community areas.

14.4.10 Construction vehicle movements required to construct the Proposed Scheme would include the delivery of plant and materials, movement of excavated materials and site worker trips. Works would include utilities diversions, earthworks, underpass, viaduct, bridge and highway construction.

14.4.11 Construction activities would be managed from compounds. Details of the construction compounds are provided in Section 2.3. The locations of the compounds are shown in Map Series CT-05 in the Volume 2: LA14 Map Book.

Strategic and local road network traffic

14.4.12 The primary HGV access routes for construction vehicles would be the strategic and/or primary road network with the use of the local road network limited, where reasonably practicable. The construction routes would also provide access to compounds. Where reasonably practicable, HGVs would use the site haul routes alongside the route of the Proposed Scheme to reduce the impact on the local road network. In this area, it is expected that the main construction routes would use:

- the A1 junction with the A6201 Wrangbrook Lane;
- the A628 Hemsworth Bypass/Barnsley Road between Barewell Hill and the A638 Wakefield Road (in Ackworth Moor Top);
- the A638 Doncaster Road/Wakefield Road between the A628 Barnsley Road (in Ackworth Moor Top) and the A645 Weeland Road;
- the A645 Weeland Road/Wakefield Road between the A638 Doncaster Road and the B6133 Common Side Lane;
- the A6201 Sprockhovel Way/Wrangbrook Lane between the A628 Hemsworth Bypass and the A1;
- the B6133 Common Side Lane;
- the B6134 Havertop Lane between Premier Way South and the A655

Pontefract Road;

- the B6273 Southmoor Road/Garmil Lane between Common Road and the A628 Hemsworth Bypass and between the A638 Doncaster Road and Swine Lane;
- the B6378 Pontefract Road;
- the B6428 Newstead Lane/Hemsworth Lane from north-east of Havercroft to the A638 Doncaster Road;
- Common Road from east of Burntwood Lane to the B6273 Southmoor Road;
- Barewell Hill/Barnsley Road between the A628 Hemsworth Bypass and Robin Lane;
- Robin Lane;
- Swine Lane; and
- Common Side Lane/Sewerbridge Lane.

14.4.13 In addition to increases in traffic flows due to construction traffic, construction of the Proposed Scheme is expected to result in temporary highway closures and diversions or realignments as set out in Section 2.3. The works to construct both temporary and permanent highway diversions/realignments could also result in disruption to highway users. These are expected to include:

- overnight and weekend closures of the A628 Hemsworth Bypass between Barewell Hill and the B6273 Southmoor Road;
- overnight and weekend closures of the A638 Doncaster Road at the western end of Towers Lane;
- overnight and weekend closures of the A645 Weeland Road between the A638 Doncaster Road and the B6378 Pontefract Road;
- closure of Common Road from east of Burntwood Lane to Holmsley Lane, with local diversion routes available; and
- closure of Barnsley Road at Robin Lane, with local diversion routes available.

14.4.14 Permanent changes to highways are reported under operation.

14.4.15 Changes in traffic have the potential, at some locations, to result in increased travel distance, congestion and delays and increased traffic severance for non-motorised users. The assessment of these changes will be reported in the formal ES.

14.4.16 Assessment of the traffic and transport impacts from utilities works, either separately or in combination with other works, will be reported in the formal ES.

Accidents and safety

14.4.17 Changes in traffic as a result of the Proposed Scheme could result in changes in accident risk. The impacts on accident risk during construction of the Proposed Scheme will be reported in the formal ES.

Public transport network

14.4.18 It is expected that the construction of the Proposed Scheme would require temporary bus route diversions, including bus services 28, 28C, 29, 29B, 30, 36, 39 and 195. Bus services 28, 28C, 29, 29B, 36 and 195 would be diverted via the A628 Hemsworth Bypass, while bus services 30 and 39 would be diverted via Holmsley Lane. This could result in increased journey times and the need to relocate bus stops. In addition, bus routes could be affected where they run on proposed construction routes. Any consequent effects will be reported in the formal ES.

14.4.19 There are interfaces with the existing rail network in this area, in particular on the operation of the Doncaster to Wakefield Line and the Pontefract to Wakefield Line. The majority of the rail possessions would have little or no impact on the operation of rail services as they would be relatively minor localised works, such as work on and adjacent to the route of the Proposed Scheme when not in use. Rail possessions would be required to undertake localised works including the construction of bridges over the existing railway. This could potentially result in disruption to services, although many of the interventions would be combined to reduce the frequency of potential disruption. The effects of railway possessions will be assessed and reported in the formal ES.

Non-motorised users

14.4.20 The construction works associated with the Proposed Scheme would require the temporary closure or diversion/realignment of PRoW and roads. There would be temporary alternative routes for a number of PRoW in the vicinity of the Proposed Scheme. Where necessary, PRoW would be re-routed around construction compounds.

14.4.21 There would be temporary alternative routes for a number of PRoW in the vicinity of the Proposed Scheme. It is currently expected that the following PRoW would be temporarily diverted or realigned:

- Hemsworth Footpath 23 (south-east of Barewell Hill/Barnsley Road);
- Hemsworth Footpath 22 (east of Vissitt Lane);
- Hemsworth Footpath 5 (east of Newstead);
- Huntwick-with-Foulby and Nostell Footpath 1 (north of Swine Lane);
- Huntwick-with-Foulby and Nostell Footpath 4 (south-east of New Crofton);
- Crofton Footpath 11 (south-east of New Crofton);
- Sharlston Footpath 12 (between New Crofton and the A638 Doncaster Road);
- Crofton Footpath 9 (south of Towers Lane); and
- Crofton Footpath 5 (north of the A638 Doncaster Road).

14.4.22 Permanently diverted PRoW are reported under operation, although these PRoW could also be subject to temporary closure or diversion/realignment.

14.4.23 The changes to PRoW are likely to result in some increases in travel distance with the potential for adverse significant effects. The assessment of these will be reported in the formal ES.

Permanent effects

14.4.24 Any permanent effects of construction will be considered in the assessment of operation for traffic and transport. This is because the impacts and effects of ongoing increases in travel demand and the wider impacts and effects of the operations phase need to be considered together.

Other mitigation measures

14.4.25 The implementation of the measures in the draft CoCP, in combination with the construction workforce travel plan would help mitigate transport-related effects during construction of the Proposed Scheme.

14.4.26 Any further traffic and transport mitigation measures required during the construction of the Proposed Scheme will be considered based on the outcomes of the assessment. These will be reported in the formal ES.

Summary of likely residual significant effects

14.4.27 Construction of the Proposed Scheme would have the potential to lead to additional congestion and delays for road users on a number of routes including: the A1M/A1; the A628 Hemsworth Bypass; the A638 Doncaster Road/Wakefield Road; the A645 Weeland Road/Wakefield Road; the A6201 Sprockhovel Way/Wrangbrook Lane; the B6133 Common Side Lane; the B6134 Havertop Lane; the B6273 Southmoor Road/Garmil Lane; the B6378 Pontefract Road; the B6428 Newstead Lane/Hemsworth Lane; Common Road; Barewell Hill/Barnsley Road; Swine Lane; and Common Side Lane/Sewerbridge Lane. Increases in traffic could also result in increased traffic severance for non-motorised users of the routes and changes in traffic could result in changes in accident risk.

14.4.28 Construction of the Proposed Scheme is also likely to result the temporary closures and diversions or realignments of the following: the A628 Hemsworth Bypass; the A638 Doncaster Road; the A645 Weeland Road; Common Road and Barnsley Road.

14.4.29 Construction of the Proposed Scheme would require the temporary diversion of eight bus routes, including: bus routes 28, 28C, 29, 29B, 30, 36, 39 and 195. This could result in increased bus journey times and the need to relocate bus stops.

14.4.30 Rail possessions could result in disruption to rail passengers on the Doncaster to Wakefield Line and the Pontefract to Wakefield Line.

14.4.31 Construction of the Proposed Scheme would require the temporary closure or diversion/realignment of PRoW, including: Hemsworth Footpath 23; Hemsworth Footpath 22; Hemsworth Footpath 5; Huntwick-with-Foulby and Nostell Footpath 1; Huntwick-with-Foulby and Nostell Footpath 4; Crofton Footpath 11; Sharlston Footpath 12; Crofton Footpath 9; and Crofton Footpath 5.

14.4.32 The assessment of significant effects in relation to traffic and transport during construction of the Proposed Scheme will be reported in the formal ES.

14.5 Effects arising from operation

Avoidance and mitigation measures

14.5.1 The following measures have been included as part of the design of the Proposed Scheme and would avoid or reduce impacts on transport users:

- reinstatement of roads on or close to their existing alignments, where reasonably practicable; and
- replacement, diversion or realignment of PRoW.

Assessment of impacts and effects

14.5.2 The following section considers the impacts on traffic and transport and the likely consequential effects resulting from the operational phase of the Proposed Scheme. Operational effects arising from the Proposed Scheme in year 2033 and year 2046 will be reported in the formal ES.

Key operation transport issues

14.5.3 The operation of the Proposed Scheme would be unlikely to have any substantial impacts within this area due to increased traffic, as there are no stations or depots proposed within the South Kirkby to Sharlston Common area. The maintenance of the Proposed Scheme would generate limited vehicular trips and the effect would not be significant.

14.5.4 The operational impacts are therefore primarily related to permanent diversion, realignment and closure of roads and the diversion or closure of PRoW.

Highway network

Strategic and local road network traffic

14.5.5 The Proposed Scheme would result in a number of permanent highway changes. These include:

- Common Road would be realigned via an overbridge to accommodate the Proposed Scheme;
- Burntwood Lane would be diverted to join the realigned Common Road;
- Holmsley Lane would be closed where it would cross the route of the Proposed Scheme to the north of Common Road, with access to existing properties retained;
- the B6273 Southmoor Road would be realigned to the east of its existing alignment where it would cross the route of the Proposed Scheme on the B6273 Southmoor Road overbridge. The existing B6273 Southmoor Road would be closed where it would be crossed by the route of the Proposed Scheme to the east and retained as access to properties;
- Barnsley Road at Robin Lane would be realigned via an overbridge to

accommodate the Proposed Scheme;

- Robin Lane would be diverted to the south-west of its existing alignment to a new junction with Barewell Hill. The existing line of Robin Lane would be closed at the junction with Barnsley Road and retained as access to properties to the west of the route of the Proposed Scheme on Robin Lane and Vissitt Lane. A pedestrian link to Barnsley road would be provided;
- the B6428 Newstead Lane would be realigned to the north-west of its existing alignment where it would cross the route of the Proposed Scheme on the B6428 Newstead Lane overbridge. The existing B6428 Newstead Lane would be closed on the east and west sides of the route of the Proposed Scheme and retained as access to properties;
- Carr Lane would be diverted to join the realigned B6428 Newstead Lane;
- Swine Lane would be realigned to the south-east of its existing alignment where it would cross the route of the Proposed Scheme on the Swine Lane overbridge. The existing Swine Lane would be closed to the west of the route and retained for access to properties. To the east of the route, access to properties would be retained from the realigned Swine Lane;
- Towers Lane would be closed at its western junction with the A638 Doncaster Road, with access to properties retained via the eastern junction with the A638 Doncaster Road;
- the B6378 Pontefract Road would be closed where it would cross the route of the Proposed Scheme, with access to properties retained on the eastern and western sides of the route; and
- junction modification works to the A638 Doncaster Road junction with A645 Weeland Road to accommodate the additional traffic movements due to the closure of the B6378 Pontefract Road.

14.5.6 The permanent highway changes are not expected to result in significant changes in travel distance, with the exception of B6378 Pontefract Road. The effects of these changes including those on non-motorised users will be reported in the formal ES.

Accidents and safety

14.5.7 Changes in traffic could result in changes in accident risk. Operational effects arising from the Proposed Scheme will be reported in the formal ES.

Public transport network

14.5.8 The permanent realignment of roads could increase travel distances for bus passengers. However, as most of the realignments are likely to be less than 1km in length, it is not currently expected that there would be significant effects on public transport within the South Kirkby to Sharlston Common area.

Non-motorised users

14.5.9 A number of PRoW that cross the route of the Proposed Scheme would be either permanently realigned or diverted, including:

- Hemsworth Footpath 24 would be realigned to the south of its existing alignment where it would cross the route of the Proposed Scheme via the Hemsworth Footpath 24 underbridge;
- Hemsworth Footpath 23 would be realigned to the south-east of its existing alignment where it would cross the route of the Proposed Scheme via the Hemsworth Footpath 23 overbridge;
- Hemsworth Footpath 22 would be realigned to cross the route of the Proposed Scheme via the Hemsworth Footpath 22 overbridge;
- Hemsworth Bridleway 8 would be realigned to the south-east of its existing alignment where it would cross the route of the Proposed Scheme via the Hemsworth Bridleway 8 accommodation overbridge;
- Hemsworth Footpath 5 would be realigned to the north-west of its existing alignment where it would cross the route of the Proposed Scheme via the Hemsworth Footpath 5 accommodation underbridge;
- Hemsworth Footpath 7 would be diverted to the north-east of its existing alignment to the Hemsworth Footpath 5 realignment where it would cross the route of the Proposed Scheme via the Hemsworth Footpath 5 accommodation underbridge;
- Hemsworth Footpath 4 would be diverted to the north-west of its existing alignment onto Swine Lane;
- Huntwick-with-Foulby and Nostell Footpath 1 would be diverted to the south-west of its existing alignment on the east side of the Proposed Scheme. On the west side of the Proposed Scheme, Huntwick-with-Foulby and Nostell Footpath 1 would be realigned to the east of its existing alignment where it would cross under the route of the Proposed Scheme beneath the Nostell viaduct;
- Crofton Footpath 11 would be realigned to the south-east of its existing alignment where it would cross the route of the Proposed Scheme via the Crofton Footpath 11 accommodation underbridge;
- Sharlston Footpath 12 would be realigned to the north-west of its existing alignment where it would cross the route of the Proposed Scheme via the Sharlston Footpath 12 underbridge;
- Crofton Footpath 9 would be realigned to the north-west of its existing alignment, where it would connect with the A638 Doncaster Road to cross the route of the Proposed Scheme beneath Crofton viaduct and continue along Towers Lane;
- Crofton Footpath 5 would be realigned to the south-east of its existing

alignment beneath Crofton viaduct; and

- Crofton Footpath 6 would be closed to the north of the A638 Doncaster Road where it would cross the replacement floodplain storage area on the west side of the route of the Proposed Scheme.

14.5.10 The realignment of some of the PRoW would increase journey distance and time for non-motorised users and may result in significant effects. No diversion is expected to require additional travel distance in excess of 500m.The assessment of these changes will be reported in the formal ES.

Other mitigation measures

14.5.11 HS2 Ltd is continuing to engage with local highway and transport authorities regarding the need for highway and public transport measures to mitigate the impacts of the Proposed Scheme in the South Kirkby to Sharlston Common area.

14.5.12 Any further traffic and transport mitigation measures required during the operation of the Proposed Scheme will be considered based on the outcomes of the assessment. These will be reported in the formal ES.

Summary of likely residual significant effects

14.5.13 Operation of the Proposed Scheme would require the permanent diversion of: Robin Lane and Carr Lane, the permanent realignment of the B6273 Southmoor Road, the B6428 Newstead Lane and Swine Lane, and the permanent closure of Holmsley Lane, Towers Lane and the B6378 Pontefract Road. Increases in traffic could also result in increased traffic severance for non-motorised users of the routes and changes in traffic could result in changes in accident risk.

14.5.14 Operation of the Proposed Scheme would require the permanent realignment or diversion of 13 PRoW including: Hemsworth Footpath 24; Hemsworth Footpath 23; Hemsworth Footpath 22; Hemsworth Bridleway 8; Hemsworth Footpath 5; Hemsworth Footpath 7; Hemsworth Footpath 4; Huntwick-with-Foulby and Nostell Footpath 1; Crofton Footpath 11; Sharlston Footpath 12; Crofton Footpath 9; Crofton Footpath 5; and Crofton Footpath 6.

14.5.15 The assessment of significant effects in relation to traffic and transport during operation of the Proposed Scheme will be reported in the formal ES.

Monitoring

14.5.16 Volume 1, Section 9 sets out the general approach to environmental monitoring during operation of the Proposed Scheme.

14.5.17 There are no other area-specific monitoring requirements currently proposed for traffic and transport in the South Kirkby to Sharlston Common area.

15 Water resources and flood risk

15.1 Introduction

15.1.1 This section provides a description of the current baseline for water resources and flood risk in the South Kirkby to Sharlston Common area. The likely impacts and significant effects identified to date arising from the construction and operation of the Proposed Scheme on surface water and groundwater bodies and their associated water resources are reported. The likely impacts and significant effects of the Proposed Scheme on flood risk and land drainage are also reported.

15.1.2 Engagement has been undertaken with the Environment Agency, Canal & River Trust (CRT) and Lead Local Flood Authorities (LLFA), Wakefield Metropolitan District Council (WMDC) and Barnsley Metropolitan Borough Council (BMBC). Engagement has also been undertaken with Yorkshire Water Services Limited (the local water and sewerage undertaker). The purpose of this engagement has been to obtain relevant baseline information and to discuss the Proposed Scheme and potential effects. Engagement with these stakeholders will continue as part of the development of the Proposed Scheme.

15.1.3 Maps showing the location of the key environmental features (Map Series CT-10), the key construction (Map Series CT-05) and key operational (Map Series CT-06) features of the Proposed Scheme can be found in the Volume 2: LA14 Map Book. This map book also includes Map Series WR-01 and WR-02 showing surface water and groundwater baseline information respectively.

15.1.4 Volume 3: Route-wide effects, Water resources and flood risk (Section 16) covers the following at a route-wide level:

- the risk to water resources associated with accidents or spillages from trains during operation of the Proposed Scheme;
- a summary of how the Proposed Scheme aims to demonstrate compliance with the statutory requirements of the Water Framework Directive (WFD); and
- route-wide flood risk issues related to alignment of the Proposed Scheme with the Sequential Test and Exception Test policies in the National Planning Policy Framework (NPPF)[165].

15.2 Scope, assumptions and limitations

15.2.1 The scope, assumptions and limitations for the water resources and flood risk assessment are set out in Volume 1, Section 8 and the Scope and Methodology Report (SMR)[166].

15.2.2 Unless indicated otherwise, the spatial scope of the assessment (the study area) is based upon the identification of surface water and groundwater features within 1km

[165] National Planning Policy Framework, DCLG, 2015.
[166] Supporting document: HS2 Phase 2b Environmental Impact Assessment Scope and Methodology Report

of the centre line of the route of the Proposed Scheme, as described in Section 2.2 of this report. In the South Kirkby to Sharlston Common community area, the study area has been extended to include a 3km extension of the land potentially required during construction of the Proposed Scheme along the existing Dearne Valley railway line.

15.2.3 This assessment is based on desk study information, including information provided to date by consultees and stakeholders, as well as surveys of accessible water features.

15.2.4 Where surveys have not been undertaken due to land access constraints, a precautionary approach has been adopted in the assessments of receptor value and impact magnitude.

15.2.5 Hydraulic analysis is currently being undertaken of watercourse and key structures within flood risk areas. This includes modelling of two tributaries of the Red Beck.

15.2.6 Groundwater levels have been inferred from the available Environment Agency groundwater level monitoring boreholes, historic borehole logs and topographic data, as well as from spring and watercourse locations.

15.2.7 Impacts on biological receptors such as aquatic fauna and flora are assessed in Section 7, Ecology and biodiversity.

15.2.8 The assessments in this working draft ES are based on professional judgement using the information that is currently available. A precautionary approach has been adopted with regard to assessing the potential for adverse impacts to occur. The surveys, analysis and modelling work currently in progress, and the results of the consultation process, will be used to refine the assessments reported in the formal ES.

15.3 Environmental baseline

Existing baseline - Water resources and WFD

Surface water

15.3.1 All surface water bodies in the study area fall within the Don and Rother, and Aire and Calder management catchments of the Humber river basin district (RBD).

15.3.2 The river basin management plan[167] identifies the chemical[168] and ecological[169] status of surface water bodies, and the quantitative[170] and chemical[171] status of groundwater bodies within this RBD.

[167] Environment Agency (2015), Water for life and livelihoods Part 1: Humber river basin district: River basin management plan.
[168] The chemical status of surface waters reflects concentrations of priority and hazardous substances present.
[169] The ecological status of surface waters is determined based on the following elements:
- Biological elements – communities of plants and animals (for example, fish and rooted plants), assessed in the Ecology and biodiversity section;
- Physico-chemical elements – reflects concentrations of pollutants such as metal or organic compounds, such as copper or zinc;
- Hydromorphological elements – reflects water flow, sediment composition and movement, continuity (in rivers) and the structure of physical habitats.

[170] The quantitative status of groundwaters reflects the presence or absence of saline or other intrusions, interactions with surface water, issues related to groundwater dependent terrestrial ecosystems (GWDTE) and overall water balance.
[171] The chemical status of a groundwater body reflects effects on drinking water protected areas, its general quality, the importance of water quality within the water body for GWDTEs and surface water interactions and whether there are intrusions of poor quality groundwater present.

15.3.3 To be compliant with WFD legislation, the Proposed Scheme should not cause deterioration of a water body from its current status; nor prevent future attainment of good status where this has not already been achieved. The Proposed Scheme should also avoid adverse impacts on protected or priority species and habitats.

15.3.4 Specialist field surveys are being undertaken, where access is available. Receptor values will be adjusted to reflect the outputs from these surveys, in close consultation with the Environment Agency. In the absence of field surveys, surface water bodies, other than minor ponds and ditches, have been identified within this assessment as being of either high or very high value on a precautionary basis.

15.3.5 Summary information relating to the surface water bodies potentially affected by the Proposed Scheme within the study area is provided in Table 27. The receptor value attributed to each individual water body is based on the methodologies set out in the SMR.

Table 27: Surface water body receptors

Water body name and location[172]	**Designation**	**Q95 value (m^3/s)[173]**	**Receptor value**	**Parent WFD water body name and identification number[174]**	**Current WFD Status / Objective[175]**
Howell Beck[176] WR-01-366 D5	Ordinary watercourse	0.002	Moderate	Frickley Beck from Source to Ea Beck GB104027063140	Moderate / Good by 2027
Langthwaite Beck WR-01-367b C8-C9	Ordinary watercourse	0.003	High		
Tributary of Langthwaite Beck WR-01-367b C9-D9	Ordinary watercourse	<0.002	Low		
Tributary of Hague Hall Beck 1 WR-01-367b D9-D10	Ordinary watercourse	0.002	Low		
Tributary of Hague Hall Beck 2 WR-01-367b E9-E10	Ordinary watercourse	0.002	Moderate		
Tributary of Hague Hall Beck 3	Ordinary watercourse	<0.002	Low	Ea Beck from Source to Frickley Beck	Moderate / Good by 2027

[172] The feature locations are indicated by the grid coordinates on the relevant Volume2:LA14: Map Book figure (in this case WR-01).
[173] This is the flow within the watercourse that is exceeded for 95% of the time.
[174] The Environment Agency has attributed each surface water and groundwater body a unique water body identification (ID) number.
[175] Status and objectives are based on those set out in the 2015 Environment Agency River basin management plan.
[176] Howell Beck extends from west to east across the boundary between the South Kirkby to Sharlston Common area (LA14) and the Ravenfield to Clayton area (LA13), although the culvert allowing the beck to pass under the Proposed Scheme would be located in the Ravenfield to Clayton area. The assessment of the impacts and effects associated with Howell Beck culvert is, therefore, reported in Volume 2, Community area report, LA13 Ravenfield to Clayton

Water body name and location[172]	**Designation**	**Q95 value (m^3/s)[173]**	**Receptor value**	**Parent WFD water body name and identification number[174]**	**Current WFD Status / Objective[175]**
WR-01-367b F5				GB104027063240	
Tributary of Hague Hall Beck 4 WR-01-367B G5	Ordinary watercourse	<0.002	Low		
Tributary of Hague Hall Beck 5 WR-01-367B G5	Ordinary watercourse	<0.002	Low		
Frickley Dike WR-01-367b H5	Ordinary watercourse	<0.002	Low	Cudworth Dyke from Source to River Dearne GB104027063230	Poor / Good by 2027
Tributary of Frickley Dike WR-01-367b H5	Ordinary watercourse	<0.002	Low		
Tributary of River Went 1 WR-01-367b I6	Ordinary watercourse	<0.002	Low	Hoyle Mill Stream from Source to River Went GB104028047290	Good / Good by 2015
Tributary of River Went 2 WR-01-367b J6	Ordinary watercourse	<0.002	Low		
Tributary of River Went 3 WR-01-367b J6	Ordinary watercourse	0.002	Low		
Tributary of Hessle Beck 1 WR-01-368a D5	Ordinary watercourse	<0.002	Low	Went from Source to Hoyle Mill Stream GB104027063380	Poor / Good by 2027
Tributary of Hessle Beck 2 WR-01-368a D5	Ordinary watercourse	<0.002	Low		
Tributary of Hardwick Beck 1 WR-01-368a E6	Ordinary watercourse	<0.002	Low		
Tributary of Hardwick Beck 2 WR-01-368a E6	Ordinary watercourse	<0.002	Low		
Tributary of Hardwick Beck 3 WR-01-368a F6	Ordinary watercourse	<0.002	Low		

Water body name and location[172]	Designation	Q95 value (m^3/s)[173]	Receptor value	Parent WFD water body name and identification number[174]	Current WFD Status / Objective[175]
Tributary of Hardwick Beck 4 WR-01-368a F6	Ordinary watercourse	<0.002	Low		
Tributary of Oakenshaw Beck 1 WR-01-368a G5	Ordinary watercourse	0.002	Low	Oakenshaw Beck from Source to River Calder GB104027062560	Moderate / Moderate by 2015
Tributary of Oakenshaw Beck 2 WR-01-368a G5	Ordinary watercourse	<0.002	Low		
Tributary of Red Beck 1 WR-01-368a H5	Ordinary watercourse	<0.002	Low		
Tributary of Red Beck 2 WR-01-368a H5	Ordinary watercourse	<0.002	Low		

Abstractions and permitted discharges (surface water)

15.3.6 There are no licensed surface water abstractions in the study area.

15.3.7 Records of private unlicensed surface water abstractions, which comprise those for quantities less than $20m^3$ per day, have been obtained from the local authorities. This data indicates that there are no registered private unlicensed surface water abstractions within the study area. As there is no obligation to register private water supplies, unregistered private surface water supplies may be present. Private water supplies would be assessed as high value receptors unless details obtained from the owner indicate otherwise.

15.3.8 There are six[177] consented discharges to surface waters within the study area, two of which are within the land required for the Proposed Scheme. These have been assessed as being receptors of low value.

Groundwater

15.3.9 The geology of the study area is described in Section 10, Land quality, and the superficial and bedrock hydrogeology is summarised in Table 28. Unless stated otherwise, the geological groups listed would all be crossed by the Proposed Scheme. Table 28 also identifies the receptor values attributed to each groundwater receptor based on the methodologies set out in the SMR.

[177] The number of consents listed here is different to the number listed in Section 10, Land quality. This is because the Water resources and flood risk default study area comprises all land within 1km of the centreline of the Proposed Scheme; the Land quality default study area extends 250m from the land required for the construction of the Proposed Scheme. These default study areas are extended where the potential for wider pathways exists.

Table 28: Summary of geology and hydrogeology in the study area

Geology[178]	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status[179]	WFD status objective[180]	Receptor value
Superficial deposits						
Alluvium	Along Howell Beck and along a tributary of Oakenshaw Beck also likely to be associated with other streams within the study area	Clay, silt, sand and gravel	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Peat	Approximately 1km north-west of Hemsworth as an elongated patch which crosses the land required for construction of the Proposed Scheme.	Organic rich clay or humic deposits	Unproductive	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low
Bedrock						
Pennine Upper Coal Measures Formation	In the southern part of the study area, from South Kirkby to Horncastle Hill.	Interbedded mudstone/ siltstone/ sandstone with coal seams and some areas of mapped/named sandstone.	Secondary A	Don and Rother Millstone Grit and Coal Measures (GB40402G992300) Poor	Good by 2027	Moderate
				Aire and Calder Carb Limestone (GB40402G700400) Poor	Poor by 2015	Moderate

[178] In recent years the British Geological Survey has revised the nomenclature used to describe the geological materials present in Great Britain, with the publication of a series of lithostratigraphic framework reports. Some of these reports cover an entire geological period e.g. The Carboniferous and others cover a single group e.g. the Triassic Mercia Mudstone. The nomenclature used in these reports supersede the nomenclature introduced in the 1980s. While some traditional names have been retained by this process, many new names have also been generated, and many geological maps have not yet been updated. Some stratigraphic units have been renamed twice in the last 35 years. To reflect this, the previous name used for geological units (if different) is shown in brackets.
[179] These objectives are as stated in the 2015 Environment Agency River basin management plan.
[180] These objectives are as stated in the 2015 Environment Agency River basin management plan.

Geology[178]	Distribution	Formation description	Aquifer classification	WFD body (ID) and current overall status[179]	WFD status objective[180]	Receptor value
Pennine Middle Coal Measures	In the northern part of the study area, from Horncastle Hill to Sharlston Common.	Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams with some areas of mapped/named sandstone.	Secondary A	Aire and Calder Carb Limestone (GB40402G700400) Poor	Poor by 2015	Moderate
				Don and Rother Millstone Grit and Coal Measures (GB40402G992300) Poor	Good by 2027	Moderate

Superficial deposit aquifers

15.3.10 The basis of the receptor values attributed to the superficial deposit aquifers present within the study area, as shown in Table 28, is outlined briefly as follows:

- alluvium has been classified by the Environment Agency as a Secondary A aquifer. It may be capable of supporting water supplies at a local rather than regional scale and may also form an important source of baseflow to rivers. It has therefore been classified as a moderate value receptor; and
- peat has been classified by the Environment Agency as Unproductive and has therefore been classified as a low value receptor.

Bedrock aquifers

15.3.11 The basis of the receptor values attributed to the bedrock aquifers present within the study area, as shown in in Table 28, is outlined briefly as the Pennine Upper Coal Measures (locally comprising mudstone, sandstone and siltstone units and the Ravenfield Rock, Brierley Rock, Newstead Rock and Ackworth sandstone units), and the Pennine Middle Coal Measures (comprising mudstone, sandstone and siltstone units) have been classified as Secondary A aquifers by the Environmental Agency. These aquifers may be capable of supporting water supplies at a local rather than regional scale and may also form an important source of baseflow to rivers. They have therefore been classified as moderate value receptors.

WFD status of groundwater bodies

15.3.12 A summary of locations, current overall WFD status, and future overall status objectives associated with the designated bedrock groundwater bodies within the study area is provided in Table 28. The value attributed to each of these receptors is also indicated.

15.3.13 The superficial deposits in the study area are not formally designated as WFD groundwater bodies but may be hydraulically connected to the WFD bedrock aquifers.

Abstraction and permitted discharges (groundwater)

15.3.14 There are no groundwater abstractions licenced for public water supply within the study area. There are no source protection zones (SPZ) associated with licensed public water supplies within the study area.

15.3.15 There are no private groundwater abstraction licences registered in the study area.

15.3.16 Records of private unlicensed groundwater abstractions, which comprise those for quantities less than 20m^3 per day, have been obtained from the local authorities. This data indicates that there are no registered private unlicensed groundwater abstractions within the study area. As there is no obligation to register private water supplies, unregistered private groundwater supplies may also be present. Private water supplies have been assessed as high value receptors unless details obtained from the owner indicate otherwise.

15.3.17 There are three[181] consented discharges to groundwater within the study area. These discharges have been assessed as low value receptors.

Groundwater - surface water interactions

15.3.18 Desk based assessment using Ordnance Survey maps and detailed river network data provided by the Environment Agency identified 32 features within the study area that had potential to be springs. Access was possible to inspect four of these features, of which:

- one was found to be non-existent and removed from the assessment; and
- three were inconclusive and have therefore been assessed as potential springs. One of these features is within the land required for the construction of the Proposed Scheme, east of Newstead. All three were assessed as low value receptors.

15.3.19 The 28 potential spring features that have yet to be inspected are assumed to be high value receptors on a precautionary basis. None of these potential spring features are within the land required for the construction of the Proposed Scheme.

15.3.20 There are seven ponds within the land required for the Proposed Scheme. The nature and relative value of these features, the magnitude of the impacts that the Proposed Scheme would have on them, and the mitigation proposed, are outlined in Section 7, Ecology and biodiversity.

[181] The number of consents listed here is different to the number listed in Section 10, Land quality. This is because the Water resources and flood risk default study area comprises all land within 1km of the centreline of the Proposed Scheme, the Land quality default study area extends 250m from the land required for the construction of the Proposed Scheme. These default study areas are extended where the potential for wider pathways exists.

Water dependent habitats

15.3.21 The following nature conservation site within the study area is potentially groundwater dependent; Manface Quarry Local Wildlife Site (LWS), which covers an area of approximately 2.6ha and is located to the immediate south-west of the Proposed Scheme, with 0.6ha within the land required for the Proposed Scheme. This LWS includes areas of wetland. Further details of the ecology of this site, including the reporting on the effects and associated other mitigation, are provided in Section 7, Ecology and biodiversity.

15.3.22 No designated nature conservation sites within the study area which are dependent on surface water flows have the potential to be affected by the Proposed Scheme.

Existing baseline - flood risk and land drainage

15.3.23 The Environment Agency's Flood map for planning (rivers and sea)[182] has been used to scope the baseline flood risk for flooding from main rivers and ordinary watercourses. These plans define 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).

15.3.24 The updated Flood map for surface water[183] has been used to scope surface water flood risks. Infrastructure failure flood risks have been scoped using the Environment Agency risks of flooding from reservoirs national dataset[184]. The British Geological Survey's (BGS) Groundwater flooding susceptibility data set[185], has been used to assess the future risk of groundwater flooding.

15.3.25 The following reports were used to help determine the baseline flood risk within the study area:

- WMDC Strategic Flood Risk Assessment (2009) (SFRA)[186];
- WMDC Local Flood Risk Management Strategy (2016) (LFRMS)[187];
- BMBC Preliminary Flood Risk Assessment Report (2011) (PFRA)[188]; and
- BMBC SFRA (2010)[189].

[182] GOV.UK (2018) Flood map for planning. Available online at: https://flood-map-for-planning.service.gov.uk
[183] GOV.UK (2018) Learn more about this area's flood risk. Available online at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=402498&northing=282043&address=100070518535
[184] GOV.UK (2018) Learn more about this area's flood risk. Available online at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=402498&northing=282043&address=100070518535
[185] British Geological Survey (BGS) (2018) BGS groundwater flooding. Available online at: http://www.bgs.ac.uk/products/hydrogeology/groundwaterFlooding.html
[186] JBA Consulting (2009) Central Wakefield Area Action Plan; Strategic Flood Risk Assessment. Available online at: http://www.wakefield.gov.uk/Documents/planning/planning-policy/information-monitoring/strategic-flood-risk-assessment/central-wakefield-strategic-flood-risk-assessment.pdf
[187] Wakefield Metropolitan District Council (2016) Local Flood Risk Management Strategy. Available online at: http://www.wakefield.gov.uk/Documents/roads-parking/land-drainage-flooding/flood-risk-management-strategy.pdf
[188] Barnsley Metropolitan Borough Council (2011) Preliminary Flood Risk Assessment Report.
[189] JBA Consulting (2010) Barnsley Strategic Flood Risk Assessment.

River flooding

15.3.26 The study area includes areas of floodplain (Flood Zone 2 and 3) associated with Hague Hall Beck, a tributary of Hardwick Beck and a tributary of Oakenshaw Beck. Table 29 shows all relevant watercourses within the study area with receptors that would potentially be affected by any changes in flood magnitude. The value of these receptors, based on the definitions in Table 57 of the SMR, is also indicated.

Table 29: River flood risk sources and receptors

Source	Location description and figure/coordinate[190]	Receptor potentially affected	Receptor value / sensitivity to flooding
Hague Hall Beck	Downstream of Brierley culvert WR-01-367b G5	Agricultural land	Moderate
Tributaries of Hardwick Beck 1 and 2	Downstream of Nostell viaduct WR-01-368a E6	Agricultural land	Moderate
		A638 Doncaster Road	High
		Nostell Priory Lakes and Nostell Priory Lakes LWS	Moderate
Tributary of Oakenshaw Beck 1	Downstream of Crofton viaduct WR-01-368a G5	Agricultural land	Moderate
		Residential properties and roads within Crofton	High
		B6378 Lodge Lane/Cock Lane	Moderate

Surface water flooding

15.3.27 There are numerous areas that are susceptible to surface water flooding within the study area. The key sources and receptors with potential to be affected are shown in Table 30. The value of these receptors, based on Table 57 of the SMR, is also indicated.

Table 30: Surface water flood risk sources and receptors

Source	Location description and figure/coordinate[191]	Receptor potentially affected	Receptor value
Surface water flow path at Langthwaite Beck	Langthwaite Common WR-01-367b C8-C9	Broadway Road and associated residential properties	High
		Beech Street and associated residential properties	Moderate
		Dearne Valley railway line	Very high
Surface water flow path at Barnsley Road	Moorthorpe	Barnsley Road	High

[190] This is the location at which the source intersects the Proposed Scheme, as indicated by the grid coordinates on the relevant Volume 2: LA14 Map Book figure (in this case WR-01).
[191] This is the location at which the source intersects the Proposed Scheme, as indicated by the grid coordinates on the relevant Volume 2: LA14 Map Book figure (in this case WR-01).

Source	Location description and figure/coordinate[191]	Receptor potentially affected	Receptor value
	WR-01-367b D9	Dearne Valley railway line and Moorthorpe Station	Very high
Surface water flow paths at Hague Hall Beck	South Kirkby WR-01-367b E9-E10	Dearne Valley railway line	Very high
		South Kirkby Marsh	Low
		Faith Street and associated residential properties	High
		Carr Lane and associated residential properties	High
Surface water flow paths in and around South Moor between Dunsley drop inlet culvert and Brierley culvert	South Moor WR-01-367b F5 to G5	Agricultural land	Moderate
		B6273 Southmoor Road	Moderate
		Barnsley Road	High
Surface water flow paths in and around Cross Hill between Rushworth Wood culvert and West End culvert	Cross Hill WR-01-367b I6	Agricultural land	Moderate
		Residential properties and roads within Kinsley	High
Surface water flow path at Kinsley culvert	Kinsley WR-01-367b J6	Residential properties and roads within Kinsley	High
		Agricultural land	Moderate
Surface water flow path at Horncastle Hill inverted siphon	Fitzwilliam WR-01-368a D5	Residential properties and roads within Fitzwilliam	High
		B6428 Newstead Lane	Moderate
		Residential properties on Garmil Head Lane	High
		Agricultural land	Moderate
		Doncaster to Wakefield Line	Very high
Surface water flow paths in and around New Crofton between Nostell viaduct and New Crofton culvert	New Crofton WR-01-368a E6 to F6	Agricultural land	Moderate
		Doncaster to Wakefield Line	Very high
		Residential properties and roads in New Crofton	High
Surface water flow paths in and around Spring Hill between Crofton viaduct and Holme Bank culvert	Spring Hill WR-01-368a G5	Residential properties and roads within Sharlston	High
		Residential properties and roads within Crofton	High

Source	Location description and figure/coordinate[191]	Receptor potentially affected	Receptor value
		A638 Doncaster Road	High
		Pond located south of A638 Doncaster Road	Low
		Pond at Spring Hill	Low
		Agricultural land	Moderate
Surface water flow path at Sharlston culvert	Sharlston WR-01-368a H5	Agricultural land	Moderate
		Pontefract to Wakefield Line	Very High
		Cow Lane	Moderate
		Northfield Road	Moderate
		Residential properties in Sharlston Common	High

Artificial water bodies

15.3.28 Flooding from artificial water bodies may occur due to failure of an impounding structure, such as a dam or canal embankment. There are no artificial water bodies with potential implications for flood risk within the study area.

Groundwater flooding

15.3.29 Information related to the historical incidents of groundwater flooding in the South Kirkby to Sharlston Common area is provided within the WMDC LFRM[192] and the BMBC PFRA[193]. The LFRM has identified that groundwater may have contributed to historical flooding within the area. The PFRA indicates that groundwater flooding contributed to flooding in the area in June 2007 and July 2012. No further details are provided.

15.3.30 The BGS Groundwater flooding susceptibility data set indicates that there is some potential for groundwater flooding to occur within the wider study area where the underlying geology is sandstone, or to the north of Newstead, where there are isolated areas of made ground.

Land drainage

15.3.31 Existing topography, soils and land drainage systems within the study area are described in Section 4, Agriculture, forestry and soils. The rivers and watercourses within the area are connected to an extensive network of existing open drains. Subsurface drainage systems are also likely to be present in fields used for agriculture. The land drainage function of these systems, which is important for crop productivity, is potentially sensitive to increases in water levels within the receiving watercourses.

[192] Wakefield Metropolitan District Council (2016) *Local Flood Risk Management Strategy*. Available online at: http://www.wakefield.gov.uk/Documents/roads-parking/land-drainage-flooding/flood-risk-management-strategy.pdf
[193] Barnsley Metropolitan Borough Council (2011) *Preliminary Flood Risk Assessment Report*. Available online at: https://www.barnsley.gov.uk/media/4874/barnsley-pfra-report.pdf

15.4 Effects arising during construction

Avoidance and mitigation measures

15.4.1 The principal strategy adopted to limit the temporary and permanent effects of the Proposed Scheme is through avoidance of sensitive receptors wherever reasonably practicable. Where receptors could not be avoided, mitigation measures have been incorporated where appropriate and reasonably practicable, to limit the potential effects. Section 16 of the draft Code of Construction Practice (CoCP)[194] includes a range of mitigation measures that aim to reduce construction impacts as far as is reasonably practicable. The avoidance and mitigation measures that are of particular relevance to water resources and flood risk during construction are described in the following sections of this report.

Water resources and WFD

15.4.2 The avoidance of sensitive receptors has reduced the risks associated with the Proposed Scheme not complying with the requirements of the WFD. Examples of this strategy include:

- avoidance of channels and floodplain areas, where reasonably practicable – the route of the Proposed Scheme will avoid passing along river or stream valleys, such as that of Frickley Dike and its tributary, tributaries of Hague Hall Beck, tributaries of the River Went, tributaries of Hessle Beck, tributaries of Hardwick Beck, tributaries of Oakenshaw Beck, and tributaries of Red Beck and their associated floodplains. Instead it would pass over these watercourses on viaducts spanning the floodplain, with piers set back from the channel;
- avoidance, where reasonably practicable, of water dependent habitats, including natural springs that can play a key role in the hydrology and hydrogeology of such ecosystems; and
- avoidance, where reasonably practicable, of major public water supplies and smaller licensed and unlicensed abstractions of surface water and groundwater.

15.4.3 The presence of any unregistered private water supplies, their function and the means of protecting or if necessary replacing them would be discussed with any landowners potentially affected by the Proposed Scheme.

15.4.4 The temporary works shown on Map Series CT-05 in the Volume 2: LA14 Map Book have been informed by a detailed consideration of the water resources constraints and have sought to avoid sensitive features wherever reasonably practicable.

15.4.5 Watercourse realignments are proposed at the following locations: a tributary of Hague Hall Beck at Dunsley drop inlet culvert; a tributary of Hardwick Beck 2 at New Crofton culvert; and a tributary of Red Beck 1 at Sharlston culvert.

[194] Supporting document: Draft Code of Construction Practice

15.4.6 The aim will be to design these with equivalent hydraulic capacity to the existing channels. The Proposed Scheme would also aim to ensure that field subsurface drainage systems can be adapted to discharge into the new channel. Where such watercourses are natural channels, the design aim will be to incorporate appropriate features to retain and, where reasonably practicable, enhance their hydromorphological condition[195].

15.4.7 Watercourse diversions, which would result in changes in flow regime within discrete sections of channel, have been avoided wherever possible. There is one diversion of a tributary of the River Went into Kinsley culvert proposed within this study area.

15.4.8 For watercourses that are not in their natural condition, the design aim for realignments and diversions will be to incorporate measures, where reasonably practicable, to improve their hydromorphological condition, provided this is compatible with their flood risk and land drainage functions.

15.4.9 The design of infrastructure required within or in proximity to an existing channel (including bridge abutments, intermediate piers and outfalls) will aim to reduce impacts on the natural hydromorphology of watercourse channels, as far as is reasonably practicable.

15.4.10 The draft CoCP includes requirements to protect water bodies and their associated water resources from the potential impacts of pollution from construction site runoff, including where appropriate:

- provision of maps showing sensitive areas and buffer zones where no pollutants are to be stored or used; and
- preparation of method statements for silt management, site drainage at compounds and satellite compounds, for the storage and control of oils and chemicals and the prevention of accidental spillages, in consultation with the Environment Agency, and if appropriate, the LLFA and other relevant authorities as part of the approvals process. These method statements will cover, where applicable:
  - the avoidance of discharges of site runoff to ditches, watercourses, drains, sewers or soakaways without the prior approval of the appropriate authority;
  - measures to prevent silt-laden runoff and other pollutants entering the water environment; and
  - restrictions or controls on excavation within watercourses to limit effects on water quality, sedimentation, fisheries and aquatic ecology.

15.4.11 Method statements will be required for all watercourse crossings and channel realignments required for site haul routes. The method statements will describe how potential changes to flood risk, water quality and channel hydromorphology will be managed during the establishment, use and decommissioning of all site haul routes.

[195] "Hydromorphological condition" reflects the extent to which water flow, sediment composition and movement, continuity (in rivers) and the structure of physical habitats departs from that expected of a natural river or stream system.

15.4.12 Permanent culverts proposed on the smaller watercourse crossings within this study area include: Dunsley drop inlet culvert; Rushworth Wood culvert; Kinsley culvert; New Crofton culvert; Sharlston culvert and Horncastle Hill inverted siphon. The detailed design of these structures will be developed in general accordance with Construction Industry Research and Information Association (CIRIA) and Environment Agency guidance and in consultation with Environment Agency specialists. The design has sought to mitigate the impact on the hydromorphology of the affected watercourses, as follows:

- drop inlet culverts and inverted siphons have been avoided wherever reasonably practicable and are proposed on minor headwater channels and ditches only. There is one exception to this in the South Kirkby to Sharlston Common area, where there would be one inverted siphon on an ordinary watercourse, Hessle Beck 1, which is classified as a low value receptor;
- culvert lengths have been reduced as far as is reasonably practicable; and
- invert levels will be set below the firm bed of the watercourse to allow a natural substrate to develop along the bed of the culvert.

15.4.13 The wider issues associated with these culverts, and how their detailed design will aim to ensure no deterioration in the status of any of the relevant water bodies WFD quality elements, will be considered within the formal ES.

15.4.14 Existing groundwater abstraction boreholes or monitoring points will be protected from physical damage, insofar as reasonably practicable, including appropriate decommissioning of abandoned boreholes in order to prevent pollution pathways. If boreholes are to be decommissioned and replaced with alternatives, the contractors will follow the latest good practices. This principle will also be applicable to springs potentially affected by the Proposed Scheme, although additional measures may be required to mitigate temporary construction impacts. Wherever reasonably practicable, the design will aim to recreate affected spring features nearby.

15.4.15 Measures will be introduced, as required, to mitigate the temporary and permanent effects on groundwater flows and water quality during excavation and construction of foundations and cuttings as far as is reasonably practicable. The types of measure likely to be adopted could include:

- installation of cut-off[196] structures around excavations;
- ensuring cut-off structures are driven to sufficient depths to meet an underlying strata or zone of lower permeability;
- promoting groundwater recharge, such as discharging pumped water to recharge trenches around excavations to maintain baseline groundwater and surface water conditions; and
- incorporating passive bypasses within the design, which could comprise a

[196] Impermeable barrier preventing water flow

'blanket' of permeable material, such as gravel, placed around temporary structures allowing groundwater to bypass the below-ground works, without a rise in groundwater levels on the upstream side.

15.4.16 The exact requirements will be refined and method of mitigation will be designed following ground investigation at foundation or cutting locations.

Flood risk and land drainage

15.4.17 The design of the Proposed Scheme will aim to mitigate permanent impacts on flood risk and land drainage as follows:

- the floodplain avoidance strategy would ensure that the impacts on flood flows within rivers and streams, and their floodplains, would be limited to those associated with the intermediate pier structures on the viaducts. The Proposed Scheme includes replacement floodplain storage areas to replace losses associated with the piers and highway realignment;
- the temporary works shown on Map Series CT-05 in the Volume 2: LA14 Map Book have been informed by a detailed consideration of the flood risk constraints and have sought to avoid flood zones wherever reasonably practicable;
- provision has been made to pass surface water runoff and land drainage flows beneath sections of raised embankment that will cross surface water flow paths where reasonably practicable. This will be achieved using perimeter drainage and culverts, with their inverts set below the likely level of any upstream field subsurface drainage systems;
- in locations where the route of the Proposed Scheme will cross watercourses, the design aim is for structures to accommodate flood flows up to and including the 1 in 100 (1%) annual probability flood with an allowance for climate change based on latest guidance issued by the Environment Agency[197];
- runoff from the footprint of the infrastructure could occur more rapidly post-construction due to steeper slope angles and the permeability of the newly-created surfaces. The design of drainage systems aims to ensure that there will be no significant increases in flood risk downstream, during storms up to and including the 1 in 100 (1%) annual probability design event, with an allowance for climate change based on the latest guidance issued by the Environment Agency;
- balancing ponds for new sections of highway and railway drainage have been sized on a precautionary basis, pending more detailed information about the permeability and runoff characteristics of existing and proposed ground surfaces;

[197] Environment Agency, (2016), Adapting to Climate Change. Advice for Flood and Coastal Erosion Risk Management Authorities.

- where the Proposed Scheme will pass in cutting, drainage measures will be provided with the aim of preventing flow into the cutting and diverting this water into its natural catchment. Where reasonably practicable, runoff from the cuttings will also be drained to the catchments to which this water would naturally drain, avoiding transfer of water from one water body to another, which could increase flood risk or impact on land drainage systems; and
- measures will be introduced to reduce any potentially significant effects on groundwater flood risk as far as is reasonably practicable, including the incorporation of passive hydraulic bypasses at cuttings and other below ground structures. These could for example comprise a 'blanket' of permeable material such as gravel.

15.4.18 The nominated undertaker will, insofar as reasonably practicable, ensure that flood risk is managed throughout the construction period and will consider flooding issues when planning sites and storing materials. If necessary, temporary provision will be made to reduce to the potential for impacts on existing land drainage systems during construction. Some of the specific measures referred to in the draft CoCP, include:

- preparation of flood risk assessments and method statements for temporary works, including main construction and satellite compound drainage, watercourse crossings and realignments and temporary realignments in consultation with the Environment Agency, and where applicable, the LLFA and other relevant regulators;
- location of storage, machinery, equipment and temporary buildings outside flood risk areas where reasonably practicable;
- construction of outfalls during periods of low flow to reduce the risk of scour and erosion;
- design of temporary watercourse realignments with equivalent hydraulic capacity to the existing channels, ensuring that field subsurface drainage systems can be adapted to discharge into the new channel; and
- having regard to the requirement for construction activities to avoid any increases in flood risk to vulnerable receptors.

15.4.19 In accordance with Section 16 of the draft CoCP, monitoring would also be undertaken in consultation with the Environment Agency and, where applicable, the LLFA, to ensure that temporary structures are installed, maintained and removed in accordance with the relevant environmental approvals and that impact on existing land drainage systems are managed appropriately.

Assessment of impacts and effects

15.4.20 This section describes the significant effects following the implementation of the avoidance and mitigation measures. The majority of the potential temporary impacts on the water environment during construction will be avoided or mitigated by the working methods outlined in the draft CoCP. The mitigation embedded into the

design has focused on reducing permanent impacts resulting from the presence of the Proposed Scheme to as low a level as is reasonably practicable.

Temporary effects – Water resources and WFD

Surface water

15.4.21 Potential temporary impacts on surface water quality, due to site runoff and increased pollution risk, are a key concern during construction and have the potential to affect abstractions and the water environment more generally. However, the practices outlined in the draft CoCP are considered adequate to mitigate any impacts, such that there are unlikely to be any significant effects.

Groundwater

Aquifers

15.4.22 The proposed cuttings in the South Kirkby to Sharlston Common area would intersect the Pennine Upper Coal Measures and the Pennine Middle Coal Measures Secondary A aquifers. Whilst it is likely there would be minor localised impacts, the implementation of the measures outlined in the draft CoCP is likely to mean that any impacts on the overall status of these aquifers would not be significant.

15.4.23 Where cuttings could affect local receptors, such as groundwater abstractions or springs, this is reported in the sections below.

Abstractions

15.4.24 No groundwater abstractions have been identified within the study area.

Groundwater – surface water interactions

15.4.25 No potential for temporary significant effects has been identified in connection with groundwater - surface water interactions.

Water-dependent habitats

15.4.26 Manface Quarry LWS is located immediately adjacent to Howell Wood cutting. Temporary dewatering and drainage at the cutting is likely to result in the lowering of the groundwater table at Manface Quarry LWS, which results in a minor hydrological impact. However, construction of the Proposed Scheme would result in the removal of 23.7% of this LWS. Effects related to Manface Quarry LWS, which is an ecological receptor, are discussed in Section 7, Ecology and biodiversity.

Temporary effects - Flood risk and land drainage

15.4.27 Construction of Nostell viaduct and Crofton viaduct, the culverts required for the tributaries of Hague Hall Beck, River Went, Hardwick Beck, Oakenshaw Beck and Red Beck and the inverted siphon required for the tributary of Hessle Beck would require temporary working within flood zones. Construction sequencing and temporary works design will be carefully considered and assessed in terms of potential impacts on flood risk. Method statements detailing how these works would be undertaken will be produced by the nominated undertaker in consultation with the Environment Agency and the LLFA. It is not anticipated that these temporary activities would result in significant effects related to flood risk and land drainage.

Permanent effects – Water resources and WFD

15.4.28 Permanent effects are those initially caused by activity to construct the Proposed Scheme but which would also remain after the Proposed Scheme has been constructed and is present in the area.

Surface water

15.4.29 The assessment has not identified any localised impacts on surface water receptors that would give rise to permanent significant effects on surface water quality and channel hydromorphology in the study area.

Groundwater

Aquifers

15.4.30 It is currently anticipated that implementation of the avoidance and mitigation measures would ensure that there are no permanent significant effects related to the impact of the proposed cuttings on water levels and quality in the aquifers intercepted by the Proposed Scheme.

15.4.31 Where cuttings could affect local receptors, such as aquifers or springs, this is reported in the sections below.

Abstractions

15.4.32 No groundwater abstractions have been identified within the study area.

Groundwater – surface water interactions

15.4.33 There would be a potentially permanent reduction in groundwater catchment to six potential spring features: south of Common Road; east of South Kirkby Common; north of Hilltop Estate; east of Dunsley Lane; at Dunsley Lane; and at Cobb Carr Plantation. These features are assumed to be high value receptors on a precautionary basis and their loss would, therefore, potentially result in a permanent moderate adverse effect, which would be significant.

Water dependent habitats

15.4.34 Manface Quarry LWS is located immediately adjacent to Howell Wood cutting. Permanent dewatering and drainage at the cutting is likely to result in the lowering of the groundwater table at Manface Quarry LWS, which results in a minor hydrological impact. However, construction of the Proposed Scheme would result in the removal of 23.7% of this LWS. Effects related to Manface Quarry LWS, which is an ecological receptor, are discussed in Section 7, Ecology and biodiversity.

Permanent effects - flood risk and land drainage

15.4.35 The assessment has not identified any localised impacts that would give rise to permanent significant effects related to flood risk in the South Kirkby to Sharlston Common area.

Other mitigation measures

15.4.36 Additional mitigation measures to further reduce the temporary and permanent impacts of construction stage activities, where there is potential for the Proposed Scheme to result in significant effects are described in the sections below.

Groundwater

15.4.37 A survey of the six potential spring features potentially impacted by the Proposed Scheme will be undertaken to determine their value and to identify whether further mitigation is required. If they are confirmed to be springs, measures would be implemented to ensure that any significant adverse effects would be mitigated.

Summary of likely residual significant effects

15.4.38 In the absence of the other mitigation measures set out above, the Proposed Scheme would potentially result in residual significant effects to the potential springs located south of Common Road, east of South Kirkby Common, north of Hilltop Estate, east of Dunsley Lane, at Dunsley Lane and at Cobb Carr Plantation. These would be permanent moderate adverse effects which are significant.

15.4.39 It is currently anticipated that it should be possible to develop the means of mitigating these impacts, to ensure that there are no residual significant effects arising from construction of the Proposed Scheme.

15.5 Effects arising from operation

Avoidance and mitigation measures

15.5.1 The principal issue of concern during operation of the Proposed Scheme is the potential for accidental spillages to occur that could result in the release of contaminants into the water environment. This issue has been assessed on a route-wide basis in Volume 3: Route-wide effects (Section 16), where the mitigation measures associated with this risk are described. A draft operation and maintenance plan for water resources and flood risk will be provided in the formal ES.

15.5.2 The design takes into account the policies in the NPPF and will aim to ensure that the Proposed Scheme is safe from flooding without increasing flood risk elsewhere. Evidence of application of the Sequential Test and Exception Tests in the NPPF is provided on a route-wide basis in Volume 3: Route-wide effects.

15.5.3 Sustainable drainage systems will be used where reasonably practicable. These will help to remove any suspended material within runoff from the Proposed Scheme through filtration, vegetative adsorption or settlement. The drainage systems proposed will aim to ensure that the quantity and quality of water draining from the Proposed Scheme during its operational phase will have a negligible impact on the water environment.

15.5.4 A summary of the route-wide WFD compliance assessment process is provided in Volume 3: Route-wide effects. This describes the ongoing assessment process and how measures will be embedded into the design that are specifically designed to ensure that the Proposed Scheme complies with the requirements of the WFD, where

reasonably practicable. It is currently anticipated that the Proposed Scheme will be compliant with WFD legislation.

Assessment of impacts and effects

15.5.5 There are considered to be no significant adverse effects related to water resources and flood risk arising from operation of the Proposed Scheme.

Other mitigation measures

15.5.6 There are considered to be no further measures required to mitigate adverse effects on surface water resources, groundwater resources or flood risk.

Summary of likely residual significant effects

15.5.7 The assessment shows that there would be no residual significant effects on surface water, groundwater or flood risk during operation of the Proposed Scheme.

Monitoring

15.5.8 Volume 1, Section 9 sets out the general approach to monitoring of water resources and flood risk during operation of the Proposed Scheme.

15.5.9 There are no area-specific requirements for monitoring water resources and flood risk during operation of the Proposed Scheme.

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