LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA25 | Castle Bromwich and Bromford

November 2013

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ES 3.2.1.25

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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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Structure of the HS2 Phase One Environmental Statement

The Environmental Statement (ES) documentation comprises:

- Non-technical summary (NTS) – which provides a summary in non-technical language of the Proposed Scheme, the likely significant environmental effects of the Proposed Scheme, both beneficial and adverse, and the means to avoid or reduce the adverse effects;
- Volume 1: Introduction to the ES and the Proposed Scheme. This describes High Speed Two (HS2), and the environmental impact assessment process, the approach to consultation and engagement, details of the permanent features and generic construction techniques as well as a summary of main strategic and route-wide alternatives and local alternatives (prior to 2012) considered;
- Volume 2: Community forum area reports and map books – 26 reports and associated map books providing an assessment of local environmental effects;
- Volume 3: Route-wide effects – provides an assessment of the effects of the Proposed Scheme where it is not practicable to describe them within the CFA descriptions in Volume 2;
- Volume 4: Off-route effects – provides an assessment of the off-route effects of the Proposed Scheme;
- Volume 5: Appendices and map books – contains supporting environmental information and associated map books; and
- Glossary of terms and list of abbreviations – contains terms and abbreviations, including units of measurement, used throughout the ES documentation.

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, South Yorkshire and the East Midlands will be served by high speed trains running at speeds of up to 360kph (225mph).

1.1.2 HS2 is proposed to be built in two phases. Phase One, the subject of this ES, will involve the construction of a new railway line of approximately 230km (143 miles) between London and Birmingham. Construction will begin in 2017 and the line will become operational by 2026; with a connection to the West Coast Main Line (WCML) near Lichfield and to the existing HS1 railway line in London.

1.1.3 During Phase One beyond the dedicated high speed track, high speed trains will connect with and run on the existing West Coast Main Line (WCML) to serve passengers beyond the HS2 network to destinations in the north. A connection to HS1 will also allow some services to access that high speed line through east London and Kent and connect with mainland Europe via the Channel Tunnel.

1.1.4 Phase Two will involve the construction of lines from Birmingham to Leeds and Manchester; with construction commencing around 2023/2024, and planned to be operational by 2033.

1.1.5 Section 4 of Volume 1 describes the anticipated operational characteristics of HS2, including the anticipated frequency of train services. As Volume 1 shows, the frequency of trains is expected to increase over time and to increase further upon opening of Phase Two. In assessing the environmental effects of the Proposed Scheme the anticipated Phase Two operational frequency has been used. For further detail about operation of the scheme in the Castle Bromwich and Bromford area (CFA25), see Section 2.4.

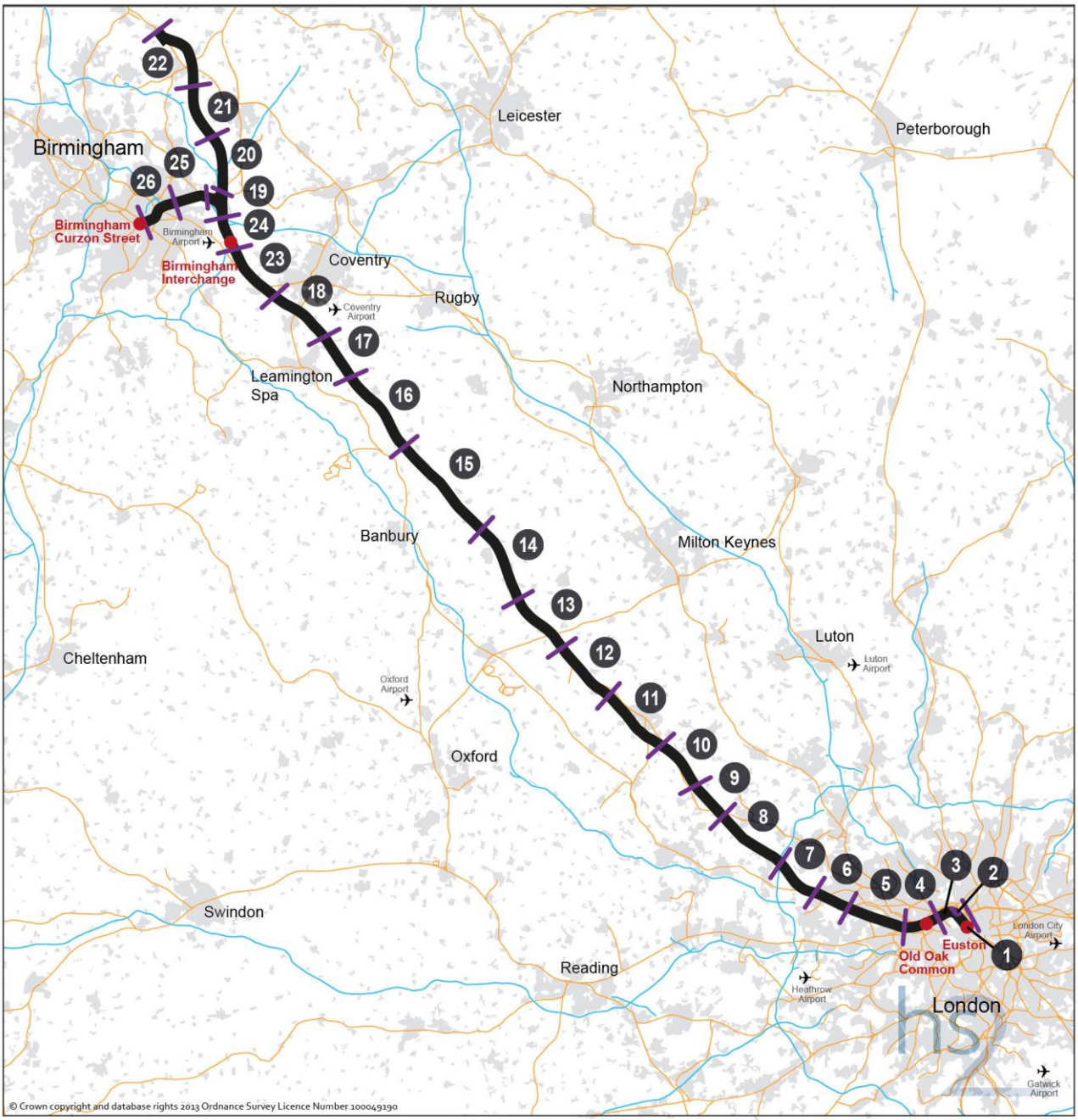
1.1.6 The Government believes that the HS2 network should link to Heathrow and its preferred option is for this to be built as part of Phase Two. However, the Government has since taken the decision to pause work on the Heathrow link until after 2015 when it expects the Airports Commission to publish its final report on recommended options for maintaining the country's status as an international aviation hub.

1.1.7 For consultation and environmental assessment purposes, the proposed Phase One route has been divided into 26 community forum areas (CFA), as shown in Figure 1. This has enabled wider public engagement on the scheme design and on the likely adverse and beneficial effects.

1.2 Purpose of this report

1.2.1 This report presents the likely significant environmental effects of the construction and operation of the Proposed Scheme on the environment within CFA25 (Castle Bromwich and Bromford). The report describes the mitigation measures that are proposed for the purpose of avoiding, reducing or managing the likely significant adverse effects of the Proposed Scheme on the environment within CFA 25.

Figure 1: HS2 Phase One route and community forum areas



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 area, description of the Proposed Scheme within the area and its construction and operation, and a description of the main local alternatives.
- Sections 3-13 – an assessment for the following environmental topics:
  - agriculture, forestry and soils (Section 3);
  - air quality (Section 4);
  - community (Section 5);
  - cultural heritage (Section 6);
  - ecology (Section 7);
  - land quality (Section 8);
  - landscape and visual assessment (Section 9);
  - socio-economics (Section 10);
  - sound, noise and vibration (Section 11);
  - traffic and transport (Section 12); and
  - water resources and flood risk assessment (Section 13).

1.3.2 Each environmental topic section comprises: an introduction to the topic, a description of the environmental baseline within the area, the likely significant environmental effects arising during construction and operation of the Proposed Scheme and proposed mitigation measures for any significant adverse effects.

1.3.3 Environmental effects have been assessed in accordance with the methodology set out in Volume 1, the Scope and Methodology Report (SMR) (see Volume 5: Appendix CT-001-000/1) and SMR Addendum (see Volume 5: Appendix CT-001-000/2).

1.3.4 Where appropriate, potential climate change impacts and adaptation measures are discussed in the relevant environmental topic section. Volume 1 and Section 6A of the SMR Addendum also include additional information about climate change adaptation and resilience.

1.3.5 The maps relevant to Castle Bromwich and Bromford are provided in a separate corresponding document entitled Volume 2, CFA25 Map Book, which should be read in conjunction with this report.

1.3.6 The Proposed Scheme described in this report is that shown on the Map Series CT-05 (construction) (Volume 2, CFA25 Map Book) and CT-06 (operation) (Volume 2, CFA25 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 1.4.

1.3.7 In addition to the environmental topics covered in Sections 3-13 of this report, electromagnetic interference is addressed in Volume 1 and climate (greenhouse gas emissions and carbon), and waste and material resources are addressed in Volume 3. An assessment of potential environmental effects beyond the CFA has also been undertaken and this 'off-route' assessment is reported in Volume 4.

2 Overview of the area and description of the Proposed Scheme

2.1 Overview of the area

2.1.1 The Castle Bromwich and Bromford CFA covers an approximately 5.1km section of the Proposed Scheme within the Birmingham City Council (BCC) administrative area. The Solihull Metropolitan Borough Council (SMBC) administrative area is located just to the south at the eastern end of the route and the eastern edge of the route is on the boundary of the North Warwickshire Borough Council (NWBC) administrative area[1].

2.1.2 The area includes parts of the Sutton New Hall, Castle Bromwich, Tyburn and Hodge Hill Wards (Figure 2). It extends from just south of where the B4118 Birmingham Road or Water Orton Road (the road name changes at about the point of the Proposed Scheme, with B4118 Birmingham Road used for consistency in this report) crosses the M6, west of Bromford Drive.

2.1.3 Coleshill Junction (CFA19) lies to the east and Washwood Heath to Curzon Street (CFA26) lies to the west.

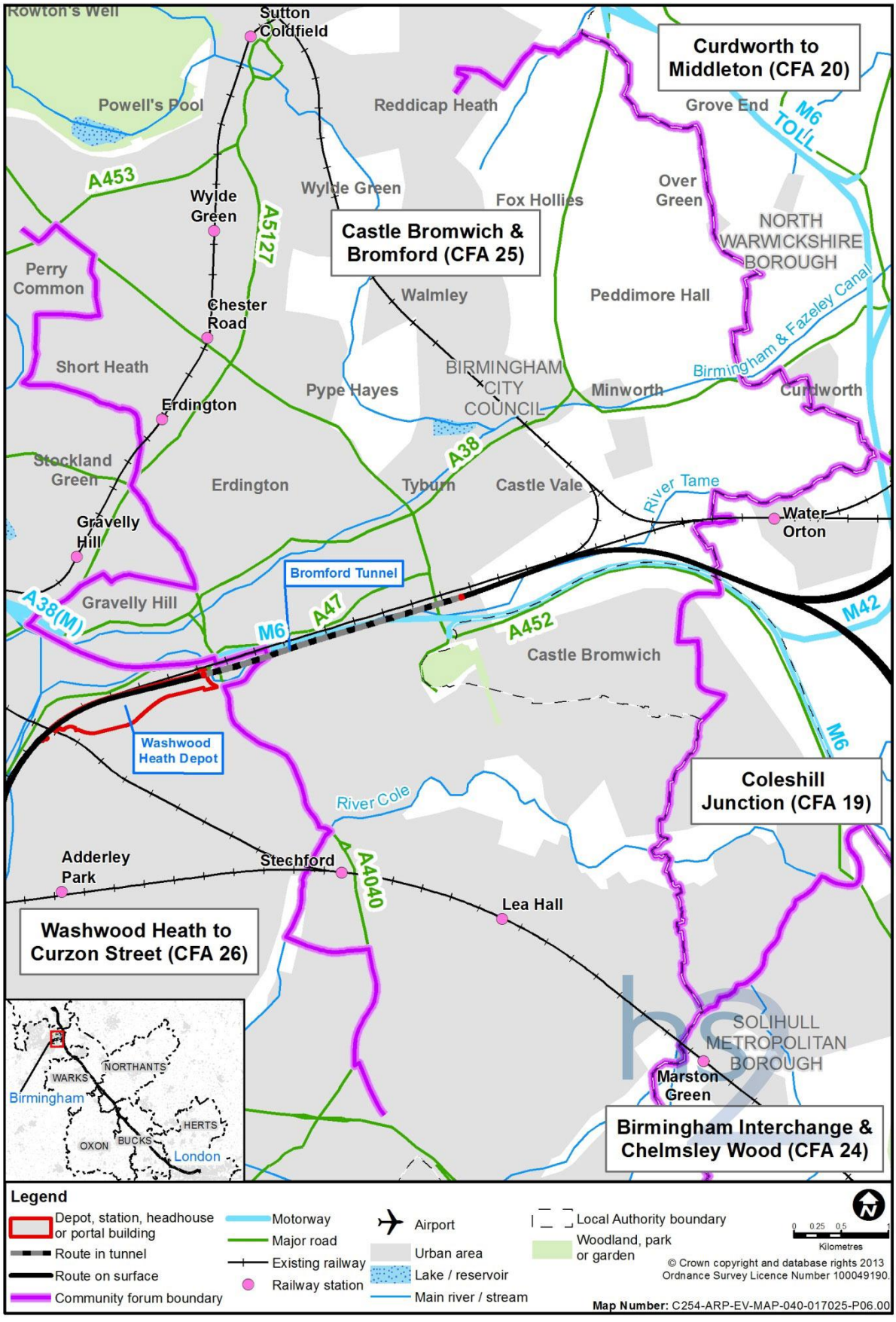
Settlement, land use and topography

2.1.4 The Castle Bromwich and Bromford area is predominantly urban in character, but its eastern end lies on the rural fringe (see Volume 2: Maps CT-10-067 to CT-10-068a). The rural and open area around the B4118 Birmingham Road and Park Hall nature reserve are located in this eastern end. The rest of the area is generally dominated by light industrial, commercial and infrastructure uses through Castle Vale, Castle Bromwich and Bromford. The industrial and commercial areas make use of lower lying land close to the River Tame and also the corridor of the main transport infrastructure (such as the M6 and Birmingham and Derby line) that follow the valley. The main residential areas are generally on higher ground, away from the valley floor (which has always been prone to flooding), although Bromford is close to the River Tame and the Proposed Scheme.

2.1.5 Topographically, there are two high points in this area. The first high point is at the western end of this area at approximately 85m above Ordnance Datum (AOD), where the valley floor generally falls to the east, away from the ridge on which Birmingham city centre is located, along the valley of the River Tame to approximately 77m AOD at Park Hall nature reserve. The river valley is the dominant topographic feature that defines the land use and views in this area. It is also the basis of the local environment including floodplain and locally important wildlife corridors. The second high point is at the eastern end of this area, near the B4118 Birmingham Road, at the top of the River Tame valley slope on the south side of Park Hall Wood. This site has a spot height of approximately 106m AOD and, apart from the dramatic drop into the valley floodplain, it also falls away gently to the east.

[1] Although NWBC policy has been considered in the broad assessment of the study area, the land required for the construction and operation of the Proposed Scheme in this CFA falls outside the NWBC administrative area.

Figure 2: Area context map



Key transport infrastructure

2.1.6 The River Tame valley is a major transport corridor into Birmingham city centre and comprises both rail and road infrastructure. The Birmingham and Derby line runs broadly from the east into Birmingham New Street station and similarly the M6, A452 and A47 Fort Parkway, all major roads, use this east/west corridor. Consequently, there are a number of locally important public highway crossing points of this corridor comprising (starting from the east) B4118 Birmingham Road, A452 Chester Road and A4040 Bromford Lane.

Socio-economic profile

2.1.7 To provide a socio-economic context for the area, data is presented for the demographic character areas (DCA) of Castle Bromwich, Castle Vale and Bromford[2]. In total, the population of the Castle Bromwich and Bromford area is approximately 13,200; of which Castle Bromwich DCA is approximately 5,300, Castle Vale DCA is approximately 3,600 and Bromford DCA is approximately 4,300, which highlights the urban nature of the area. In 2011, the unemployment rate for Castle Bromwich DCA was 7%; 17% in Castle Vale DCA; and 20% in Bromford DCA[3] compared to the West Midlands (9%) and England (7%).

Notable community facilities

2.1.8 The area includes the large residential suburb of Castle Bromwich and the residential estates of Castle Vale and The Firs and Bromford, each with distinct communities and local facilities.

2.1.9 The suburb of Castle Bromwich, located within the northern extent of the SMBC administrative area, is an expanded historic settlement, with Castle Bromwich Hall, St. Mary and St. Margaret Church and the surrounding designated Castle Bromwich conservation area to the west. To the south of Castle Bromwich is a youth and community centre that neighbours the Castle Bromwich Junior School. There are several nearby primary schools and the Oaklands Special School (previously known as Lanchester School) and Park Hall Academy secondary school to the north of Castle Bromwich, south of the A452.

2.1.10 The Castle Vale residential area, located approximately 9km north-east of Birmingham city centre, is a post-war housing estate that has undergone various regeneration initiatives with the construction of new housing and community facilities. There are several primary schools and the Greenwood Academy (secondary school) within the estate. In addition, the Castle Vale Campus located in the centre of the estate includes a library and a skills centre operated by Birmingham Metropolitan College. The Castle Vale Retail Park to the west of the residential areas provides several superstores, whilst Reed Square in the centre of the estate includes a range of neighbourhood services.

2.1.11 The Firs and Bromford estate is located to the south of the M6, approximately 8km north-east of Birmingham city centre. The estate includes a neighbourhood centre to the north, off Bromford Drive, with a range of services including a neighbourhood

[2] A DCA represents a community that, depending on the area, may consist of a local ward, neighbourhood or village(s).
[3] All statistics come from Office for National Statistics (ONS) (2012). *2011 Census. London, ONS.*

office, a community centre, the Bromford residents' club, a public house (The Bromford Bridge Members Club) and convenience shops. Adjacent to the centre is the Tame Valley Academy (primary school) and the Bromford Bridge Christian Church.

2.1.12 Medical provision within this area is of a local scale, serving the residential areas of Castle Bromwich, Castle Vale and the Firs and Bromford. Within Castle Bromwich, there is a residential care home for adults with learning disabilities, two dentists and one general practitioner (GP) surgery. Castle Vale provides two residential care homes, one dentist and two GP surgeries. The Bromford estate also offers two GP surgeries as well as a counselling service, and the Bromford Lane Care Home which provides residential care to both the elderly and young adults.

2.1.13 North of the M6, accessed via the A47 Fort Parkway, is the Fort Shopping Park with a range of shops and restaurants.

Recreation, leisure and open space

2.1.14 There are large areas of open space throughout the Castle Bromwich area, with Lanchester Park to the north-east of the main residential area, adjacent to the A452. The gardens of Castle Bromwich Hall provide a visitor attraction with an important heritage value, whilst the Hall provides a hotel with conference and event facilities and a restaurant.

2.1.15 To the north of Castle Bromwich and the M6, Park Hall nature reserve provides a recreational resource with organised visits and volunteering opportunities managed by the Wildlife Trust for Birmingham and the Black Country.

2.1.16 To the south-east of the Castle Vale estate is Farnborough Road Park, a large public open space, which includes Vale Stadium, the Castle Vale football ground. The park provides several grassed football pitches and a local children's play area.

2.1.17 The Firs and Bromford estate is bound by a green corridor of public open space to the north, running parallel to the M6. It includes a children's play area, skate park, a multi-use games area and a network of footpaths linking parts of the estate.

2.1.18 There are no Public Rights of Way (PRoW) within the part of the study area situated within the BCC administrative area. There are numerous public highways with footways that provide pedestrian access which have been assessed within Section 12 (Traffic and transport).

Policy and planning context

Planning framework

2.1.19 Given that HS2 is being developed on a national basis to meet a national need, it is not included or referred to in many local plans. Nevertheless, in seeking to consider the Proposed Scheme in the local context, relevant local plan documents and policies have been considered in relation to environmental topics.

2.1.20 The following local policies have been considered and referred to where appropriate to the assessment:

- the Birmingham City Council Unitary Development Plan (BUDP) (2005) is the current adopted development plan for the area[4];
- the Birmingham Development Plan Options Consultation Document (BDP) (2012) is at an early stage of preparation[5]. The BDP will ultimately replace the BUDP;
- the Solihull Unitary Development Plan (SUDP) (2006) is the current adopted development plan for the SMBC administrative area[6];
- the Solihull Draft Local Plan (SDLP) (2012) has reached submission stage and is currently subject to examination by the Secretary of State[7]. Once this plan has been adopted, the policies within it will replace those within the SUDP; and
- the North Warwickshire Local Plan (NWLP) (2006) is the current adopted development plan for the NWBC administrative area[8]. This will be replaced by the emerging Core Strategy[9] which has reached submission stage and the examination by the Secretary of State is due to commence in January 2014.

2.1.21 There are a number of key planning designations in the area, which include conservation areas, listed buildings, scheduled monuments, historic parks and gardens, ancient woodland and other non-designated heritage assets. These are shown on the maps in Volume 2: Map CT-10-067 to 068a.

2.1.22 Emerging policies are not generally considered within this report, unless a document has been submitted to the Secretary of State for approval. The Birmingham Development Plan, which will replace the BUDP, is currently under consultation, it will be submitted to the Secretary of State for formal examination during 2014.

Committed development

2.1.23 Developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme, are shown on Volume 5: Maps CT-13-067 to 068a and listed in Volume 5: Appendix CT-004-000. It has been assumed that these developments will have been completed by 2017. These are termed 'committed developments' and are treated as potential receptors from the Proposed Scheme. Where these developments have a particular relevance to an assessment topic, this is noted in the future baseline section for that topic. The following developments are relevant to several topics assessments in this area:

- full planning permission (2012/06220/PA) for the erection of an employment building for B8 (storage and distribution) use, associated access, parking, drainage and landscaping at Prologis, Minworth, Sutton Coldfield (see Volume 5: Map CT-13-067, H3); and
- full planning permission (2011/05335/PA) for the erection of a residential development comprising 42 flats with associated car parking, access roads,

[4] Birmingham City Council (BCC) (2005). *Birmingham City Council Unitary Development Plan*. BCC.
[5] Birmingham City Council (BCC) (2012). *Birmingham Development Plan Options Consultation*. BCC.
[6] Solihull Metropolitan Borough Council (SMBC) (2006). *Solihull Unitary Development Plan 2006*. SMBC.
[7] Solihull Metropolitan Borough Council (SMBC) (2012). *Solihull Draft Local Plan: Shaping a Sustainable Future*. SMBC.
[8] North Warwickshire Borough Council (NWBC) (2006). *North Warwickshire Local Plan* (NWLP). NWBC.
[9] North Warwickshire Borough Council (NWBC) (pre-submission), *North Warwickshire Core Strategy*. NWBC.

footpaths, bin stores and boundary treatments at Bromford Lane, Ward End (see Volume 5: Map CT-13-068a, D8).

2.1.24 However, where a committed development lies wholly or partly within the land required for the Proposed Scheme, it is assumed that the development will not be commenced or completed in its proposed form. Such developments are noted in Volume 5: Appendix CT-004-000.

2.1.25 No developments have been identified which are likely to have cumulative effects, when considered together with the Proposed Scheme.

2.1.26 Planning applications yet to be determined 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 are listed in Volume 5: Appendix CT-004-000. They are not included in the assessment[10]. The progress of these proposals is being monitored by HS2 Ltd.

2.2 Description of the Proposed Scheme

2.2.1 The following section describes the main features of the Proposed Scheme in the Castle Bromwich and Bromford area, including the main environmental mitigation measures. Further generic information on typical permanent features is provided in Volume 1, Section 5. Similarly, a general description of the approach to mitigation is set out in Volume 1, Section 9.

2.2.2 The Proposed Scheme will require some land on a permanent basis, key features of which are illustrated in Volume 2: Maps CT-06-135 to CT-06-139a (Volume 2). Land that will also be required, but only on a temporary basis for construction, is set out in Section 2.3.

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

2.2.4 Since the draft ES (May 2013) was published the following changes have been introduced as permanent features of the Proposed Scheme:

- increasing the overall Bromford tunnel depth (from the top of the tunnel being 15m below ground level in the draft ES, to now 30m); and
- reconfiguring the route alignment through Castle Bromwich Business Park.

Overview

2.2.5 The route of the Proposed Scheme through this area is approximately 5.1km long and will commence at the BCC and NWBC administrative area boundaries, just south of the B4118 Birmingham Road, north of Chelmsley Wood. The route will run west, initially in a deep cutting (continuing from Coleshill Junction, CFA19) through higher ground, and then emerging onto a viaduct across the valley floor and the diverted River Tame. The route will then continue on embankment across the extended Plants

[10] For traffic and transport and topics that make use of traffic flow forecasts, future baseline and with the Proposed Scheme flows take into account all planned development, including proposed development, to establish a robust baseline.

Brook and Dunlop Channel, typically 10-15m south of the Birmingham and Derby line, near its junction with the line which runs towards Sutton Coldfield.

2.2.6 The route will then descend to below ground level initially in a cutting with retaining walls, before entering a tunnel, the portal of which will be situated approximately 300m east of the A452 Chester Road.

2.2.7 The tunnel will pass beneath the A452 Chester Road, River Tame, M6, and Bromford Drive. At this point, the route (still in tunnel) will leave the Castle Bromwich and Bromford area (the remaining part of the tunnel is described in the Washwood Heath to Curzon Street CFA26 report). The entire length of the tunnel from Castle Bromwich Business Park to the Drew's Lane Industrial Estate will be 2.9km (see Volume 2: Maps CT-06-136, A7 to CT-06-138a, B7).

Water Orton overbridge cutting and Park Hall Wood embankment

2.2.8 The route will start in this area heading generally west, towards Birmingham city centre. The route will be in deep cutting (known as Water Orton cutting), up to 18m deep, as it passes from the adjacent Coleshill Junction area (CFA19) into the Castle Bromwich and Bromford area. The route will pass under the B4118 Birmingham Road.

2.2.9 The area of land required for the construction of the Proposed Scheme will include most of Park Hall nature reserve, including the wooded scarp slope in the south, adjacent to the M6. Powers are being sought in the hybrid Bill to allow flexibility during the construction stage, in particular for the diversion of the existing National Grid overhead power line. The removal of the mature and ancient woodland will be kept to a reasonable minimum to allow for the Water Orton cutting and diversion of the power line. For the purpose of the assessment of the power line diversion, the woodland loss is assumed to be a width of 60m along the line of the diversion as indicated on Volume 2: Maps CT-05-135b, D4 to A8 and CT-05-136, J7 to E8. Woodland outside of this strip will be retained and protected. Any variation having a different significant effect will be subject to appraisal at the appropriate time.

2.2.10 Key design features of this section will include (see Volume 2: Map CT-06-135b):

- the Water Orton cutting of approximately 700m in length within this area and up to 18m deep, from the BCC and NWBC administrative boundary to the Park Hall escarpment, passing beneath the B4118 Birmingham Road (see Volume 2: Map CT-06-135b, H7 to E6);
- the Water Orton Road overbridge and retaining walls carrying the B4118 Birmingham Road at existing ground level over the route in the cutting described above (see Volume 2: Map CT-06-135b, F6);
- a realigned private access track from the B4118 Birmingham Road into the Park Hall nature reserve (see Volume 2: Map CT-06-135b, F6 to D6);
- the diversion of an existing fuel pipeline where it crosses under the B4118 Birmingham Road to run along the northern edge of the route and then connecting back into the existing pipeline just east of a gap in the trees along the Park Hall escarpment (see Volume 2: Map CT-06-135b, H6 to F5);

- the Park Hall Wood embankment, which extends approximately 70m in length from the Water Orton cutting to the adjacent viaduct abutments and up to 6m high for the railway (see Volume 2: Map CT-06-135b, D6);
- an area of woodland and grassland planting to the north of the B4118 Birmingham Road to replace habitat lost in the Park Hall nature reserve (see Volume 2: Map CT-06-135b, F5); and
- a balancing pond, to receive drainage from the western end of the cutting, and associated access tracks adjacent to the Park Hall Wood embankment (see Volume 2: Map CT-06-135b, D5).

River Tame viaduct to Castle Bromwich retained cut

2.2.11 The route will head west from the Park Hall Wood embankment, onto the River Tame viaduct, across the diverted River Tame and then onto a raised embankment, up to 8m above ground level, adjacent to and parallel with the Birmingham and Derby line. The route will pass over Plants Brook and the Dunlop Channel before entering the eastern edge of the Castle Bromwich Business Park. From this point the route will descend into cutting (known as Castle Bromwich retained cutting), heading towards the proposed tunnel. Key design features of this section will include (see Volume 2: Maps CT-06-135b to CT-06-137):

- two additional sections of the diversion of an existing fuel pipeline through Park Hall nature reserve. One section will divert horizontally (see Volume 2: Maps CT-06-135b, C5, to CT-06-136, E7) and the other will be lowered vertically under the route;
- the River Tame viaduct of approximately 780m in length with the main deck of the structure being up to approximately 10m above ground level, for the route to cross the River Tame at Park Hall nature reserve (see Volume 2: Maps CT-06-135b, D6 to CT-06-136, H6). The viaduct will include a 1.4m high solid safety fence close to the rail and, although this is for maintenance staff protection, it will have some noise attenuation value. The west end of the viaduct will be accessible for maintenance via Tameside Drive;
- realignment of the River Tame channel through Park Hall nature reserve, with new channel connections for Plants Brook and the Dunlop Channel (see Volume 2: Maps CT-06-136, I6 to D8);
- flood storage replacement areas excavated and side slopes regraded to tie back into existing ground levels through Park Hall nature reserve (see Volume 2: Maps CT-06-135b, E5 to CT-06-136, D9);
- planting of the flood storage replacement areas as marshy grassland (see Volume 2: Maps CT-06-135b, E5 to CT-06-136, D9);
- woodland habitat creation (see Volume 2: Map CT-06-136, G8 and F8);
- the Park Hall retained fill and Langley Wood embankment approximately 600m in length adjacent to the south side of the Birmingham and Derby line and on the north side of the Park Hall nature reserve (see Volume 2: Map CT-06-136, H6 to E6);

- the Castle Bromwich retained cutting of approximately 700m length for the route as it descends into the tunnel within the Castle Bromwich Business Park (see Volume 2: Map CT-06-136, E6 to A7);
- three balancing ponds and associated access tracks; two north of the Birmingham and Derby line and one at the eastern end of the Castle Bromwich Business Park (see Volume 2: Map CT-06-136, I5, F6 and D7 respectively). There will be landscape planting around the balancing pond near to Farnborough Road Park (see Volume 2: Map CT-06-136, F6);
- the Castle Bromwich auto-transformer station, with a footprint of approximately 43m by 22m, at the eastern end of Castle Bromwich Business Park (see Volume 2: Map CT-06-136, D7);
- the permanent diversion of two sewers, south of the route, which are affected by the proposed River Tame realignment and excavation of a balancing pond;
- the permanent diversion of underground Western Power low voltage electricity cables, crossing under the route, on the east side of Castle Bromwich Business Park; and
- the diversion of National Grid overhead power lines over the route and associated pylons within the extents of the eastern end of Park Hall nature reserve and Castle Bromwich Business Park. The proposed diversion will be south of the current alignment (see Volume 2: Maps CT-06-135b, D4 to A8 and CT-06-136, J7 to E8).

Bromford tunnel

2.2.12 From the eastern tunnel portal westwards to the boundary with Washwood Heath to Curzon Street (CFA26), the Proposed Scheme will comprise a twin-bore tunnel (i.e. there will be two adjacent tunnels: one tunnel bore will run a track west towards Curzon Street station and the second bore will run the other track east towards Water Orton and the proposed Delta Junction).

2.2.13 The area of land required for the Proposed Scheme will include the Castle Bromwich Business Park and Hayward Industrial Estate (the two business parks are adjacent and so, for clarity, generally, references to the larger Castle Bromwich Business Park in this ES also relate to the Hayward Industrial Estate). Proposals will be developed for the reconfiguration of the business park and industrial estate so as to minimise the effects on businesses, residents and social infrastructure and to allow as many as possible to stay in the area. Any such reconfiguration will be subject to discussion with landowners and BCC, and obtaining the necessary planning permission. The land for the construction of the eastern tunnel portal, the infrastructure and its associated features will be required permanently.

2.2.14 Key design features of this section will include (see Volume 2: Maps CT-06-137 to CT-06-138a):

- a twin bore Bromford tunnel which will be approximately 2.9km in length (see Volume 2: Maps CT-06-136, A7, to CT-06-138a, B7), approximately 2.2km of which will be in the Castle Bromwich and Bromford area and the remainder in

the Washwood Heath to Curzon Street area (see CFA26) to the west. The top of the tunnel bore will be up to 30m below the existing ground level, with the track level up to 37m below ground level;

- each bore will have an external diameter of approximately 8.25m as excavated and a finished internal diameter of approximately 7.55m once lined. There will be cross-passages connecting the two bores, for access, approximately every 380m;
- the Bromford tunnel east portal (see Washwood Heath to Curzon Street (CFA26) for Bromford tunnel west portal). There will be an assembly area at the tunnel portal to accommodate any emergency evacuation of passengers and also vehicular access for emergency services to these points. Buildings at the tunnel portal will house the control equipment for the tunnel and ventilation fans (see Volume 2: Map CT-06-136, A7); and
- the permanent diversion of National Grid gas distribution main at Castle Bromwich Business Park.

2.2.15 The route will then continue, in tunnel, into the Washwood Heath and Curzon Street area (CFA26).

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the strategy for construction of the Proposed Scheme in the Castle Bromwich and Bromford area, including:

- overview of the construction process;
- description of the advance works;
- description of the engineering works to build the railway;
- construction waste and material resources;
- commissioning the railway; and
- indicative construction programme.

2.3.2 The assessment presented in this ES is based on the construction arrangements as described in this section.

2.3.3 In addition to the land that will be required permanently by the Proposed Scheme (see Section 2.2), land will be required on a temporary basis for construction. Key temporary construction features are illustrated on the construction maps series CT-05 (Volume 2). Following construction works, land required temporarily will be prepared for its eventual end use, which will include being returned to its pre-construction use wherever appropriate.

2.3.4 A guide to standard construction techniques is provided in Volume 1, Section 6. In instances for which more than one possible construction technique might be possible, this section specifies which technique has been assumed for the purposes of the assessment.

Overview of the construction process

2.3.5 Building and preparing the railway 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; site preparation and enabling works; main earthworks and structure works; boring of the two tunnels and site restoration;
- railway installation works, including: establishment of construction compounds; infrastructure installation; connections to utilities; changes to the existing rail network; and
- system testing and commissioning.

2.3.6 General provisions relating to the construction process are set out in more detail in Volume 1, Section 6 and the draft CoCP (see Volume 5: Appendix CT-003-000) including:

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

Advance works

2.3.7 General information about advance works can be found in Volume 1, Section 6.5. Advance works will be required before commencing construction works and will typically include:

- further detailed site investigations and surveys;
- further detailed environmental surveys;
- advance mitigation works including, where appropriate, contamination remediation, temporary habitat creation and translocation, and archaeological field evaluation;
- site establishment with temporary fence construction; and
- utility diversions.

Engineering works

2.3.8 Construction of the railway will require engineering works along the entire length of the route, and within land adjacent to the route. This will comprise four broad types of engineering work:

- civil engineering works, such as earthworks, erection of bridges and viaduct;
- civil engineering works, such as bored tunnel;

- operation of a small gauge tunnel railway which will form an essential part of the tunnel boring machine (TBM) logistics and support system, supplying the machines with tunnel lining segments and other consumables using rail mounted vehicles. This railway will be twin tracked from the Washwood Heath site in CFA26 and through the tunnel in this area to enable two-way traffic and servicing of cross passage construction; and
- railway installation works, such as laying ballast or slabs and tracks, and/or installing power supply and communications features.

2.3.9 The construction of the Proposed Scheme will be subdivided into sections, each of which will be managed from compounds. The compounds will act as the main interface between the construction work sites and the public highway, as well as performing other functions as described below. Compounds will either be main compounds or satellite compounds, which are generally smaller. Some compounds will be used for civil engineering works and others for railway installation works, and in some cases for both.

2.3.10 In the Castle Bromwich and Bromford area, there will be one main compound and five civil engineering satellite compounds and two railway installation satellite compounds (both of which will be separate to the compounds established for the civil engineering works). One of the satellite compounds, the B4118 Water Orton Road overbridge satellite compound, will be managed from the M6 Motorway (Coleshill Heath Road) main compound located in the Coleshill Junction area (CFA19).

2.3.11 Figure 3 shows the management relationship for civil engineering works compounds and Figure 4 for the railway installation works compounds. Details about individual compounds are provided in subsequent sections of this report.

General overview of construction compounds

2.3.12 Main compounds will be used for core project management staff (i.e. engineering, planning and construction delivery), and commercial and administrative staff. These management teams will directly manage some works and/or coordinate satellite compounds, which will manage other works. In general, main compounds will contain:

- space for the storage of bulk materials (aggregates, structural steel and steel reinforcement);
- space for the receipt, storage and loading/unloading of excavated material either onto or off the site;
- an area for the fabrication of temporary works equipment and finished goods;
- fuel storage;
- plant and equipment storage;
- office space for management staff, limited car parking for staff and site operatives, and welfare facilities; and
- necessary operational parking.

2.3.13 Satellite compounds will be used as the base to manage specific works along a section of the route. They will usually provide office accommodation for limited numbers of staff, local storage for plant and materials, limited car parking for staff and site operatives, and welfare facilities.

2.3.14 The Bromford Tunnel east portal (east) main compound will accommodate a roadhead which will require an additional area of land adjacent to the compound for the storage and loading and unloading of bulk earthworks materials which are moved to and from the site on public highways.

2.3.15 In addition, areas adjacent to some compounds will be used for the storage of topsoil stripped as part of the works prior to it being used when the land is reinstated to its former use.

2.3.16 Further information on the function of compounds, including general provisions for their operation, including security fencing, lighting, utilities supply, site drainage, codes of worker behaviour are set out in Volume 1, Section 6.3, and the draft CoCP, Section 5.

Construction traffic routes

2.3.17 The movement of construction vehicles carrying materials, plant, other equipment and workforce (or moving empty) will take place both within the construction sites, on public roads and via the rail network. The construction compounds will provide the interface between the construction works and the public highway or rail network, and the likely road routes to access compounds are described in subsequent sections below.

2.3.18 Movements between the construction compounds and the work sites will be on designated haul roads within the site, often along the line of the new railway or running parallel to it.

Figure 3: Schematic of construction compounds for civil engineering works

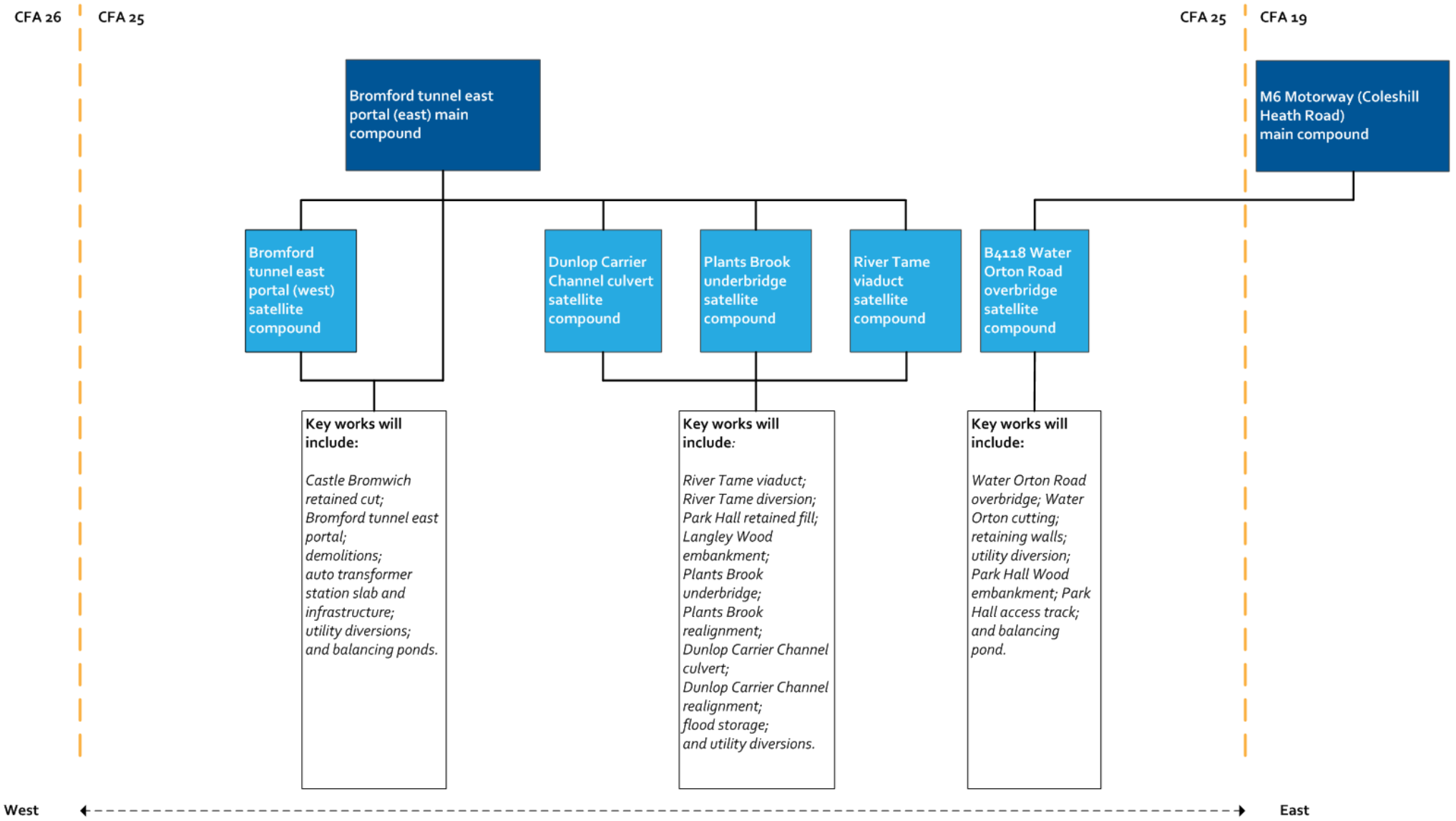
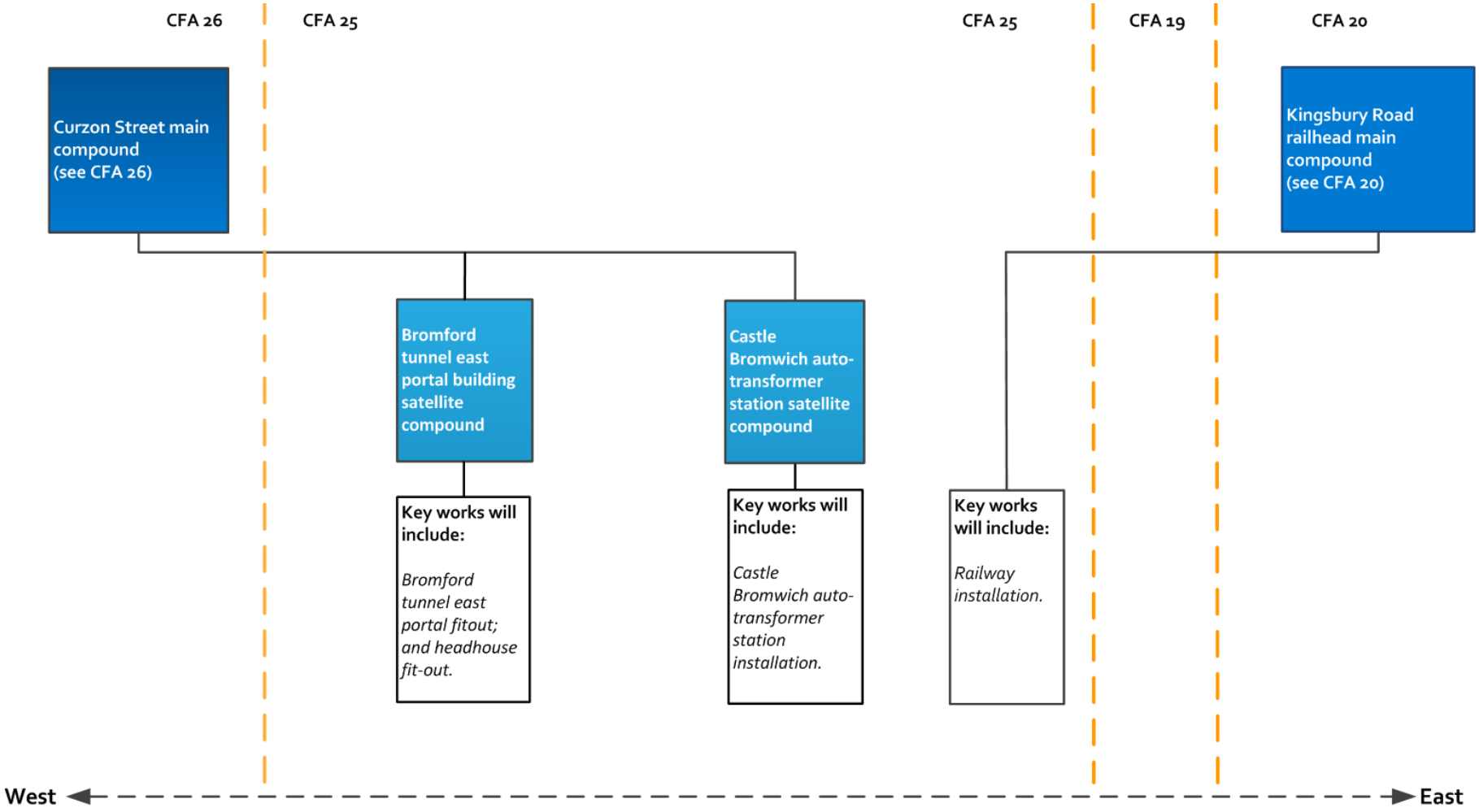


Figure 4: Schematic of construction compounds for railway installation works



2.3.19 The information below describes the works to be undertaken from firstly the civil engineering compounds and then the railway installation compounds.

B4118 Water Orton Road overbridge satellite compound

2.3.20 This compound (see Volume 2: Map CT-05-135b, F5) will be used for civil engineering from the start of this CFA to north of the B4118 Birmingham Road. The compound will:

- be operational for approximately five years and three months, comprising civil engineering works, starting in 2017;
- support up to 40 workers each day throughout the civil engineering works period;
- will not provide worker accommodation facilities (there is no temporary worker accommodation in this area. Some workers may be able to use the temporary worker accommodation at the proposed Birmingham Interchange site (see CFA24));
- be accessed off the B4118 Birmingham Road. A temporary haul road will be constructed within the construction area from the Coleshill Junction area (CFA19) across the B4118 Birmingham Road and down the Park Hall nature reserve access track into the nature reserve; and
- be managed from the M6 Motorway (Coleshill Heath Road) main compound in Coleshill Junction (CFA19).

2.3.21 A programme for the key works associated with this compound is shown in Figure 5. Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- topsoil strip and haul road construction;
- utility diversions (fuel pipeline);
- construction of B4118 Water Orton Road overbridge over the route;
- excavation of a balancing pond and associated outfall to the River Tame;
- cutting and earthworks, including piled retaining walls and embankment;
- conversion of the haul road into a permanent access to Park Hall nature reserve; and
- reinstatement, landscaping and planting.

2.3.22 No demolitions will be required.

2.3.23 The permanent diversion of one Esso fuel pipe line, 300mm diameter, over a length of approximately 500m, approximately 10m to the north of the route, will be required. The diversion extends into the adjacent Coleshill Junction area (CFA19) (note: this pipeline will be diverted again, as described for River Tame Viaduct satellite

compound below). The utilities construction technique described under advance works in Volume 1, Section 6.4 will be adopted for this work.

2.3.24 The compound will be used primarily to manage the construction of the B4118 Water Orton Road overbridge extension, the Water Orton cutting and the Park Hall Wood embankment. The bridges, cutting and embankment, and piling techniques in Volume 1, Sections 6.17, 6.8 and 6.11, respectively, will be adopted.

2.3.25 The majority of excavated material that will be generated in the Castle Bromwich and Bromford area is expected to be suitable for beneficial re-use as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either within this area or elsewhere along the route. The construction of the Proposed Scheme within the Castle Bromwich and Bromford area may be able to beneficially incorporate selected types of excess excavated material from neighbouring areas. There may also be opportunities for selected types of excess excavated material within the Castle Bromwich and Bromford area to be used within neighbouring areas.

2.3.26 There will be temporary material stockpiles adjacent to the Water Orton cutting and also the Park Hall Wood embankment.

2.3.27 No permanent diversions of roads will be required, although the B4118 Birmingham Road will have the carriageway temporarily moved to one side while the new bridge is constructed on the current alignment of the road at ground level, before the deep cutting is excavated beneath it. The highways techniques in Volume 1, Sections 6.10, will be adopted.

2.3.28 No alternative routes of footpaths, cycleways or bridleways will be required, with the exception of the temporary realignment of the footway as part of the B4118 Water Orton Road overbridge construction.

2.3.29 In addition, future provision of private access to Park Hall nature reserve from the B4118 Birmingham Road will be provided by retention of the site haul road following construction. Access to Park Hall nature reserve will be required by the Wildlife Trust for Birmingham and the Black Country, the Environment Agency, and utilities providers, such as National Grid and Esso, as well as HS2 Ltd for the River Tame viaduct maintenance.

2.3.30 No diversions of watercourses will be required.

2.3.31 Finalisation works will include reinstatement works adjacent to the cutting, including earthworks regrading and planting. This area includes an area of habitat creation to the north of the B4118 Birmingham Road. The site restoration and landscape treatment techniques in Volume 1, Sections 6.21, will be adopted.

M6 Motorway (Coleshill Heath Road) main compound (see CFA19)

2.3.32 This compound is not located within CFA25 and no works will be directly undertaken from it, but it will provide support to the civil engineering works at the B4118 Water Orton Road overbridge satellite compound, as illustrated in Figure 3. See CFA19 for more information about the compound.

River Tame viaduct; Plants Brook underbridge; and Dunlop Carrier Channel culvert satellite compounds

2.3.33 These three compounds (see Volume 2: Map CT-05-135b, D6, and Map CT-05-136, H7 and F7, respectively) will be used for civil engineering, and will be located in Park Hall nature reserve. The compounds will:

- be operational for approximately four years and three months, for civil engineering works, starting in 2017;
- support up to 98 workers in total from these compounds each day (49 from the River Tame satellite compound, 21 from Plants Brook underbridge satellite compound and 28 from Dunlop Carrier Channel satellite compound) throughout the civil engineering works period;
- will not provide worker accommodation facilities;
- be accessed via the site haul road from either the access track off B4118 Birmingham Road or the highway maintenance access off the M6 junction 5 or Tameside Drive via a temporary road bridge across the River Tame. The temporary haul road will be constructed within the construction area from the B4118 Birmingham Road across Park Hall nature reserve and across a temporary road bridge into Castle Bromwich Business Park; and
- be managed from Bromford tunnel east portal (east) main compound for the civil engineering works (see Volume 2: Map CT-05-136, D8).

2.3.34 A programme for the key works associated with this compound is shown in Figure 5, although it should be noted that there will be some sharing of the tasks for these three compounds. Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- utility diversions (overhead power line, including demolition of four pylons, and fuel pipeline);
- topsoil strip and haul road construction, including a temporary road bridge over the River Tame;
- excavation of flood storage areas in Park Hall nature reserve;
- realignment of the River Tame through Park Hall nature reserve;
- construction of Plants Brook underbridge and Dunlop Carrier Channel culvert and associated watercourse channel extensions;
- key classic railway systems works in this section of the route will take approximately six months to complete and will include minor modification of the existing equipment to accommodate the construction of Park Hall retained fill, Langley Hill embankment and balancing ponds adjacent to the Birmingham to Derby line;

- embankment earthworks (Park Hall retained fill and Langley Wood embankment) and drainage;
- construction of the River Tame viaduct; and
- reinstatement, landscaping and planting.

2.3.35 Much of the current area of this site is a nature reserve, so site clearance will involve vegetation and habitat clearance. These works will be preceded by pre-construction protected species surveys. The site also includes a number of archaeological assets, which will be subject to pre-construction surveys (see Section 6). The site clearance, enabling works and mobilisation technique described in Volume 1, Section 6.7, will be adopted.

2.3.36 No demolitions of buildings will be required. Demolition of four steel frame electricity pylons within Park Hall nature reserve will be required.

2.3.37 The diversion of the following two known utilities will be required. The utilities construction technique described under advance works in Volume 1, Section 6.4, will be adopted for this work):

- permanent diversion of Esso fuel pipe line, 300mm diameter, over a length of approximately 1.3km, generally located 125m to the south of the centreline of the route (this is an additional diversion of the utility discussed above); and
- permanent diversion of National Grid overhead power line, over an approximate 1.4km, generally 175m to the south of the route.

2.3.38 A permanent realignment of the River Tame will be required to provide space for the Proposed Scheme which will be along the current river alignment and avoid the new pier positions at the western end of the River Tame viaduct. The flood storage replacement areas will require excavation adjacent to the existing floodplain and will be undertaken in accordance with detailed method statements.

2.3.39 The Plants Brook underbridge satellite compound will be used to manage construction of the Plants Brook underbridge, which will be approximately 50m long. The bridge construction technique described in Volume 1, Section 6.17, will be adopted.

2.3.40 The Dunlop Carrier Channel culvert satellite compound will be used to manage construction of the Dunlop Carrier Channel culvert, which will be approximately 50m long. The drainage and watercourse diversions construction technique, as described in Volume 1, Section 6.9, will be adopted.

2.3.41 The River Tame viaduct satellite compound will be used to manage construction of the River Tame viaduct, which will be approximately 780m long. The viaduct construction technique, described in Volume 1, Section 6.16, will be adopted.

2.3.42 Key classic railway systems works in this section of the route will take approximately six months to complete and will include minor modification of the existing equipment to accommodate the construction of Park Hall retained fill, Langley Hill embankment and balancing ponds adjacent to the Birmingham to Derby line. Works to the existing

classic railway network in this section of the Proposed Scheme will include the Park Hall retained fill wall between the route and the Birmingham and Derby line and also three new drainage pipe crossings under the existing railway network. The cutting and embankment, and piling techniques in Volume 1, Sections 6.8 and 6.11, respectively, will be adopted.

2.3.43 No diversions of roads will be required.

2.3.44 No alternative routes of footpaths, cycleways or bridleways will be required. However, the alternative provision for the existing nature reserve access track described above, will continue into this satellite compound area.

2.3.45 The finalisation works will include reinstatement works under and adjacent to the viaduct. As the site is currently a nature reserve, this reinstatement will include habitat creation including woodland and grass planting and ponds (see Section 7). The site restoration and landscape treatment techniques in Volume 1, Sections 6.21, will be adopted.

Bromford tunnel east portal (east) main compound

2.3.46 This compound (see Volume 2: Map CT-05-136, D8) will manage all of the works in this area (with the exception of the works from the B4118 Water Orton Road overbridge satellite compound) and be used for civil engineering works between the River Tame and the centre of the Castle Bromwich retained cut. The compound will:

- be operational for approximately five years and three months for civil engineering works, starting in 2017;
- support approximately 45 workers each day throughout the civil engineering works period;
- will not provide worker accommodation facilities; and
- be accessed via Tameside Drive from either the A452 Chester Road (to the west) or a temporary haul road across a temporary road bridge across the River Tame to the east. This haul road will cross the Park Hall nature reserve and connect with the B4118 Birmingham Road (the haul road will then continue on towards the Coleshill Junction area (CFA19)).

2.3.47 A programme for the key works associated with this compound is shown in Figure 5. Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- building demolition;
- utilities diversions;
- construction of Castle Bromwich retained cut (eastern end);
- construction of the eastern tunnel portal;
- earthworks, including stockpile storage, and drainage;

- construction of balancing ponds and associated access roads;
- construction of auto-transformer slab base, associated access roads and infrastructure;
- dismantling of the TBM when it breaks through into the eastern tunnel portal after drilling from the Washwood Heath site (in CFA26). This will happen once for each of the two tunnel bores; and
- reinstatement.

2.3.48 Demolition of eight buildings will be required:

- a three-storey industrial recycling facility, Tameside Drive, Castle Bromwich Business Park;
- two single-storey brick industrial premises, Units 7, 8, 9, 10, 11, 12, 13, 14, 14a Orton Way, Hayward Industrial Estate;
- a single-storey brick industrial premises, Units 15, 16, 17, 18, 19, 20 Orton Way, Hayward Industrial Estate; and
- a single-storey, steel frame canopy; one single-storey, steel frame car wash; one two-storey office; two single-storey commercial/office buildings; all at British Car Auctions, Langley Drive, Castle Bromwich.

2.3.49 No diversions of any roads will be required. There will, however, be a shared access for construction with the remaining businesses along Tameside Drive.

2.3.50 No alternative routes of any footpaths, cycleways or bridleways will be required.

2.3.51 Diversions of three known utilities and the installation of one new utility will be required. The utilities construction technique described under advance works in Volume 1, Section 6.4 will be adopted for this work:

- permanent realignment of a sewer, south of the route, comprising 450mm, 600mm and 300mm diameter pipes for a length of approximately 250m. These pipes are affected by the proposed River Tame realignment and excavation of a balancing pond;
- permanent realignment of underground Western Power low voltage electricity cables, crossing under the route, on the east side of Castle Bromwich Business Park, for a length of approximately 1.9km; and
- permanent new electricity supply and telephone cable to the Castle Bromwich auto-transformer station.

2.3.52 The compound will be used to manage construction of the Bromford tunnel east portal, including finishes, and the Castle Bromwich retained cut, which will be approximately 700m long. The Bromford tunnel east portal will generate approximately 12,600m^3 of excavated material and the Castle Bromwich retained cut will generate approximately 169,000m^3. There will be a temporary material stockpile adjacent to the Bromford tunnel east portal (east) main compound. The piling construction technique, as described in Volume 1, Section 6.11, will be adopted. Some

of these works are likely to occur at night, particularly with regard to the protection barrier.

2.3.53 Two balancing ponds in this area will be situated to the north of the existing Birmingham and Derby line and will require separate access for construction. One pond will be accessed via Midpoint Way from Water Orton Lane at Minworth and the other via Javelin Avenue, Castle Vale. Both of these ponds will require drainage pipes to be driven beneath the Birmingham and Derby line to create outfalls to the River Tame. There will also be a third balancing pond constructed at the eastern end of Castle Bromwich Business Park, accessed from Tameside Drive.

2.3.54 Construction of the auto-transformer station sub base will have its own access road off the east end of Tameside Drive and include provision of a hard standing base, new power supply and telephone cable.

2.3.55 Construction activities for the tunnel will be carried out and managed from the west Bromford tunnel portal (east) main compound at Washwood Heath in the adjacent Washwood Heath to Curzon Street area (CFA26). The TBM will be driven from the Washwood Heath site and the tunnel excavated materials will be removed from that site. The TBM will breakthrough in this area first, in the Castle Bromwich Business Park, and after the first bore it will be dismantled and returned to Washwood Heath to bore the second tunnel. The tunnel construction technique, as described in Volume 1, Section 6.12, will be adopted. For further information regarding the Bromford tunnel, refer to Volume 2, Washwood Heath to Curzon Street area (CFA26).

2.3.56 Finalisation works will include reinstatement works adjacent to the tunnel portal. The site restoration and landscape treatment techniques in Volume 1, Sections 6.21, will be adopted.

Bromford tunnel east portal (west) satellite compound

2.3.57 This compound (see Volume 2: Map CT-05-136, B6 and CT-05-137, I6) will be used for civil engineering, at the western end of the Castle Bromwich retained cut. The compound will:

- be operational for approximately five years and three months for civil engineering works, starting in 2017;
- support approximately 20 workers each day throughout the civil engineering works period;
- will not provide worker accommodation facilities;
- be accessed via Tameside Drive from either the A452 Chester Road (to the west) or a temporary haul road across a temporary road bridge across the River Tame to the east. This haul road will cross the Park Hall nature reserve and connect with the B4118 Birmingham Road (the haul road will then continue on towards the Coleshill Junction area (CFA19)); and
- be managed from the Bromford tunnel east portal (east) main compound.

2.3.58 A programme for the key works associated with this compound is shown in Figure 5. Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- building demolition;
- utility diversions;
- construction of Bromford tunnel east portal and Castle Bromwich retained cut (western end) in conjunction with Bromford tunnel east portal (east) main compound;
- construction of Bromford tunnel east portal headhouse and plant house and associated access roads;
- Bromford tunnel preparation and finishing works; and
- reinstatement, landscaping and planting.

2.3.59 No demolitions will be required, other than those listed above in Bromford tunnel east portal (east) main compound section, which will share these works.

2.3.60 No diversions of any roads will be required.

2.3.61 No alternative routes of any footpaths, cycleways and bridleways will be required

2.3.62 A permanent diversion of a National Grid gas distribution main at Castle Bromwich Business Park, comprising one 450mm diameter medium pressure pipe, for a length of approximately 140m will be required. The utilities construction technique described under advance works in Volume 1, Section 6.4 will be adopted for this work.

2.3.63 In addition, there is an 0.45m diameter cast iron low pressure gas main in Chillinghome Road in Bromford, which will be relaid (in polyethylene material) over a length of 450m to counter possible settlement. Works will be carried out within the highway and feeds to houses will be re-connected.

2.3.64 The compound will be used to support the construction of the Bromford tunnel east portal and Castle Bromwich retained cut as described above in the Bromford tunnel east portal (east) main compound section. The tunnel construction technique, as described in Volume 1, Section 6.13, will be adopted.

2.3.65 Finalisation works will include reinstatement works adjacent to the tunnel portal. The site restoration and landscape treatment techniques in Volume 1, Sections 6.21, will be adopted.

Castle Bromwich auto-transformer satellite compound (rail systems)

2.3.66 This compound (see Volume 2: Map CT-05-136, D7) will be used to facilitate installation of the Castle Bromwich auto-transformer station. The compound will:

- facilitate the installation of the Castle Bromwich auto-transfomer station for one year and six months, starting in 2022;

- support 25 workers each day throughout the rail systems installations works period;
- be accessed via the public highway network onto Tameside Drive. Permanent access will have been provided by the civil engineering contract prior to the railway systems contractor mobilising to commence the installation of the fit out works; and
- managed from Curzon Street station main compound (see below and CFA26).

Bromford tunnel east portal building satellite compound (rail systems)

2.3.67 This compound (see Volume 2: Maps CT-05-136, B7, and CT-05-137, I7) will be used to facilitate the Bromford tunnel east portal fit out, including installation of ventilation fans and other equipment in the tunnel and fit out of the portal building.

2.3.68 This compound will be used for rail systems installations. The compound will:

- facilitate the railway system construction period for two years, starting in 2021. Commissioning will be undertaken after these dates and prior to the railway opening;
- support approximately 25 workers each day throughout the rail systems installation works period;
- be accessed via Langley Drive, from Tameside Drive. Permanent access will have been provided by the civil engineering contract prior to the railway systems contractor mobilising to commence the fit out works; and
- be managed from Curzon Street main compound (see below and Volume2, CFA26).

Curzon Street main compound (see CFA26)

2.3.69 This compound (see Volume 2: Maps CT-05-142, G5) is not located within CFA25 and no works will be directly undertaken from it, but it will provide support to the two railway installation satellite compounds in this area, as described above and illustrated in Figure 4. See Washwood Heath to Curzon Street (CFA26) for more information regarding this compound.

Kingsbury Road railhead main compound (see CFA20)

2.3.70 This compound is not located within this area and no works will be directly undertaken from it, but it will provide support to all railway installation works, particularly in open route, as described above and illustrated in Figure 4. See Curdworth to Middleton (CFA20) for more information regarding this compound.

2.3.71 The railway systems installation works will include track, overhead line equipment, communications equipment and traction power supply. The installation of track in open areas will comprise the laying of ballast and/or slab tracks, rail and sleepers. The railway systems installation will have its own mobile welfare facilities for the site staff.

Construction waste and material resources

2.3.72 Forecasts of the amount of construction, demolition and excavation waste (CDEW) and worker accommodation site waste that will be produced during construction of the Proposed Scheme in the Castle Bromwich and Bromford area have been prepared and are presented in Volume 5: Appendix WM-001-000.

2.3.73 The majority of excavated material that will be generated across the Proposed Scheme will be reused as engineering fill material or in the environmental mitigation earthworks of the Proposed Scheme, either with or without treatment.

2.3.74 Based on the mitigation earthworks design approach adopted for the Proposed Scheme, local excess or shortfall of excavated material within the Castle Bromwich and Bromford area will be managed with the aim of contributing to the overall balance of excavated material on a route-wide basis. The overall balance of excavated material is presented in Volume 3, Section 14.

2.3.75 The quantity of surplus excavated material originating from the Castle Bromwich and Bromford area that will require off-site disposal to landfill as excavation waste is shown in Table 1. This is the forecast quantity of contaminated excavated material that is chemically unsuitable for reuse within the Proposed Scheme and which will be taken directly from the Castle Bromwich and Bromford area for off-site disposal to either non-hazardous or hazardous landfill. This represents a proportion of the total quantity of surplus excavated material that will require disposal which altogether is reported on a route-wide basis in Volume 3: Section 14.

2.3.76 The quantities of demolition, construction and worker accommodation site waste that will be reused, recycled and recovered (i.e. diverted from landfill) have been based on the landfill diversion performance of similar projects as follows:

- demolition waste: 90%;
- construction waste: 90%; and
- worker accommodation site waste: 50%.

2.3.77 The quantities of demolition, construction and worker accommodation site waste that will require off-site disposal to landfill are shown in Table 1.

Table 1: Estimated construction, demolition and excavation waste

Waste type	Estimated material quantities that will be generated (tonnes)	Estimated quantity of waste for off-site disposal to landfill (tonnes)
Excavation	1,907,860	41,469
Demolition	67,552	6,755
Construction	58,345	5,834
Worker accommodation site	0	0
TOTAL	2,033,757	54,058

2.3.78 The assessment of the likely significant environmental effects associated with the disposal of CDEW and worker accommodation site waste has been undertaken for the Proposed Scheme as a whole (see Volume 3: Section 14).

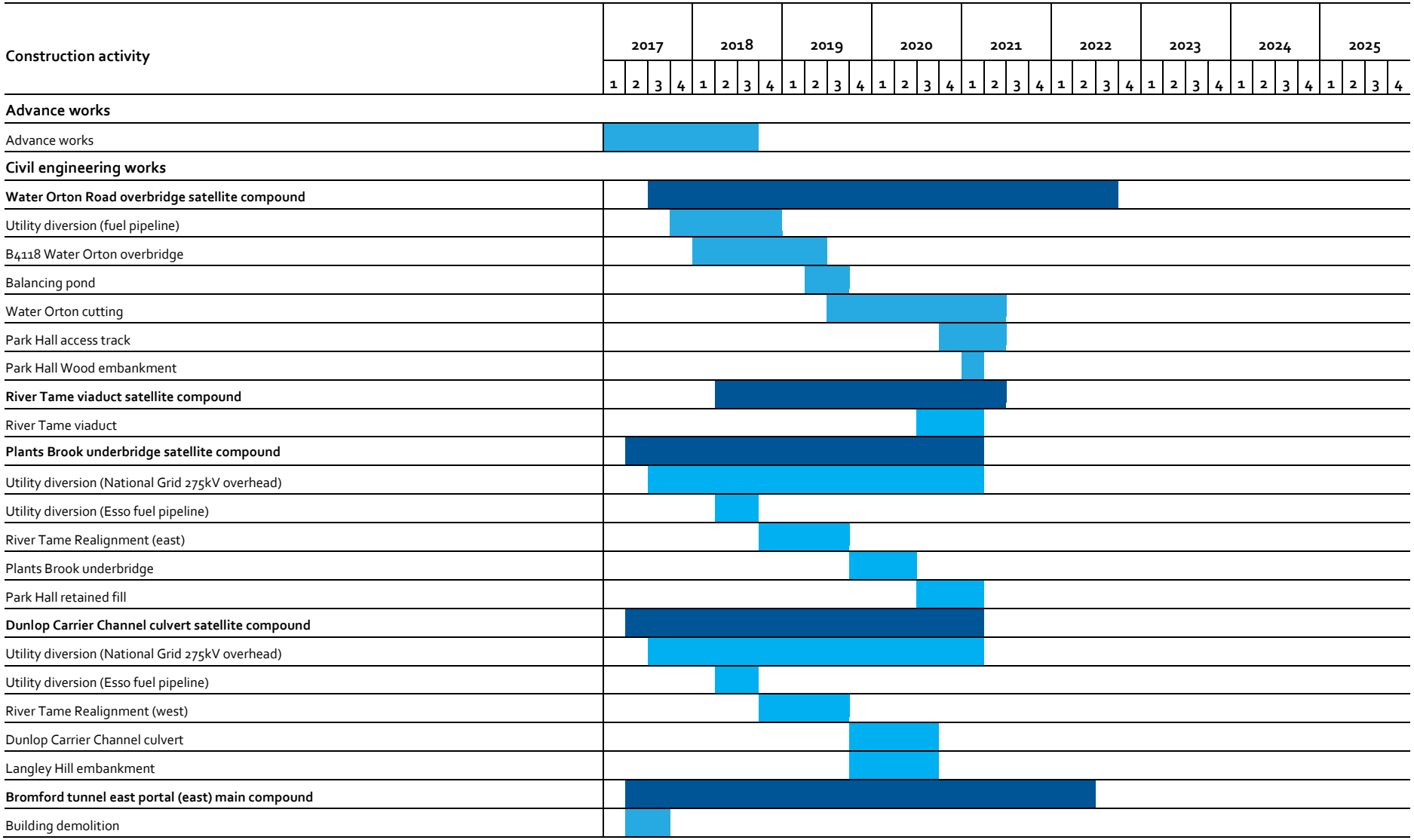
Commissioning of the railway

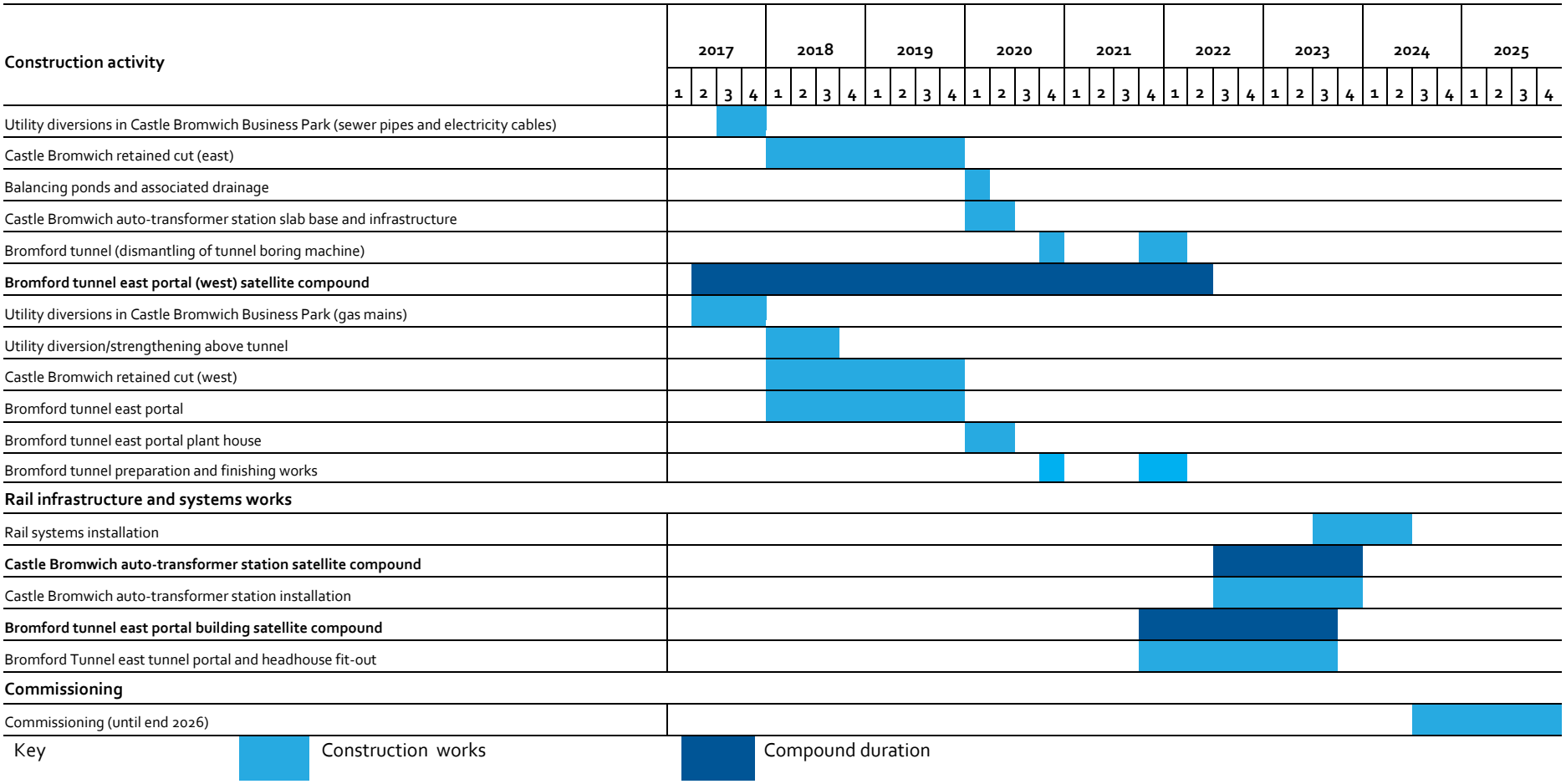
2.3.79 Commissioning is the process of testing the infrastructure to ensure that it operates as expected. This will take place in the period prior to opening. Further details are provided in Volume 1: Section 6.26.

Construction programme

2.3.80 A construction programme that illustrates indicative periods for the construction activities in this area is provided in Figure 5.

Figure 5: Indicative construction programme




Construction activity
2017
2018
2019
2020
2021
2022
2023
2024
2025
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
Utility diversions in Castle Bromwich Business Park (sewer pipes and electricity cables)
Castle Bromwich retained cut (east)
Balancing ponds and associated drainage
Castle Bromwich auto-transformer station slab base and infrastructure
Bromford tunnel (dismantling of tunnel boring machine)
Bromford tunnel east portal (west) satellite compound
Utility diversions in Castle Bromwich Business Park (gas mains)
Utility diversion/strengthening above tunnel
Castle Bromwich retained cut (west)
Bromford tunnel east portal
Bromford tunnel east portal plant house
Bromford tunnel preparation and finishing works
Rail infrastructure and systems works
Rail systems installation
Castle Bromwich auto-transformer station satellite compound
Castle Bromwich auto-transformer station installation
Bromford tunnel east portal building satellite compound
Bromford Tunnel east tunnel portal and headhouse fit-out
Commissioning
Commissioning (until end 2026)
Key
Construction works
Compound duration

2.4 Operation of the Proposed Scheme

Operational specification

2.4.1 Volume 1, Section 4 describes the envisaged operational characteristics of Phase One of HS2 as a whole and how they may change when Phase Two is also operational.

HS2 services

2.4.2 It is anticipated that, with Phase One in place, initially there would be three trains per hour each way passing through the Castle Bromwich and Bromford area in the morning and evening peak hours, and fewer during other times. The first trains of the day would leave the terminus stations no earlier than 05:00 Monday to Saturday (and 08:00 on Sundays) and the last would arrive no later than midnight.

2.4.3 It is anticipated that with Phase Two in place the frequency could rise to nine trains per hour each way during peak hours. The assessment of sound, noise and vibration has taken into account the frequency during Phase Two.

2.4.4 In this area, trains will run at speeds up to 230kph (145mph), with the majority in tunnel. The trains will be either single 200m long trains or two 200m long trains coupled together, depending on demand and time of day.

2.4.5 Each train could hold up to 550 people (one-unit train) or 1,100 people (two-unit train).

2.4.6 Additional train movements will be required at the start and end of the day to and from and within the Washwood Heath depot, which is within 200m of the western end of this area (see CFA26 for further details).

Maintenance

2.4.7 Volume 1, Section 4 describes the maintenance regime for HS2.

2.4.8 The intention is that inspections of the route will take place on a regular basis, at night when the railway is not operating. There would be routine preventative maintenance, including grinding and milling of the rails to keep them in good condition, and more periodic heavy maintenance as necessary.

Operational waste and material resources

2.4.9 Forecasts of the amount of operational waste that will be produced annually during operation of the Proposed Scheme have been prepared and are presented in Volume 5: Appendix WM-001-000.

2.4.10 Railway station and train waste refers to waste that will arise at each station. It will include waste from station operations and passenger waste removed from trains at terminating stations. This has only been reported for areas along the route in which these stations will be located.

2.4.11 Rolling stock maintenance waste is that which will be generated by the relevant train operating company at rolling stock maintenance facilities. This has only been reported for the areas along the route in which these facilities will be located.

2.4.12 Track maintenance waste and ancillary infrastructure waste (for example waste from depots, signalling locations, operations and maintenance sites) has been estimated

using an average waste generation rate per kilometre length of total track. For this reason, both track maintenance waste and ancillary infrastructure waste has been reported for each area along the route.

2.4.13 The quantity of operational waste that will be reused, recycled and recovered (i.e. diverted from landfill) has been based on landfill diversion performance information from Network Rail and other sources as follows:

- railway station and trains: 60%;
- rolling stock maintenance: 80%;
- track maintenance: 85%; and
- ancillary infrastructure: 60%.

2.4.14 On this basis, approximately 75 tonnes of operational waste will be reused, recycled and recovered during each year of operation of the Proposed Scheme in the Castle Bromwich and Bromford area. Approximately 16 tonnes will require disposal to landfill (see Table 2).

Table 2: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste generated per annum (tonnes)	Estimated quantity of waste for disposal to landfill per annum (tonnes)
Railway station and train	0	0
Rolling stock maintenance	0	0
Track maintenance	84	13
Ancillary infrastructure	7	3
TOTAL	91	16

2.4.15 The assessment of the likely significant environmental effects associated with the disposal of operational waste has been undertaken for the Proposed Scheme as a whole (see Volume 3, Section 14).

2.5 Community forum engagement

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

2.5.2 The engagement undertaken within this community forum area is summarised below. A series of community forum meetings and discussions with individual landowners, organisations and action groups were undertaken. Community forum meetings were held on:

- 2 April 2012 at Arden Hall, Castle Bromwich;
- 12 June 2012 at Arden Hall, Castle Bromwich;
- 26 September 2012 at The Firs and Bromford Community Centre, Bromford;

- 6 December 2012 at Spitfire House, Castle Vale;
- 20 March 2013 at Arden Hall, Castle Bromwich; and
- 17 September 2013 at Ambridge House, Bromford.

2.5.3 In addition to HS2 Ltd representatives, attendees at these community forum meetings typically included local residents (and residents groups), public representatives, representatives of local authorities and parish and district councils, action groups, affected landowners and other interested stakeholders.

2.5.4 The main themes to emerge from these meetings were:

- an understanding of the EIA process and consideration of construction impacts;
- potential air quality impacts and dust from road diversions and congestion during construction;
- effect on community facilities, particularly in Bromford (before the tunnel was announced at the forums as the Proposed Scheme);
- concerns regarding the effect on wildlife along Dunlop Channel, which is located to the north of the existing track;
- the ancient woodland at Park Hall and the potential wildlife impact;
- the nature conservation area in Castle Vale and that deer are local to the conservation area;
- concerns regarding the potential noise and vibration, particularly in the Castle Vale area;
- that careful consideration was required for construction, particularly in and around Castle Vale and Bromford Estate; and
- potential for the Proposed Scheme to increase flood risk, particularly to residential properties.

2.5.5 In addition to the engagement through the community forums, the draft ES and Design Refinement consultations were launched on 16 May 2013 for a period of eight weeks and closed on the 11 July 2013. As part of these consultations, members of local communities and other interested parties were notified, provided with information and invited to engage on issues pertinent to the draft ES and the development of the scheme. Details of the local consultation events were provided on HS2 Ltd.'s website, social media, posters at local venues, national and regional advertising and to properties within 1km of the Proposed Scheme. In the Castle Bromwich and Bromford area consultations on the draft ES and on the Design Refinement were held on 6 June 2013 at The Firs and Bromford Community Centre, Bromford.

2.5.6 HS2 Ltd staff attended the events, including engineers and environmental specialists, for members of the public to speak to.

2.5.7 Responses from the draft ES consultation have been analysed and an overview of those received and how the ES has taken account of responses is contained in the Draft ES Consultation Summary Report (Volume 5: Appendix CT-008-000).

2.6 Route section main alternatives

2.6.1 The main strategic alternatives to the Proposed Scheme are presented in Volume 1 and the Alternatives Report, Volume 5: Appendix CT-002-000. The main local alternatives considered for the Proposed Scheme within this area are described in this section.

2.6.2 Since April 2012, as part of the design development process, a series of local alternatives have been reviewed within workshops attended by engineering, planning and environmental specialists. During these workshops, the likely significant environmental effects of each design option have been reviewed. The purpose of these reviews has been to ensure that the Proposed Scheme draws the appropriate balance between engineering requirements, cost and potential environmental impacts.

Park Hall viaduct

2.6.3 As part of the design development process since the January 2012 announced scheme, consideration has been given to the design of the viaduct across the Park Hall nature reserve and the River Tame. The following options were considered:

- January 2012 announced scheme (which defined the alignment and the incorporation of a viaduct to cross the Park Hall nature reserve and River Tame);
- option 1: concrete trough deck;
- option 2: half through steel box beams;
- option 3: below track concrete deck with steel beams; and
- option 4: the Proposed Scheme – pre-cast pre-stressed concrete beams.

2.6.4 All of the options were along the same route as the January 2012 scheme, but considered alternative more detailed designs for the viaduct crossing the Park Hall nature reserve and River Tame. Options 1 and 3 would use a large quantity of concrete. Option 3 would also require more in-situ work in the floodplain. Option 2 has half through steel box beams which are generally more difficult to maintain and can generate more noise than the others in operation. With regards to environmental performance, Option 4 will result in a marginally greater visual impact due to its greater mass when compared to Option 2. The pre-cast pre-stressed concrete construction for Option 4 would reduce the construction duration, particularly as much of the work is to be done off-site and therefore minimises work in the flood plain, thereby reducing construction amenity impacts, including traffic related impacts, on Castle Bromwich and Bromford. Option 4 is also considered more suitable than the other options for high-speed rail.

2.6.5 The key factor for this structure was the suitability for high speed rail operation and for this reason HS2 Ltd decided to adopt Option 4 as the Proposed Scheme.

Park Hall River Tame realignment

2.6.6 The route will pass over and along the existing course of the River Tame within the Park Hall nature reserve. Consequently a realignment of the river is required.

2.6.7 As part of the design development process since the January 2012 announced scheme, further analysis has been undertaken of this realignment. The Proposed Scheme for the river realignment incorporates a channel which will run parallel to the existing River Tame alignment, and require flood storage areas within Park Hall nature reserve, which are extensions of areas that currently flood. This proposed river realignment will pass under the route at a point near the sludge beds associated with the Minworth Sewage Treatment Works and run adjacent to but some 50-100m south of the existing river before re-joining the original alignment to the east of Castle Bromwich Business Park.

2.6.8 The following options were considered:

- January 2012 announced scheme (which proposed a new straight channel alignment immediately south of the Proposed Scheme);
- option 1: meandering channel cutting through part of the existing pond, with flood storage at Minworth Sewage Treatment Works;
- option 2: meandering channel cutting through an existing pond (broadly following the likely historic river course);
- option 3: meandering channel avoiding a large pond (to retain it as habitat) (but still broadly following the likely historic river course); and
- option 4: the Proposed Scheme (straight channel immediately south of the route).

2.6.9 The options considered were in more detail than the January 2012 scheme, with Option 4, the Proposed Scheme, being the most direct development of it. The key environmental issues that have influenced the selection of this option relate to the potential to create a more naturalistic river channel that would be more appropriate to the nature reserve setting and be a part of the habitat.

2.6.10 A meandering channel, related to Options 2 and 3, would adversely affect the flood regime in the area, resulting in increased flood risk to areas downstream. To address this, extensive flood storage areas would need to be provided (which would require additional land) on the site of existing sewage sludge ponds. This, in turn, would result in a requirement for extensive excavation and potential remediation of contaminated land associated with the sludge ponds.

2.6.11 The Proposed Scheme option of a realignment parallel to the current River Tame alignment was chosen as it will allow the Park Hall nature reserve to maintain its current mode of flooding and avoid the requirement for additional land and substantial ground treatment. The Proposed Scheme includes the creation of

replacement floodplain storage areas within the nature reserve so as to avoid an increase in flood risk either upstream or downstream.

Bromford tunnel

2.6.12 A key element of the Proposed Scheme running along the River Tame valley in Birmingham will be the need for it to cross the M6 where the motorway starts to head north-west. The most appropriate location to cross the M6 is in the vicinity of Bromford, where the M6 is currently located on an elevated viaduct. The design through the Bromford section is tightly constrained by the existing M6 viaduct, the River Tame (which passes beneath the M6) and existing utility infrastructure (including high voltage overhead power lines, and associated pylons, and buried pipelines). There is also the existing residential area of Bromford and open space, which is limited in extent in this part of Birmingham. Therefore, as part of the design development process since the January 2012 announced scheme, consideration has been given to the specific design of the Proposed Scheme in this location.

2.6.13 The Proposed Scheme at this location comprises a tunnel.

2.6.14 The following options were considered in the Bromford area:

- January 2012 announced scheme (an above ground route through Castle Bromwich Business Park and under the elevated M6 through Bromford, requiring extensive works particularly to A452 Chester Road, A4040 Bromford Lane and River Tame realignment);
- option 1: the January 2012 announced scheme beneath M6 viaduct, but with a concrete cover to the Proposed Scheme to allow maintenance of the M6 elevated viaduct above;
- option 2: the January 2012 announced scheme but within a new combined Hs2/M6 viaduct structure;
- option 3: the Proposed Scheme (tunnel);
- option 4: crossing the M6 further east, passing through Castle Bromwich Business Park and running the route parallel to the M6 through Bromford;
- option 5: crossing the M6 further east, opposite the Park Hall nature reserve, passing south of Castle Bromwich Business Park and running the route parallel to and south of the M6 through Bromford; and
- option 6: use the classic rail infrastructure corridor.

2.6.15 The Proposed Scheme (Option 3) revises the January 2012 announced scheme as follows:

- an eastern tunnel portal is proposed approximately 70m east of Langley Drive, Castle Bromwich;
- a western tunnel portal is proposed approximately 200m west of Bromford Lane (in the Washwood Heath to Curzon Street area (CFA26));

- inclines to the tunnel portals will commence at the east at approximately 700m east of the A452 Chester Road and at the west at approximately 150m east of the existing Stechford and Aston line (in the Washwood Heath to Curzon Street area CFA26);
- an eastern access to the Washwood Heath depot will be provided from the western tunnel portal (in the Washwood Heath to Curzon Street area (CFA26));
- the River Tame realignment at Bromford along the tunnel section will no longer be required;
- major utility diversions opposite Bromford will no longer be required;
- the Bromford Lane modification will no longer be required (in the Washwood Heath to Curzon Street area (CFA26)); and
- the A452 Chester Road modification will no longer be required.

2.6.16 Key environmental considerations for this design element include: water and flood risk, landscape impacts associated with loss of open space and significant change to the existing visual landscape, restriction or loss of access to open space, proximity to utility infrastructure, particularly electricity pylons and fuel pipeline (including the potential need for relocation of these assets) and community and socio-economic impacts, including loss of community facilities, impacts on River Tame valley Academy, residential areas (particularly Bromford) and impacts on businesses, and traffic related impacts due to the need for extensive highways works.

2.6.17 The tunnel option will avoid any major works or disruption beneath the M6 viaduct and also there is no longer a need to move the River Tame south (from under the M6), with a consequent loss of community facilities, open space and play areas. The substantial relocation of the National Grid overhead power lines and pylons for the length of the tunnel will no longer be required, although the precise requirements are subject to on-going liaison with National Grid. The proposed tunnel will also no longer require any major highway works at A452 Chester Road or A4040 Bromford Lane and will therefore result in a significantly reduced impact on local businesses and traffic.

2.6.18 The potential for a longer tunnel, moving the eastern tunnel portal to the east of the B4118 Birmingham Road, was raised at the 20th March 2013 community forum. Lengthening the tunnel would have the potential benefit of avoiding disruption to the Castle Bromwich Business Park and also not requiring the realignment of the River Tame and associated impacts on floodplain and the Park Hall nature reserve. It would, however, likely require two tunnel shafts, and would require a complicated connection with the Proposed Scheme Delta junction to the east. It has not been included in the Proposed Scheme.

2.6.19 The Proposed Scheme option of the tunnel is considered to offer the greatest environmental benefits in comparison to the other options because of:

- reduced impacts on community facilities (in Bromford);
- reduced impacts on public open space (in Bromford);

- reduced traffic and nuisance impacts associated with major highways (A452 Chester Road, A4040 Bromford Road, A47 Heartland Parkway) and utilities diversions (gas main and overhead power lines);
- reduced landscape and visual impacts; and
- reduced operational noise impacts.

2.6.20 The tunnel was selected for the Proposed Scheme as in addition to the environmental benefits, it offers significant cost savings particularly by avoiding major road and utility works. Although this option will generate approximately 900,000m^3 of excavated material from the tunnelling, the vast majority of this will be reused within the Proposed Scheme. There will still be some demolition of business properties near the tunnel entrance in Castle Bromwich Business Park and at the proposed Washwood Heath depot site (located in the Washwood Heath to Curzon Street area (CFA26)), but these would be similar to those identified for the other options.

3 Agriculture, forestry and soils

3.1 Introduction

3.1.1 This section provides a description of the current baseline for agriculture, forestry and soils and an assessment of the likely impacts and significant effects as a result of the construction and operation of the Proposed Scheme. 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.

3.1.2 The quality of agricultural land in England and Wales is assessed according to the Agricultural Land Classification (ALC) system[11], 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 the impacts on agricultural land is the extent to which land of best and most versatile (BMV) agricultural quality (Grades 1, 2 and 3a) is affected by the Proposed Scheme.

3.1.3 Forestry is considered as a land use feature and the impacts have been assessed quantitatively. The qualitative effects on forestry land and woodland are addressed principally in the ecology and landscape and visual assessments (see Sections 7 and 9).

3.1.4 Soil attributes other than for food or biomass production are identified in this section but the resulting function or service is assessed in other sections, notably cultural heritage, ecology and landscape and visual assessment (see Sections 6, 7 and 9).

3.1.5 The main issue for farm holdings is the disruption by the Proposed Scheme of the physical structure of agricultural holdings and the operations taking place upon them, during both its construction and operational phases. Key engagement has been undertaken with farmers and landowners affected by the Proposed Scheme to obtain factual information on the scale and nature of the farm and forestry operations and related farm-based uses.

3.1.6 Details of published and publicly available information used in the assessment, and the results of surveys undertaken within this CFA, are contained in Volume 5: Appendix AG-001-025.

3.2 Scope, assumptions and limitations

3.2.1 The assessment scope, key assumptions and limitations for the agriculture, forestry and soils assessment are set out in Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

3.2.2 Common assumptions that have been applied to the Proposed Scheme, such as the restoration of agricultural land to pre-existing quality, the handing back of land used

[11] Ministry of Agriculture, Food and Fisheries (MAFF) (1988). *Agricultural Land Classification of England and Wales*. MAFF.

temporarily to the original landowner and the non-replacement of capital items demolished, are set out in Volume 1. There are no assumptions or limitations that are specific to the assessment in this study area.

3.3 Environmental baseline

Existing baseline

3.3.1 This section sets out the main baseline features that influence the agricultural and forestry use of land within this area. These include the underlying soil resources which 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.

Soils and land resources

Topography and drainage

3.3.2 The main topographical features within the study area are described in detail in the landscape and visual assessment (Section 9). The arterial drainage in this area is provided by the River Tame, which runs eastwards through the fringes of Birmingham. The floodplain of the River Tame occupies land generally lower than 80m above Ordnance Datum (AOD) and is bounded on its southern and south-eastern edge by a steep wooded scarp beyond which the land rises to a low ridge at 106m AOD and falls gently eastwards.

Geology and soil parent materials

3.3.3 The main geological features are described in detail in land quality (Section 8).The predominant underlying geology of the area mapped by the British Geological Survey (BGS)[12] is Triassic mudstones (Mercia Mudstone Group) (see Volume 5: Map WR-02-025). This is overlain by alluvial deposits in the floodplain of the River Tame and on higher ground to the south-east by superficial deposits of glaciofluvial origin.

Description and distribution of soil types

3.3.4 The characteristics of the soils are described by the Soil Survey of England and Wales bulletin for the Midland region[13] and shown on the National Soil Map[14]. The soils are grouped into associations of a range of soil types. They are described in more detail in Volume 5 and their general distribution is shown on Volume 5: Map AG-02-025.

3.3.5 The Soil Survey of England and Wales maps two associations within the study area:

- Fladbury 1 association soils are found on the floodplain area. These typically comprise medium to heavy clay topsoils overlying slowly permeable, clayey subsoils derived from alluvial deposits and are subject to groundwater waterlogging associated with fluctuating river levels and perennial flooding. These soils generally fall within Wetness Class IV; and

[12] British Geological Survey, *Geology of Britain Viewer* [Online]. Available at: http://mapapps.bgs.ac.uk/geologyofbritain/home/html [Accessed 01.08.13].
[13] Soil Survey of England and Wales. (1984). *Soils and their Use in Midland and Western England Harpenden: Soil Survey of England and Wales, Bulletin no.15*.
[14] Cranfield University (2001). *The National Soil Map of England and Wales* 1:250,000 scale, National Soil Resources Institute, Cranfield University, UK.

- Arrow association soils which are situated outside the floodplain area on higher ground which typically comprise of coarse loamy soils. These are of variable permeability and occasionally seasonally waterlogged derived from superficial fluvioglacial sands and gravels. These soils are most commonly assessed as being Wetness Class II-III.

3.3.6 Other soil associations occurring in the wider locality are shown on Volume 5: Map AG-02-025. These associations are outside the study area and not affected by the Proposed Scheme, therefore they are not described here.

Soil and land use interactions

Agricultural land quality

3.3.7 The principal soil/land use interaction in the study area 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 and the site.

3.3.8 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. There are two distinct soil characteristics within the study area which are those of the poorly drained floodplain soils (Fladbury 1) contrasting with the slightly better drained soils of the higher ground sited on the glaciofluvial deposits (Arrow).

3.3.9 Climate in the area does not in itself place any limitation upon land quality, but the interactions of climate with soil characteristics are important in determining the wetness and droughtiness limitations of land[15,16]. The climatic parameters are further described in Volume 5: Appendix AG-001-025. The local climate has a moderate annual average rainfall (663-705 mm) typical of lowland England, but a Field Capacity Day regime of 154to 164 which is slightly greater than average for lowland England (150 days), and moderately cool temperatures and moderate moisture deficits[17]. The interaction of climate and soil characteristics imposes a slight limitation to agricultural capability.

3.3.10 Gradient and changing slopes are not limiting to agricultural land use in this area, with the steep scarp slope occupied by non-agricultural woodland soils. Flooding in the floodplain of the River Tame in terms of its extent, duration, frequency and timing is a potential limiting factor.

3.3.11 Under the local climatic conditions, the better drained Arrow soils on the higher ground are limited to Subgrade 3a quality and shown as such in Volume 5: Map AG-01-066b to AG-01-068a. The poorly drained floodplain soils (Fladbury 1

[15] A soil wetness limitation exists where the soil water regime adversely affects plant growth or imposes restrictions on cultivations or grazing by livestock. The severity of the limitation is influenced by the amount and frequency of rain in relation to evapotranspiration, the duration of waterlogging and the texture of the uppermost layers of the soil.
[16] To achieve full yield potential a crop requires an adequate supply of soil moisture throughout the growing season. Droughtiness is likely to be a limitation to crop growth in areas with relatively low rainfall or high evapotranspiration, or where the soil holds only small moisture reserves available to plant roots.
[17] Field Capacity Day is a meteorological parameter which estimates the duration of the period when soil moisture deficit is zero, and the number of days when opportunities for agricultural field work are restricted by wetness. 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 and opportunities for mechanised field work are then possible.

association) will have wetness and potential flooding constraints limiting them to no greater than Subgrade 3b quality. However, these soils are restricted to an area which is in non-agricultural land uses, and will be classified as such in the ALC system.

3.3.12 Department for Environment, Food and Rural Affairs (Defra) mapping shows that there is generally a moderate likelihood of encountering BMV land in the locality, which makes such land a resource of medium sensitivity to loss in this area[18].

Other soil interactions

3.3.13 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[19] and The Natural Choice: securing the value of nature[20] and include:

- the storage, filtration and transformation of water, carbon and nitrogen in the biosphere;
- support of ecological habitats, biodiversity and gene pools;
- support for the landscape;
- protection of cultural heritage;
- providing raw materials; and
- providing a platform for human activities, such as construction and recreation.

3.3.14 Forestry resources represent a potentially multifunctional source of productive timber, landscape amenity, biodiversity and carbon storage capacity. The woodland and associated open land in the study area is, however, primarily of biodiversity interest and contained within the Park Hall nature reserve. The value and sensitivity of the resources in this latter respect are assessed in Section 7 Ecology.

3.3.15 The floodplain of the River Tame represents the functional flood environment, as set out in Section 13 Water resources and flood risk assessment. Flood Zone mapping available from the Environment Agency shows there to be a significant risk of flooding within this area.

3.3.16 The presence of soil-borne cultural assets is detailed in Cultural heritage (Section 6). There are a number of assets within the area of the Park Hall nature reserve. These predominantly relate to now demolished structures associated with the Great House and earlier activity. Ridge and furrow cultivation remains have a soil related aspect.

Land use

Land use description

3.3.17 The study area is predominantly urban in character. A small tract of open land occurs at its eastern end comprising the Park Hall nature reserve and land in equestrian usage

[18] Department for Environment, Food and Rural Affairs (Defra) (2005). *Likelihood of Best and Most Versatile Agricultural Land*. Defra.
[19] Department for Environment, Food and Rural Affairs (Defra) (2009). *Soil Strategy for England*. Defra.
[20] Department for Environment, Food and Rural Affairs (Defra) (2011). *The Natural Choice: securing the value of nature*. Defra.

adjacent to the B4118 Birmingham Road. Within the nature reserve, the predominant land uses are those relating to the management of woodland, grassland and water for nature conservation purposes. Although there is some incidental grazing associated with these uses, they are essentially non-agricultural. Outside the area of the nature reserve, all the remaining land is under grass which is used for grazing and recreational purposes associated with equestrian activities.

3.3.18 A number of environmental designations potentially influence land use within the study area. The whole area is a Nitrate Vulnerable Zone (NVZ), which is an area in which nitrate pollution is a potential problem. Statutory land management measures apply which seek to reduce nitrogen losses from agricultural sources to water. Some agricultural land is also subject to management prescriptions associated with the Environmental Stewardship Scheme which seeks either generally (the Entry Level Scheme) or specifically (the Higher Level Scheme) to retain and enhance the landscape and biodiversity qualities and features of farm land. Holdings which have land entered into an agri-environment scheme are identified in activity is restricted to the use of grassland for grazing associated with non-agricultural interests. Insofar as that land use falls within the definition of agriculture and the scope of this aspect of the environmental assessment and includes land based interests additional to farming, the affected interests are included within the agricultural study.

3.3.19 There are three relevant holdings as set out in Table 3. The boundaries of these interests are shown on Volume 5: Map AG-01-067 along with the location of the main buildings.

3.3.20 Table 3 sets out the sensitivity of individual holdings to change, which is determined by the extent to which they have the capacity to absorb or adapt to impacts, which in turn is governed primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, and 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. Smaller (less intensively used) units, such as pony paddocks associated with residential properties, have a low sensitivity.

3.3.21 Woodland within the study area is limited to the steep slope bounding the floodplain of the River Tame and comprises ancient and broad-leaved semi-natural woodland; an important habitat contributing to the suite of habitats within Park Hall nature reserve. Generally woodland is relatively sparse and represents only 4% of the land cover compared to the national average of 10% reflecting the study area's urban context.

Number, type and size of holdings

3.3.22 Agricultural activity is restricted to the use of grassland for grazing associated with non-agricultural interests. Insofar as that land use falls within the definition of agriculture and the scope of this aspect of the environmental assessment and includes land-based interests additional to farming, the affected interests are included within the agricultural study.

3.3.23 There are three relevant holdings as set out in Table 3. The boundaries of these interests are shown on Volume 5: Map AG-01 -067 along with the location of the main buildings.

3.3.24 Table 3 sets out the sensitivity of individual holdings to change, which is determined by the extent to which they have the capacity to absorb or adapt to impacts, which in turn is governed primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, and 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. Smaller (less intensively used) units, such as pony paddocks associated with residential properties, have a low sensitivity.

Table 3: Summary characteristics of holdings

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA25/1 Twisted Oak Stables	Equestrian	11.8	Livery	No	High
CFA25/2* Land north of B4118 Birmingham Road	Equestrian	2.3	Not known	Not known	Low
CFA25/3 Park Hall nature reserve	Nature conservation	40.1	None	Yes	Low

* No Farm Impact Assessment interview conducted; data estimated

Future baseline

Construction (2017)

3.3.25 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. No committed developments have been identified in this local area that will materially alter the baseline conditions in 2017 for agriculture, forestry and soils.

3.3.26 The future of agri-environment schemes is uncertain at present due to on-going reform of the Common Agricultural Policy. The majority of schemes seem likely to cease over the next two to three years and replacements are uncertain. Whilst this will remove a level of support from the agricultural industry that has been used to offset some of the costs incurred in managing land in an environmentally responsible manner, it is unlikely to materially alter the way agricultural land is managed in the future. Whilst some field margins may be cropped closer to hedgerows and stocking rates may increase in some locations, the baseline set out in the previous section is unlikely to change significantly.

Operation (2026)

3.3.27 No committed developments have been identified in this local area that will materially alter the baseline conditions in 2026 for agriculture, forestry and soils.

3.4 Effects arising during construction

Avoidance and mitigation measures

3.4.1 During the development of the design, the provision of alternative access arrangements from the B4118 Birmingham Road to enable continued use of land within the Park Hall nature reserve has been incorporated to avoid or mitigate impacts on forestry or soils during construction.

3.4.2 In addition, there is a need to reduce environmental impacts to soils during construction. It is an essential element of the construction process that the soil resources from the areas required temporarily and permanently are stripped and stored so that land required temporarily for construction purposes which is currently in agricultural use can be returned to that use, where agreed, and to its pre-existing agricultural condition.

3.4.3 Subject to the adoption of good practice techniques in handling, storing and reinstating soils on land where agricultural or forestry uses are to be resumed, there will be no reduction in the long term capability which will downgrade the quality of disturbed land. Some land with heavier textured soils may require careful management during the aftercare period to ensure this outcome.

3.4.4 Compliance with the draft CoCP (see Volume 5: Appendix CT-003-000) will reduce environmental impacts during construction. Of particular relevance to agriculture, forestry and soils are:

- the reinstatement of agricultural land which is used temporarily during construction to agriculture, where this is the agreed end use (draft CoCP Section 6);
- the provision of a method statement 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 will include any remediation measures necessary following the completion of works (draft CoCP, Section 6);
- a requirement for contractors to monitor and manage flood risk and other extreme weather events which may affect agriculture, forestry and soil resources during construction (draft CoCP, Section 16);
- arrangements for the maintenance of farm and field accesses affected by construction (draft CoCP, Section 6);
- the protection and maintenance of existing land drainage and livestock water supply systems, where reasonably practicable (draft CoCP, Sections 6 and 16.2);
- the protection of agricultural land adjacent to the construction site, including the provision and maintenance of appropriate stock-proof fencing (draft CoCP, Sections 6 and 9);

- the adoption of measures to control the deposition of dust on adjacent agricultural crops (draft CoCP, 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 (draft CoCP, Section 9);
- the adoption of measures to prevent, as far as reasonably practicable, the spread of soil-borne, crop and animal diseases from the construction area (draft CoCP, Sections 6 and 9); and
- liaison and advisory arrangements with affected landowners, occupiers and agents, as appropriate (draft CoCP, Sections 5 and 6).

Assessment of impacts and effects

3.4.5 The cessation of existing land uses will be required not only on the land on which permanent works will be sited, but also on the land used temporarily to facilitate the construction of those permanent works.

3.4.6 All the land required for the Proposed Scheme and for its construction will, in places, sever and fragment individual fields and operational units of agricultural and forestry land. This will result in potential effects associated with the ability of affected agricultural interests to continue 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 scheme design seeks, however, to minimise this structural disruption, and to incorporate inaccessible severed land as part of environmental mitigation works.

3.4.7 The timing and duration of various construction elements are set out in Section 2.3. Where land is restored to agricultural use it will be subject to a further period of five years of managed aftercare to ensure stabilisation of the soil structure where appropriate.

Temporary effects during construction

Impacts on agricultural land

3.4.8 During the construction phase, the total area of agricultural land used will be 10.6ha as shown on Table 4. Of this total, 0.7ha will be restored and available for agricultural use following construction.

Table 4: Agricultural land required for the construction of the Proposed Scheme

	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Grade 1	0	0	0
Grade 2	0	0	0
Subgrade 3a	10.6	100	0.7
BMV subtotal	10.6	100	0.7
Subgrade 3b	0	0	0
Grade 4	0	0	0
Grade 5	0	0	0
Total agricultural land	10.6	100	0.7

3.4.9 The disturbance during construction to 10.6ha of land of BMV quality is assessed as an impact of low magnitude due to the small area of land involved, and as, BMV land in this local area is receptor of medium sensitivity, the construction effect on BMV land is assessed as a minor adverse effect of the Proposed Scheme which is not significant.

3.4.10 Following construction the land required temporarily will be primarily reinstated to its pre-existing agricultural condition. Topsoil or subsoil material arising from the Proposed Scheme and permanently displaced will be incorporated into the Proposed Scheme design either within the area or elsewhere along the route, subject to the soil movement plans that will be prepared during the detailed design stage.

Nature of the soil to be disturbed

3.4.11 The sensitivity of the soils is greatest in relation to those which will be disturbed by construction activity and returned to an agricultural or other rural land-based use upon completion of the Proposed Scheme. The quantum of each disturbed soil type is less important than the sensitivity of particular soils to the effects of handling during construction and reinstatement of land.

3.4.12 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 Soils21. These principles will be followed throughout the construction period. The Arrow soils are well drained and relatively easily managed whereas the heavier textured Fladbury 1 soils are more susceptible to compaction and smearing when moved in wet conditions or by inappropriate equipment and need particularly careful handling to avoid damage to soil structure.

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

Impacts on holdings

3.4.13 Land may be required from holdings both permanently and temporarily (i.e. the latter only during the construction period). In most cases, the temporary and permanent land requirement will occur simultaneously at the start of the construction period, and it is the combined effect of both that will have the most impact on the holding. In due course some agricultural land will be restored and the impact on the individual holding will reduce, but the following assessment focuses on the combined effect during the construction phase. The residual permanent effects are discussed at the end of this section.

3.4.14 The effects of the Proposed Scheme on individual agricultural and related interests are summarised in Table 5. This table shows the total area of land required on a particular holding in absolute terms and as a percentage of the total area farmed. It also shows the area of land that will be returned to the holding following the construction period. The degree of impact is based on the proportion rather than the absolute area of land required. The holding/reference name provides a unique identifier and relates to Volume 5: Maps AG-01-067 to AG-01-054a and Volume 5: Appendix AG-001-025.

3.4.15 The effects of temporary severance during construction are judged on the ease and availability of access to severed land. For the most part these will be the same during and post construction, but occasionally they will differ between the two phases. The disruptive effects, principally of construction noise and dust, are assessed according to their effects on land uses and enterprises. Full details of the nature and significance of effects are set out in Volume 5: Appendix AG-001-025. Where the total sum of the land required by ALC grades differs from the total sum of the land required by holding, the difference is because some holdings are affected in more than one CFA and some holdings include non-agricultural land. The combined impact on holdings is reported once in the CFA where the main holding is located.

Table 5: Summary of temporary construction effects on holdings during construction

Holding reference/name	Total area required	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA25/1 Twisted Oak Stables	8.3ha – 70% High	Negligible	Medium/High	Major	0.7ha
CFA25/2* Land north of B4118 Birmingham Road	2.3ha – 100% High	High	High	Moderate	oha
CFA25/3 Park Hall nature reserve	37.9ha – 95 % High	Low	High	Moderate	31.7ha

* No Farm Impact Assessment interview conducted; data estimated

3.4.16 Overall, it is considered that all three affected holdings will experience major or moderate effects during construction which are significant.

3.4.17 No farm enterprises which are sensitive to noise or vibration emitted during the construction phase, for example intensive poultry houses, have been identified near to the Proposed Scheme. Equestrian buildings will, however, be affected. Those at Twisted Oak Stables will be available for continued use. It is, however, uncertain whether they will remain in commercial use given their close proximity to construction activity, which may render them unattractive to livery clients. In this eventuality, the construction effect would be of a high magnitude.

Cumulative effects

3.4.18 There are no known cumulative effects arising from the construction of the Proposed Scheme as a consequence of other development projects affecting agricultural land in the locality.

Permanent effects from construction

Impacts on agricultural and forestry land

3.4.19 Land used for the construction of the Proposed Scheme will fall into a number of categories when work is complete, as follows:

- part of the operational railway and kept under the control of the operator;
- returned to agricultural use (with restoration management);
- used for drainage or flood storage which may also retain some agricultural use; or
- used for ecological and landscape mitigation.

3.4.20 Following construction and restoration to agricultural land, the total net area of agricultural land that will remain permanently removed from agriculture will be 9.9ha as shown on Table 6. A further 1.5ha of forestry land will also be permanently removed. The areas referred to agricultural land of a particular grade that is required permanently for the Proposed Scheme, and its proportion of the total area of agricultural land required permanently.

Table 6: Agricultural and forestry land required permanently

Agricultural land quality	**Total area required (ha)**	**% agricultural land**
Grade 1	0	0
Grade 2	0	0
Subgrade 3a	9.9	100
BMV subtotal	9.9	100
Subgrade 3b	0	0
Grade 4	0	0
Grade 5	0	0
Total agricultural land	9.9	100
Forestry land	1.5	0

3.4.21 The permanent loss of 9.9ha of land of BMV quality is assessed as an impact of low magnitude due to the relatively small area of land involved. As previously, BMV land in this local area is a receptor of medium sensitivity so that the permanent effect on BMV land is assessed as a minor adverse effect of the Proposed Scheme which is not significant.

3.4.22 All the land currently in equestrian use and located to the north of the B4118 Birmingham Road will be required for ecological mitigation purposes and will be removed from any potential mainstream agricultural use.

3.4.23 Areas engineered to provide improved flood storage capacity will retain existing natural soil resources, but existing habitats will be displaced.

3.4.24 All the land between the B4118 Birmingham Road and Parkhall Wood will be removed from current equestrian uses and the potential for any future agricultural use to provide for ecological and landscape mitigation. Areas of woodland within Parkhall Wood and Parkhill Wood, adjacent to the M6 motorway will be permanently affected by the construction of the Proposed Scheme and utility diversions. These areas comprise some 1.5ha which is about 1.4% of the total permanent land requirement. The extent of woodland cover in the study area is some 4%, which is less than the average national woodland cover (10%). Consequently the woodland resources are sensitive to change. However, the areas affected are small and quantitatively the loss of woodland will not be significant. The quantitative losses will be mitigated by the planting of 4.2ha of woodland and the translocation of soils from the areas of ancient and semi-natural woodlands affected. This ecological and landscape mitigation is addressed in Sections 7 and 9.

Impacts on holdings

3.4.25 The permanent residual effects from the construction of the Proposed Scheme on individual agricultural and related interests is summarised in Table 7. The land required column refers to the area of land permanently required to operate the Proposed Scheme (in absolute terms and as a percentage of the overall area farmed). The degree of impact is based on the proportion of land required. The effects of severance are judged on the ease and availability of access to severed land once construction is completed and the impact on farm infrastructure refers mainly to the loss of or damage to farm capital, such as property, buildings and structures, and the consequential effects on land uses and enterprises. Full details of the nature and scale of effects are set out in Volume 5: Appendix AG-001-025.

Table 7: Summary of permanent effects on holdings from construction

Holding reference/name	Land required	Severance	Infrastructure	Scale of effect
CFA 25/1 Twisted Oak Stables	7.6ha – 64% High	Negligible	High	Major
CFA 25/2* Land north of B4118 Birmingham Road	2.3ha – 100% High	Negligible	High	Major
CFA 25/3 Park Hall nature reserve	6.2ha – 16% Medium	Negligible	Negligible	Minor

* No Farm Impact Assessment interview conducted; data estimated.

3.4.26 Overall, it is likely that two interests, Twisted Oak Stables (CFA25/1) and the equestrian interest on land to the north of the B4118 Birmingham Road (CFA25/2), will experience moderate or major permanent adverse effects from the construction of the Proposed Scheme which are significant. The interest in CFA25/2 will be wholly displaced, while Twisted Oak Stables will experience substantial land loss, due to the diversion of the route of a fuel pipeline through the holding, and potential redundancy of its stable complex and exercise area. Although financial compensation will be available, there can be no certainty that this will be used to reduce the above adverse effects by the purchase of replacement land or 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 to use compensation payments to replace assets.

Cumulative effects

3.4.27 There are no know permanent cumulative effects arising from the construction of the Proposed Scheme as a consequence of other development projects affecting agricultural land in the locality.

Other mitigation measures

3.4.28 No other mitigation measures are proposed.

Summary of likely significant residual effects

3.4.29 Three holdings have been identified that will experience significant temporary effects, including loss of land and possible redundancy of buildings.

3.4.30 Two holdings have been identified that will experience significant permanent effects, including loss and possible redundancy of buildings. In the case of one of these holdings there will be a total loss of land and buildings. Another affected interest will be likely to remain as a functional unit.

3.5 Effects arising from operation

Avoidance and mitigation measures

3.5.1 No measures are required to mitigate operational effects of the Proposed Scheme on agriculture, forestry and soils.

Assessment of impacts and effects

3.5.2 Potential impacts arising from the operation of the Proposed Scheme will include:

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

3.5.3 The potential for significant effects on sensitive livestock receptors from noise has been assessed. No likely significant effects have been identified. A potential residual equestrian receptor has been identified. This is a livery unit whose future is likely to reflect customer response to changed circumstance rather than any direct noise effects.

3.5.4 The propensity of linear transport infrastructure to harbour and spread noxious weeds is not only a consequence of the management of the highway and railway land, but also of the readiness of weed spread onto such land from adjoining land, which could be exacerbated with the effects of climate change. The presence of noxious weeds, ragwort in particular, will be controlled through the adoption of an appropriate management regime which identifies and remedies areas of weed growth which might threaten adjoining agricultural interests.

Summary of likely significant residual effects

3.5.5 No significant residual effects on agriculture, forestry and soils have been identified for the operation of the Proposed Scheme.

4 Air quality

4.1 Introduction

4.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality arising from the construction and operation of the Proposed Scheme, covering nitrogen dioxide (NO_2), fine particulate matter (PM10 and PM2.5)[22] and dust.

4.1.2 With regard to air quality, the main issues are anticipated to result from the emissions of the above pollutants from construction activities and equipment, road traffic and dust emissions associated with demolition, site preparation works, construction works and the use of haul roads and road traffic during construction and operation of the Proposed Scheme.

4.1.3 Detailed reports on the air quality data and assessments for this area, as well as relevant maps are contained within Volume 5. These include:

- Appendix AQ-001-025;
- Map AQ-01-025; and
- Map AQ-02-25-01.

4.1.4 Maps showing the location of the key environmental features can be found in the Volume 2 map books.

4.2 Scope, assumptions and limitations

4.2.1 The assessment scope, key assumptions and limitations for the air quality assessment are set out in the SMR (Volume 5: Appendix CT-001-000/1), the SMR Addendum (Volume 5: Appendix CT-001-000/2) and their appendices. This report follows the standard assessment methodology.

4.2.2 The study area for the air quality assessment has been determined on the basis of where impacts on air quality might occur from construction activities, from changes in the nature of traffic during construction and operation or where road alignments have changed.

4.2.3 The assessment of impacts arising from construction dust emissions has been undertaken using the methodology based on that produced by the Institute of Air Quality Management (IAQM)[23]. It is important to note that this methodology provides a means of assessing the scale and significance of effects that is partly dependent on the approximate number of receptors within close proximity to the dust-generating activities. In doing so, it assigns a lower scale of effect to cases where the number of properties is small, e.g. fewer than 10 properties within 20m of dust-generating activities. Thus, a single property very close to a construction site cannot experience a

[22] 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 micrometres in diameter.
[23] Institute of Air Quality Management (IAQM) (2011). *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance*. IAQM.

'significant effect' as defined by this methodology. The assessment presented here reaches a conclusion that incorporates this concept of significance being proportional to the number of people affected. However, in cases where less than 10 properties are within 20m of the construction activity, it will still be the case that mitigation in accordance with the CoCP will be applied.

4.2.4 The assessment of construction traffic impacts has used traffic data that is based on an estimate of the average daily flows in the peak month throughout the construction period (2017-2026). However, the assessment assumes 2017 vehicle emission rates and 2017 background pollutant concentrations. The reason for this is because both pollutant emissions from exhausts and background pollutant concentrations are expected to reduce year by year as a result of vehicle emission controls, and so the year 2017 represents the worst case for the assessment. Furthermore, it has been assumed that the changes in construction traffic would occur for the whole year. In many cases, this represents a pessimistic assumption as the duration of the proposed construction works may be much shorter.

4.3 Environmental baseline

Existing baseline

4.3.1 The environmental baseline reported in this section represents the environmental conditions identified within the study area. The main source of existing air pollutants in the area is emissions from road traffic. Concentrations of road traffic related pollutants are highest along busy roads and diminish when further away from the roads.

4.3.2 Estimates for NO2, PM10 and PM2.5 concentrations have been obtained from background concentration maps produced nationally by the Department for the Environment, Food and Rural Affairs (Defra)[24].

4.3.3 The Castle Bromwich and Bromford area lies within Birmingham City Council (BCC) and Solihull Metropolitan Borough Council (SMBC) administrative areas. BCC maintains six automatic monitoring stations of which two are located within the study area. They are both located off Tyburn Road, near to its junction with Bromford Lane. One of the monitoring stations is representative of local conditions in close proximity to a busy road. The other monitoring station is representative of local conditions at an urban location that is set back from the busy road. In addition, there are 12 diffusion tube sites measuring concentrations of NO2 within the BCC area, of which only one site is located within the study area. SMBC does not monitor or measure air quality within the study area.

4.3.4 Data collected by BCC show that some areas of the Castle Bromwich and Bromford area currently experience long term average concentrations of NO2 that are above the relevant air quality standard, especially at locations in close proximity to major

[24] Department for Environment, Food and Rural Affairs (Defra) (2010). Based Background Maps for NOx, NO2, PM10 and PM2.5 [Online]. Available at: http://laqm.defra.gov.uk/maps/maps2010.html [accessed July 2013].

roads[25]. Air quality standards for PM10 and PM2.5 are met at locations where they are monitored within the study area. Five-year concentration trends at these sites are shown in Volume 5: Appendix AQ-001-025.

4.3.5 An Air Quality Management Area (AQMA) has been designated for the whole extent of Birmingham by BCC, in recognition of the widespread NO_2 concentrations in excess of that defined by the air quality standard for the annual average ($40\mu g/m^3$) (Volume 5: Map AQ-01-025). There is no AQMA declared within SMBC.

4.3.6 There are many receptors within the study area, given its urban nature and the proximity of numerous residential properties and commercial premises to construction activities and roads where traffic flows will change. In particular, high densities of housing are located on Cadbury Drive, Spitfire Way and Blenheim Way. These receptors are within 100m of the north of the boundary required for construction activities, including the demolition of buildings and structures on Castle Bromwich Business Park, the earthworks associated with Bromford tunnel east portal and the movement of construction vehicles on haul roads. There are no ecological receptors with statutory designations affected by the construction activities within the Castle Bromwich and Bromford area. However, land is required for construction activities within Park Hall nature reserve, which is a locally designated Site of Importance for Nature Conservation (SINC).

Future baseline

4.3.7 Appendix CT-004-000 identifies developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the future baseline for the assessment of effects from the construction and operation of the Proposed Scheme.

4.3.8 The potential cumulative impact from committed developments on air quality acting in conjunction with the effects from the construction and operation of the Proposed Scheme have been considered as part of this assessment. This has been achieved by including changes in traffic predicted as a result of the committed developments within the traffic data used for the air quality assessments for construction and operation, in which the future air quality baselines are defined as the 'without Proposed Scheme scenarios' at each stage.

Construction (2017)

4.3.9 Future background pollutant concentrations have been sourced from Defra background maps for 2017, which predict NO_2 and PM10 levels in 2017 to be lower than in the 2012 baseline.

Operation (2026)

4.3.10 Future background pollutant concentrations have been sourced from Defra background maps for 2026, which predict NO_2 and PM10 levels in 2026 to be lower than in the 2012 baseline.

[25] Long-term concentrations are usually described by the annual average concentration. Short-term concentrations refer to those which are measured as daily or hourly averages and for which standards refer to peak concentrations, usually captured as a percentile concentration. The short term standard for NO_2 is expressed as the 99.8th percentile of hourly concentrations in a year.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 Emissions to the atmosphere will be controlled and managed during construction through the route-wide implementation of the CoCP, where appropriate. The draft CoCP includes a range of mitigation measures that are accepted as being suitable to reduce impacts as low as reasonably practicable. It also makes provision for the preparation of Local Environmental Management Plans (LEMPs) which will set out how the project will adapt and deliver the required environmental and community protection measures within each area. This will be achieved through the implementation of specific measures required to control dust and other emissions from activities in the area.

4.4.2 The assessment has assumed that the general measures detailed in Section 7 of the draft CoCP (Volume 5: Appendix CT-003-000) will be implemented. These include:

- contractors being required to manage dust, air pollution, odour and exhaust emissions during construction works;
- inspection and visual monitoring after engagement with the local authorities to assess the effectiveness of the measures taken to control dust and air pollutant emissions;
- cleaning (including watering) of haul roads and designated vehicle waiting areas to suppress dust;
- keeping soil stockpiles away from sensitive receptors where reasonably practicable, also taking into account the prevailing wind direction relative to sensitive receptors;
- using enclosures to contain dust emitted from construction activities; and
- undertaking soil spreading, planting or sealing of completed earthworks as soon as reasonably practicable following completion of earthworks.

Assessment of impacts and effects

Temporary effects

4.4.3 Impacts from the 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 human receptors sensitive to dust, as well as ecological receptors sensitive to dust.

4.4.4 An assessment of construction traffic emissions has also been undertaken for two scenarios in the construction period; a without the Proposed Scheme scenario and a with the Proposed Scheme scenario.

4.4.5 In the Castle Bromwich and Bromford area, dust-generating activities will occur at construction sites at Castle Bromwich Business Park (Bromford tunnel east portal), Park Hall nature reserve (River Tame realignment, River Tame viaduct and Dunlop Carrier Channel culvert) and at the eastern extent of the route in this study area, as it heads towards Water Orton. Dust emissions are most likely to be associated with

demolition, site preparation works, the excavation of the Bromford tunnel eastern tunnel portal, construction of the River Tame viaduct and the use of haul roads to and from the construction sites and compounds.

4.4.6 Given the mitigation contained within the draft CoCP, the assessment of impacts arising from dust emissions has concluded that they will be slight adverse or negligible in magnitude and that the effect will not be significant. The basis for this conclusion can be found in Volume 5: Appendix AQ-001-025.

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

4.4.8 The assessment of impacts arising from predicted changes to road traffic flows, and the associated emissions along the local road network has concluded that the magnitude of impact will be negligible at the majority of receptors.

Permanent effects

4.4.9 There are no permanent effects anticipated to arise during construction of the Proposed Scheme.

Cumulative effects

4.4.10 This assessment has considered the potential cumulative construction air quality effects of the Proposed Scheme and other committed developments. In this area, there is no development that would be built at the same time as the Proposed Scheme and accordingly, construction air quality impacts from the Proposed Scheme is unlikely to result in any significant cumulative effects.

4.4.11 The construction dust assessment has considered the potential cumulative air quality effects of the Proposed Scheme and other committed developments. The traffic data used for the assessment include the traffic changes expected from the committed developments and therefore their impacts have been included within the assessment.

Other mitigation measures

4.4.12 No other mitigation measures during construction are proposed in relation to air quality in this area.

Summary of likely significant residual effects

4.4.13 The methods outlined within the draft CoCP to control and manage potential air quality effects are considered effective in this location and no significant residual effects are considered likely.

4.5 Effects arising from operation

Avoidance and mitigation measures

4.5.1 No mitigation measures are proposed during operation in relation to air quality in this area.

Assessment of impacts and effects

4.5.2 Impacts from the operation of the Proposed Scheme relate mainly to changes in the volume, composition and distribution of road traffic. There are no direct atmospheric emissions from the operation of trains that will cause an impact on air quality; these have therefore not been assessed. Indirect emissions from sources such as rail wear and brakes have been assumed to be negligible.

4.5.3 The assessment of operational traffic emissions has been undertaken for two scenarios in the operation year 2026; without the Proposed Scheme scenario and a with the Proposed Scheme scenario.

4.5.4 The operation of the Proposed Scheme could affect local air quality through additional traffic generated on local roads as a result of vehicles travelling to and from new railway stations and associated infrastructure. The assessment of impacts arising from predicted changes to road traffic emissions along the local road network has established that the impact will be negligible at all receptors. The effect on local air quality as a result of the operation of the Proposed Scheme will not be significant.

Other mitigation measures

4.5.5 No mitigation measures are proposed in relation to air quality in this area during operation.

Summary of likely significant residual effects

4.5.6 No significant residual effects are anticipated for receptors as a consequence of changes to air quality in this area during operation of the Proposed Scheme.

5 Community

5.1 Introduction

5.1.1 This section reports the impacts and likely significant effects on local communities resulting from the construction and operation of the Proposed Scheme.

5.1.2 Key issues concerning the community for this study area comprise:

- loss of land required to construct and operate the Proposed Scheme at Park Hall nature reserve;
- loss of land required to construct and operate the Proposed Scheme, and amenity impacts on the users of Farnborough Road Park;
- amenity impacts on residential properties and a care home in the southern extent of Castle Vale; and
- isolation and amenity impacts on residents at a Gypsy and Traveller site on Tameside Drive adjacent to Castle Bromwich Business Park.

5.1.3 Further details of the community assessments and write-ups of open space surveys and recreational public right of way (PRoW) surveys undertaken within the CFA are contained in Volume 5: Appendix CM-001-025.

5.1.4 Community assessment maps are provided in Volume 5: Maps CM-01-156 to CM-01-159.

5.1.5 The current assessment draws upon information gathered from local and regional sources including, Birmingham City Council (BCC), the Environment Agency, the Wildlife Trust for Birmingham and the Black Country, Castle Vale Community Housing Association and Castle Vale Tenants & Residents Alliance.

5.2 Scope, assumptions and limitations

5.2.1 The assessment scope, key assumptions and limitations for the community assessment are set out in Volume 1, the SMR (Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

5.3 Environmental baseline

Existing baseline

5.3.1 Baseline data on community resources was collected up to 500m from the centre line of the Proposed Scheme and, additionally, up to 250m from the boundary of land required for construction.

5.3.2 The study area includes the area of land required temporarily and permanently for the construction and operation of the Proposed Scheme, together with a wider corridor within which receptors or resources could be affected by a combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion. In addition, the study area has regard to the proposed routeing of

construction traffic and takes account of catchment areas for community facilities which could be affected where crossed by the Proposed Scheme. Overall, the study area is taken as the area of land which encompasses the likely significant effects of the Proposed Scheme.

5.3.3 This study area includes land within Castle Vale and Bromford each of which is a distinct residential settlement served by a range of local facilities. Castle Bromwich is a suburb on the outskirts of Solihull Metropolitan Borough, partially located within the eastern extent of CFA25. Castle Bromwich is outside of the study area for the community assessment as the construction and operation of the Proposed Scheme does not require land within Castle Bromwich, which relates to community resources. In addition, the Proposed Scheme will not result in any significant amenity or isolation effects on community resources within Castle Bromwich. The assessment therefore focuses on areas within Castle Vale and Bromford.

Castle Vale

5.3.4 Castle Vale provides a wide range of facilities to serve the local neighbourhood, and a number of facilities to the south of the estate will be in close proximity to the route. These include two areas of public open space and a nature reserve, which are within the study area and partially within areas of land required to construct and/or operate the Proposed Scheme.

5.3.5 Park Hall nature reserve, to the south of the Castle Vale estate and north of the M6, is within an area of land required to construct and operate the Proposed Scheme. The nature reserve has a total area of approximately 366,200m^2 and comprises floodplain grassland, wetlands and pools along the former route of the River Tame. There are also ancient woodlands and other habitats within the south of the site. Park Hall nature reserve is an important local resource, to which visitor access is by prior appointment, with volunteering activities and guided walks. The nature reserve is managed by the Wildlife Trust for Birmingham and the Black Country, who operate a regular volunteering programme up to five days per week. In addition, school groups visit the site frequently and wildlife events also take place.

5.3.6 Land will be required for the construction and operation of the Proposed Scheme at Farnborough Road Park. The park offers a wide range of facilities including a recently improved local equipped area of play (LEAP), outdoor gym, skate park and seven grassed seasonal football pitches. The park is well used by the local community, particularly during the summer.

5.3.7 An area of Blenheim Way public open space is within land required by the Proposed Scheme. The open space at Blenheim Way provides a neighbourhood equipped area for play (NEAP) and a youth shelter alongside grassed areas and footpaths.

5.3.8 Within the residential area of Castle Vale, the Berwood Court Care Home is within the study area and will be within close proximity to works associated with the Proposed Scheme. The care home provides specialist elderly care services for up to 69 residents. Services provided include rehabilitation care on behalf of Birmingham CrossCity Clinical Commissioning Group, as well as permanent and respite care for elderly and dementia patients.

5.3.9 A number of residential properties on Cadbury Drive and Blenheim Way are within the study area, but outside of the areas of land required to construct and operate the Proposed Scheme. The properties comprise both terraced and semi-detached properties within a suburban estate setting.

5.3.10 There is a Gypsy and Traveller site within the study area, located to the south of the Castle Vale estate, within the Castle Bromwich Business Park on Tameside Drive. The site is owned by BCC, and provides a total of 15 transit pitches[26]. The site is within an area of land required for the Proposed Scheme.

Bromford

5.3.11 Bromford provides a range of local facilities that serve the Firs and Bromford residential area. The only community facility within the study area is the Bromford Bridge North East public open space, which will be partially within an area of land required by the Proposed Scheme.

Future baseline

Construction (2017)

5.3.12 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. No committed developments have been identified in this area that will materially alter the baseline conditions in 2017 for the community.

Operation (2026)

5.3.13 No committed developments have been identified in this local area that will materially alter the baseline conditions in 2026 for the community.

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 The following measures have been incorporated into the scheme design as part of the design development process to avoid or minimise the environmental impacts during construction:

- Bromford tunnel, approximately 2.9km in length, will run from Castle Bromwich Business Park to the proposed Washwood Heath depot (see Washwood Heath to Curzon Street CFA26).The tunnel will reduce the land required for the construction and operation of the Proposed Scheme and potential amenity effects on residential properties and a range of community resources including the Tame Valley Academy and facilities on Cameronian Croft;
- the depth of Bromford tunnel negates the need for certain utility works. This has reduced the land required temporarily during the construction of the Proposed Scheme and thereby avoided loss of land and reduced amenity at

[26] Birmingham, Coventry and Solihull Councils (2008), *Joint Gypsy and Traveller Accommodation Assessment*.

several community resources including the Tame Valley Academy and community facilities on Cameronian Croft;

- the construction traffic route through Farnborough Road Park has been aligned to avoid the play area;
- the works to the B4118 Birmingham Road (identified on some maps as Water Orton Road at this location) do not extend past the entrance to the Park Hall Academy, allowing retained access to the academy; and
- landscaping mitigation has been proposed to the south of Farnborough Road Park and within areas of Park Hall nature reserve, to reduce the visual impact of the Proposed Scheme from within the park and the nature reserve.

5.4.2 The draft CoCP (Volume 5: Appendix CT-003-000) includes a range of provisions that will help mitigate community effects associated with construction within this area, including:

- appointment of community relations personnel (draft CoCP, Section 5);
- community helpline to handle enquires from the public (draft CoCP, Section 5);
- sensitive layout of construction sites to minimise nuisance (draft CoCP, Section 5);
- monitoring and management of flood risk and other extreme weather events which may affect community resources during construction (draft CoCP, 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, temporary rehousing (draft CoCP, Sections 7 and 13).

Assessment of impacts and effects

5.4.3 Details of all assessments of community resources are included in Volume 5: Appendix CM-001-025. Each assessment form presents information that explains the rationale for determining the rating for sensitivity of the affected community resource, magnitude of impact and the assessment of significance.

Castle Vale

Temporary effects

Residential properties

5.4.4 Approximately ten residential properties in the south-eastern extent of Blenheim Way will be within close proximity to construction activity in both Farnborough Road Park and Castle Bromwich Business Park. The rear gardens of the properties will be adjacent to an area of land required for construction works, which will be bound by temporary fencing approximately 2.4m high. To the south of the Birmingham and Derby line at Castle Bromwich Business Park construction works will include the Castle Bromwich auto-transformer station satellite compound, construction haul

roads, the construction of the tunnel portal and demolition works. Significant daytime noise effects will occur due to a range of works, including demolition, site clearance, haul road construction, re-soiling and Dunlop Carrier Channel works. Significant night-time noise effects will occur due to the installation of railway protection barrier. Significant visual effects are expected to the east across Farnborough Road Park and to the south across Castle Bromwich Business Park. The combination of noise and visual effects will result in a major adverse effect on the amenity of residents of these properties for approximately eight months in total, and is therefore considered to be significant.

5.4.5 Approximately eight residential properties on Cadbury Drive will experience a combination of environmental effects as they will be within close proximity to construction works at the Castle Bromwich Business Park, which will be less than 100m south of the properties. The properties will be separated from the works by the existing Birmingham and Derby line. During construction, the northern part of Castle Bromwich Business Park will be used for works associated with the Bromford tunnel east portal. Nine buildings or structures within the business park will be demolished to accommodate these works. Significant night-time noise effects are expected due to the installation of a railway protection barrier. Significant visual effects are likely due to views of construction activity at Castle Bromwich Business Park, including demolition of buildings, the construction of Bromford tunnel east portal (west) satellite compound and the construction of the Bromford tunnel east portal. The combination of significant noise and visual effects for approximately one month in total will result in a moderate adverse effect on the amenity of the residents of these properties, and is therefore considered to be significant.

5.4.6 The amenity of Gypsies and Travellers located at a site on Tameside Drive, in the Castle Bromwich Business Park, will be impacted by nearby construction activities. This will include the demolition of nine buildings or structures within the business park, and the construction of the proposed Bromford tunnel east portal. These works will result in significant adverse visual effects. Construction traffic routes are proposed on the roads surrounding the Gypsy and Traveller site, including Tameside Drive, Langley Drive and Orton Way. Significant Heavy Goods Vehicle (HGV) traffic effects will be experienced by residents of the site arising from an increase in HGV construction traffic on Tameside Drive, passing the site. The combination of visual and HGV traffic effects will result in a major adverse effect on the amenity of the residents for approximately five years in total, and is therefore considered to be significant.

5.4.7 Tameside Drive provides the only pedestrian and vehicular access route into the Gypsy and Traveller site. Tameside Drive will be used as a construction traffic route with a gated access and egress point, to the immediate east of the access to the site, leading to a haul road. The construction haul road will provide access to the Bromford tunnel east portal (east) main compound and associated construction works. This compound will be located approximately 50m from the Gypsy and Traveller site, from the closest point. There will be a significant increase in traffic on Tameside Drive due to workers and construction vehicles accessing the compound. This will include busy vehicle movements for approximately two years and three months in total, with average daily combined two way vehicle trips during this period of 15-20 cars and/or Light Goods Vehicle (LGV) and 56-110 HGVs. Increases in traffic flows will result in a

significant effect on accessibility on Tameside Drive (see Traffic and transport, Section 12). This is likely to disrupt pedestrian and vehicular access to the Gypsy and Traveller site. In addition, there will be two construction compounds and a temporary earthworks stockpile to the immediate east, as well as temporary fencing (approximately 2.4m high) along the eastern and northern boundary of the Gypsy and Traveller site. The proximity and scale of these construction features is likely to create a visual barrier around the site.

5.4.8 The disruption to accessibility of the Gypsy and Traveller site and the presence of visual barriers surrounding the site will result in a major adverse isolation effect on the residents, and is therefore considered to be significant.

Community infrastructure

5.4.9 Berwood Court Care Home will be located less than 100m north of the construction boundary at Castle Bromwich Business Park. The care home will be separated from the works by the existing Birmingham and Derby line. During construction, the northern part of Castle Bromwich Business Park will be used for works associated with the Bromford tunnel east portal. Nine buildings or structures within the business park will be demolished to accommodate these works. Significant daytime noise effects are expected due to a range of works associated with the proposed east tunnel portal to the south of the care home. Significant visual effects are likely due to views of construction activity including the demolition of buildings on the business park, the Bromford tunnel east portal (west) satellite compound and the construction of the Bromford tunnel east portal. Residents at the care home are likely to be particularly vulnerable to amenity effects. The combination of noise and visual effects will result in a major adverse effect on the amenity of the residents of the care home for approximately seven months in total, and is therefore considered to be significant.

Open space and recreational PRoW

5.4.10 Land required temporarily at Park Hall nature reserve totals approximately 290,350m^2. Land will be required for the construction of the Water Orton cutting, Park Hall Wood embankment, Langley Hill embankment and River Tame viaduct which will carry the route through the nature reserve. Construction haul roads will be created through the site from the B4118 Birmingham Road in the east and Castle Bromwich Business Park in the west. Three satellite construction compounds with storage areas (River Tame viaduct satellite compound, Plants Brook underbridge satellite compound, Dunlop Carrier Channel culvert satellite compound) will be located within the nature reserve for a period of between three to four years. The nature reserve will be closed to visitors throughout the construction period and will be reopened following the completion of the construction works (including railway installation and commissioning works). Park Hall nature reserve is an important local resource, playing a role in educating people about the natural environment as well as providing a recreational resource. The closure of the nature reserve will have a major adverse effect, and is considered to be significant.

5.4.11 An area of land in the south-western corner of Farnborough Road Park will be required temporarily to provide access to a diverted water main outside of the park boundary.

The area of land required includes a section of the footpath which currently provides access to the park from Cadbury Drive.

5.4.12 In addition, the footpath that runs to the west of Plants Brook is required to accommodate a construction haul road to the proposed balancing pond to the south of the park. This haul road will also be required for permanent use to enable occasional maintenance access of the balancing pond (see Permanent effects, Section 5.4). During construction, the land required will be bound by temporary fencing. If access from both footpaths is to be lost during the same period, an alternative access point will be provided from Javelin Avenue. This will retain pedestrian access to the junior football pitch and grassed area, and also enable maintenance of the pitch and grassed area. The overall construction period at Farnborough Road Park will be approximately three years, and the total land required temporarily is approximately 8,100m^2 which equates to 16% of the total park. The works will not compromise the function of the park as a recreational resource. The temporary loss of land will be a minor adverse effect on the users of the park, and this is not considered to be significant.

5.4.13 Significant visual effects are likely at several points across Farnborough Road Park during the construction period. Visual effects in the west and north of the park will arise due to views of transmission towers in Park Hall nature reserve and construction works associated with the River Tame viaduct and Langley Hill embankment. From the north of the park, construction of the proposed B4118 Water Orton Road overbridge and Water Orton cutting will also be visible. In addition, the presence of HGV construction traffic travelling through the park may affect the character and quality of the park. The combination of significant visual and HGV traffic effects will result in a major adverse effect on the amenity of the users of Farnborough Road Park for approximately three years in total, and this is considered to be significant.

5.4.14 An area of land is required temporarily within Blenheim Way public open space to accommodate utility works associated with the removal of an underground high voltage electricity cable. The land required is a grassed area of approximately 50m^2 which equates to 0.4% of the total site. Blenheim Way public open space will continue to be accessible and function as intended for the duration of the works, which are expected to last for less than six months. There will be a negligible adverse effect, not considered to be significant.

Permanent effects

Open space and recreational PRoW

5.4.15 Park Hall nature reserve will be subject to permanent impacts arising during construction. An area of land approximately 31,000m^2 will be required permanently, which equates to 8% of the total nature reserve. The route will enter the eastern part of the nature reserve in cutting before passing onto a viaduct across the realigned River Tame and then onto a raised embankment adjacent to and parallel with the Birmingham and Derby line. The River Tame currently flows along the northern edge of the nature reserve in the form of a straight, man-made channel. The river will be realigned from its existing channel further south through the nature reserve,

remaining roughly parallel to the Birmingham and Derby line and the route on embankment and a small section of viaduct.

5.4.16 Additional permanent works within Park Hall nature reserve will include the provision of a realigned access track from the B4118 Birmingham Road, the diversion of a National Grid overhead power line, diversion of a fuel pipeline, realignment/extension of the Dunlop Channel and Plants Brook, erection of retaining walls, and the excavation and re-grading of an extensive replacement floodplain storage area across the centre of the site. Following the completion of construction works, the nature reserve will be replanted with woodland, wetland and grassland habitat creation. Engagement will continue with the Environment Agency and the Wildlife Trust for Birmingham and the Black Country regarding these restoration works. It is estimated that the nature reserve will re-open to visitors in 2025 once these works are complete. Once the nature reserve has re-established, it is considered that there will be a minor adverse effect on users of the nature reserve as a result of the land required for the operation of the Proposed Scheme, and this is not considered to be significant.

5.4.17 In Farnborough Road Park, the footpath that runs to the west of Plants Brook is required permanently to provide a vehicular access route. The access route will join the proposed permanent access track south of Plants Brook and will be used on an occasional basis for maintenance works to the proposed balancing pond to the south of the park. The balancing pond and track will be lined with landscape mitigation planting. The land required permanently is approximately 5,600m^2 which equates to 11% of the total park. It is predicted that the occasional use of this land will not cause any significant inconvenience to users of the park. This will be a minor adverse effect on users of Farnborough Road Park, and is not considered to be significant.

Bromford

Temporary effects

5.4.18 No permanent effects have been identified on community resources in Bromford arising from construction.

Permanent effects

Community infrastructure

5.4.19 The Bromford tunnel will pass through the area, passing beneath the A452 Chester Road, the River Tame, the M6 and Bromford Drive. Several community facilities in Bromford will be located within an area of land required permanently for sub surface works associated with the tunnel. Community facilities within this area of land include; The Fort Jester restaurant and public house, Tame Valley Academy, Bromford Neighbourhood Office, Bromford Resident's Club, Bromford Bridge Members Club and Firs and Bromford Sports and Community Centre. No works will be required at ground level; therefore these facilities will not be affected.

Open space and recreational PRoW

5.4.20 Four public open spaces in Bromford will be located within an area of land required permanently for sub surface works associated with the tunnel. These are; Bromford Bridge North East, Warstone Communal Garden, Bromford Bridge North Linear and

Bromford Bridge North Play Area. No works will be required at ground level; therefore these spaces will not be affected.

5.4.21 Bromford Bridge North East is an area of linear green space situated adjacent to the existing M6 viaduct in the north-eastern extent of the Bromford estate. In addition to the land required in Bromford Bridge North East for subsurface works, an area of land approximately 10,800m^2 (14% of the public open space) is required occasionally to allow access to undertake strengthening works to an existing gas main beneath the open space. The public open space will remain publicly accessible. There will be a negligible adverse effect on the space, and therefore not considered to be significant.

Cumulative effects

5.4.22 No permanent cumulative effects have been identified during construction in the Castle Vale and Bromford areas.

Other mitigation measures

5.4.23 The assessment has concluded that there are significant adverse effects arising during construction of the Proposed Scheme in relation to community resources.

5.4.24 The area of land required for the Proposed Scheme will include the Castle Bromwich Business Park (including the Gypsy and Traveller site on Tameside Drive). Proposals will be developed for the reconfiguration of the business park so as to minimise the effects on businesses, residents and social infrastructure and to allow as many as possible to stay in the area. Any such reconfiguration will be subject to discussion with landowners and BCC, and obtaining the necessary planning permission. The land for the construction of the Bromford tunnel east portal, the infrastructure and its associated features will be required permanently.

5.4.25 No other mitigation is proposed.

Summary of likely significant residual effects

5.4.26 Park Hall nature reserve will be affected by the loss of land required during the construction period. The amenity of Farnborough Road Park will be temporarily affected due to construction traffic and visual effects. Some residents at Blenheim Way, Cadbury Drive, Berwood Court Care Home and the Gypsy and Traveller Site, at Castle Bromwich Business Park, will also experience temporary amenity effects due to the proximity of construction works, resulting in other environmental effects. Residents at the Gypsy and Traveller site at Castle Bromwich Business Park will also experience temporary isolation effects due to surrounding construction works.

5.5 Effects arising from operation

Avoidance and mitigation measures

5.5.1 There are no relevant measures which have been incorporated into the scheme design as part of the design development process.

Assessment of impacts and effects

5.5.2 No significant effects have been identified during operation of the Proposed Scheme.

Cumulative effects

5.5.3 No cumulative effects have been identified during operation of the Proposed Scheme.

Other mitigation measures

5.5.4 The above assessment has concluded there are no significant adverse effects arising during operation, therefore no further mitigation is proposed at this stage.

Summary of likely significant residual effects

5.5.5 No significant residual effects on community resources have been identified for the operation of the Proposed Scheme.

6 Cultural heritage

6.1 Introduction

6.1.1 This section of the report provides a description of the current baseline for heritage assets and reports the likely impacts and significant effects resulting from the construction and operation of the Proposed Scheme. Consideration is given to the extent and heritage value (significance) of assets including archaeological and palaeo-environmental remains, historic buildings and the built environment and historic landscapes.

6.1.2 With regard to heritage assets, the main issue is the extent to which designated and non-designated assets are affected by the Proposed Scheme. Impacts on assets as a result of the Proposed Scheme will occur largely through the physical removal and alteration of assets and changes to their setting.

6.1.3 Maps showing the location of the key environmental features can be found in Volume 2, Maps series CT-10. Maps showing the location of all designated and non-designated heritage assets can be found in Volume 5: Maps CH-02-154b to CH-02-157a and CH-01-156 to CH-01-160a. Detailed reports on the cultural heritage character and surveys undertaken within the local area are contained in the Volume 5 Appendices. These include:

- Appendix CH-001-025 – Baseline Report;
- Appendix CH-002-025 – Gazetteer of Heritage Assets;
- Appendix CH-003-025 – Impact Assessment Table; and
- Appendix CH-004-025 – Survey Reports.

6.1.4 Throughout this section, assets within the study areas are identified with a unique reference code, CBB000; further detail on these assets can be found in the gazetteer in Volume 5: Appendix CH-002-025.

6.1.5 Engagement has been undertaken with Birmingham City Council (BCC) authority planning archaeologist, Solihull Metropolitan Borough Council (SMBC) conservation officer and the Warwickshire County Council (WCC) local authority planning archaeologist with regard to the nature of the cultural heritage assets within the local area.

6.2 Scope, assumptions and limitations

6.2.1 The assessment scope, key assumptions and limitations for the cultural heritage assessment are set out in Volume 1, the SMR (Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

6.2.2 The setting of all designated heritage assets up to 2km of the centre line of the route has been considered. 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, temporarily and permanently, to construct the Proposed Scheme plus 250m. For the

purposes of this assessment, any assets within the 10mm settlement contour[27] are included within the assessment.

6.2.3 The cultural heritage methodology includes the consideration of the intra-project effects of a number of technical topic assessments, for example, landscape and visual, ecology and water resources and flood risk. Consequently, these interactions have been included in the assessment of impacts and effects.

6.2.4 In undertaking the assessment the following limitations were identified:

- the Light Detection and Ranging LiDAR[28] data examined did not encompass the full extent of the study area; and
- not all areas of survey as identified in the archaeological risk model[29] were available for survey.

6.2.5 However, non-intrusive field survey was undertaken in a number of areas to provide data regarding the nature of sub-surface archaeological assets. Information from other sources of data, including the Historic Environment Record (HER) and local archives was utilised to provide information relating to the potential archaeological assets that may be present.

6.3 Environmental baseline

Existing baseline

6.3.1 In compiling this assessment, documentary baseline data was collected from a variety of sources as set out in Volume 5: Appendix CH-001-025.

6.3.2 In addition to collating this baseline data, the following surveys were undertaken:

- walkover and site reconnaissance from areas of public access or in locations where access was granted. This was undertaken to understand the character and form of heritage assets and the historic landscape; to review the setting of assets; and to identify previously unknown assets.
- desk-top review of remote sensing data including LiDAR, aerial photographs and hyperspectral data (Volume 5: Appendix CH-004-025); and
- a programme of non-intrusive surveys including geophysical surveys (Volume 5: Appendix CH-004-025).

Designated assets

6.3.3 Two separate lengths of ancient woodland at Parkhall Wood (CBB007 and CBB008) are located partially or wholly within the land required, temporarily or permanently, for the construction of the Proposed Scheme (Volume 5: Maps CH-02-154b to CH-02-157a).

[27] The area in which ground settlement is estimated to be 10mm in depth above the bored tunnel.
[28] Light detection and ranging (LiDAR) is a high resolution remote sensing technique to capture 3D data.
[29] The archaeological risk model is an approach that enables the identification of those areas of the Proposed Scheme where archaeological assets are known or suspected and provides a mechanism for the prioritisation of the programme of survey.

6.3.4 The following designated assets are located within the 2km study area (see Volume 2, CFA25 Map Book and Volume 5: Maps CH-02-154b to CH-02-157a):

- two scheduled monuments: a medieval bridge at Water Orton (CBB 004) (also a listed building) and the remains of a motte and bailey castle at Castle Bromwich (CBB 044);
- three Grade I listed buildings: Castle Bromwich Hall (CBB046), bakehouse (CBB043) at Castle Bromwich Hall, and the church of St. Mary and St. Margaret, Castle Bromwich (CBB049);
- three Grade II* listed buildings: stable block (CBB041) at Castle Bromwich Hall, pigeon house (CBB040) at Castle Bromwich Hall, and gatepiers (CBB045) at Castle Bromwich Hall;
- nineteen Grade II listed buildings of which three are within Castle Bromwich Hall (CBB046) and three are within Castle Bromwich Conservation Area (CBB039, CBB038 and CBB037);
- one Grade II* registered Castle Bromwich Hall Park and Garden (CBB035); and
- the Castle Bromwich Conservation Area (CBB076).

Non-designated assets

6.3.5 There are no non-designated assets of moderate value that lie wholly or partially within the land required, temporarily and permanently, for the construction of the Proposed Scheme.

6.3.6 The following identified non-designated assets of low value lie wholly or partially within the land required, temporarily and permanently, for the construction of the Proposed Scheme:

- fourteen archaeological assets which are associated with Park Hall Manor, comprising the Great House (CBB020), walled garden (CBB018), the deer park (CBB012), dovecote (CBB014), bridge (CBB015), possible leat (CBB010), outbuildings (CBB022), and a trackway (CBB033). Assets also include ridge and furrow at Park Hall (CBB021, CBB029 and CBB031), saw pits (CBB011 and CBB025) and the site of a prehistoric burnt mound (CBB032);
- Minworth Deer Park (CBB013); and
- two areas of woodland identified as being of historic interest: Langley Hill Wood (CBB030) and Parkhill Wood (previously known as Spring Hill Wood) (CBB023).

6.3.7 All non-designated heritage assets within 250m of the land required, temporarily and permanently, for the construction of the Proposed Scheme are listed in the gazetteer, Volume 5: Appendix CH-002-025, and identified on Volume 5: Maps CH-01-156 to CH-01-160a. There are a number of built heritage assets, the setting of which have been considered, for example: the locally listed building, Dunlop Ltd base stores (main fort) building (CBB063).

Cultural heritage overview

6.3.8 The underlying solid geology of the study area consists predominantly of Mercia Mudstone within which is a thin horizon of siltstone and sandstone (Arden Sandstone). This is overlain by widespread deposits of alluvium and river terrace deposits associated with the River Tame which overlie glacial deposits. These deposits are of variable thickness and extent. At the eastern extent of the study area, from Parkhall wood to the North Warwickshire Borough Council administrative boundary sands and gravels are present.

6.3.9 Throughout the River Tame valley there are significant areas of made ground, which is the result of intensive industrial land-use. Much of this made ground is located within the valley floor and has been deposited to provide development platforms for settlement activity and embankments for road and railway infrastructure which typically dates to the mid-20th century. The topography of the study area within the River Tame valley is generally flat lying at around 80m above Ordnance Datum (AOD). At the eastern end of the study area a distinct scarp slope rises to 106m AOD and falls away gently to the east.

6.3.10 In the Birmingham area, early prehistoric activity is largely evidenced through artefact finds, such as stone axes, flint arrowheads and pottery. These artefacts are more often recovered from sand and gravel quarries, and from within river terraces but none have been recovered from sites within the study area. Evidence for Bronze Age activity is represented by burnt mounds at Park Hall (CBB032) and Berwood (CBB054), which are interpreted as indicators of domestic activity. As in these instances burnt mounds are more often located along low-lying river valleys and it is assumed that these mounds may be indicators of nearby domestic settlement located on higher, drier ground.

6.3.11 The study area is located within the area of three Iron Age tribal groups – the Corieltauvi to the east, the Cornovii to the north-west and the Dobunni to the south-west. Whilst a number of enclosed settlements and hillforts have been identified from aerial photographs within the region, no assets of this date have been recorded within the study area, which probably remained largely forested during this and earlier periods.

6.3.12 There is very little evidence for Romano-British activity within the study area and it appears that, as with earlier periods, large parts of the study area continued to be covered by extensive areas of forest. A Roman coin and fragments of pottery found in the grounds of Castle Bromwich Hall (CBB046) and a timber structure and pits found at Castle Bromwich castle (CBB044) may be evidence for defence of a river crossing point and provide an interesting example of continuity of purpose between the Roman and the medieval periods.

6.3.13 Place name evidence of Bromwich means 'settlement in the broom', broom being a yellow flowering bush that grew in abundance in the area. Castle Bromwich castle (CBB044) is a 15th century addition to the name Bromwich to distinguish the settlement from the other areas known as Bromwich in the area[30], which suggests

[30] Solihull Metropolitan Borough Council (2013). *Castle Bromwich History* [Online]. Available at: http://www.solihull.gov.uk/localhistory/16337.html [Accessed 11.09.13].

that the settlement of Castle Bromwich was established during the early medieval period. Elsewhere within the study area it would appear that habitation within the un-cleared forest was still low density.

6.3.14 During the medieval period, settlement became more widespread as the forest started to be cleared. At the time of the Domesday Survey (AD 1086) Castle Bromwich (CBB050), was recorded as part of the Coleshill Hundred administrative area. During the 12th century Bromwich Castle (CBB044), a motte and bailey castle, was constructed to defend the crossing of the River Tame. During the 16th century a manor house was constructed within the outer bailey to the south of the motte. The manor at Castle Bromwich had been endowed with a church by the 13th century and the present church of St. Mary and St. Margaret at Castle Bromwich (CBB049), though substantially altered in the 18th century, is likely to have medieval origins.

6.3.15 During the medieval period, woodland and heathland within the Arden area was cleared and enclosed and a large number of moated homesteads and farmsteads were established. The moated sites at, Berrandale Road (CBB059), Haye Hall (CBB066), Erdington Hall (CBB072) and Berwood Hall (CBB034) are all evidence of this period of land clearance. Medieval settlement activity has also been recorded at Bromford End (CBB069). The site of a deer park at New Park, Minworth (CBB013) and the deer park at Park Hall (CBB012) are also features of this period of land clearance.

6.3.16 The manor of Park Hall is first recorded in 1365, and originated as a hunting lodge located within the extensive deer park. The moated site at Park Hall which was abandoned during the 16th century was replaced on an adjacent site during the 17th century by the brick built great house (CBB020) and associated structures such as the dovecote (CBB014). Evidence of agricultural activity within the manor is evidenced by areas of ridge and furrow (CBB029) as well as a possible leat (CBB010). Within the manor of Park Hall there is also evidence for the survival of historic woodland (CBB007 and CBB008) some of which retain evidence for woodland management, comprising woodland banks (CBB023) and saw pits (CBB025) within Parkhill Wood.

6.3.17 The stone built bridge at Water Orton, a scheduled monument (CBB004), which provides a crossing of the River Tame on the route to Minworth, dates to c 1520 and replaces an earlier bridge on the same site.

6.3.18 The manor at Castle Bromwich was particularly prosperous and in the 17th century the earlier manor house, that had been built within the remains of the motte and bailey, was replaced by a much larger country house the Grade I listed Castle Bromwich Hall (CBB46) set within extensive Grade II* gardens and parkland (CBB035) and with a service court on its east side comprising the Grade II* listed stables (CBB41) and the Grade I listed bakehouse (CBB043).

6.3.19 The rural character of the study area comprising both moated sites and a number of smaller farmsteads, such as at the Grade II listed Pype Hayes Hall (CBB061) and the Grade II listed Forge Farmhouse (CBB027), was largely retained until the 19th century. Since the 19th century the character of the study area has changed to become a dense urban area with residential areas located primarily south of the river within Castle Bromwich and industrial and commercial areas on the north bank of the river.

6.3.20 The Birmingham and Fazeley Canal (completed 1789), which passes through Tyburn and retains an 18th century bridge (CBB062) and a 19th century Roving Bridge (CBB075), enabled the transport of goods and materials to and from Birmingham. The connection of Birmingham to the canal network resulted in a rapid industrialisation of the city giving rise to prosperity and a substantial growth in population. The completion of the Birmingham and Derby line (1839), which passes through the River Tame valley, provided even greater transport links and commercial opportunity. Industrial activity in the 19th century within the study area is evident in a number of mills that were established along the River Tame. The mill at Castle Bromwich (CBB057) is recorded in use as a corn mill between 1820 and 1870. Bromford Mill (CBB067) may have earlier origins first as a corn mill then forge but by the 19th century was used for the manufacture of paper and by the 1850s steel rolling and wire drawing.

6.3.21 By the early 20th century large tracts of land between the canal and the River Tame to the south, had been developed for industrial purposes. The Birmingham offices and factory of the Dunlop Rubber Company (CBB063) a locally listed building were built in the 1920s to the west of the Castle Bromwich aerodrome, an open area of grassland which had been requisitioned by the Royal Flying Corps during 1914-1918. During the inter-war years the aerodrome continued in use as a mixed civilian and military airfield. In 1936 land adjacent to the aerodrome was acquired by the air ministry on which was built the Castle Bromwich aircraft factory (CBB058) for the manufacture of Spitfires. After WWII the aircraft factory buildings were used for the manufacture of cars. The aerodrome was closed in the 1950s and its site built over for residential development.

6.3.22 The growth of Birmingham's residential suburbs out towards Castle Bromwich began in earnest during the inter-war years. During the 1920s and 1930s the Birmingham based architect C E Bateman was responsible for a number of traditionally designed houses such as the Grade II listed houses on Rectory Lane (CBB038 and CBB039) and the grade II listed Tyburn public house (CBB060). Elsewhere housing is of a more modest and undistinguished character.

6.3.23 The Bromford M6 viaduct was completed by 1971 and along with numbers of tall rise apartment blocks characterises much of the urban character of present day Bromford.

6.3.24 The historic development of the landscape within the area is characterised by extensive urbanisation and the legibility of the preceding rural landscape is limited. It is considered that the Proposed Scheme will represent a continuation of the established pattern of urbanisation.

Future baseline

Construction (2017)

6.3.25 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. None of the identified developments affect the assessment of the Proposed Scheme's likely construction impacts on heritage assets.

Operation (2026)

6.3.26 No committed developments have been identified in this local area that will materially alter the baseline conditions in 2026.

6.4 Effects arising during construction

Avoidance and mitigation measures

6.4.1 The draft CoCP sets out the provisions that will be adopted to control effects on cultural heritage assets. The provisions include the following (Volume 5: Appendix CT-003-000):

- management measures that will be implemented for assets that are to be retained within the land required for the construction of the Proposed Scheme (draft CoCP, Section 8);
- the use of appropriate equipment and methods to limit ground disturbance and settlement followed by monitoring, protection and remediation (draft CoCP, Section 10);
- the preparation of project wide principles, standards and techniques for works affecting heritage assets (draft CoCP, Section 8);
- a programme of archaeological investigation and recording to be undertaken prior to/or during construction works affecting the assets (draft CoCP, Section 8); and
- a programme of historic building investigation and recording to be undertaken prior to modification or demolition of the assets (draft CoCP, Section 8).

6.4.2 Measures have been introduced into the design of the Proposed Scheme to reduce setting impacts consisting of the running of the route in tunnel from east of Park Hall. This removes the potential for any setting impacts on the designated assets within Castle Bromwich, including the conservation area (CBB076), the Grade I listed Castle Bromwich Hall (CBB046) and associated buildings, and the Grade II* registered Park and Garden at Castle Bromwich Hall (CBB035).

Assessment of impacts and effects

Temporary effects

6.4.3 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 will occur to assets both within the land required for the construction of the Proposed Scheme and assets in the wider study area due to the visibility of plant, cranes and equipment, as well as other construction factors.

6.4.4 No significant effects will occur as a result of temporary impacts on the setting of designated or non-designated heritage assets within the study area.

Cumulative effects

6.4.5 There will be no cumulative effects from temporary impacts on heritage assets within the study area.

Permanent effects

6.4.6 The following significant effects will occur as a result of physical impacts on heritage assets within the land required for the construction of the Proposed Scheme.

6.4.7 Archaeological deposits within and associated with Park Hall Deer Park (CBB012), an asset of low value, will be partially removed by the construction of the Water Orton cutting, the Park Hall Wood embankment, excavation for flood storage areas, site compounds and haul roads within the Park Hall nature reserve, the River Tame realignment and balancing ponds.

6.4.8 Parkhall Wood (CBB007, CBB008), an asset of high value, will be affected by partial clearance of the south-west portion of the woodland for construction of the Water Orton Road embankment and the Water Orton cutting through the scarp slope. This will constitute a high adverse impact and major adverse effect.

6.4.9 Buried linear assets of low value, visible on aerial photographs within the site of the former Castle Bromwich airfield and military WWII factories (CBB016), which extends north of the Proposed Scheme, will have the southern part removed by the excavation of balancing ponds to the north of the Birmingham and Derby line. This will constitute a moderate adverse impact and moderate adverse effect.

6.4.10 Archaeological remains of the Great House of Park Hall (CBB020), an asset of low value, will be totally removed by construction of the River Tame viaduct, and the River Tame viaduct satellite compound, excavation required for the creation of flood storage areas and the diversion of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.11 The extant remains of the walled garden of Park Hall (CBB018), an asset of low value, will be totally removed by construction of the River Tame viaduct, the River Tame viaduct satellite compound, excavation required for the creation of flood storage areas and the realignment of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.12 Archaeological remains of agricultural outbuildings associated with Park Hall (CBB022), assets of low value, will be totally removed by construction of the River Tame viaduct, excavation required for the creation of flood storage areas and the realignment of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.13 The remains of a bridge (CBB015), an asset of low value, will be totally removed by excavation required for the creation of replacement floodplain storage areas in Park Hall nature reserve. This will constitute a high adverse impact and moderate adverse effect.

6.4.14 The site of a dovecote (CBB014), an asset of low value, will be totally removed by construction of the River Tame viaduct, excavation required for the creation of flood

storage areas and the realignment of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.15 Ridge and furrow adjacent to the site of Park Hall (CBB021), an asset of low value, will be totally removed by construction of the River Tame viaduct, excavation required for the creation of flood storage areas and the realignment of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.16 Ridge and furrow (CBB031), an asset of low value, will be totally removed by excavation required for the creation of flood storage areas and diversion of overhead power lines. This will constitute a high adverse impact and moderate adverse effect.

6.4.17 Ridge and furrow to the north of Langley Hill Wood (CBB029), an asset of low value, will be totally removed by construction of the River Tame viaduct, excavation required for the creation of flood storage areas and the realignment of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.18 A ditch, possibly a mill leat (CBB010), an asset of low value, will be totally removed by excavation required for the creation of flood storage areas and the realignment of the River Tame. This will constitute a high adverse impact and moderate adverse effect.

6.4.19 A trackway (hollow way) at Park Hall (CBB033), an asset of low value, will be removed by excavation required for the creation of flood storage areas and construction of a haul road to connect the area of construction with Tameside Drive. This will constitute a high adverse impact and moderate adverse effect.

6.4.20 Parkhill Wood (CBB023), an asset of low value, will be affected by clearance of parts of the woodland to enable the diversion of overhead power lines as an early construction activity. This will constitute a high adverse impact and moderate adverse effect.

6.4.21 A saw pit within Parkhill Wood (CBB025), an asset of low value, will be totally removed by construction activities associated with the diversion of the overhead power lines. This will constitute a high adverse impact and moderate adverse effect.

6.4.22 A wood bank within Parkhill Wood (CBB023), an asset of low value, will be totally removed by construction activities associated with the diversion of the overhead power lines. This will constitute a high adverse impact and moderate adverse effect.

6.4.23 Langley Hill Wood (CBB030), an asset of low value, will be affected by partial clearance of the woodland as an early construction activity, including the erection of temporary construction fencing. This will constitute a high adverse impact and moderate adverse effect.

6.4.24 The site of a prehistoric burnt mound Park Hall (CBB032), an asset of low value, will be totally removed by the River Tame realignment and excavation required for balancing ponds. This will constitute a high adverse impact and moderate adverse effect.

6.4.25 There will be no significant effects as a result of permanent impacts on the setting of heritage assets and no designated assets are located within the 10mm settlement contour to the Bromford tunnel or its eastern portal.

Cumulative effects

6.4.26 There will be no cumulative effects from permanent impacts on heritage assets within the study area.

Other mitigation measures

6.4.27 Refinements to the mitigation measures incorporated into the design of the Proposed Scheme or included in the draft CoCP will be considered during detail design to reduce further the significant effects described above. These refinements will include, where appropriate, the identification of:

- suitable locations for advance planting, to reduce impacts on setting of assets; and
- locations where there physical impact on below ground assets can be reduced through the design of earthworks.

Summary of likely significant residual effects

6.4.28 As no mitigation beyond that described has been identified, the residual effects are the same as those reported in the permanent effects section.

6.4.29 A range of archaeological assets will be permanently lost due to the construction of the Proposed Scheme, in particular in the area of Park Hall nature reserve. These assets include those associated with Park Hall Deer Park, buried linear assets associated with the former Castle Bromwich airfield and military WWII factories, remains of the great house of Park Hall and agricultural outbuildings and the site of a dovecote. A programme of archaeological works will be undertaken to investigate, analyse, report and archive these assets.

6.4.30 The Proposed Scheme will not require the demolition of any designated built heritage assets, but will result in the demolition of the non-designated extant remains of the walled garden of Park Hall and structures associated with this including the remains of a bridge. A programme of built heritage works will be undertaken to investigate, analyse, report and archive these assets.

6.4.31 The Proposed Scheme will permanently remove the following elements of the historic landscape: Parkhall Wood and wood bank, Langley Hill Wood and Park Hill Wood and wood bank. In addition elements of ridge and furrow which contribute to the setting of historic settlements and buildings such as Park Hall will be removed. Further consideration will be given to the historic vegetation and landscapes as part of the planting and landscape design plans that will be further prepared for HS2.

6.5 Effects arising from operation

Avoidance and mitigation measures

6.5.1 The design of the Proposed Scheme includes the placement of the route in tunnel from Castle Bromwich Business Park to the west of Park Hall. This removes the potential for any setting and noise impacts during operation on the highly graded designated assets within Castle Bromwich including the conservation area (CBB076),

the Grade I listed Castle Bromwich Hall (CBB046) and associated buildings and the Grade II* registered Castle Bromwich Park and Gardens (CBB035).

Assessment of impacts and effects

6.5.2 The assessment considers the Proposed Scheme once operational and all effects are considered to be permanent. There will be no physical impacts on buried archaeological remains or other heritage assets arising from the operation of the Proposed Scheme. Impacts on the setting of heritage assets arising from the physical presence of the Proposed Scheme are described as permanent occurring within the construction phase and are not repeated in detail here, albeit that they will endure through the operation of the Proposed Scheme. Where there is a combined effect on the setting of an asset from the presence of the constructed scheme and its operation, this is reported in the assessment of operation.

6.5.3 No assets will experience significant environmental effects as a result of permanent changes to their setting arising from the operation of the Proposed Scheme.

Cumulative effects

6.5.4 There will be no cumulative effects from operational impacts on heritage assets within the study area.

Other mitigation measures

6.5.5 No other mitigation measures have been considered necessary.

Summary of likely significant residual effects

6.5.6 No assets will experience significant effects as a result of permanent changes to their setting arising from the operation of the Proposed Scheme.

7 Ecology

7.1 Introduction

7.1.1 This section describes the ecological baseline and identifies likely impacts and significant ecological effects that will arise from the construction and operation of the Proposed Scheme. These include impacts on species, habitats and sites designated for their importance for nature conservation.

7.1.2 The principal ecological issues in this area are those associated with land required for the construction of the Proposed Scheme within Park Hall Site of Importance for Nature Conservation (SINC). They are: habitat loss and fragmentation, affecting ancient woodland and marshy grassland; temporary loss of riparian habitat alongside the River Tame for the realignment of a stretch of the river within the nature reserve; extensive ground works in the floodplain of the River Tame (the river is also a Site of Local Importance for Nature Conservation (SLINC)); and the diversion of National Grid overhead power line.

7.1.3 Volume 5 of the ES contains supporting information to the ecological assessment reported in this section, including:

- ecological baseline data (Appendix EC-001-004, EC-002-004, EC-003-004 and EC-004-004); and
- register of local/parish level effects which are not described individually in Volume 2 (Appendix EC-005-004).

7.1.4 As well as survey data, the assessment draws on existing information gathered from national organisations and from regional and local sources including: Birmingham City Council, Canal & River Trust (formerly British Waterways), EcoRecord (the biological records centre for Birmingham and the Black Country), Environment Agency and the Wildlife Trust for Birmingham and the Black Country.

7.2 Scope, assumptions and limitations

7.2.1 The scope and methodology of the ecological assessment are introduced in the SMR (Volume 5: Appendix CT-001-000/1) and SMR Addendum (Volume 5: Appendix CT-001-000/2). Further detail, including the study area for individual surveys, is provided within the SMR Addendum. The assessment methodology is summarised in Section 8 of Volume 1, along with route-wide assumptions and limitations. Limitations associated with particular surveys are reported in Volume 5: Appendices EC-001-004, EC-002-004, EC-003-004 and EC-004-004. Where the Proposed Scheme is in tunnel in this section, all baseline surveys were scoped out on the basis that no impacts associated with construction or operations are expected with regard to habitats and species.

7.2.2 A Water Framework Directive assessment has been undertaken in conjunction with the environmental assessment. Details of this assessment are presented in Volume 5: Appendix WR-001-000.

7.2.3 Where data are limited, a precautionary baseline has been built up according to the guidance provided in the SMR Addendum (Volume 5: Appendix CT-001-000/2). This constitutes a 'reasonable worst case' basis for the subsequent assessment.

7.2.4 The precautionary approach to the assessment has been adopted to identify the likely significant ecological effects of the Proposed Scheme.

7.3 Environmental baseline

Existing baseline

7.3.1 This section describes the ecological baseline relevant to the assessment: the designated sites, habitats and species recorded in this area. Further details are provided in the reports presented in Volume 5: Appendix EC-001-004, Appendix EC-002-004, Appendix EC-003-004, Appendix EC-004-004 and Volume 5: Map Series EC-01 to EC-12. Statutory and non-statutory designated sites are shown on Volume 5: Map Series EC-01.

7.3.2 Land required for the construction of the Proposed Scheme and that adjacent to it consists mainly of low lying floodplain alongside the River Tame, comprising marshy grassland, reed bed and pond habitat. Broadleaved woodland including small areas of ancient woodland occur on the higher lying land. The wider area is a mix of residential and industrial land use, interspersed with small areas of urban habitats, typical for the outskirts of Birmingham. The largest expanses of semi-natural habitat occur within Park Hall SINC.

7.3.3 In the west of the study area the route of the Proposed Scheme descends below ground level, initially in cutting, to enter the proposed Bromford tunnel. The tunnel will pass beneath the A452 Chester Road, River Tame, M6 and Bromford Drive before leaving the study area (see Section 2.3). The baseline does not include descriptions of sites, habitats or species above the route of the tunnel, as no ecological impacts are anticipated in these areas.

Designated sites

7.3.4 There are no statutory designated sites located within 500m of the land required for the construction of the Proposed Scheme.

7.3.5 There are two SLINCs and one SINC which are relevant to the assessment in this area. They are:

- Park Hall SINC is located immediately to the north of the M6 and west of Water Orton. It is also a nature reserve and is managed by the Wildlife Trust for Birmingham and the Black Country. The SINC is known locally as Park Hall nature reserve. It is designated for its broadleaved semi-natural woodland (including one area listed on the ancient woodland inventory), scrub, marshy grassland, swamp vegetation and water bodies, as well as the plants, aquatic invertebrates (including four species of County Rare[31] diving beetle), amphibians and birds these habitats support. The habitats within the SINC are

[31] 'County Rare' refers to 'Notable' (Chadd & Extence, 2004) species that are scarce in the West Midlands. Chadd, R. and Extence, C. (2004), *The conservation of freshwater macro-invertebrate: a community-based scheme*. Aquatic Mar. Freshw. Ecosyst. 14:597-624.

located partly within the land required for the construction of the Proposed Scheme. The SINC is of county/metropolitan value;

- Water Orton Sidings SLINC is located to the north of the M6 and immediately east of the railway triangle north of Park Hall nature reserve. The SLINC is located partially within the land required for the construction of the Proposed Scheme and designated for its calcareous grassland and the diverse assemblage of plants and terrestrial invertebrates that this habitat type supports. The SLINC is of district/borough value.
- River Tame SLINC flows through the area to the east of Birmingham city centre, between the M6 and the Birmingham and Derby line. Sections of the SLINC are located within the land required for the construction of the Proposed Scheme, including where it flows through Park Hall SINC, and it is notified for its watercourse habitats, which are known to support bullhead (a fish), birds, bats, otters and other species. The SLINC also contains areas of marshy grassland and swamp; and supports a variety of species including meadow foxtail, cuckoo flower and the County Rare meadow-rue. The SLINC is of district/borough value.

Habitats

7.3.6 The following habitat types which occur in this area are relevant to the assessment.

Woodland

7.3.7 Broadleaved semi-natural woodland occurs in three areas in Park Hall SINC and within the land required to construct the Proposed Scheme. Species present include ash, oak and field maple and together represent National Vegetation Classification (NVC) communities W8 *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland and W10 *Quercus robur – Pteridium aquilinum – Rubus fruticosus* woodland. A part of the woodland at Park Hall SINC is listed on the ancient woodland inventory which exhibits a species-rich field layer, though it is suspected that all of the broadleaved semi-natural woodland within Park Hall SINC is of ancient origin. The broadleaved semi-natural woodland is all in a good ecological condition and is of county/metropolitan value.

Watercourses

7.3.8 The River Tame and two of its tributaries (Dunlop Channel and Plants Brook) exist within the land required to construct the Proposed Scheme and are contained within artificial channels and are subject to flooding following heavy rainfall. These watercourses are a habitat of principal importance listed in Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006[32]). The River Tame is of district/borough value. The Dunlop Channel and Plants Brook are each of local/parish value.

[32] *Natural Environment and Rural Communities Act 2006* (Chapter 16). London. Her Majesty's Stationery Office.

Marshy grassland

7.3.9 An area of approximately 3.2ha of marshy grassland occurs on the floodplain of the River Tame within the land required to construct the Proposed Scheme and is subject to flooding and cattle grazing. The marshy grassland is a habitat of principal importance. It is of county/metropolitan value.

Swamp

7.3.10 Swamp and reed bed vegetation occurs within the railway triangle to the north of Park Hall SINC, outside the land required to construct the Proposed Scheme. A further area of approximately 1.4ha of swamp and reed bed vegetation occurs within the SINC itself, within the extent of the Proposed Scheme. The areas of swamp are habitats of principal importance and are collectively of district/borough value.

Water bodies

7.3.11 There are 17 ponds, which represent habitats of principal importance, which exist at Park Hall SINC and within the land required to construct the Proposed Scheme. These ponds support typical species diversity and collectively are of county/metropolitan value. Ponds outside of Park Hall SINC, and outside of the land required, are of district/borough value.

Hedgerows

7.3.12 Short sections of species-poor hedgerow occur within the land required for construction of the Proposed Scheme. These are not defined as important under the wildlife and landscape criteria specified in the Hedgerows Regulations 1997[33], and are small in extent. These hedgerows are collectively of local/parish value.

Neutral grassland

7.3.13 Large areas of species-rich neutral grassland and species-poor neutral grassland occur within and around the floodplain of the River Tame at Park Hall SINC. These habitats exist within the land required to construct the Proposed Scheme. Areas of these grassland habitats supporting higher levels of species diversity are likely to represent habitats of principal importance or local Biodiversity Action Plan (local BAP) habitats. The species-rich grasslands at Park Hall SINC are of county/metropolitan value. The species-poor grasslands within the SINC are of local/parish value.

7.3.14 Semi-improved species-poor neutral grassland occurs within Park Hall SINC, and hence within the land required, as well as within the area to the south of Dunlop Way, west of the A452 Chester Road, within the railway triangle north of Park Hall SINC and within the area of equestrian interest immediately to the east of Park Hall SINC, all of which lie outside the land required to construct the Proposed Scheme. The semi-improved grassland areas are small in extent and are in poor condition. They are of local/parish value.

[33] *The Hedgerows Regulations 1997* (1997 No. 1160). London. Her Majesty's Stationery Office.

Scrub

7.3.15 Dense and/or scattered scrub occurs in the area south of Dunlop Way and west of the A452 Chester Road, within the railway triangle north of Park Hall SINC and within the SINC, all of which lie outside the land required to construct the Proposed Scheme. Each individual area of scrub is small in extent and is of local/parish value.

Tall ruderal vegetation

7.3.16 Areas of tall ruderal vegetation occur in the area to the south of A47 Fort Parkway and west of Dunlop Way, within the railway triangle north of Park Hall SINC and within Park Hall SINC, both within and outside of the land required to construct the Proposed Scheme. Collectively they are of local/parish value.

Scattered trees

7.3.17 Scattered broadleaved trees occur within Park Hall SINC all of which lie within the land required to construct the Proposed Scheme. Whilst they are likely to have colonised naturally, they represent a semi-natural habitat type which is small in extent. They are collectively of local/parish value.

Protected and/or notable species

7.3.18 A summary of the species relevant to the assessment is provided in Table 8: Protected and/or notable species .

Table 8: Protected and/or notable species

Species/ species group	Value	Receptor	Baseline and rationale for valuation
Birds	County/ metropolitan	Wintering populations of teal and snipe at land north of Park Hall SINC.	Peak counts of 73 teal and 46 snipe, both Amber List[34] species, were recorded during surveys outside of the land required.
	County/ metropolitan	A breeding population of lesser spotted woodpecker at land north of Park Hall SINC.	A nest of this nationally rare Red List[33] species which is uncommon in the West Midlands was recorded during the surveys outside of the land required.
	County/ metropolitan	A breeding population of grasshopper warbler at Park Hall SINC.	A breeding territory of this Red List species which is uncommon in the West Midlands was recorded during the surveys within the land required.
	County/ metropolitan	A breeding population of peregrine at an undisclosed site.	An Annex 1 and Schedule 1 species which is uncommon in the West Midlands was recorded during the survey. It is located outside the area of land required for the construction of the Proposed Scheme.
	District/borough	Wintering waterfowl assemblage associated	Peak counts of 11 gadwall, 24 shoveler, 2 shelduck and 2 tufted

[34] Eaton MA, Brown AF, Noble DG, Musgrove AJ, Hearn R, Aebischer NJ, Gibbons DW, Evans A and Gregory RD (2009) Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 102, pp296–341.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
		with land north of Park Hall SINC.	duck were recorded during surveys. Woodcock and green sandpiper were also recorded outside of the land required. All are Amber List species.
	District/borough	Wintering populations of woodcock and green sandpiper at Park Hall SINC.	Amber listed woodcock and green sandpiper were recorded during the surveys within the land required.
	District/borough	Breeding populations of waterfowl at land north of Park Hall SINC.	Breeding territories of gadwall, tufted duck and little grebe were recorded during the surveys outside the land required. All are Amber List species.
	District/borough	Small breeding populations of garden warbler at Park Hall SINC	Kingfisher, an Annex 1 and Schedule 1 species, was recorded during the surveys within the land required.
	District/borough	Small breeding populations of kingfisher and garden warbler at Park Hall SINC.	A breeding territory of a garden warbler, a Green List[33] species, was recorded during the surveys within the land required.
	Local/parish	An assemblage of breeding birds at Park Hall SINC (excluding kingfisher, garden warbler and grasshopper warbler).	Breeding territories of 25 species, including one Red List species and 5 Amber List species were recorded during the surveys within the land required.
Flora	County/ metropolitan	Dittander at Park Hall SINC.	A small population of dittander, a Nationally Scarce species, was recorded during the surveys within the land required.
	District/ borough	Marsh stitchwort at Park Hall SINC.	A small population marsh stitchwort, a Birmingham and Black Country Very Rare species was recorded during the surveys within the land required.
	District/ borough	An assemblage of rare plant species at Park Hall SINC.	An assemblage of plants species including small populations of water-crowfoot, a Birmingham and Black Country Rare species, and sweet briar, a Birmingham and Black Country Very Rare species, was recorded during the surveys within the land required.
Aquatic-macro invertebrates	County/ metropolitan	An assemblage of aquatic-macro invertebrate species, including rare and notable species of diving beetle at Park Hall SINC.	A diverse assemblage of aquatic-macro invertebrates within the water bodies, including four species of county rare diving beetle (*Hygrotus nigrolineatus, Hygrotus confluens, Hydroglyphus geminus and Ilybius guttiger*) and three other species of diving beetle, which are of notable conservation importance

Species/ species group	Value	Receptor	Baseline and rationale for valuation
			(*Rhantus suturalis, Helochares lividus and Ilybius guttiger*), were recorded within ditches and ponds during the course of the surveys within the land required.
Water vole	County/ metropolitan	A small population of water vole on the River Tame where it passes through Park Hall SINC.	A small, remnant and hence particularly notable population of a species of principal importance which on a local scale is otherwise predominantly absent, was recorded during the surveys both within and outside the land required.
Terrestrial invertebrates	County/ metropolitan	An assemblage of invertebrate species at Park Hall SINC.	An assemblage of common invertebrate species characteristic of the marsh, grassland and woodland habitats present were recorded during the survey period. Desk study records also exist for one species of principal importance, two GB Red List species and 21 nationally scarce species within the land required
Otter	District/borough	A small otter population foraging and commuting along the River Tame where it passes through Park Hall SINC and an artificial holt within Park Hall SINC.	A small population of this species of principal importance was recorded during the surveys along the River Tame both within and outside the land required.
Bats	District/ borough	A population of common pipistrelle associated with Park Hall SINC and the River Tame.	A medium sized population of this species of principal importance was recorded foraging and dispersing along the base of the wooded embankments and along the River Tame at Park Hall SINC during the surveys within the land required.
	Local/parish	An assemblage of bat species at Park Hall SINC.	Small populations of *Myotis* sp., Noctule, Leisler's, brown long-eared bat, serotine, soprano pipistrelle and *Nyctalus* sp, each species of principal importance, were recorded foraging and dispersing along the base of the wooded embankments and along the River Tame at Park Hall SINC during the surveys within the land required.
Amphibians	District/ borough	A metapopulation of great crested newt at Park Hall SINC.	A small population (peak count of six individuals) of a species of principal importance to nature conservation was recorded during the surveys.
	District/ borough	Metapopulations of common frog, common toad and smooth newt at	Moderate sized populations of common frog, common toad and smooth were recorded across the network of 17 ponds and associated

Species/ species group	Value	Receptor	Baseline and rationale for valuation
		Park Hall SINC.	terrestrial habitat during the surveys within the land required.
Reptiles	Local/parish	A population of grass snake at Park Hall SINC.	A small number of grass snake recorded in suitable habitat during the survey period within the land required.
	Local/parish	A population of grass snake at the railway triangle north of Park Hall SINC.	A small number of grass snake recorded in suitable habitat during the survey period both within and outside the land required.
Badger	Local/parish	A main sett and an outlier sett recorded at an undisclosed location within the survey area.	A common and widespread species recorded during the survey period.
Fish	Local/parish	An assemblage of fish species within the River Tame SLINC	A moderate diversity of fish species within the River Tame SLINC where it passes through Park Hall SINC within the land required.

Future baseline

Construction (2017)

7.3.19 A summary of the known developments which are assumed to be mostly built and occupied prior to construction of the Proposed Scheme is provided in Volume 5: Appendix CT-004-000. These developments will affect the character and value of ecological resources as described below.

7.3.20 One development is considered to affect the character and value of ecological resources. Full planning permission (2012/06220/PA) for the erection of an employment building for B8 (storage and distribution) use, associated access, parking, drainage and landscaping at Prologis, Minworth, Sutton Coldfield (see Volume 5: Map CT-13-067, H3) will result in the loss of 8.2ha of the railway triangle north of Park Hall SINC. It is considered that this will have potential to reduce the current value of this location with regard to wintering birds. It is also likely that this development will reduce the value of the swamp habitat in this area from district/borough to local/parish by the date at which construction of the Proposed Scheme commences because there will only be a small extent of this habitat of principal importance remaining.

Operation (2026)

7.3.21 There are no known committed developments or changes to management in this area that will affect the operational baseline.

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 and avoid or reduce impacts to features of ecological value:

- the incorporation of the Bromford tunnel as opposed to a surface option through this area has removed the need for the realignment of a stretch of the River Tame at Bromford, along with associated impacts. The inclusion of the tunnel has also removed other impacts associated with construction of the surface option elements, such as road realignments, viaduct construction and bridge demolitions and construction; and
- construction of the River Tame viaduct over the River Tame floodplain, in place of embankment, will reduce impacts on dispersal routes used by birds, bats and river-based fauna and allow riparian plant habitat to remain in place. The crossings of rivers have been designed to ensure where practicable no footings will be placed in the channels themselves and to reduce the levels of shading on the watercourses concerned.

7.4.2 The assessment also assumes implementation of the measures set out within the draft CoCP, Volume 5: Appendix CT-003-000, which include translocation of protected species where appropriate.

Assessment of impacts and effects

Designated sites

7.4.3 Park Hall SINC contains a mosaic of habitat types which includes 4.4ha broadleaved semi natural woodland, of which approximately 3ha (69%) is ancient woodland and therefore irreplaceable. There is approximately 25ha of swamp and reed bed as well as neutral, semi-improved and marshy grassland. The River Tame flows along the length of the nature reserve for approximately 2km and is a key component of Park Hall SINC's functional integrity, since the marshy grassland and swamp and reed bed habitats depend upon irregular inundation from the river.

7.4.4 The Proposed Scheme requires the construction of a cutting and the diversion of a National Grid overhead power line through much of the broadleaved semi-natural woodland within the site. This represents a permanent loss of 2.7ha of broadleaved semi-natural woodland and 0.7ha of ancient woodland. Approximately 23% of the ancient woodland will be lost and all of the broadleaved semi-natural woodland will be affected. Although not all of the woodland will be directly beneath the footprint of the works, the fragments that will remain will be isolated and are predicted to decline in value, such that their biodiversity interest will be effectively lost.

7.4.5 The loss of ancient broadleaved woodland, broadleaved semi-natural woodland, swamp, reed bed as well as neutral, semi-improved and marshy grassland habitats within Park Hall SINC (representing 79% of the site) will have a significant adverse effect on the functional integrity of the nature reserve, and it will no longer be able to support the habitats and associated species for which it was designated. There will be

a permanent adverse effect on site integrity that is significant at the county/metropolitan level.

7.4.6 The realignment of the River Tame SLINC where it flows through Park Hall SINC, which is a habitat of district/borough value, could temporarily result in increased sediment loading of the watercourse downstream, adversely impacting on the ability of aquatic plants to photosynthesise and potentially result in the displacement of riparian plants and aquatic invertebrates. It could also potentially result in a change in bank habitats and flow dynamics of the watercourse. However, after implementation of the draft CoCP, which will include the installation of pollution interceptors during realignment works, no permanent significant residual effects are expected with regard to the River Tame SLINC downstream of the section to be realigned. Further detail is provided in the Water resource and flood risk assessment (Section 13).

7.4.7 The realignment of the watercourse where it flows through Park Hall SINC will result in the loss of this section of the River Tame SLINC itself. The integrity of this section of the River Tame SLINC will therefore be adversely affected. This will be a significant effect at district/borough level.

7.4.8 No impacts are expected on Water Orton SLINC.

Habitats

7.4.9 Earthworks and diversion of the National Grid overhead power line within Park Hall SINC, and extensive ground works in the floodplain of the River Tame SINC will result in the permanent loss of approximately 0.7ha of ancient woodland and 2.7ha of broadleaved semi-natural woodland of the NVC community, W10 *Quercus robur-Pteridum aquilinum – Rubus fruticosus* woodland. This will result in a permanent adverse effect on the conservation status of this habitat which will be significant at the county/metropolitan level.

7.4.10 Extensive ground works in the floodplain including the diversion of the fuel pipe line will result in the loss of 3.2ha of marshy grassland at Park Hall SINC. This will result in a permanent adverse effect on the conservation status of this habitat which will be significant at the county/metropolitan level.

7.4.11 Extensive ground works in the floodplain including the diversion of the fuel pipe line will result in the permanent loss of 15.3ha of species-rich neutral grassland and 4.9ha of species-poor neutral grassland at Park Hall SINC. Some of these are likely to qualify as habitats of principal importance or as local BAP habitats. The loss of these habitats will result in a permanent adverse effect on the conservation status of species-rich grasslands which will be significant at the county/metropolitan level, and on species-poor grasslands which will be significant at the local/parish level.

7.4.12 Extensive ground works in the floodplain including the diversion of the fuel pipe line will result in the permanent loss of 1.4ha of swamp vegetation at Park Hall SINC. This will result in a permanent adverse effect on the conservation status of this habitat which will be significant at the district/borough level.

7.4.13 A total of 17 ponds and approximately 265m of ditch habitat will be lost to extensive ground works in the floodplain of the River Tame associated with the Proposed

Scheme. The loss of these habitats will result in a permanent adverse effect on their conservation status which will be significant at the county/metropolitan level.

7.4.14 It is considered unlikely that any other effects on habitat receptors at more than the local/parish level will occur. Effects at the local/parish level are listed in Volume 5 Appendix EC-005-004.

Species

7.4.15 With regard to aquatic-macro invertebrates, the permanent loss of 17 ponds and approximately 265m of ditch habitat within Park Hall SINC will remove the habitat required for the assemblage of aquatic macro-invertebrates, including the four County Rare diving beetles (Hygrotus nigrolineatus, Hygrotus confluens, Hydroglyphus *geminus* and *Ilybius guttiger*) as well as three other species of diving beetle which are of Notable conservation importance (*Rhantus suturalis*, *Helochares lividus* and *Ilybius guttiger*). This will result in a permanent adverse effect on the conservation status of the populations concerned that is significant at county/metropolitan level.

7.4.16 Part of the River Tame where it flows across Park Hall SINC is currently used by water vole. Realignment of this section of the River Tame will affect the use of the river corridor for foraging, resting and breeding by this species, which could result in a lack of breeding success for the duration of the works, thereby resulting in a decline in population status. This will represent a permanent adverse impact on the conservation status of this population that is significant at county/metropolitan level.

7.4.17 Realignment of the River Tame across Park Hall SINC will affect the use of the river corridor for foraging and commuting by otter, and destruction of the artificial holt present in this location, which could result in a lack of breeding success for the duration of the works, thereby resulting in a decline in population status. This will represent a temporary adverse impact on this species which will be significant at district/borough level and which is anticipated to have duration of between one and three years.

7.4.18 The permanent loss of ancient woodland, broadleaved semi-natural woodland, marshy grassland, pond, swamp and reed bed habitats and species-poor hedgerows and the realignment of the River Tame will lead to a reduction in suitable foraging habitat, and the potential disruption of dispersal corridors used by common pipistrelle bats. Therefore there is potential for a permanent adverse effect on the conservation status of this species which would be significant at the district/borough level. However, for all other species of bat recorded during the survey period, such effects will result in an adverse effect that is significant at local/parish level.

7.4.19 The loss of pond, swamp and reed bed habitats, as well as marshy grassland has the potential to significantly affect the breeding and foraging success of the great crested newt metapopulation at Park Hall SINC which will lead to a population decline and potential local extinction. This will result in a permanent adverse effect on the conservation status of the local metapopulation that is significant at district/borough level.

7.4.20 The loss of pond, swamp an reed bed habitats, as well as marshy grassland has the potential to significantly affect the breeding and foraging success of the common

frog, common toad and smooth newt metapopulations at Park Hall SINC which will lead to population declines and potential local extinctions. This will result in a permanent adverse effect on the conservation status of these local metapopulations that is significant at the district/borough level.

7.4.21 The permanent loss of ancient woodland, broadleaved semi-natural woodland, species-rich neutral grassland, species-poor neutral grassland and temporary loss of marshy grassland has the potential to significantly affect the foraging success of the small populations of green sandpiper and woodcock at Park Hall SINC. This will result in a permanent adverse effect on the conservation status of these populations that is significant at district/borough level.

7.4.22 The permanent loss of ancient woodland, broadleaved semi-natural woodland, species-rich neutral grassland, species-poor neutral grassland, pond, swamp and reed bed habitats and temporary loss of marshy grassland has the potential to adversely affect the assemblage of terrestrial invertebrate species and the small population of grasshopper warbler at Park Hall SINC. This will result in permanent adverse effects on the conservation status of the terrestrial invertebrate assemblage and the small population of grasshopper warbler, each of which is significant at county/metropolitan level.

7.4.23 Works associated with the realignment of the River Tame have the potential to significantly affect the breeding and foraging success of the small breeding population of Kingfisher at Park Hall SINC. This will result in a temporary adverse effect on the conservation status of this population that is significant at district/borough level and which is anticipated to have a duration of between one and three years.

7.4.24 The permanent loss of ancient woodland, broadleaved semi-natural woodland, species-rich neutral grassland, species-poor neutral grassland and temporary loss of marshy grassland has the potential to affect the breeding and foraging success of the small breeding population of garden warbler at Park Hall SINC. This will result in a permanent adverse effect on the conservation status of this population that is significant at district/borough level.

7.4.25 The permanent loss of ancient woodland, broadleaved semi-natural woodland, species-rich neutral grassland, species-poor neutral grassland and temporary loss of marshy grassland has the potential to affect the breeding and foraging success of the small breeding bird assemblage (excluding kingfisher, garden warbler and grasshopper warbler) at Park Hall SINC. This will result in a permanent adverse effect on the conservation status of this population that is significant at local/parish level.

7.4.26 The permanent loss of wetland, woodland and grassland habitats has the potential to significantly affect the assemblage of rare and notable plant species, including the small populations of water-crowfoot and sweet briar, which are present within Park Hall SINC. This will result in a permanent adverse effect on the conservation status of this assemblage that is significant at district/borough level.

7.4.27 It is considered unlikely that any other effects on species receptors at more than the local/parish level will occur. Local/parish level effects are listed in Volume 5 Appendix EC-005-004.

Other mitigation measures

7.4.28 This section describes additional measures designed to reduce or compensate for significant ecological effects. These include habitat creation and habitat enhancement.

7.4.29 Translocation of soils from beneath the route at Parkhall Wood to a 0.5ha receptor area within Park Hall SINC, coupled with subsequent planting of this area with broadleaved semi-natural woodland will assist with the retention of biodiversity value of the remaining strips of woodland, by providing a link between fragments as well as an additional replacement area. Further native broadleaved woodland planting will be undertaken to an extent of 0.6ha in the location where the route passes through Park Hall SINC on embankment, and 3.1ha within the area of an existing equestrian interest, which lies adjacent to Park Hall SINC and B4118 Birmingham Road. This planting and the associated development of woodland plant and animal communities will help maintain the extent and integrity of the remaining broadleaved semi-natural woodland on the site. Together, these areas of woodland planting will result in a net gain of 0.8ha of broadleaved semi-natural woodland within this section of the Proposed Scheme. Due to the loss of 0.7ha of ancient woodland from Park Hall SINC, a permanent adverse effect at the county/metropolitan level will remain.

7.4.30 An additional 16.6ha of marshy grassland will be created within Park Hall SINC alongside the diverted River Tame within the replacement flood storage area. The grassland will be established in accordance with the principles of mitigation. Once these marshy grassland habitats have become established there will be a significant beneficial effect at the county/metropolitan level.

7.4.31 A total of 3.9ha of species-rich neutral grassland will be created at several locations on the embankments of the Proposed Scheme through Park Hall SINC. However, a net loss of 11.4ha of species-rich neutral grassland will remain which will result in a permanent adverse effect at the county/metropolitan level.

7.4.32 The diversion of the River Tame where if flows through Park Hall SINC will also result in a temporary adverse effect on otter. However, provision will be made to ensure the maintenance of dispersal corridors along the existing and the realigned sections of the River Tame. A replacement otter holt will also be provided at an appropriate location within the extent of Park Hall SINC in accordance with the ecological principles of mitigation. Consequently, with these measures in place no significant effects are expected on this species.

7.4.33 As detailed above, an additional 3.1ha of broadleaved woodland will be created within the area of an existing equestrian interest which lies adjacent to Park Hall SINC and B4118 Birmingham Road, along with two ponds with a combined area of 0.5ha and a further 2.3ha of species-rich neutral grassland. These works will be undertaken in accordance with the ecological principles of mitigation (Volume 5: Appendix CT-001-000/2). Consequently, no significant residual impacts are anticipated with regard to water vole or amphibian populations, including the metapopulation of great crested newt.

7.4.34 The new ponds will also provide suitable replacement habitat for aquatic-macro invertebrates. It is anticipated that many species, including the four County Rare

species recorded within Park Hall SINC, will naturally colonise the new ponds, encouraged by the placement of silt and substrate from ponds to be lost. Following creation of these new pond habitats, no significant impacts are anticipated with regard to the assemblage of aquatic macro-invertebrates, including the four County Rare species, currently present within Park Hall SINC.

7.4.35 The creation of broadleaved semi-natural woodland, species-rich neutral grassland, and marshy grassland will provide new habitats for the small populations of green sandpiper, garden warbler and woodcock at Park Hall SINC. There will be a temporary adverse effect on these species at the district/borough level until these habitats have become established, after which no residual effect is expected.

7.4.36 The diversion of the River Tame where it flows through Park Hall SINC will result in a temporary adverse effect on kingfisher which will be significant at the district/borough level, though once these works are completed no significant effects are expected on this species. Further information on the proposals for the diversion is set out in Section 13 Water resources and flood risk assessment.

7.4.37 The habitat creation measures detailed above, including the recreation of species-rich neutral grassland, marshy grassland, ponds and broadleaved semi-natural woodland, coupled with the translocation of woodland soils and silts from the ponds which will be lost, will provide new habitats for the assemblage of terrestrial invertebrates currently present within Park Hall SINC. This will reduce the effects of construction on the terrestrial invertebrate assemblage to a level that is significant at the local/parish scale.

7.4.38 The habitat creation measures detailed above, including the recreation of species-rich neutral grassland, marshy grassland, ponds and broadleaved semi-natural woodland, will also compensate for those bat foraging habitats lost for the Proposed Scheme. The appropriate planting of hedgerows, as detailed above, as well broadleaved semi-natural woodland on and in the vicinity of the embankments of the Proposed Scheme will also help maintain existing bat dispersal corridors and promote future dispersal beneath the River Tame viaduct span. Following the implementation of the measures proposed it is anticipated that any adverse impacts on bats during the construction of the Proposed Scheme will be reduced to a level at which they will not result in any significant effect on the conservation status of the species concerned.

Summary of likely significant residual effects

7.4.39 The mitigation, compensation and enhancement measures described above reduce the effects on ecology in the study area. However, at Park Hall SINC, there will be permanent loss of 0.7ha of ancient broad-leaved woodland, which cannot be replaced, and permanent loss of 2.7ha of broad-leaved semi-natural woodland. There will also be permanent loss of 11.4ha of species rich neutral grassland, 1.4ha of swamp vegetation and reed bed, as well as approximately 265m of ditch habitat and 17 ponds.

7.4.40 There would be a permanent beneficial effect owing to the creation of 16.6ha of marshy grassland at Park Hall SINC.

7.4.41 Owing to the loss of swamp vegetation and reed bed there would be a permanent adverse effect on the small population of grasshopper warbler which will be significant at the county/metropolitan level.

7.5 Effects arising from operation

Avoidance and mitigation measures

7.5.1 In order to avoid or reduce impacts on features of ecological value all culverts will be suitable to allow passage for mammals such as otter and water vole, taking into account flood events, or will have an alternative dry tunnel installed.

Assessment of impacts and effects

7.5.2 The operation of the Proposed Scheme has the potential to result in a variety of impacts on bat populations including those as a result of collision with passing trains, turbulence and noise. The point at which such impacts are considered to result in a significant adverse effect on the conservation status of the population concerned will differ between species. As a consequence the following assessment of operational impacts takes into account the differing character and nature of the bat populations and/or assemblages concerned in determining the likely effects of the Proposed Scheme on each of these receptors.

7.5.3 Noise, vibration and lighting from passing trains have the potential to disturb bat species foraging and commuting within habitats close to the Proposed Scheme. Understanding of the impact of noise on bats caused by passing trains is limited. There is some evidence to suggest that gleaning bats, such as brown long-eared, will have reduced foraging success within areas where there is persistent noise from busy roads. However, noise generated from passing trains will be regular but temporary and as such will differ from that resulting from a busy road.

7.5.4 Due to the large areas over which bats forage it is likely that any loss of, or displacement from, suitable foraging habitat in the vicinity of the Proposed Scheme would in itself amount to only a small proportion of the wider available resource. However, the impact of any such disturbance or displacement could be greatly increased if bats are hampered in moving between breeding sites, hibernation sites and other roosts which they commonly use. Through implementation of the mitigation measures previously detailed it is anticipated that the medium sized population of common pipistrelle, which is known to forage and disperse across Park Hall SINC, will not be adversely impacted.

7.5.5 Where the route bisects, or is located in close proximity to existing features known to be used regularly by foraging or commuting bats, there is an increased risk that bats could be killed or injured as a result of collisions with passing trains or associated turbulence. The significance of any such effect will be dependent on both the flight habitat of the species concerned and the vertical alignment of the Proposed Scheme (i.e. is the railway in cutting, on embankment, on a viaduct, or at grade) at the point the impact occurs.

7.5.6 Within this section of the Proposed Scheme the medium sized population of common pipistrelle is likely to be impacted through collisions with passing trains or associated turbulence. This is expected to occur where the Proposed Scheme bisects a known bat

dispersal corridor, which exists along the base of the wooded embankment at Park Hall SINC, and where there is greater risk of bats colliding with trains and/or affected by turbulence. This is likely to represent a permanent adverse effect on the conservation status of the local common pipistrelle population significant at the district/borough level.

7.5.7 The noise made by passing trains has the potential to disturb birds within habitats close to the Proposed Scheme. Birds habituate to loud noises that they hear regularly and frequently, and hence it is considered that this will not generally cause significant effects. There is some evidence to suggest that breeding bird densities can be reduced where there is persistent noise from busy roads due to birds being unable to hear each other's songs. However, this is not expected to occur with the Proposed Scheme as trains will pass quickly. The effect of train noise on breeding birds is therefore not considered to be significant.

7.5.8 It is considered unlikely that any other effects on species receptors at more than the local/parish level will occur. Effects at the local/parish level are listed in Volume 5: Appendix EC-005-004.

Other mitigation measures

7.5.9 Additional planting will be provided at specific locations within Park Hall SINC, including at the base of the wooded embankment where the Proposed Scheme goes into viaduct, to encourage the dispersal of bats and birds beneath the River Tame viaduct, and hence minimise the risk of potential collision with trains. This planting will comprise broadleaved semi-natural woodland at the base of the wooded slope leading to, and extending onto, the embankments of the Proposed Scheme to help maintain existing bat dispersal corridors. Once established, this would reduce effects on common pipistrelle bats to local/parish level. This is an effect on the local population rather than the favourable conservation status of the species at a national level.

Summary of likely significant residual effects

7.5.10 Taking into account the mitigation, compensation and enhancement proposed, no significant residual ecological effects are expected during operation.

8 Land quality

8.1 Introduction

8.1.1 This section presents the baseline conditions that exist along the Proposed Scheme in relation to land quality and reports the likely impacts and any significant effects 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, mining or mineral resources point of view, including: geological sites of special scientific interest (SSSI), local geological sites (LGS), areas of current underground or opencast mining, and areas of designated mineral resources. Mitigation measures are presented and any residual effects are summarised.

8.1.2 Potentially contaminated areas of land have been identified that could affect, or be affected by, the construction of the Proposed Scheme (for example contaminated soils may need to be removed or the construction may alter existing contamination pathways). Each of these areas has been studied in order 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. In addition, a review has been undertaken to establish whether the operation of the Proposed Scheme will lead to contamination of its surrounding environments and what needs to be done to prevent such contamination.

8.1.3 The main environmental features of this area include: the River Tame, Plants Brook and linking surface drainage and overflow channels; large areas of superficial sand and gravel deposits which constitute a Secondary A aquifer; densely populated residential areas and their associated community facilities; and the Park Hall nature reserve.

- a number of land uses that are considered to have the potential to be contaminative, including the former Castle Bromwich Waste Treatment Site landfill and Tameside Drive-Langley Drive landfill. (Volume 5: Map LQ-01-067 as sites 25-6, D6, and 25-11 to 25-16, C7). Earthworks will be required in these areas of landfill where the Bromford tunnel portal will be approximately 17m below existing ground level; and
- the potential for tunnelling activities in the study area to encounter contamination which will be greatest at the eastern tunnel portal. Whilst tunnelling will generate significant quantities of excavated materials, this will be predominantly natural Mercia Mudstone.

8.1.4 Details of baseline information and the land quality assessment methodology are outlined in the following appendices:

- the SMR (Volume 5: Appendix CT 001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2); and
- Volume 5: Appendix LQ-001-025: Land quality appendix.

8.1.5 Land contamination issues are closely linked with those involving water resources and waste. Issues regarding groundwater resources are addressed in Water resources and

flood risk assessment (Section 13). Issues regarding the disposal of waste materials including contaminated soils, are addressed in Waste and material resources (Volume 3, Section 13).

8.1.6 Engagement has been undertaken with Birmingham City Council (BCC), Solihull Metropolitan Borough Council (SMBC) and North Warwickshire Borough Council (NWBC) Environmental Health Departments, the Environment Agency, West Midlands Fire Service and the Ministry of Defence (MOD) regarding contaminated land, and with the Spatial Planning Department of SMBC regarding mineral resources. Information from NWBC and Warwickshire County Council (WCC) provided for Coleshill Junction (CFA19) has also been reviewed as this is the adjacent study area.

8.2 Scope, assumptions and limitations

8.2.1 The assessment scope, key assumptions and limitations for the land quality assessment are set out in Volume 1 and the SMR (see Volume 5: Appendix CT-001-000/1) and its addendum (see Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

8.2.2 Baseline data has been reviewed for the area of land required to construct the Proposed Scheme together with a buffer extending out for a minimum of 250m, but in the case of groundwater data up to 1km. This is defined as the study area. The assessment that follows has not assessed new or diverted utilities that will be located within the boundaries of existing highways. These are scoped out of the assessment as although there is work below ground, it is predominantly within highway construction i.e. non-contaminative materials. These are low risk with regard to land contamination issues, and therefore unlikely to cause any significant land quality effects.

8.2.3 Familiarisation visits to the study area were made where the location of the Proposed Scheme was viewed from points of public access only. In addition, visits to key sites have been undertaken to validate the data collected. Key sites are those which are considered to have the greatest potential for contamination and are considered to be at risk of being affected by the Proposed Scheme. Not all sites identified as a priority for inspection have been visited because of land access constraints. Site visits have been undertaken to confirm documentary knowledge regarding the sites and the lack of complete site walkovers is considered unlikely to have substantially impacted the land quality assessment. Site visit notes are presented in Volume 5: Appendix LQ-001-025.

8.3 Environmental baseline

Existing Baseline

8.3.1 Unless stated otherwise, all features described in this land quality section are presented in Volume 5: Maps LQ-01-066b to LQ-01-068a.

Geology

8.3.2 This section describes the underlying ground conditions within the study area. It first describes any made ground present, followed by near surface superficial deposits and

lastly describes the deeper bedrock geology. The geological mapping is illustrated on Volume 5: Map WR-02-025.

8.3.3 The study area mostly encompasses developed urban and semi urban areas. Made ground has been identified in most available borehole records and is expected to have been derived locally for land raising, as part of general development, as well as highway and railway earthworks in the area. Four historical landfills have been identified: the Sports Ground off Farnborough Road landfill, the Castle Bromwich Waste Treatment Site landfill, Tameside Drive-Langley Drive landfill and the "Land Rear of Freight Rover Works" landfill. All have records of receiving industrial, commercial and household waste. Further details of these are given in Table 9: Landfill sites located in or within 250m of the study area

8.3.4 In addition to the recorded landfill sites, known areas of made ground are present in the following locations:

- intermittent flood bund on the southern bank of the River Tame which is present throughout the study area;
- infilling of the original River Tame channels present throughout the study area;
- railway land associated with the Birmingham and Derby line throughout the study area;
- earthworks and landscape bunds associated with the construction of the M6 in the western extent of the study area;
- a series of infilled pits and ponds in the Park Hall nature reserve;
- made ground from the Medieval Park Hall Farm, following the footprint of the yard and outbuildings, in the east section of the Park Hall nature reserve; and
- a general distribution of made ground associated with industrial development adjacent to and to the north of the Birmingham and Derby line, between the Minworth Sewage Treatment Works (Volume 5: Map LQ-01-067, I4) and west of the A452 Chester Road.

8.3.5 Superficial glacial deposits form a discontinuous covering over the solid geology and beneath the made ground and fluvial and head deposits are present across the upper parts of the River Tame valley sides. Most of the glacial deposits beneath the study area are sands and gravels, which are extensive but not continuous. Alluvium generally overlays glacial deposits from around Park Hall nature reserve to the western end of the study area. The thickness of this layer varies but it can be up to around 6m in places. In addition, there are areas of river terrace deposits present on the northern side of the River Tame valley near Park Hall nature reserve and Castle Bromwich Business Park. These deposits also extend to Bromford between the A452 Chester Road and the Fort Shopping Centre (Volume 5: Map LQ-01-068a, E5). Head deposits have also been identified typically to 1.5m in thickness, but locally up to 5m, within the Park Hall nature reserve, on the slopes forming the Tame River Valley, south of the Fort Industrial Park (Volume 5: Map LQ-01-068a, I5) and west of the Bromford Bridge Resident's Club (Volume 5: Map LQ-01-068a, F7).

8.3.6 The geological map indicates glacial deposits to be present at the start of the study area at Parkhall Wood and again to the south of the Birmingham and Derby line within the Park Hall nature reserve, Castle Bromwich Business Park (Volume 5: Map LQ-01-067, C7) and west of the A452 Chester Road.

8.3.7 The Mercia Mudstone Group underlies much of the study area. The Mercia Mudstone Group typically comprises weak red brown silty mudstone, with minor amounts of carbonate and gypsum when unweathered. The Arden Sandstone Formation occurs within the Mercia Mudstone as a thin horizon of siltstone and sandstone and when unweathered is a medium strong rock. The Arden Sandstone Formation is not mapped as outcropping at the surface in the study area, although British Geological Survey (BGS) borehole[35] records have identified it at about 20m depth at the western end of the study area. The Bromsgrove Sandstone is present beneath the Mercia Mudstone Group.

8.3.8 At its eastern limits, the study area crosses the southern side of the River Tame valley, which is a steep topographical feature (15-20m high). The geology in this area (approximately 3.8km west of the B4118 Birmingham Road along the route to directly south of the existing Birmingham and Derby line at the River Tame crossing point) comprises Mercia Mudstone with bands of dolomitic sandstone and siltstone (skerries), overlain by a thin covering of glacial deposits (sand and gravel). The occurrence of the more weathering resistant skerry bands is partly responsible for this topographic feature. Head deposits exist at the base of this feature.

8.3.9 The Dicken's Heath Fault, trending approximately north to south, crosses the study area between the A452 Chester Road and the area west of the Bromford Drive and Reynoldstown Road junction. Another unnamed fault, also trending north to south, crosses just east of the B4118 Birmingham Road. Both faults are downthrown to the east.

Groundwater

8.3.10 There are three main categories of aquifer identified within the study area. The alluvium, river terrace deposits and glaciofluvial deposits are classified as Secondary A aquifers[36], the Mercia Mudstone is classified as a Secondary B aquifer, and the Head is classed as a Secondary Undifferentiated aquifer. The Arden Sandstone within the Mercia Mudstone is classed a Secondary A aquifer.

8.3.11 Groundwater is expected to be shallow and present within the superficial deposits across this study area. The Mercia Mudstone Group is water-bearing in places by virtue of the siltstones and sandstones of the skerries and the Arden Sandstone. Groundwater contained in these parts of the sequence is generally confined by the overlying mudstones.

8.3.12 The Environment Agency reports[37] that there are no licensed groundwater abstractions from the superficial deposits or the Mercia Mudstone Group within the study area. There are no Source Protection Zones (SPZ) in this study area. There are,

[35] Landmark report.
[36] Aquifer descriptions are defined in the Glossary.
[37] Landmark Data.

however, three groundwater abstractions which abstract directly from the Bromsgrove Sandstone which is present at depth beneath the Mercia Mudstone.

8.3.13 Further detail on groundwater abstractions and groundwater in the study area can be found in Water resources and flood risk assessment (Section 13).

Surface waters

8.3.14 The study area crosses and follows the realignment of the River Tame throughout much of the Park Hall nature reserve, where Plants Brook also joins the River Tame. The Dunlop Channel joins the River Tame east of the Castle Vale Housing Estate, and immediately to the west of the Park Hall nature reserve (Volume 5: Map LQ-01-067, E6). There are a number of artificial ponds at the site of the Minworth Sewage Treatment Works to the north (Volume 5: Map LQ-01-067, I4) and several other minor watercourses and ponds within the study area.

8.3.15 There are no licensed surface water abstractions within the study area.

8.3.16 Further information on surface waters in the study area can be found in Water resources and flood risk assessment (Section 13).

Current and historical land use

8.3.17 From the start of the study area to immediately east of the Tameside Drive civic amenity site (Volume 5: Map LQ-01-067, D7) land use is predominantly residential and rural, with the exception of an industrial and distribution park (Prologis Park) in the north (Volume 5: Map LQ-01-067, centred on H3). There are ponds and a historic landfill site (Sports Ground off Farnborough Road landfill, incorporating Castle Vale Tip (Volume 5: Map LQ-01-067, centred on F4) in the north of the study area. Park Hall nature reserve lies between the B4118 Birmingham Road and an area south of the Tameside Drive civic amenity site (Volume 5: Map LQ-01-067, D7).

8.3.18 Industrial and commercial land use characterises the area between just west of the Tameside Drive civic amenity site and the western extent of the study area, west of Bromford Lane. Land uses shown on Volume 5: Map LQ-01-068a include the Valor Gas (Oil Storage Depot) site (Volume 5: Map LQ-01-068a, D5), the Fort Shopping Centre (Volume 5: Map LQ-01-068a, E5), car sales showrooms (Volume 5:Map LQ-01-068a, F6), the Jaguar Land Rover Limited manufacturing facility (Volume 5: Map LQ-01-068a, I4), the Fort Dunlop Building (Volume 5: Map LQ-01-068a, G5), Fort Dunlop power plant (Volume 5: Map LQ-01-068a, H5), a car storage site (Volume 5: Map LQ-01-068a, H5) and the Fort Industrial Park (Volume 5: Map LQ-01-068a, I5). Other notable land use up to the Tameside Drive civic amenity site includes the Castle Bromwich Business Park (Volume 5: Map LQ-01-067, C7) together with various light industrial units, many of which are currently vacant. An incinerator ash waste recovery process operates under licence, north of the Tameside Drive civic amenity site (Volume 5: Map LQ-01-068a, D7).

8.3.19 Residential land use with associated educational and amenity facilities, including sports pitches and playing fields, are present to the north of the Birmingham and Derby line, east of the A452 Chester Road. Residential land use and associated facilities are also dominant to the south of the River Tame and Park Hall nature reserve.

8.3.20 In addition, potentially contaminative historical land uses in the study area include: realignment of the River Tame and local infilling of the former channel, a sewage treatment works (Volume 5: Map LQ-01-067, D5), a fertiliser works north-west of the Park Hall nature reserve (Volume 5: Map LQ-01-067, E6), and the industrial development of the Fort Dunlop Rubber Works (Volume 5: Map LQ-01-068a, G5), the British Industries Fair Buildings (Volume 5: Map LQ-01-067, C6), an aerodrome (Volume 5: Map LQ-01-067, E2), the Jaguar Land Rover Limited plant previously used to manufacture Spitfire aircraft (Volume 5: Map LQ-01-068a, centred on I4), part of the former Leyland DAF Vans (LDV) site (Volume 5: Map LQ-01-068a, C7), the Greenworks Training Academy (Volume 5: Map LQ-01-068a, D7) and an abattoir (Volume 5: Map LQ-01-067, C7).

8.3.21 There are four historic landfills in the study area and these are detailed in Table 9: Landfill sites located in or within 250m of the study area. All have records of receiving industrial, commercial and household waste and as such, these sites may be associated with a wide range of contaminants. In addition, these sites may be emitting landfill gases, such as carbon dioxide (CO_2), methane or volatile organic compounds (VOC).

Table 9: Landfill sites located in or within 250m of the study area

Name	Location	Description
Sports Ground off Farnborough Road landfill (incorporating Castle Vale Tip)	Located in Castle Vale immediately east of Farnborough Road Park and 100m north of Park Hall nature reserve, Volume 5: Map LQ-01-067, F4.	The Environment Agency[38] records the Sports Ground off Farnborough Road landfill to have accepted inert, commercial, and household waste until 1971. Data sourced from Envirocheck[39] records the landfill as containing clay, sand, ash, clinker and rubble. The Castle Vale Tip is recorded to have accepted inert, commercial, and industrial waste between 1970 and 1972. No ground gas data has been viewed for these sites.
Castle Bromwich Waste Treatment Site landfill	Located in Castle Bromwich beneath the Tameside Drive civic amenity site and BCC's waste recovery facility, Volume 5: Map LQ-01-067, D6.	The Environment Agency record this site to have accepted industrial waste prior to closure in 1966. Data sourced from Envirocheck, records this landfill as containing ash, clay, brick, gravel, paper, glass, wire, leather and timber. No ground gas data has been viewed although anecdotal evidence from BCC suggests that elevated ground gas levels have been recorded at site.
Tameside Drive – Langley Drive Landfill Site	Located in and adjacent to Castle Bromwich Business Park, Volume 5: Map LQ-01-067, C7.	The Environment Agency record the site to have accepted industrial, commercial and household waste from 1947 to the 1970s. Data sourced from Envirocheck, records the landfill as containing clay, building rubble, ash and general waste. No ground gas data has been viewed for this site.
Land rear of Freight Rover Works landfill site	Located in Bromford beneath UK Mail and north-east part of former LDV site, Volume 5: Map LQ-01-068a, C7.	The Environment Agency records indicate that inert, commercial and household waste was deposited here up until 1950. There are indicated to be two separate areas of landfill.

[38] Environment Agency [Online]. Available at: www.environment-agency.gov.uk [Accessed: 3rd February 2013].
[39] Landmark Information Group; Envirocheck Records; under license to HS2.

Other regulatory data

8.3.22 Regulatory data provided by the Landmark Information Group has been reviewed which includes, pollution incidents, radioactive and hazardous substances consents and environmental permits (previously landfill, Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) licences). A number of these have been recorded in the study area. Notable data are as follows:

- 29 minor pollution incidents to the River Tame have been recorded within the study area; and
- there is one Contaminated Land Regulations Entry Notice for the Sports Ground off Farnborough Road landfill site. This entry states "Environmental Protection Act Part IIa: Remediated Contaminated Land". Through engagement undertaken with BCC it has been established that the remediation concerned the implementation of land use management to control dust pathways, rather than intervention with physical, biological or chemical remediation of the site.

Mining and mineral areas

8.3.23 The Mercia Mudstone has been historically excavated in the Park Hall nature reserve for marl, probably as part of land improvements in the 18th and 19th centuries. These pits appear to have been dug on the south side of the River Tame valley.

8.3.24 Currently, there is no mineral extraction or mining activity within the study area or designations for any future mining activities. There are no mineral safeguarding areas or preferred areas of search for mining and mineral resources within the study area.

Geo-conservation resources

8.3.25 There are no geo-conservation resources identified within the study area.

Receptors

8.3.26 The receptors that have been identified within this study area are summarised in Table 10: Summary of sensitive receptors

Table 10: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land contamination	People	Residents (north and south of Bromford Drive, Kingsleigh Drive, Parkfield Drive, and the area south of Farnborough Road) (Volume 5: Maps LQ-01-066b to LQ-01-068a)	High
		Schools (Park Hall Academy, Chivnor Primary, Tame Valley Academy (Volume 5: Maps LQ-01-067 and LQ-01-068a)	High
		Users of public open space (Lanchester Park and Bosworth's Wood, land north of Parkfield Drive, Castle Vale sports ground, land west of properties located south of Farnborough Road, land south of River Tame between the A452 Chester Road and Bromford Lane) (Volume 5: Maps LQ-01-066 to LQ-01-068a)	Moderate
		Workers (Castle Bromwich Business Park, Fort Industrial Park, Bromford Central Industrial Estate off Bromford Lane, and commercial premises off Bromford Drive) (Volume 5: Maps LQ-01-067 and LQ-01-068a)	Moderate
	Controlled waters	Secondary A aquifers (superficial glaciofluvial and river terrace deposits, Arden sandstone)	High
		Secondary B aquifers (Mercia Mudstone)	Low
		Artificial ponds and drains on site of historic sewage works (Volume 5: Map LQ-01-067)	Low
		Natural ponds and drains within Park Hall nature reserve (Volume 5: Map LQ-01-067)	High
		Rivers (River Tame, Plants Brook, Dunlop Channel and overflow channels) (Volume 5: Maps LQ-01-066b to LQ-01-068a)	Moderate
	Built environment	Buildings and property	Low
		Underground structures and services	Low
	Ecological	Park Hall nature reserve (Volume 5: Map LQ-01-067)	Moderate

Future baseline

Construction (2017)

8.3.27 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. The potential for the baseline to change in the lead up to construction is limited to the extent to which any new development necessitates remediation or mitigation measures to control potential contamination releases. Any new development in the study area on potentially contaminated land will need to be suitable for its intended use as set out in the National Planning Policy

Framework (NPPF)[40]. To meet this requirement new development sites may require remediation to be undertaken. This will mean that some areas described as potentially contaminated in the current and historical land use, may no longer be of significance at the time of construction of the Proposed Scheme. Known committed developments where this might apply include:

- Plot 5, Prologis Park, Midpoint, Minworth has permission for the erection of a storage and distribution building with eight hectares floor area and access, parking, drainage and landscaping (planning reference no 2012/06220/PA). Located on the Minworth Sewage Treatment Works site (shown in Volume 5: Map LQ-01-067, I2); and
- a residential development of 42 flats with associated car parking, access roads, footpaths, bin stores and boundary treatment at the former Amber windows site, Bromford Lane, Ward End, Birmingham (planning reference 2012/05335/PA) shown in Volume 5: Map LQ-01-068a, D8. Records studied at BCC indicate that this site formerly housed underground tanks and was remediated in 2007 to the satisfaction of the regulator by Armac Group for residential use.

8.3.28 The potential for baseline to change will also depend on whether any further Part IIa determinations[41] are made by the Local Authority. A number of mechanisms drive these determinations therefore they are difficult to predict. Where Part IIa determinations are made, the potential baseline change will occur where remediation works are subsequently undertaken.

8.3.29 Based on the above, the land quality assessment does not consider these possible future changes to the baseline.

Operation (2026)

8.3.30 The potential for the baseline to have changed by the time the Proposed Scheme is operational is limited to the extent to which any new development (between 2017 and 2026) necessitates remediation or mitigation measures to control potential contamination. No committed developments have been identified in this local area that will materially alter the baseline conditions in 2026 for land quality.

8.4 Effects arising during construction

Avoidance and mitigation measures

8.4.1 The construction assessment takes into account the mitigation measures contained within the draft CoCP presented in Volume 5: Appendix CT-003-000. The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme. Its requirements in relation to work in contaminated areas will ensure the effective management and control of the work. Such requirements include:

[40] Department for Communities and Local Government (DCLG) (2012). *National Planning Policy Framework*. London, DCLG.
[41] Land which meets the Part IIa (of the Environmental Protection Act 1990) definition of contaminated land.

- methods to control noise, waste, dust, odour gases and vapours (draft CoCP, Sections 5, 7, 13 and 15);
- methods to control spillage and prevent contamination of adjacent areas (draft CoCP, Section 5);
- the management of human health exposure, for both construction workers and people living and working nearby (draft CoCP, Section 11);
- methods for the storage and handling of excavated materials, both contaminated and uncontaminated (draft CoCP, Section 7 and 15);
- management of any unexpected contamination found during construction (draft CoCP, Section 11);
- a post remediation permit to work system (draft CoCP, Section 11);
- storage requirements for hazardous substances such as oil (draft CoCP, Section 16);
- traffic management to ensure that there is a network of designated haul roads to minimise compaction/degradation of soils (draft CoCP, Section 7); and
- methods to monitor and manage flood risk and other extreme weather events which may affect land quality during construction (draft CoCP, Sections 16).

8.4.2 The draft CoCP requires that prior to and during construction a programme of further investigations, which may include both desk based and site based work, will take place in order to confirm the full extent of areas of contamination and a risk assessment undertaken to determine what, if any, site specific remediation measures will be required to allow the Proposed Scheme to be constructed safely and to prevent harmful future migration of contaminants (draft CoCP, Section 11). The investigation and assessment of potentially contaminated sites will be undertaken in accordance with:

- Environment Agency CLR11 Model Procedures for the Management of land Contamination (2004)[42]; and
- British Standards BS10175 Investigation of Potentially Contaminated Sites (2011)[43].

8.4.3 Where significant contamination is encountered, a remedial options appraisal will be undertaken to define the most appropriate remediation techniques. This appraisal will be undertaken based on multi-criteria attribute analysis that considers environmental, resource, social and economic factors in line with Sustainable Remediation Forum UK 'A Framework for Assessing the Sustainability of Soil and Groundwater Remediation' (2010)[44]. The preferred option will then be developed into a remediation strategy, in consultation with regulatory authorities prior to implementation.

[42] Environment Agency (2004). *CLR11 Model Procedures for the Management of Land Contamination*. Environment Agency.
[43] British Standard (2011). BS10175 Investigation of Potentially Contaminated Sites. British Standard.
[44] Sustainable Remediation Forum UK (2010). *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation*.

8.4.4 Contaminated soils excavated from the site, wherever feasible, will be treated as necessary to remove or render any contamination inactive, and reused within the Proposed Scheme where needed and suitable for use. Techniques such as stabilisation methods, soil washing and bio-remediation to remove oil contaminants may be used. Contaminated soil disposed off-site will be taken to a soil treatment facility, another construction site (for treatment, as necessary, and reused) or to an appropriately permitted landfill site.

Assessment of impacts and effects

8.4.5 At the eastern end of the study area, the Proposed Scheme will pass out of a deep cutting, onto the River Tame viaduct across the realigned River Tame and then onto the Langley Hill embankment, adjacent to and parallel with the Birmingham and Derby line. The route then enters the eastern edge of the Castle Bromwich Business Park. From here it will descend into the Castle Bromwich retained cut, heading towards the proposed Bromford tunnel.

8.4.6 From the eastern tunnel portal westwards to the boundary with the Washwood Heath to Curzon Street area (CFA26), the Proposed Scheme will comprise a twin-bore tunnel. Tunnelling will generate a significant amount of excavated material. The potential for tunnelling activities in this area to encounter contamination will be greatest at the tunnel portal, where the approach will be in cutting through areas of historical landfill (Castle Bromwich Waste Treatment Site landfill and Tameside Drive-Langley Drive landfill).

8.4.7 The Bromford tunnel east portal (east) main compound will be located in the south-eastern corner of Castle Bromwich Business Park, approximately 200m north of the M6. This will be a strategic hub for project and commercial management and administration. There will also be seven satellite compounds. These compounds will include maintenance facilities for plant and machinery and fuel storage in bunded tanks.

Land contamination

8.4.8 In line with the assessment methodology, as set out in the SMR, SMR Addendum and its appendices, an initial screening process was undertaken (identified in the methodology as Stages A and B) to identify areas of current or historical contaminative use within the study area and to consider which of these might pose a contaminative risks to the Proposed Scheme. In total, 127 sites were considered during this screening process; 40 of these sites were taken forward for more detailed risk assessments (Stages C and D), in which the potential risks were assessed more fully. The types of sites identified for further assessment include a former aerodrome, historic landfills, current and historic industrial and engineering works, a former sewage works, and informal areas of infilled ground. The Stage 2 sites are shown and labelled in Volume 5: Maps LQ-01-066b to LQ-01-068a.

8.4.9 Conceptual site models (CSMs) have been produced for the 36 sites taken through to the Stage C and D assessments. The detailed CSM are provided in Volume 5: Appendix LQ-01-025 and the results of the baseline risk assessments are summarised in this section. The following factors have determined the need for a Stage C and D assessments:

- whether the site is on or off the Proposed Scheme or associated offline works, e.g. roads;
- the vertical alignment, i.e. whether the Proposed Scheme is in cut or on embankment;
- the presence of underlying Principal or Secondary A aquifers or nearby watercourses; and
- the presence of adjacent residential properties or sensitive ecological receptors.

8.4.10 Potentially contaminated sites have been grouped, and assessed together, where appropriate. Further detail on the basis for the CSM groups is presented in Volume 5: Appendix LQ-001-025. The groups are defined as follows:

- CSM Group A: Sites within the land required to construct the Proposed Scheme, potentially containing soil/groundwater contamination and ground gas;
- CSM Group B: Sites within the land required to construct the Proposed Scheme, potentially containing soil/groundwater contamination only;
- CSM Group C: Sites that fall outside of the land required to construct the Proposed Scheme, potentially containing soil/groundwater contamination and ground gas; and
- CSM Group D: Sites that fall outside of the land required to construct the Proposed Scheme, potentially containing soil/groundwater contamination only.

8.4.11 A summary of the baseline CSMs is provided in Table 11: Summary of baseline CSMs for sites which may pose a contaminative risk for the Proposed Scheme. The impacts and baseline risks quoted are 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, it is based on precautionary, worst case assumptions and may therefore report a higher risk than that which actually exists.

Table 11: Summary of baseline CSMs for sites which may pose a contaminative risk for the Proposed Scheme

Area ref (1)	Area name	Main potential impacts	Main baseline risk (3)
25-06, 25-14, 25-16, 25-92, 25-130, 25-134 and 25-135 shown on Volume 5: Map LQ-01-067 (CSM group A sites)(2)	Key sites include: former landfill sites (Castle Bromwich Waste Treatment Site, Tameside Drive-Langley Drive site) Current industrial units (British Car Auctions, civic amenity site and Castle Bromwich Incinerator Bottom Ash Processing Facility)	Potential impact on human health on-site[45] (long term)	Moderate/low
		Potential impact on human health adjacent to the site (long-term)	Low
		Potential impact on	Moderate/low

[45] For CSM groups A and B, on-site means within the potential contaminated site identified under the "Area reference" column

Area ref (1)	Area name	Main potential impacts	Main baseline risk (3)
		groundwater quality	
		Potential impact on surface water quality	Moderate/low
		Potential impact on property receptors (buildings, foundations, and services)	Moderate/low
		Potential impact on ecological receptors (Park Hall nature reserve)	Moderate/low
25-08, 25-17, 25-18, 25-64, 25-78, 25-80, 25-82, 25-88, and 25-113 shown on Volume 5: Maps LQ-01-066b to LQ-01-068a (CSM group B Sites)(2)	Key sites include: former aerodrome, abattoir, railway station, sewage works, fertiliser works, engineering works, infilled land and railway land Current Castle Bromwich Business Park, Esso pipeline, railway land, and various small industrial/commercial units	Potential impact on human health on-site (long term)	Moderate/low
		Potential impact on human health adjacent to the site (long-term)	Low
		Potential impact on groundwater quality	Moderate/low
		Potential impact on surface water quality	Moderate/low
		Potential impact on ecological receptors (Park Hall nature reserve)	Low
25-11, 25-12, 25-13, 25-15, 25-86, 25-89, 25-117, 25-119, 25-120, 25-125, 25-126 and 25-136 shown on Volume 5: Maps LQ-01-067 and LQ-01-068a (CSM group C sites)(2)	Key sites include: former landfill sites (Tameside Drive-Langley Drive landfill, sports ground off Farnborough Road landfill (incorporating Castle Vale Tip), "land rear of Freight Rover Works landfill", refuse heap, sewage works, historic worked/infilled land, former LDV site Current Greenworks Training Academy, various industrial units/uses including UK Mail depot	Potential impact on human health on-site (long term)	Moderate/low
		Potential impact on human health adjacent to the site (long-term)	Low
		Potential impact on surface water quality	Moderate/low
		Potential impact on groundwater quality	Moderate/low
		Potential impact on property receptors (buildings, foundations, and services)	Moderate/low
		Potential impact on ecological receptors (Park Hall nature	Low

Area ref (1)	Area name	Main potential impacts	Main baseline risk (3)
		reserve)	
25-04, 25-05, 25-10, 25-23, 25-25, 25-62, 25-63, 25-67, 25-84, 25-87, 25-114 and 25-122 shown on Volume 5: Maps LQ-01-067 and LQ-01-068a (CSM group D Sites)(2)	Key sites include: former aerodrome, former tanks, tube works, infilled land and railway land Current Dura Automotive Body and Glass Systems, railway land, Fort Industrial Park, Jaguar Land Rover Limited, National Grid storage yard and various small commercial/industrial units	Potential impact on human health on-site (long term)	Moderate/low
		Potential impact on human health adjacent to the site (long-term)	Low
		Potential impact on groundwater quality	Moderate/low
		Potential impact on surface water quality	Moderate/low
		Potential impact on ecological receptors (Park Hall nature reserve)	Low
25-04, 25-06, 25-80, 25-82, 25-86, 25-88, 25-92, 25-130, 25-134, 25-135 and 25-136 shown on Volume 5: Map LQ-01-067 (Site specific CSM: River Tame realignment through Park Hall nature reserve and replacement floodplain storage)	Within land required to construct the Proposed Scheme: Current Esso pipeline Outside of land required to construct the Proposed Scheme: Former landfill sites (Castle Bromwich Waste Treatment Site, Castle Vale Tip), sewage works, fertiliser works, aerodrome Current civic amenity site, Castle Bromwich incinerator bottom ash processing facility	Potential impact on human health on-site (long term)	Low
		Potential impact on human health adjacent to the site (long-term)	Very low
		Potential impact on groundwater quality	Moderate/low
		Potential impact on surface water quality	Moderate/low
		Potential impact on property receptors (buildings, foundations, and services)	Low
		Potential impact on ecological receptors (Park Hall nature reserve)	Low
25-06, 25-08, 25-11, 25-12, 25-14, 25-15, 25-16, 25-17, 25-18, 25-82, 25-84, 25-88, 25-113 shown on Volume 5: Map LQ-01-067 (Site specific CSM: eastern tunnel portal and approach)	Within land required to construct the Proposed Scheme: Former landfill sites (Castle Bromwich Waste Treatment Site landfill, Tameside Drive-Langley Drive – landfill), fertiliser works. Current Castle Bromwich incinerator bottom ash processing facility, civic amenity site, Castle Bromwich	Potential impact on human health on-site (long term)	Moderate/low
		Potential impact on human health adjacent to the site (long-term)	Low
		Potential impact on surface water quality	Moderate/low

Area ref (1)	Area name	Main potential impacts	Main baseline risk (3)
	Business Park Outside of the land required to construct the Proposed Scheme: Tameside Drive-Langley Drive landfill site), aerodrome, sewage works and abattoir.	Potential impact on groundwater quality	Moderate/low
		Potential impact on ecological receptors (Park Hall nature reserve)	Moderate/low
		Potential impact on property receptors (buildings, foundations, and services)	Moderate/low

(1) Each area is assigned a unique identification number (refer to Volume 5: Appendix LQ-01-25).

(2) CSM have been prepared as part of the detailed land contamination methodology (Volume 5: Appendix LQ-01-25) for baseline, construction and post construction phases. Sites have been grouped where appropriate.

(3) The moderate risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported moderate existing baseline risk in the absence of site investigation a precautionary, worst case risk is reported in the table.

Temporary effects

8.4.12 An assessment of the effect of contamination has been undertaken by comparing the CSM developed for potential contaminated land sites at baseline, construction and post construction stages.

8.4.13 Table 12: Summary of temporary (construction) effects presents the summary of the resulting construction effects. The details of these comparisons are presented in Volume 5: Appendix LQ-001-025. 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. 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 remain as moderate. This will 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.

Table 12: Summary of temporary (construction) effects

Area ref[1]	Main baseline risk	Main construction risk[2]	Temporary effect and significance
25-06, 25-14, 25-16, 25-92, 25-130, 25-134 and 25-135 shown on Volume 5: Map LQ-01-067 (CSM group A sites)	Potential impact on human health on-site (long term) = moderate/low risk	Not applicable as receptor no longer present due to land required to construct the Proposed Scheme	N/A
	Potential impact on human health adjacent to the site (long-term) = low risk	Low to moderate/low risk	Negligible to minor adverse (N)
	Potential impact on groundwater quality =	Moderate/low risk to moderate risk	Negligible to minor adverse (N)

Area ref[1]	Main baseline risk	Main construction risk[2]	Temporary effect and significance
	moderate/low risk		
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on property receptors (buildings, foundations, and services) Property receptors – buildings, foundations, and services = moderate risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
25-08, 25-17, 25-18, 25-64, 25-78, 25-80, 25-82, 25-88, and 25-113 shown on Volume 5: Maps LQ-01-66b to LQ-01-068a (CSM group B sites)	Potential impact on human health on-site (long term) = moderate/low risk	Not applicable as receptor no longer present due to land required to construct the Proposed Scheme	N/A
	Potential impact on human health adjacent to the site (long-term) = low risk	Low risk	Negligible (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = low risk	Low risk to moderate/low risk	Negligible to minor adverse (N)
25-11, 25-12, 25-13, 25-15, 25-86, 25-89, 25-117, 25-119, 25-120, 25-125, 25-126 and 25-136 shown on Volume 5: Maps LQ-01-067 and LQ-01-068a (CSM group C sites)	Potential impact on human health on-site (long term) = moderate/low risk	Moderate/low risk	Negligible to minor adverse (N)
	Potential impact on human health adjacent to the site (long-term) = low risk	Low risk to moderate/low risk	Negligible to minor adverse (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)

Area ref[1]	Main baseline risk	Main construction risk[2]	Temporary effect and significance
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk to Moderate risk	Negligible to minor adverse (N)
	Property Receptors – Buildings, Foundations, and Services = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = low risk	Low risk to moderate/low risk	Negligible to minor adverse (N)
25-04, 25-05, 25-10, 25-23, 25-25, 25-62, 25-63, 25-67, 25-84, 25-87, 25-114 and 25-122 shown on Volume 5: Maps LQ-01-067 and LQ-01-068a (CSM group D sites)	Potential impact on human health on-site (long term) = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on human health adjacent to the site (long-term) = low risk	Low risk	Negligible (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = low risk	Low risk to moderate/low risk	Negligible to minor adverse (N)
25-04, 25-06, 25-80, 25-82, 25-86, 25-88, 25-92, 25-130, 25-134, 25-135, and 25-136 shown on Volume 5: Map LQ-01-067 (Site specific CSM: River Tame realignment through Park Hall nature reserve and flood compensation)	Potential impact on human health on-site (long term) = low to very low risk	Not applicable as receptor no longer present due to land required to construct the Proposed Scheme	Not applicable (N)
	Potential impact on human health adjacent to the site (long-term) = very low risk	Very low risk	Negligible (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Property Receptors – Buildings, Foundations, and Services = low risk	Low risk	Negligible (N)

Area ref[1]	Main baseline risk	Main construction risk[2]	Temporary effect and significance
	Impact on ecological receptors (Park Hall nature reserve) = low risk	Low risk to moderate/low risk	Negligible to minor adverse (N)
25-06, 25-08, 25-11, 25-12, 25-14, 25-15, 25-16, 25-17, 25-18, 25-82, 25-84, 25-88, 25-113 shown on Volume 5: Map LQ-01-067 (Site specific CSM: eastern tunnel portal and approach)	Potential impact on human health on-site (long term) = moderate/low risk	Not applicable as receptor no longer present due to land required to construct the Proposed Scheme	N/A
	Potential impact on human health adjacent to the site (long-term) = low risk	Low risk to moderate/low risk	Negligible to minor adverse (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Property Receptors – Buildings, Foundations, and Services = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)
	Impact on ecological receptors (Park Hall nature reserve) = moderate/low risk	Moderate/low risk to moderate risk	Negligible to minor adverse (N)

(1) See Table 10 for site names

(2) The moderate/low to moderate main construction risk identified in the above table does not necessarily imply an unacceptable risk. Application of the processes and measures within the CoCP will ensure that the site risks during the construction stage are controlled.

8.4.14 Table 12: Summary of temporary (construction) effects shows that the Proposed Scheme results in either no change or a slight increase in the level of risk already existing at each site for both on-site and off-site receptors. However, these effects are assessed as not significant and adoption of the draft CoCP makes it unlikely that there will be adverse consequences. However, it is considered that there may still be temporary minor adverse effects during the construction period from ground disturbance in these areas.

8.4.15 The route will cut into the Castle Bromwich Waste Treatment Site landfill on the approach to the Bromford tunnel east portal, with a further deeper cut below current ground level into the Tameside Drive-Langley Drive landfill. The nearby Park Hall nature reserve, the River Tame and groundwater are sensitive receptors in this area and consideration will need to be given to the potential impact upon any existing groundwater, leachate, and gas control systems within these landfill sites, and the measures required to minimise ground gas or leachate migration both during construction and subsequently.

8.4.16 During construction of the Bromford tunnel dewatering may be required which has the potential to mobilise off-site sources of contamination.

8.4.17 The River Tame realignment at Park Hall nature reserve and the creation of flood storage replacement area to the south will require significant earthworks which could result in an impact on the River Tame. Realignment of the Esso fuel pipeline to a single crossing will also be required, although this has been positioned away from the route of the proposed River Tame realignment.

8.4.18 The Bromford tunnel east portal (east) main compound will include the storage of potentially hazardous substances, such as fuels and lubricating oils. This main compound and the satellite site compounds may also be used for temporary storage of potentially contaminated soils. The measures outlined in the draft CoCP will manage risks from the potentially hazardous substances stored at the construction compounds.

8.4.19 There are not expected to be any significant temporary cumulative effects.

Permanent Effects

8.4.20 Baseline and post-construction CSM have been compared to assess the permanent (post-construction) effects.

Table 13: Summary of permanent (post construction) effects

Area ref	Main baseline risk	Main post construction risk	Post construction effect and significance (Yes or No)
25-06, 25-14, and 25-16 shown on 25-06, 25-14, 25-16, 25-92, 25-130, 25-134 and 25-135 shown on Volume 5: Map LQ-01-067 (CSM group A sites)	Potential impact on human health on-site (long term) = moderate/low risk	Very low risk to low risk	Negligible to moderate beneficial (Y)
	Potential impact on human health adjacent to the site (long-term) = low risk	Very low risk to low risk	Negligible to minor beneficial (N)
	Potential impact on groundwater quality = moderate/low risk	Very low risk to low risk	Minor to moderate beneficial (Y)
	Potential impact on surface water quality = moderate/low risk	Very low risk to low risk	Minor to moderate beneficial (Y)
	Potential impact on property receptors (buildings, foundations, and services) = moderate/low risk	Very low risk to low risk	Minor to moderate beneficial (Y)
	Potential impact on ecological receptors (Park Hall nature reserve) = moderate/low risk	Very low risk to low risk	Minor to moderate beneficial (Y)

Area ref	Main baseline risk	Main post construction risk	Post construction effect and significance (Yes or No)
25-08, 25-17, 25-18, 25-64, 25-78, 25-80, 25-82, 25-88, and 25-113 shown on Volume 5: Maps LQ-01-066b to LQ-01-068a (CSM group B sites)	Potential impact on human health on-site (long term) = moderate/low risk	Very low risk to low risk	Negligible to moderate beneficial (Y)
	Potential impact on human health adjacent to the site (long-term) =low risk	Very low risk to low risk	Negligible to minor beneficial (N)
	Potential impact on groundwater quality = moderate/low risk	Very low risk to low risk	Minor to moderate beneficial (Y)
	Potential impact on surface water quality = moderate/low risk	Very low risk to low risk	Minor to moderate beneficial (Y)
	Potential impact on ecological receptors (Park Hall nature reserve) = low risk	Very low risk	Minor beneficial (N)
25-11, 25-12, 25-13, 25-15, 25-86, 25-89, 25-117, 25-119, 25-120, 25-125, 25-126 and 25-136 shown on Volume 5: Maps LQ-01-67 and LQ-01-068a (CSM group C sites)	Potential impact on human health on-site (long term) = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on human health adjacent to the site (long-term) = low risk	Low risk	Negligible (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on property receptors (buildings, foundations, and services) = low risk	Moderate/low risk	Negligible (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = moderate/low risk	Low risk	Negligible (N)
25-04, 25-05, 25-10, 25-23, 25-25, 25-62, 25-63, 25-67, 25-84, 25-87, 25-114 and 25-122 shown on Volume 5:	Potential impact on human health on-site (long term) =	Moderate/low risk	Negligible (N)

Area ref	Main baseline risk	Main post construction risk	Post construction effect and significance (Yes or No)
Maps LQ-01-67 and LQ-01-068a (CSM group D Sites)(2)	moderate/low risk		
	Potential impact on human health adjacent to the site (long-term) = low risk	Low risk	Negligible (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = low risk	Low risk	Negligible (N)
25-04, 25-06, 25-80, 25-82, 25-86, 25-88, 25-92, 25-130, 25-134, 25-135, and 25-136 shown on Volume 5: Map LQ-01-067 (Site specific CSM: River Tame realignment through Park Hall nature reserve and flood compensation)	Potential impact on human health on-site (long term) = low risk	Low risk	Negligible (N)
	Potential impact on human health adjacent to the site (long-term) = very low risk	Very Low risk	Negligible (N)
	Potential impact on groundwater quality = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on surface water quality = moderate/low risk	Moderate/low risk	Negligible (N)
	Potential impact on property receptors (buildings, foundations, and services) = low risk	Low risk	Negligible (N)
	Potential impact on ecological receptors (Park Hall nature reserve) = low risk	Low risk	Negligible (N)
25-06, 25-08, 25-11, 25-12, 25-14, 25-15, 25-16, 25-17, 25-18, 25-82, 25-84, 25-88, 25-113 shown on Volume 5: Map LQ-01-067 (Site specific CSM: eastern tunnel portal and approach)	Potential impact on human health on-site (long term) = moderate/low risk	Very low risk to low risk	Negligible to moderate beneficial (Y)
	Potential impact on human health adjacent to the site (long-term) = low risk	Very low risk to low risk	Negligible to minor beneficial (N)
	Potential impact on groundwater quality = moderate/low risk	Very low to low risk	Minor to moderate beneficial (Y)

Area ref	Main baseline risk	Main post construction risk	Post construction effect and significance (Yes or No)
	Potential impact on surface water quality = moderate/low risk	Very low to low risk	Minor to moderate beneficial (Y)
	Potential impact on property receptors (buildings, foundations, and services) = moderate/low risk	Very low to low risk	Minor to moderate beneficial (Y)
	Potential impact on ecological receptors (Park Hall nature reserve) = moderate/low risk	Very low to low risk	Minor to moderate beneficial (Y)

8.4.21 The magnitude of the permanent effects and their significance has been determined by calculating the change in risk between the main baseline risk (present risk under current conditions) 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 deemed to remain as moderate. This will be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside of the construction boundary. Table 13 shows that the Proposed Scheme results in either a reduction or no change in the level of risk already existing at each site for both on site and off site receptors.

8.4.22 Table 13 indicates that, where remediation is carried out on sites identified within the land required to construct the Proposed Scheme (CSM Groups A and B, the River Tame realignment CSM and the eastern tunnel portal CSM), there will in most instances, be overall minor to moderate beneficial impacts. Where potentially contaminated sites have been identified outside of the land required for the Proposed Scheme (CSM Groups C and D, the River Tame realignment CSM and western tunnel portal CSM) these will not be targeted specifically for remediation. Therefore, the residual post-construction effect on these sites is expected to be the same as that defined for the baseline.

8.4.23 Depending on the type of remediation undertaken, the beneficial effect for the landfill sites is most likely to be an improvement in groundwater quality or the severance of a gas migration pathway. The route will cut into the Castle Bromwich Waste Treatment Site landfill on the approach to the Bromford tunnel at the east portal, with a further deeper cut to approximately 17m below current ground level into the Tameside Drive-Langley Drive landfill. Consequently, earthworks will be likely to include excavation and remediation of landfill material during construction and possibly installation of gas and or leachate control systems to prevent ingress affecting the Proposed Scheme and to control migration pathways external to the construction works where such pathways may have been affected by construction.

8.4.24 Additional site-specific remediation measures will be developed at the detailed design stage if required. These measures will ensure that risks to people and property from existing contaminated land, will be controlled to an acceptable level.

8.4.25 No permanent cumulative effects have been identified for this section of the route.

Mining/mineral sites

8.4.26 There are no current mining/mineral sites identified within the study area or designations for any future mining activities.

Geo-conservation resources

8.4.27 No geo-conservation areas such as SSSI or LGS are present in the study area.

Other mitigation measures

8.4.28 At this stage, no additional mitigation measures are considered necessary to mitigate risks from land contamination at construction phase beyond those set out in the draft CoCP and instigated as part of required remediation strategies. These strategies will be determined at the detailed design stage for each specific site remediation proposal.

Summary of likely significant residual effects

8.4.29 No likely residual significant adverse effects are anticipated with the application of the mitigation measures set out.

8.4.30 Residual significant beneficial effects as a result of remediation during construction will occur at potentially contaminated sites such as Castle Bromwich Waste Treatment Site landfill and Castle Bromwich Business Park.

8.5 Effects arising from operation

8.5.1 Users of the Proposed Scheme (i.e. rail passengers), whilst within trains, will at all routine times be within a controlled environment and have, therefore, been scoped out of the assessment.

Avoidance and mitigation measures

8.5.2 Maintenance and operation of the Proposed Scheme will be in accordance with environmental legislation and good practice. Spillage and pollution response procedures similar to those outlined in the CoCP will be established for all high risk activities and employees will be trained in responding to such incidents.

Assessment of impacts and effects

8.5.3 There is one auto-transformer station located in Castle Bromwich, just east of the Tameside Drive civic amenity site. An auto-transformer station can, in principle, be a source of contamination through accidental discharge or leaks of coolants. However, the proposed auto-transformer station, in common with other modern substations, will use secondary containment appropriate to the level of risk.

8.5.4 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.

8.5.5 It is unlikely that there will be any cumulative effects on land quality receptors because of the environmental controls that will be placed on operational procedures.

Other mitigation measures

8.5.6 There may be on-going monitoring requirements following remediation works carried out during construction. Such monitoring, for example monitoring of groundwater quality or ground gas, could extend into the operational phase of the Proposed Scheme.

Summary of likely significant residual effects

8.5.7 No residual significant effects are anticipated associated with the operation of the Proposed Scheme.

9 Landscape and visual assessment

9.1 Introduction

9.1.1 This section reports the assessment of the likely significant landscape and visual effects. It starts by summarising the current conditions found within and around the Proposed Scheme and goes on to describe the significant effects that will arise during construction and operation on landscape character areas (LCAs) and visual receptors.

9.1.2 In this section, the operational assessment includes not just to the running of the trains but also the presence of the new permanent infrastructure associated with the Proposed Scheme.

9.1.3 Principal landscape and visual issues in the area include:

- temporary effects to LCAs and visual receptors during construction arising from the presence of activity associated with construction (vehicles, fencing enclosure, compounds and site offices (B4118 Water Orton Road overbridge satellite compound, River Tame viaduct satellite compound, Plants Brook underbridge satellite compound, Dunlop Carrier Channel culvert satellite compound, Castle Bromwich auto-transformer station satellite compound, Bromford tunnel east portal (west) satellite compound, Bromford tunnel east portal building satellite compound, cranes and plant equipment), demolition, removal of existing vegetation and severance of agricultural land; and
- permanent landscape and visual effects during operation arising from the presence of new engineered landforms cutting across the existing landscape, a new River Tame viaduct, realignment of the River Tame, highway infrastructure, balancing ponds, overhead line equipment and regular passing of high speed trains. Many permanent effects will reduce over time as planting established as part of the Proposed Scheme matures.

9.1.4 A separate but related assessment of effects on the setting of heritage assets is included in Cultural heritage (Section 6). Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in Volume 5: Appendix LV-001-025 which comprises the following:

- Part 1 Engagement with technical stakeholders;
- Part 2 Environmental baseline report;
- Part 3 Assessment matrices; and
- Part 4 Schedule of non-significant effects.

9.1.5 The extent of the landscape and visual study area, the distribution of visual receptor viewpoints and the location of verifiable photomontages have been discussed with Birmingham City Council (BCC) and Solihull Metropolitan Borough Council (SMBC). Summer field surveys, including photographic studies of LCAs and visual assessment of viewpoints, were undertaken between May and October 2012 and between May and June 2013. Winter surveys were undertaken between January 2013 and February 2013.

9.2 Scope, assumptions and limitations

9.2.1 The assessment scope, key assumptions and limitations for the landscape and visual assessment are set out in Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix: CT-001-000/2). This report follows the standard assessment methodology.

9.2.2 The study area has been informed by the construction and operational phase zones of theoretical visibility (ZTV), which are shown on Volume 5: Maps LV-07-098b to LV-07-100a and LV-08-098b to LV-08-100a. The ZTV has been produced in line with the methodology described in the SMR (Volume 5: Appendix CT-001-000/1), and is an indication of the theoretical visibility of the Proposed Scheme. In some locations, extensive vegetation cover will mean the actual visibility is substantially less than that shown in the ZTV. Tall construction plant (e.g. cranes and piling rigs) are excluded from the ZTV for the construction phase and overhead line equipment is excluded from the ZTV for the operational phase, but these are described and taken in to account in the assessment of effects on landscape character areas and visual receptors.

Limitations

9.2.3 During the baseline survey there were some areas which were inaccessible (such as private land, commercial premises and residential buildings). In these instances, professional judgement and three dimensional modelling has been used to approximate the likely views from these locations.

9.3 Environmental baseline

Existing baseline

Landscape baseline

9.3.1 A broad valley crosses the area from east to west. In the east, the River Tame (Volume 5: Maps LV-02-098b, H10 to LV-02-100a, F9) meanders into the Park Hall nature reserve then straight through the vegetated floodplain (centred on Volume 5: Map LV-02-098b, F4) alongside road and rail infrastructure, sewage treatment works and overhead power line and pylons. On the approach to Birmingham city centre, the river is hidden beneath the M6 corridor (Volume 5: Maps LV-02-098b, F9 to Map LV-02-100a, F9) which is elevated above swathes of light industrial and commercial estates.

9.3.2 As the valley sides become steeper, the scale of development within the valley bottom increases. Residential tower blocks occur to the immediate north and south of the M6, whereas in the east of the study area, residential areas are generally two storeys in height. The density of residential areas is broken up by open space including public parks and Park Hall nature reserve, which also forms a buffer from industrial and commercial development.

9.3.3 Within Castle Bromwich Conservation Area (centred on Volume 5: Map LV-02-099, D8), there is a cluster of heritage receptors, including the Grade I listed Castle Bromwich Hall and Church of St. Mary and St. Margaret (Volume 5: Map LV-02-099, D8) and one scheduled monument: the remains of a motte and bailey castle at Castle

Bromwich (Volume 5: Map LV-02-099, D7). Prominent transport features within the valley landscape comprise the M6, the A452 Chester Road (Volume 5: Maps LV-02-098b, E10 to LV-02-099, J5), A47 Fort Parkway (Volume 5: Maps LV-02-099, G7 to LV-02-100a, F6), A4097/A38 Kingsbury Road (Volume 5: Maps LV-02-098b, J4 to LV-02-100a, I2), and the Birmingham and Derby line (Volume 5: Maps LV-02-098b, G10 to LV-02-100a, F9).

9.3.4 Part of the study area falls within the Arden (No. 97)[46] Natural England National Character Area, however, the majority of the study area is urban in character and therefore not covered by the national landscape character assessment. Farmland and former wood-pasture are found to the south and east of Birmingham and part of the West Midlands conurbation, the latter of which forms the setting of the study area. Key characteristics relevant to the study area include complex and contrasting settlement patterns, major transport corridors such as the M6 and M42, and the presence of ancient woodlands.

9.3.5 Descriptions of all LCAs are provided in Volume 5: Appendix LV-001-025. For the purposes of this assessment the study area has been sub-divided into 23 discrete LCAs, four of which are most likely to be significantly affected. A summary of these four LCAs is provided below. The LCAs are shown on Volume 5: Maps LV-02-098b to LV-02-100a.

Cole Valley Landscape Character Area

9.3.6 The majority of this LCA is located within the adjacent Coleshill Junction area (CFA19) with just the western extent located in CFA25 between the M6 and Water Orton Road. The LCA is characterised by contrasting land uses of agriculture, residences and industry across former parkland. The landform of the LCA is a broad valley with areas of gently undulating terrain. Major transport routes and infrastructure elements heavily fragment the agricultural character of the LCA. The vegetation along the transport corridors and the field boundaries appear to be relatively well maintained.

9.3.7 The LCA is designated green belt and is therefore valued at a regional level although the transport routes and associated street lighting result in a low tranquillity. Due to the fair condition, low tranquillity and regional value the sensitivity of the LCA is considered to be medium. For the full baseline description of this LCA refer to Coleshill Junction (CFA19) Volume 5: Appendix LV-01-019.

River Tame Floodplain Landscape Character Area

9.3.8 The Park Hall nature reserve is an area of green within the wide valley of the meandering River Tame. This LCA forms an important transport corridor including the M6 and the A452 and the Birmingham and Derby line. Ancient woodland is also found within this LCA. Overhead power lines and pylons cross the landscape and together with transport infrastructure reduce tranquillity locally. The overall landscape condition is fair as the transport corridors are well maintained and Park Hall nature reserve is a managed space. The designation of Park Hall nature reserve as green belt

[46] Natural England (2012). National Character Area profile: 97. Arden. Natural England.

suggests it is valued at a regional level. Therefore, this area has a high sensitivity to change.

Farnborough Road Paddock and Open Space Landscape Character Area

9.3.9 A multi-functional, recreational open space and nature conservation area lies between the residential area of Castle Vale and the Birmingham and Derby line. Isolated trees within the open grassland and dense clusters of trees within the nature conservation area provide a sense of remoteness and tranquillity and a visual buffer to the railway. The overall landscape condition is fair as the open space appears to be maintained relative to its function and boundary fences are generally in good condition but with some signs of disrepair. It is valued at a local level and by residents living within the area, using the open spaces for recreation. Therefore, this area has a medium sensitivity to change.

Castle Bromwich Business Park Landscape Character Area

9.3.10 Medium-scale commercial and industrial units, a small, local authority designated Gypsy and Traveller site (not publically accessible), overhead power lines and pylons and a hotel and restaurant are located to the immediate north of the M6 viaduct and River Tame. Although there is tree cover in parts of the LCA providing a degree of enclosure from the M6 viaduct, the industrial land use combined with the visual presence of stationery vehicles reduces tranquillity. The overall landscape condition is poor resulting from the quality of the appearance of eastern areas of Castle Bromwich Business Park, with litter and damage to boundaries. This LCA has limited landscape value due to the industrial land use and the lack of public realm. Therefore, this area has a low sensitivity to change.

Washwood Heath Rail Corridor Landscape Character Area

9.3.11 The majority of this LCA is located within CFA26 with just the eastern extent located in CFA25 between the M6 and the Birmingham to Derby line. This predominantly industrial area follows the railway corridor from Washwood Heath in the east to meet the Digbeth Branch Canal as it approaches the city centre. The Birmingham and Derby line, associated infrastructure and sidings, and large scale warehouses are surrounded by residential areas on the valley sides to the south. There is a high level of vacant land within the Washwood Heath depot. Vegetation is limited, but semi-native and ornamental shrub planting and tree cover is present around the more recent business park units and self-set shrubs and trees are common along boundaries of older industrial units and within the railway corridor. The overall landscape condition is poor, with a low level of tranquillity and limited landscape value due to its predominantly industrial land use. Therefore, this area has a low sensitivity to change. For the full baseline description of this LCA refer to Washwood Heath to Curzon Street (CFA26) Volume 5: Appendix LV-01-026.

Visual baseline

9.3.12 Descriptions of the identified representative viewpoints are provided in Volume 5: Appendix LV-001-025. 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 which are shown in Volume 5: Maps LV-07-098b to

LV-07-100a and LV-08-098b to LV-08-100a. In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in the area – 2: Residential, 3: Recreational and 4: Transport

9.3.13 No protected views have been identified within the study area.

9.3.14 Residential receptors have a high sensitivity to change and are generally located on the edges of settlements within Castle Vale and Castle Bromwich. In the east of the study area, views are typically across an area of open space with clusters of intervening vegetation, and contain glimpses of road or rail infrastructure and overhead power lines and pylons set within the valley bottom. Moving westwards, the amount of open space reduces and views are typically of rail infrastructure and associated vegetation set against a light industrial backdrop. The extent of views can be limited locally by the amount of tree cover, particularly to the south of the M6, although this varies seasonally.

9.3.15 Recreational receptors, also with a high sensitivity to change, are located along Public Rights of Way (PRoW), footpaths and within areas of open space throughout the study area. The viewpoints are typically located in urban fringe locations, predominantly with recreational open space and tree planting forming the foreground with road or rail infrastructure a prominent feature of the middle ground and background.

9.3.16 Viewpoints of people using public transport have a low sensitivity to change and for this area are located on the Birmingham and Derby line.

Future baseline

9.3.17 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. No committed developments will be out of keeping with the existing baseline landscape character and no new visual receptors will be introduced as a result of the Proposed Scheme. Therefore, there will be no cumulative effects.

Operation (year 1 – 2026)

9.3.18 No committed developments have been identified in this local area that will materially alter the baseline conditions in 2026. Therefore, there will not be any cumulative operational effects.

9.4 Temporary effects arising during construction

9.4.1 As is commonplace with major infrastructure works, the scale of the construction activities means that works will be visible in many locations and will have the potential to give rise to significant temporary effects which cannot be mitigated practicably. Such effects 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 civil engineering works will take place, including establishment of compounds, main earthworks and structure works. The effects associated with the peak construction phase in this CFA will generally be considered to be long term given the construction programme (see Section 2.3). Overall, civil

engineering works in this CFA will be undertaken between early 2017 and the early 2022. The Bromford tunnel east portal (east) main compound will be in place for approximately five years and three months. Satellite compounds would be in place for between approximately three years and three months and five years and three months. The civil engineering works at most individual sites along the route in this CFA would occur for a period of between approximately six months and two years, with the Bromford tunnel taking just over two years. Effects during other phases of works are likely to be lesser due to less construction equipment being required at the time and a reduced intensity of construction activity.

9.4.2 The construction works that have been taken into account in determining the effects on landscape and visual receptors include:

- construction of Water Orton cutting through B4118 Birmingham Road;
- construction of retaining walls and bridge to elevate B4118 Birmingham Road over the route;
- construction of the River Tame viaduct through Park Hall nature reserve;
- construction of the retaining structures, bridges (Plants Brook underbridge and Dunlop Carrier Channel culvert) and embankments adjacent to the Birmingham and Derby line;
- realignment of the River Tame through Park Hall nature reserve;
- creation of flood storage areas in Park Hall nature reserve;
- diversion of underground Esso fuel pipeline;
- construction of Castle Bromwich auto-transformer station;
- construction of Bromford tunnel eastern portal;
- demolition of buildings in Castle Bromwich Business Park;
- demolition of buildings and structures at Washwood Heath depot;
- construction of buildings and infrastructure (including balancing ponds and auto-transformer station) associated with Washwood Heath depot;
- removal and relocation of existing pylons and overhead power lines; and
- general earthworks along the Proposed Scheme requiring cut/fill, vegetation removal, modification of landform and the presence of construction plant.

Avoidance and mitigation measures

9.4.3 Measures that have been incorporated into the draft CoCP to avoid or reduce landscape and visual effects during construction include the following (see Volume 5: Appendix CT-003-000):

- maximising the retention and protection of existing trees and vegetation where possible along the interface between Farnborough Road Park and Park

Hall nature reserve, and to the south of Cadbury Drive (draft CoCP, Section 12);

- methods to monitor and manage flood risk and other extreme weather events which may affect landscape resources during construction (draft CoCP, Section 16);
- use of well-maintained hoardings and fencing generally along the length of the construction boundary, and specifically in the vicinity of the proposed Bromford tunnel portal works – a 3.6m railway protection barrier with solid cladding to the north and 2.4m high solid site hoarding to the south (draft CoCP, Section 5);
- designing lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses in the vicinity of the proposed Bromford tunnel east portal works (draft CoCP, Section 5);
- replacement of any trees intended to be retained which may be accidentally felled or die as a consequence of construction works (draft CoCP, Section 12); and
- appropriate maintenance of planting and seeding works and implementation of management measures, to continue through the construction period as landscape works are completed, in areas located to the south east of B4118 Birmingham Road, within Park Hall nature reserve and along the interface with Farnborough Road Park. (draft CoCP, Section 12).

9.4.4 These measures have been taken account of in the assessment of the construction effects below.

Assessment of temporary impacts and effects

9.4.5 The most apparent changes to landscape character and viewpoints during construction will relate to the temporary presence of construction plant and the removal of existing landscape elements, such as trees and hedges. Changes will be most notable in and around Park Hall nature reserve, the Birmingham and Derby line and Castle Bromwich Business Park. The height of the construction plant and emerging River Tame viaduct and the close proximity of construction activities to viewpoints, coupled with the absence of intervening screening (apart from the site hoardings) will result in significant visual effects during construction. The topography in certain locations and the retention of intervening vegetation will partially screen low level construction activity.

Landscape assessment

9.4.6 The following section describes the likely significant effects on LCAs during construction. All LCAs within the study area considered to experience a non-significant effect (minor adverse or negligible) are described in Volume 5: Appendix LV-001-025.

Cole Valley Landscape Character Area

9.4.7 The majority of this LCA is located within Coleshill Junction (CFA19) with just the western extent located in CFA25 between the M6 and Water Orton Road. For the full assessment of effects on this LCA refer to Coleshill Junction (CFA19) Volume 2. The scale and extent of construction activity will reduce the tranquillity locally and the partial loss and alteration to the agricultural character of the area, together with the removal of key characteristic vegetation, are considered to result in a medium magnitude of change. The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect.

River Tame Floodplain Landscape Character Area

9.4.8 Construction activities will include the temporary realignment of B4118 Birmingham Road over the Proposed Scheme, the partial removal of ancient woodland within Park Hall nature reserve, the partial removal of Langley Hill Wood and Parkhill Wood and areas of vegetation to the north of the railway, the construction of the 18m deep Water Orton cutting adjacent to the B4118 Birmingham Road, the realignment of the River Tame, the construction of bridges and viaduct including the River Tame viaduct, Plants Brook underbridge and Dunlop Carrier Channel culvert, alterations to an existing bridge structure over the River Tame, construction of a balancing pond and replacement floodplain storage areas, and utility diversions including the relocation of pylons and overhead power lines.

9.4.9 The realignment of the River Tame will result in a large loss of grassland, ponds and wetland habitats and severance of land within Park Hall nature reserve. The construction of the Proposed Scheme will also result in the partial removal of ancient woodland at Parkhall Wood and also mature vegetation to the north of the Birmingham and Derby line. The character of the area will also be affected by the presence of large scale earthworks which will introduce temporary stockpiles into the landscape and construction plant by introducing elements that will be discordant with the rural setting.

9.4.10 Construction will temporarily introduce a range of intensive construction activities and vehicles, fencing, satellite compounds (River Tame viaduct satellite compound, Plants Brook underbridge satellite compound and Dunlop Carrier Channel culvert satellite compound) and associated lighting reducing tranquillity. The magnitude of change is, therefore, considered to be high.

9.4.11 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect.

Farnborough Road Paddock and Open Space Landscape Character Area

9.4.12 Part of the temporary working area is within this LCA, incorporating Plants Brook and an area of open space to the rear of houses along Blenheim Way. Vegetation to the rear of residential properties along Blenheim Way will be removed to enable the construction of a balancing pond and a site access point along Javelin Avenue.

9.4.13 The setting of the Farnborough Road Paddock and Open Space LCA will be indirectly impacted by construction activity within the neighbouring River Tame Floodplain. Adverse impacts associated with this LCA include the presence and movement of

cranes, the removal of areas of woodland, the addition of temporary features, such as satellite compounds (River Tame viaduct satellite compound, Plants Brook underbridge satellite compound and Dunlop Carrier Channel culvert satellite compound) and associated lighting, and fencing, utility diversions, including the relocation of pylons and overhead power lines, the construction of the River Tame viaduct, Plants Brook underbridge and Dunlop Carrier Channel culvert and the construction of the Proposed Scheme on embankment.

9.4.14 Although construction will temporarily introduce fencing, hoardings and construction traffic into a localised area of the LCA, construction traffic along Javelin Avenue and Farnborough Road will reduce the tranquillity within the wider LCA due to increased traffic on local roads. Vegetation losses at the interface with River Tame Floodplain LCA will reduce enclosure. The widespread construction activity within the adjacent LCA will further contribute to a reduction in tranquillity from medium to low.

9.4.15 The magnitude of change is considered to be high.

9.4.16 The high magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect.

Castle Bromwich Business Park Landscape Character Area

9.4.17 Construction activities will include the construction of Water Orton cutting for the Proposed Scheme as it descends to the Bromford tunnel, the partial removal of vegetation to the south of the Birmingham and Derby line, the demolition of industrial buildings, the construction of Bromford tunnel and portal approximately 250m east of the A452 Chester Road, the construction of Castle Bromwich auto-transformer station and utilities diversions to the east of A452 Chester Road bridge within the business park.

9.4.18 Construction will temporarily introduce vehicles, fencing enclosure, construction compounds (Bromford tunnel east portal (east) main compound, Bromford tunnel east portal (west) satellite compound and Castle Bromwich auto-transformer station satellite compound), cranes and other plant equipment and construction activity into the LCA. In addition, there will be increased traffic on Tameside Drive, Orton Way and the A452 Chester Road due to construction vehicles. The tranquillity of the LCA will reduce further, but will remain low during construction. Overall, the magnitude of change is considered to be medium.

9.4.19 The medium magnitude of change assessed alongside the low sensitivity of the character area, will result in a moderate adverse effect.

Washwood Heath Rail Corridor Landscape Character Area

9.4.20 The majority of this LCA is located within Washwood Heath to Curzon Street (CFA26) with just the eastern extent located in CFA25 between the M6 and the Birmingham to Derby line. For the full assessment of effects on this LCA refer to Washwood Heath to Curzon Street (CFA26) Volume 2. There will be impacts on numerous components of the LCA and a discernible reduction in tranquillity, due to the construction activity. The main changes to character will relate to the presence of cranes and demolition of prominent buildings and structures. Some vegetation occurring along river and transport corridors will be lost to accommodate the Proposed Scheme. Therefore, the

magnitude of change is considered to be medium. The medium magnitude of change, assessed alongside the low sensitivity of the character area, will result in a moderate adverse effect.

Visual assessment

9.4.21 The following section describes the likely significant effects on visual receptors during construction. The construction assessment has been undertaken during winter, 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, will be in leaf. Representative viewpoints within the study area considered to experience a non-significant effect (minor adverse or negligible) are described in Volume 5: Appendix LV-001-025.

9.4.22 The number identifies the viewpoint locations which are shown on Volume 5: Maps LV-07-098b to LV-07-100a. In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area i.e. 2: Residential, 3: Recreational and 4: Transport.

9.4.23 Where a viewpoint may represent multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with a lower sensitivity may be lower than those reported.

Viewpoint 371.2.001: View west from the B4118 Birmingham Road

9.4.24 The construction of the proposed B4118 Water Orton Road overbridge and associated clearance of existing vegetation will be visible approximately 200m in the background of the view. Construction plant and cranes constructing the River Tame viaduct within Park Hall nature reserve, together with the activity associated with the removal and relocation of the pylons 10m to 50m south of their existing position in a more elevated location will be visible above the vegetation in the background. Construction activities will introduce a degree of urbanisation that will conflict with the current rural setting. Therefore, the magnitude of change is considered to be medium.

9.4.25 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 373.3.001: View south from Castle Vale Nature Conservation Area (Farnborough Fields)

9.4.26 The construction equipment and cranes that will be required to build the River Tame viaduct, up to 10m above existing ground levels, together with the re-positioning of existing pylons and overhead power lines located approximately 10m to 50m south of their existing position in a more elevated location will be visible cutting across the middle ground of the view passing from Parkhall Wood into Park Hall nature reserve and the River Tame valley, approximately 300m from the receptor. The works to divert the River Tame will be obscured from view by intervening vegetation, but the viaduct will be approximately 10m higher than existing ground level and the associated overhead line equipment will be visible through and above the tops of intervening vegetation. Therefore, the magnitude of change is considered to be medium.

9.4.27 The view of the Proposed Scheme during construction is illustrated in the photomontage shown in Volume 2: Figure LV-01-214.

9.4.28 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

9.4.29 Construction during winter will potentially require lighting to construction sites which will illuminate parts of Park Hall nature reserve that are currently dark. However, this will be viewed in context of occasionally floodlit sports pitches and the back-drop of the M6 and the A452 on the horizon and is considered to be non-significant and there will be no magnitude of change.

Viewpoint 373.2.002: View southeast from Javelin Avenue across open space

9.4.30 The construction of the proposed B4118 Water Orton Road overbridge, the formation of the Water Orton cutting and the associated clearance of existing vegetation will be visible on the skyline in the background of the view. The removal and relocation of pylons and overhead power lines approximately 10m to 50m southwards in a more elevated location and the construction equipment and cranes that will be required to construct the River Tame viaduct and Langley Wood embankment, up to 10m above existing ground levels, including a retaining wall on its northern side through Park Hall nature reserve will be visible through and above the existing trees and vegetation in the middle ground, approximately 300m from the receptor. Therefore, the magnitude of change is considered to be medium.

9.4.31 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 373.3.003: View south from the north-western boundary of Farnborough Road Park

9.4.32 The construction of the Proposed Scheme will be visible through and above the intervening vegetation in the middle ground alongside Plants Brook and the existing Birmingham and Derby line. The re-positioning of pylons and overhead power lines approximately 10m to 50m southwards in a more elevated location and the construction equipment and cranes that will be required to construct the River Tame viaduct and Langley Wood embankment, up to 10m above existing ground levels, including a retaining wall on its northern side through Park Hall nature reserve will be visible through and over the tops of the existing trees and vegetation in the middle ground, approximately 400m from the receptor. Therefore, the magnitude of change is considered to be medium.

9.4.33 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 373.2.004: View southeast from Farnborough Road near Rawlins Croft

9.4.34 The re-positioning of pylons and overhead power lines, approximately 10m to 50m southwards in a more elevated location, will be visible against the skyline and wooded background to the view. The construction of the Langley Wood embankment up to

9m above the adjacent ground levels and the existing Birmingham and Derby line will be visible through and over the existing trees and vegetation in the middle ground, approximately 500m from the receptor.

9.4.35 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 373.4.007: View from the Birmingham and Derby train across Park Hall nature reserve

9.4.36 There will be sequential views from passing trains of construction activities in the immediate foreground. This will include construction compounds, construction of the River Tame viaduct and Langley Wood embankment, the realignment of the River Tame, the excavation of the flood storage areas, the re-positioning of existing pylons and overhead power lines and the removal of vegetation across the embankment to the M6. The construction activities will result in a substantial change to the views across the Park Hall nature reserve and floodplain. Therefore, the magnitude of change is considered to be high.

9.4.37 The high magnitude of change assessed alongside the low sensitivity of the receptor will result in a moderate adverse effect.

Viewpoints 375.2.001: Indirect views / direct views south from Cadbury Drive and 375.2.002: Indirect views / direct views south from Clayton Walk off Cadbury Drive

9.4.38 Views of construction activities will be filtered by the intervening vegetation in the foreground of the view. However, there will be views of the demolition of buildings on the Castle Bromwich Business Park, the construction of a Bromford tunnel east portal (west) satellite compound and the construction of the tunnel portal approximately 80m from the receptor. There will also be some removal of vegetation beyond the existing Birmingham and Derby line to facilitate the construction of the Proposed Scheme, thereby opening up views of demolition and construction within Castle Bromwich Business Park. Therefore, the magnitude of change is considered to be medium.

9.4.39 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 375.2.004: View south from Javelin Avenue in front of residential properties

9.4.40 The existing overhead power lines and pylons in the middle ground will be removed and replaced by pylons located approximately 10m and 50m to the south of their present positions in a more elevated position. The River Tame will be diverted to a channel located further south within Park Hall nature reserve. The River Tame viaduct and Langley Wood embankment with a retaining wall will be constructed across the nature reserve from Parkhall Wood in the east to the Birmingham and Derby line, approximately 150m from the receptor.

9.4.41 Existing vegetation in the foreground and middle ground will be retained, effectively screening low level construction activities. Cranes and larger plant will occasionally be

visible above the intervening vegetation, especially those used in the construction of the River Tame viaduct and Langley Wood embankment with a retaining wall. Therefore, the magnitude of change is considered to be medium.

9.4.42 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Viewpoint 375.2.006: View southeast from Farnborough Road across the public open space

9.4.43 The construction of the proposed B4118 Water Orton Road overbridge, the formation of the Water Orton cutting for the Proposed Scheme and associated clearance of existing vegetation will be visible on the skyline in the background of the view. The re-positioning of pylons and the construction of the River Tame viaduct through Park Hall nature reserve will be visible through and above the existing trees and vegetation in the middle ground, approximately 450m from the receptor. Therefore, the magnitude of change is considered to be medium.

9.4.44 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect.

Cumulative effects

9.4.45 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. These are termed 'committed developments' and will form part of the baseline for the construction of the Proposed Scheme. The developments have been considered and have not been found to give rise to significant cumulative effects.

Other mitigation measures

9.4.46 Other mitigation measures to further reduce the significant effects described above will be considered during the detailed design stage, including consideration of where planting can be established early in the construction programme. However, not all landscape and visual effects can be practicably mitigated due to the visibility of construction activity and the sensitivity of surrounding receptors. Therefore, no other mitigation measures are considered practicable during construction.

Summary of likely significant residual effects

9.4.47 These effects will be temporary and reversible in nature lasting only for the duration of the construction works. Any residual effects will generally arise from the widespread presence of construction activity and construction plant within the landscape and viewed from surrounding residential receptors and main roads within the study area. Further consideration will be given to these effects through the application of the controls set out in the draft CoCP. Any residual effects will generally arise from the widespread visibility of construction plant and vegetation loss from main roads throughout the study area.

9.5 Permanent effects arising during operation

9.5.1 The specific elements of the Proposed Scheme that have been taken into account in determining the effects on landscape and visual receptors includes:

- the Proposed Scheme, including overhead line equipment and running trains (including headlights and internal carriage lighting at night);
- introduction of four balancing ponds and flood storage areas;
- the permanent relocation of pylons and diversion of overhead power lines;
- introduction of bridges and viaducts including River Tame viaduct, Plants Brook underbridge and Dunlop Carrier Channel culvert;
- introduction of Bromford tunnel east portal and retaining walls; and
- the design, implementation and management of mitigation planting associated the Proposed Scheme.

Avoidance and mitigation measures

9.5.2 The operational assessment of impacts and effects is based on year 1, year 15 and year 60 of the Proposed Scheme. A process of iterative design and assessment has been employed to avoid or reduce adverse effects during the operation of the Proposed Scheme. Measures that have been incorporated into the design of the Proposed Scheme include:

- planting to filter, soften and screen views of the Proposed Scheme in areas located to the south east of B4118 Birmingham Road, within Park Hall nature reserve and along the interface with Farnborough Road Park. Selection of species will take into account possible climate change impacts associated with the quality and availability of water and the potential increase in pests and diseases;
- existing vegetation along the interface between Park Hall nature reserve and Farnborough Road Park and to the south of Cadbury Drive to help filter, soften and screen views of the Proposed Scheme; and
- planting to contribute towards mitigating for the loss of ancient woodland within Park Hall nature reserve.

9.5.3 These measures have been taken account of in the assessment of the operational effects below.

Assessment of impacts and effects

9.5.4 The likely significant effects on the landscape character and viewpoints in operation will arise from new engineered landforms cutting across the existing landscape within Park Hall nature reserve, the introduction of the River Tame viaduct within Park Hall nature reserve of approximately 10m height with associated infrastructure, permanent severance of land within Park Hall nature reserve, the introduction of overhead line equipment, the permanent removal of woodland vegetation beneath repositioned pylons and overhead power lines, large areas of marshy grassland maintained for flood storage and the introduction of regular high speed trains. At a number of locations, views of the Proposed Scheme will be filtered or partially obscured by intervening vegetation and buildings. Furthermore, some effects will reduce over time as planting established as part of the Proposed Scheme matures.

Landscape assessment

9.5.5 This section describes the significant effects on landscape character areas during year 1, year 15 and year 60 of operation. Non-significant effects on landscape character areas are presented in Volume 5: Appendix LV-001-025.

Cole Valley Landscape Character Area

9.5.6 The majority of this LCA is located within Coleshill Junction (CFA19) with just the western extent located in CFA25 between the M6 and Water Orton Road. For the full assessment of effects on this LCA refer to Coleshill Junction (CFA19) Volume 2. Given the context of existing major infrastructure, the presence of the Proposed Scheme through this LCA will not noticeably alter tranquillity. Due to the Proposed Scheme introducing prominent elements that are either largely characteristic of the existing setting but will result in a partial loss to the landscape character, the magnitude of change is considered to be medium in year 1 of operation. The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

River Tame Floodplain Landscape Character Area

9.5.7 The route will enter the LCA at B4118 Birmingham Road, east to west, in Water Orton cutting, to an approximate depth of 18m, before proceeding to the River Tame viaduct for 775m. The route will then continue to follow the route of the Birmingham and Derby line on an embankment. Landscape effects of the Proposed Scheme will include:

- the engineered Water Orton cutting to an approximate depth of 18m from B4118 Birmingham Road through an existing steep scarp slope within Park Hall nature reserve;
- permanent loss of an area of Park Hall ancient woodland and permanent loss of vegetation within parts of Langley Hill Wood, Parkhill Wood and to the north of the Birmingham and Derby line reducing enclosure;
- the realignment of the River Tame within Park Hall nature reserve will permanently alter the route of the river;
- permanent loss of vegetation to facilitate the introduction of a balancing pond to the north of the existing Birmingham and Derby line and flood storage areas, which will reduce the degree of enclosure along the railways;
- relocation of existing pylons to a more prominent position on sloping ground within Parkhill Wood and Langley Hill Wood to the south of the diverted River Tame;
- introduction of the River Tame viaduct, Plants Brook underbridge and Dunlop Carrier Channel culvert; and
- introduction of overhead line equipment, communication masts, signage and trains on embankment, which although already present within the adjacent Birmingham and Derby line corridor, introduces additional infrastructure within a largely rural context.

9.5.8 There will be a localised reduction in tranquillity within Park Hall nature reserve where the route diverts from the existing Birmingham and Derby line. Overall, tranquillity will remain medium.

9.5.9 There are limited opportunities to integrate the Proposed Scheme into the landscape within Park Hall nature reserve due to the requirement to create flood compensation areas and planting restrictions within these proposed areas. Additionally, there are spatial constraints to introduce planting or earthworks between the River Tame viaduct and the existing Birmingham and Derby line. Therefore, due to the changes in the character of the area, the magnitude of change is considered to be medium in year 1 of operation.

9.5.10 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

9.5.11 By year 15 and year 60 of operation, the magnitude of change will remain unchanged.

9.5.12 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect in year 15 and year 60 of operation.

Visual assessment

9.5.13 This section describes the significant effects on visual receptors during year 1, year 15 and year 60 of operation. Non-significant effects on visual receptors are presented in Volume 5: Appendix LV-001-025. For each viewpoint the following assessments have been undertaken:

- effects during winter of year 1 of operation;
- effects during summer of year 1 of operation;
- effects during summer of year 15 of operation; and
- effects during summer of year 60 of operation.

9.5.14 No significant effects at night time arising from additional lighting have been identified.

9.5.15 The number identifies the viewpoint locations which are shown on Volume 5: Maps LV-08-098b to LV-08-100a. In each case, the middle number (xxx.x.xxx) identifies the type of receptor i.e. 2: Residential and 4: Transport.

9.5.16 The view of the Proposed Scheme from viewpoints 373.3.001, 371.2.001 and 373.2.004 (illustrated in the photomontages shown in Volume 2: Figures LV-01-175, LV-01-173, LV-01-174 (operation year 1 winter), and LV-01-264 and LV-01-265 (operation year 15 summer) (Volume 2, CFA25 Map Book) would not be significantly affected due to the presence of intervening screening.

9.5.17 Where a viewpoint may represent multiple types of receptor, the assessment is based on the most sensitive receptors. Effects on other receptor types with a lower sensitivity may be lower than those reported.

Viewpoint 373.4.007: View from the Birmingham and Derby train across Park Hall nature reserve

9.5.18 As trains on the Birmingham and Derby line pass through Park Hall nature reserve, there will be glimpsed views of the River Tame viaduct and Langley Wood embankment with retaining wall on its northern side and the diverted River Tame. In the first year of operation, the reinstated components of the Park Hall nature reserve, together with the changes in landform and river channel, will still be relatively newly formed and immature. Therefore, the magnitude of change is considered to be high.

9.5.19 The high magnitude of change assessed alongside the low sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.20 There will be no change to the assessment during summer.

9.5.21 By year 15 and year 60, operational effects will remain unchanged.

Viewpoint 375.2.004: View south from Javelin Avenue in front of residential properties

9.5.22 The route will be visible through and above the existing vegetation in the middle ground of the view. The River Tame viaduct and Langley Wood embankment with retaining wall on its northern side will be up to 10m above the existing railway and will be prominent in the view, albeit partly screened by intervening existing vegetation. Therefore, the magnitude of change is considered to be medium.

9.5.23 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.24 During summer, mature trees in the middle ground of the view will further obscure views towards the route. Therefore, the magnitude of change is considered to be low, giving rise to a minor adverse effect.

Cumulative effects

9.5.25 Volume 5: Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the operation of the Proposed Scheme.

9.5.26 The proposed developments which are assumed to be completed by year 1 of operation of the Proposed Scheme do not give rise to significant effects due to the negligible change to the future landscape character and the distance from identified and prospective sensitive receptors. Consequently, there is no cumulative effect on LCAs and viewpoints.

Other mitigation measures

9.5.27 The permanent effects of the Proposed Scheme on landscape and visual receptors have been substantially reduced through incorporation of the measures described previously. However, not all landscape and visual effects can be mitigated due to the high visibility of elements of the Proposed Scheme and the sensitivity of the surrounding receptors. Therefore, no other mitigation measures are considered reasonably practicable during operation.

Summary of likely significant residual effects

9.5.28 The permanent effects of the Proposed Scheme on landscape and visual receptors have been substantially reduced through incorporation of avoidance and mitigation measures. The following permanent significant residual effects will remain following year 15 of operation:

- effects on the character of River Tame Floodplain LCA, due to the influence that engineered landforms and the River Tame viaduct will have on the rural landscape, and the limited opportunities to introduce planting to mitigate lost vegetation and integrate the route into the landscape; and
- effects on people travelling on the Birmingham and Derby line across Park Hall nature reserve arising from the visibility of the route and the limited opportunities to introduce planting to screen views opened up by the removal of vegetation.

10 Socio-economics

10.1 Introduction

10.1.1 This section reports the likely significant economic and employment effects during the construction and operation of the Proposed Scheme.

10.1.2 The need for a socio-economic assessment results from the potential for the Proposed Scheme to affect:

- existing businesses and community organisations and thus the amount of local employment;
- local economies, including employment; and
- planned growth and development.

10.1.3 The beneficial and adverse socio-economic effects of the Proposed Scheme are reported at two different levels: route-wide and CFA. Effects on levels of employment are reported at a route-wide level in Volume 3. Localised effects on businesses and observations on potential local economic effects are reported within each CFA report.

Construction

10.1.4 The proposed construction works will have relevance in terms of socio-economics in relation to:

- premises demolished with their occupants and employees needing to relocate to allow for construction of the Proposed Scheme; and
- potential employment opportunities arising from construction in the local area (including in adjacent CFAs).

Operation

10.1.5 The operation of the Proposed Scheme will have relevance in terms of socio-economics in relation to the potential employment opportunities created by new business opportunities.

10.2 Scope, assumptions and limitations

10.2.1 The assessment scope, key assumptions and limitations for the socio-economics assessment are set out in Section 8 of Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (Volume 5: Appendix CT-001-000/2).This report follows the standard assessment methodology.

10.2.2 There have been no variations to the socio-economic assessment methodology from engagement with stakeholders and community organisations.

10.3 Environmental baseline

Existing baseline

Study area description

10.3.1 Section 2 of this report provides a general overview of the area which includes data of specific relevance to socio-economics notably demographic and employment data. The following provides a brief overview in terms of employment, economic structure, labour market, and business premises available within the area[47].

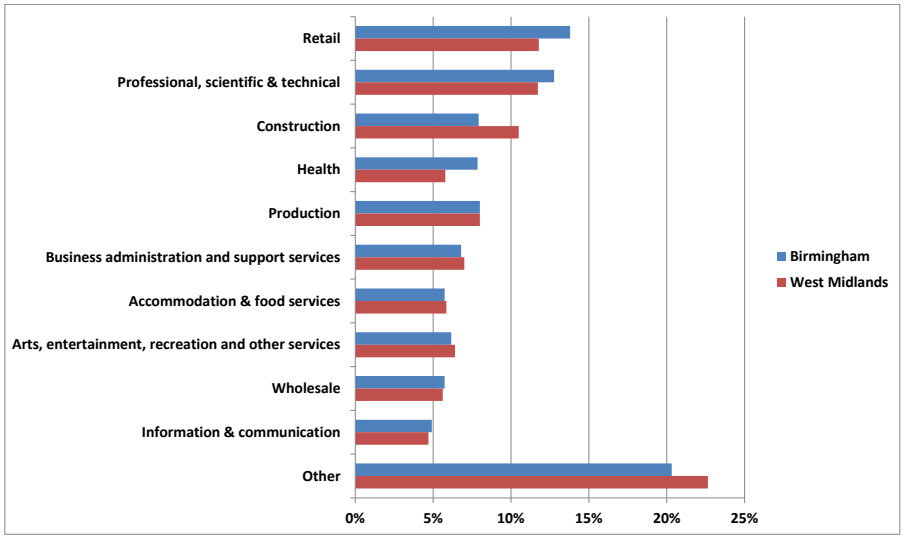
10.3.2 The Castle Bromwich and Bromford areas lie primarily within the area covered by Birmingham City Council (BCC) with the eastern edge of the area being located within the Solihull Metropolitan Borough Council (SMBC) area. Based on the distribution of affected resources, the focus of the environmental baseline is the area covered by BCC. Where possible, baseline data has been gathered on demographic character areas (DCAs)[48] to provide a profile of local communities. Volume 5: Map SE-002-153 shows the location of the DCAs. The area contains three DCAs: Castle Bromwich, Castle Vale and Bromford.

Business and labour market

10.3.3 Within Birmingham, there is a wide spread of business types reflecting a diverse range of commercial activities. The top five sectors in terms of sector share of enterprise activities in Birmingham were retail (14%); professional, scientific and technical (13%); construction (8%); health (8%) and production (8%). This is shown in Figure 6[49]. For comparison within the West Midlands region, professional, scientific and technical and retail jointly accounts for the largest number of businesses (12% each) followed by construction (10%), production (8%) and business administration and support services (7%)[50].

[47] Further information on the socio-economics baseline, with regard to business and labour market profile, within the area is contained in the Volume 5: Appendix SE-001-000.
[48] DCAs have been determined through an understanding of local context and aim to be aligned as closely as possible to groups of lower super output areas (LSOAs).
[49] The Figure presents the proportion of businesses within each business sector in the city but not the proportion of employment by sector.
[50] Office for National Statistics (ONS) (2012). *UK Business: Activity, Size and Location 2011*, ONS, London. Please note 2011 data has been presented to provide an appropriate comparison with 2011 Census data.

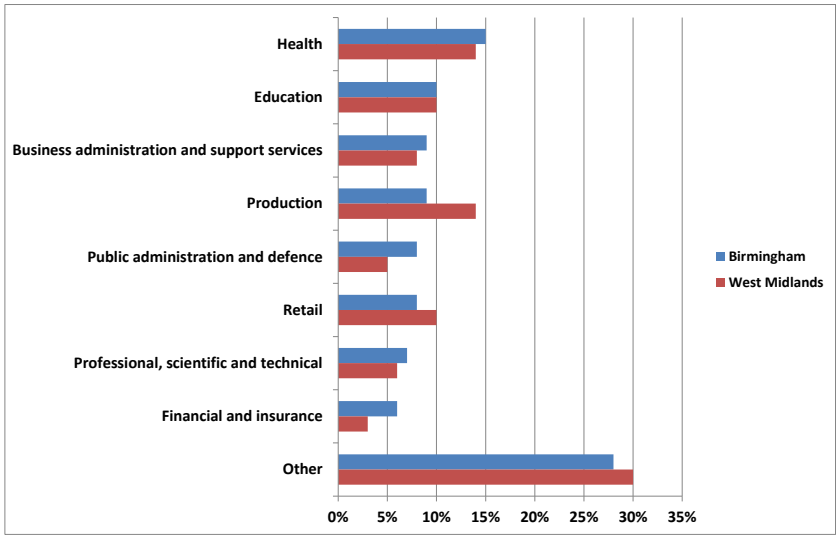
Figure 6: Business sector composition in Birmingham City and the West Midlands[51]



10.3.4 Approximately 470,000 people worked in the BCC area, with 600 working in Castle Bromwich DCA, 900 in Castle Vale DCA and 700 in Bromford DCA[52].

10.3.5 According to the ONS Business Register and Employment Survey 2011, the top five sectors in terms of share of employment in the BCC area are health (15%); education (10%); production (9%); business administration and support services (9%) and retail (8%). These compare with the top five sectors for the West Midlands region which are health (14%), production (14%), education (10%), retail (10%), and business administration and support services (8%). This is shown in Figure 7. By comparison, within the Castle Bromwich DCA the top three sectors of employment were education (32%), construction (31%) and retail (8%), health (31%), retail (30%) and education (15%) in Castle Vale DCA and education (57%); business support services and administration (19%); and health (8%) in Bromford DCA.

Figure 7: Employment by industrial sector in Birmingham City and the West Midlands[53]



[51] "Other" includes: agriculture, forestry and fishing, property, motor trades; transport and storage; finance and insurance; public administration and defence; and education sectors.
[52] ONS (2012). *Business Register and Employment Survey 2011.* ONS, London.
[53] Other' includes construction, wholesale, information and communication, motor trades, property, transport and storage (including postal), accommodation and food services, arts, entertainment, recreation and other services and agriculture, forestry and fishing sectors.

10.3.6 According to the Census 2011[54], the employment rate[55] in the BCC area was 56% (which represents 424,000 people) which is markedly lower than that recorded for both the West Midlands (62%) and England (65%). The employment rate for Castle Bromwich DCA was 67% and 49% for both Castle Vale DCA and Bromford DCA.

10.3.7 In 2011, unemployment in the BCC area was 13% which was higher than for the West Midlands (9%) and England (7%). The unemployment rate for Castle Bromwich DCA was 7%, 17% in Castle Vale DCA and 20% in Bromford DCA[56].

10.3.8 According to the Census 2011, 23% of BCC area residents aged 16 and over were qualified to National Vocational Qualification Level 4 (NVQ4), compared to 23% in the West Midlands and 27% in England, while 28% of residents had no qualifications which was higher than that recorded both for the West Midlands (27%) and England (23%). Qualification levels varied across the DCAs. In Castle Bromwich DCA, 18% of residents had NVQ4 and above compared to 8% in Castle Vale DCA and 11% in Bromford DCA. Whilst in Castle Bromwich DCA, 28% of residents had no qualifications compared to 47% in Castle Vale and 38% in Bromford DCA.

10.3.9 Castle Bromwich DCA has the highest employment rate and lowest unemployment rate of the three DCAs with the same level of residents with no qualifications as Birmingham as a whole. Castle Vale and Bromford DCAs share a higher level of unskilled and lower skilled residents relative to Birmingham as a whole. Public sector employment is an important source of employment opportunity across all three DCAs.

Property

10.3.10 In April 2012, the BCC area recorded a supply of employment land in excess of 215 hectares of which approximately 90 hectares were considered "readily available"[57]. Demand for industrial space has recovered since 2010 primarily related to the activities of Jaguar Land Rover Limited with its sites in Castle Bromwich and Solihull, which has acted as a stimulus for supplier companies to locate close to their key customer. It is, nevertheless, lower than the demand observed prior to the recession in 2008.

10.3.11 Average vacancy rate for all industrial property in the BCC area in July 2013 has been assessed as 10% based on marketed space against known stock [58]. Overall, this suggests relatively good availability of alternative accommodation and that a sufficient supply of new development land for employment use will be available based on post-recession standards of completion.

[54] ONS (2012). *Census 2011*, ONS, London.
[55] The proportion of working age (16-74 years) residents in employment. Employment comprises the proportion of the total resident population who are 'in employment' and includes full-time students who are employed.
[56] Unemployment figures have been rounded to the nearest whole number. DCA unemployment rates are presented for each DCA in this chapter while in Section 2 they are shown in aggregate.
[57] Based on the *Employment Land Study for the Economic Zones and Key Sectors in Birmingham* (2012) published by Birmingham City Council which categorises employment land into Regional Investment Sites; "Best Urban" which are high quality urban sites between 10 and 20 hectares; "Good Urban" sites which are generally greater than 0.4 hectares and "Other urban" which cover average and poor sites below 0.4 hectares. The "other urban" category has not been included in the totals quoted above.
[58] Vacant space is based on marketed space identified from Estates Gazette data (EGi); stock data is taken from information supplied by the Valuation Office (VOA).

Future baseline

Construction (2017)

10.3.12 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. Implementation of all outstanding development consents and land allocations will result in approximately an additional 440 jobs[59] by 2017. The existing composition and numbers of employers, employees and economic sectors in the area are likely to change over time in ways that cannot be accurately forecast.

Operation (2026)

10.3.13 There are no consents or allocations in this local area which are expected to accommodate material significant additional employment between 2017 and 2026.

10.4 Effects arising during construction

Avoidance and mitigation measures

10.4.1 The following measures have been incorporated into the scheme design as part of the design development process to avoid or minimise the environmental impacts during construction:

- Bromford tunnel will run from Castle Bromwich Business Park to the proposed Washwood Heath depot, reducing the land required for the construction and operation of the Proposed Scheme and reducing potential impacts on the business occupiers; and
- reductions in utility diversions avoiding any service disruptions to an adjacent rail spur servicing the Jaguar Land Rover Limited plant.

10.4.2 In order to avoid or minimise the environmental impacts during construction, the Proposed Scheme design includes provisions to maintain access to businesses during the construction phase.

10.4.3 The draft CoCP includes a range of provisions that will help to mitigate socio-economic effects associated with construction within this local area, including:

- 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 (draft CoCP Section 5);
- reducing nuisance through sensitive layout of construction sites (draft CoCP Section 5);
- applying best practicable means (BPM) during construction works to reduce noise (including vibration) at sensitive receptors (including local businesses) (draft CoCP Section 13);

[59] Potential employment has been estimated through employment floor space and the Homes and Communities Agency (HCA) *Employment Densities Guide* 2nd Ed. (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas.

- requiring contractors to monitor and manage flood risk and other extreme weather events which may affect socio-economic resources during construction (draft CoCP Sections 5 and 16); and
- site specific traffic management measures including requirements relating to the movement of traffic from business and commercial operators of road vehicles, including goods vehicles (draft CoCP Section 14).

Assessment of impacts and effects

Temporary effects

Change in business amenity value

10.4.4 No businesses have been identified within the area which are expected to experience significant amenity effects as a result of the Proposed Scheme.

Isolation

10.4.5 No businesses have been identified within the area which are expected to experience significant isolation effects as a result of the Proposed Scheme.

Construction employment

10.4.6 There are plans to locate construction compounds for the Proposed Scheme at the following locations within the Castle Bromwich and Bromford area:

- B4118 Water Orton Road overbridge satellite compound;
- River Tame viaduct satellite compound;
- Plants Brook underbridge satellite compound;
- Dunlop Carrier Channel culvert satellite compound;
- Bromford tunnel east portal (east) main compound;
- Bromford tunnel east portal (west) satellite compound;
- Castle Bromwich auto-transformer satellite compound; and
- Bromford tunnel east portal building satellite compound.

10.4.7 The use of these sites could result in the creation of up to 1344 person years of construction employment[60] opportunities, or approximately 134 full-time equivalent jobs[61] 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 assessed as part of the route-wide assessment (see Volume 3).

[60] 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.
[61] Based on the convention that 10 employment years is equivalent to one full time equivalent job.

10.4.8 Direct construction employment created by the Proposed Scheme could also lead to opportunities for local businesses to supply the project or to benefit from expenditure of construction workers. The impact of this indirect construction employment creation has been assessed as part of the route-wide assessment (see Volume 3).

Cumulative effects

10.4.9 No committed (intra-projects) developments have been identified that are considered to interact with the Proposed Scheme.

10.4.10 Cumulative effects arise in relation to the accumulation of individual resource based job displacement/ losses on a local labour market. These effects are assessed as part of the route-wide assessment (see Volume 3).

Permanent effects

Businesses

10.4.11 Businesses directly affected, i.e. those that lie within land which will be used for the construction of 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/resources are clustered together.

10.4.12 Seventeen business accommodation units within the area will be directly impacted upon by the Proposed Scheme. These together form one defined resource (because they are located next to one another) which is subject to potentially significant effects on business activities and employment. This resource is presented in Table 14: Resources with potentially significant direct effects .

Table 14: Resources with potentially significant direct effects

Resource	Description of business activity
Castle Bromwich Business Park and Hayward Industrial Estate	General industrial and warehousing premises

Impact magnitude

10.4.13 The magnitude of impact focuses on the number of jobs which are affected (either through displacement or possible loss) by the Proposed Scheme. It also considers the implications of this impact in relation to the scale of economic activity and opportunity in the area.

Sensitivity

10.4.14 The following was taken into account when considering the sensitivity of resources.

- availability of alternative, suitable premises;
- size of the local labour market;
- skill levels and qualifications of local people; and
- levels of unemployment.

Significance of effect

10.4.15 Taking account of the sensitivity of the resource and the magnitude of impact, the significance of the resultant effects is set out in Table 15.

Table 15: Significant effect on resources

Resource	Impact magnitude	Sensitivity	Significance of effect
Castle Bromwich Business Park and Hayward Industrial Estate	Medium	High	Major adverse

10.4.16 Construction of the Proposed Scheme will require the acquisition of land abutting the existing rail corridor to the north of the Castle Bromwich Business Park necessitating the demolition of some industrial and warehousing properties. A number of these businesses are an integral part of key supply chains supporting the automotive sector. The need to maintain certain travel time distances of key customers under a "just in time" delivery arrangement may mean that certain businesses will experience problems in identifying suitable alternative premises based on documented experiences within the advanced manufacturing sector. The effect on this resource and its employees is assessed to be major adverse and will therefore be significant.

10.4.17 It is estimated that the Proposed Scheme will result in the displacement or possible loss of approximately 220 jobs[62] within this area. Taking into account the availability of alternative premises and the total employed within the district (approximately 97,000), the displacement or possible loss of jobs is considered to be relatively modest compared to the scale of economic activity and opportunity in the area.

Cumulative effects

10.4.18 No committed (intra-projects) developments have been identified that are considered to interact with the Proposed Scheme.

10.4.19 Cumulative effects arise in relation to the accumulation of individual resource based job displacement/losses on a local labour market. These effects are dealt with as part of the route-wide assessment (see Volume 3).

Other mitigation measures

10.4.20 The above assessment has concluded that there are significant adverse effects arising during construction in relation to businesses directly affected by the Proposed Scheme.

10.4.21 Businesses displaced by the Proposed Scheme will be fully compensated within the provisions of the Compensation Code. HS2 Ltd recognises the importance of displaced businesses being able to relocate to new premises and will therefore provide additional support over and above statutory requirements to facilitate this process.

[62] Employment within businesses has been estimated through a combination of sources, for example, surveys of businesses, the Experian employment dataset, employment floor space and the Homes and Communities Agency (HCA) *Employment Densities Guide 2nd Edition* (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas and may vary significantly from actual employment at the sites.

10.4.22 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the line of route in terms of supplying goods and services and obtaining employment. HS2 Ltd is committed to working with its suppliers to build a skilled workforce that fuels further economic growth across the UK.

10.4.23 The area of land required for the Proposed Scheme will include the Castle Bromwich Business Park and Hayward Industrial Estate. Proposals will be developed for the reconfiguration of the business park and industrial estate following construction so as to minimise the socio-economic effects on business, residents and social infrastructure and to allow as many as possible to stay in the area. Any such reconfiguration will be subject to discussion with landowners and BCC, and obtaining the necessary planning permission. The land for the construction of the Bromford tunnel east portal, the infrastructure and its associated features will be required permanently.

Summary of likely significant residual effects

10.4.24 Likely significant residual effects are shown on Volume 5: Maps SE-01-068b to SE-01-072a.

10.4.25 The Proposed Scheme will require demolitions within the Castle Bromwich Business Park.

10.5 Effects arising during operation

Avoidance and mitigation measures

10.5.1 No mitigation measures are proposed during operation within this area.

Assessment of impacts and effects

Resources with direct effects

10.5.2 There are no resources considered likely to experience significant direct effects during the operational phase of the Proposed Scheme within this area.

Change in business amenity

10.5.3 No businesses have been identified within the area which are expected to experience significant amenity effects as a result of the Proposed Scheme.

Operational employment

10.5.4 Operational employment will be created at locations along the route including stations, train crew facilities and infrastructure/maintenance depots which are considered unlikely to be accessed by residents of the area. Some of these employment opportunities will be accessible to residents in the locality especially those at the proposed Washwood Heath depot and Birmingham Interchange and Curzon Street stations and given the transport accessibility of the area within the Birmingham travel to work area, residents living further afield.

10.5.5 Direct operational employment created by the Proposed Scheme could also lead to indirect employment opportunities for local businesses in terms of supplying the project or benefiting from expenditure of directly employed workers on goods and services.

10.5.6 The impact of operational employment creation has been assessed as part of the route-wide assessment (see Volume 3).

Cumulative effects

10.5.7 No committed developments have been identified that are considered to interact with the Proposed Scheme.

Other mitigation measures

10.5.8 The assessment has concluded that operational effects within the area will be either negligible or beneficial and therefore mitigation is not required.

Summary of likely significant residual effects

10.5.9 No significant residual socio-economic effects are likely to arise during operation of the Proposed Scheme.

11 Sound, noise and vibration

11.1 Introduction

11.1.1 This section reports the assessment of the likely noise and vibration significant effects arising from the construction and operation of the Proposed Scheme for the Castle Bromwich and Bromford area on:

- people, primarily where they live ('residential receptors') in terms of a) individual dwellings and b) on a wider community basis, including any shared community open areas[63]; and
- community facilities such as schools, hospitals, places of worship, and also commercial properties such as offices and hotels, collectively described as 'non-residential receptors' and 'quiet areas'[64].

11.1.2 The assessment of likely significant effects from noise and vibration on agricultural, community, cultural heritage or ecological receptors and the assessment of tranquillity are presented in Sections 3, 5, 6, 7 and 9 of this report respectively.

11.1.3 In this assessment 'sound' is used to describe the acoustic conditions which people experience as a part of their everyday lives. The assessment considers how those conditions may change through time and how sound levels and the acoustic character of community areas is likely to be modified through the introduction of the Proposed Scheme. Noise is taken as unwanted sound and hence adverse effects are noise effects and mitigation is, for example, by noise barriers.

11.1.4 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 e.g. resulting from changes in traffic patterns on existing roads or railways that result from the construction or operation of the Proposed Scheme.

11.1.5 This section sets out the means to avoid or reduce the adverse effects that may occur.

11.1.6 The approaches to assessing sound, noise and vibration and appropriate mitigation are outlined in Volume 1 and scope and methodology are defined in the following documents:

- Scope and Methodology Report (SMR) (Volume 5: Appendix CT-001-000/1); and
- SMR addendum (Volume 5: Appendix CT-001-000/2).

[63] 'shared community open areas' are those that the emerging National 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 to local green space) that is nearby.

[64] Quiet areas are defined in the Scope and Methodology Report as either Quiet Areas as identified under the Environmental Noise Regulations or are resources which are prized for providing tranquillity (further information is provided in Volume 5: Appendix SV-001-000).

11.1.7 More detailed information and mapping regarding the sound, noise and vibration assessment for Castle Bromwich and Bromford is available in the relevant appendices in Volume 5:

11.1.8 sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000);

- sound, noise and vibration baseline (Volume 5: Appendix SV-002-025);
- sound, noise and vibration construction assessment (Volume 5: Appendix SV-003-025);
- sound, noise and vibration operation assessment (Volume 5: Appendix SV-004-025); and
- Map Series SV-01, SV-02, SV-03 and SV-04 (Volume 5 Map book Sound, noise and vibration).

11.2 Environmental baseline

Existing baseline

11.2.1 The Castle Bromwich and Bromford area spans the M6 corridor. The M6 in this area is one of the busiest stretches of motorway in Europe and is elevated for much of its length as it passes through the study area. Running close by the M6 is a busy railway from Birmingham running east from the city and onward to Derby and the north-east and Leicester and the east. An additional freight-only line from the north merges with the main line just east of Castle Vale.

11.2.2 To the north of the M6/rail corridor, the west of the area contains industrial and commercial premises including a large car factory (Jaguar Land Rover Limited) and The Fort Shopping Park.

11.2.3 To the east of the extensive residential area of Castle Vale are more commercial premises and open land. To the south of the M6 and railway corridor lie the largely residential areas of Castle Bromwich and Bromford.

11.2.4 The Castle Bromwich Business Park lies north of the M6 and south of the railway where the two diverge south of Castle Vale. Some of the commercial properties on Castle Bromwich Business Park, are significant contributors to the sound environment at residential properties immediately north of the Birmingham and Derby line in Castle Vale.

11.2.5 Other main arterial roads in the area are the A452 Chester Road and the A47 Fort Parkway. Daytime sound levels at residential properties close to the M6 and A452 are typically 65 to 70dB[65] reducing to typically around 55dB further into the residential areas.

[65] Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,16hr}$.

11.2.6 The reduction in sound level between daytime and night-time[66] sound levels is relatively small (typically less than 5dB) due to the continuous nature of sound from the M6 and other major roads.

11.2.7 The area lies approximately 6km to the north-west of Birmingham Airport and under its flight-path. The sound environment is therefore characterised by the sounds of road traffic from the motorway and other major roads, railways, aircraft and industrial and commercial premises.

11.2.8 Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for this area in Volume 5: Appendix SV-002-025.

11.2.9 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[67], with the exception of those receptors closest to existing railways. On a reasonable worst case basis, vibration from the Proposed Scheme has therefore been assessed at all receptors using specific thresholds, below which receptors will not be affected by vibration, as described in Volume 1, Section 8. No vibration baseline measurements have therefore been undertaken.

Future baseline

11.2.10 Without the Proposed Scheme, existing sound levels in this area are likely to increase slowly over time. This is primarily due to road traffic growth. Changes in car technology may offset some of the expected sound level increases due to traffic growth on low speed roads. On higher speed roads[68], tyre sound dominates and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

Construction (2017)

11.2.11 The assessment of noise from construction activities assumes a baseline year of 2017 which represents the period immediately prior to the start of the construction period. As a reasonable worst case, it has been assumed that no change in baseline sound levels will occur between the existing baseline (2012/13) and the future baseline year of 2017. The assessment of noise from construction traffic assumes a baseline year of 2021, representative of the middle of the construction period when the construction traffic flows are expected to be at their peak. Further information can be found in the Traffic and transport assessment in Section 12.

Operation (2026)

11.2.12 The assessment is based upon the predicted change in sound levels that result from the Proposed Scheme. The assessment initially considered a worst case (that would overestimate the change in levels) by assuming that sound levels would not change from the existing baseline year of 2012/2013. Where significant effects were identified on this basis, the effects have been assessed using a baseline year of 2026 to coincide with the proposed start of passenger services. The future baseline is for the sound environment that would exist in 2026 without the Proposed Scheme.

[66] Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr.}$
[67] Further information is available in Volume 5: Appendix SV-001-000, the SMR and its Addendum.
[68] Tyre noise typically becomes the dominant sound source for steady road traffic at speeds above approximately 30mph.

11.3 Effects arising during construction

Local assumptions and limitations

Local assumptions

11.3.1 The construction arrangements that form the basis of the assessment are presented in Section 2.3 of this report.

11.3.2 The following activities have been assumed to be undertaken during the evening and night-time for reasons of safety, engineering practicability or to reduce the impact on existing transport:

- installation and removal of the temporary railway protection barrier to the north of Bromford tunnel east portal works;
- dismantling the tunnel boring machine (TBM) at the Bromford tunnel east portal after both tunnel drives; and
- installation of the tunnel finishes at the Bromford tunnel east portal.

11.3.3 Additionally it is anticipated that there may be some further short periods of night-time working during road and rail possession periods. It is expected that the noise effects would be limited in duration and hence are not considered to be significant. The management and control processes in the draft CoCP (Volume 5: Appendix CT-003-000) would reduce any adverse noise effects.

11.3.4 The assessment takes account of people's perception of noise throughout the day. More stringent criteria are applied during evening and night-time periods, when people are more sensitive to noise, compared to the busier and more active daytime period.

11.3.5 TBMs will be used to excavate the Bromford tunnel, each of the two tunnel drives will start from the Washwood Heath depot site (in the Washwood Heath to Curzon Street area (CFA26)) and progress from west to east. Materials (including tunnel lining segments), people and equipment will be transported from the surface in the Washwood Heath depot site to each TBM using small construction trains, which will travel at relatively low speeds. Excavated material from each TBM will be transported to the surface by conveyor to the Washwood Heath depot site. It has been assumed that significant noise and vibration effects arising from use of the temporary railway will be avoided through appropriate design and maintenance specification. Other methods of material movement may be employed; however, these would result in lower ground-borne noise and vibration.

Local limitations

11.3.6 In this area, there are a number of locations where the land or property owners did not permit baseline sound level monitoring to be undertaken at their premises. However, sufficient information has been obtained to undertake the assessment. Further information is provided in Volume 5: Appendix SV-002-025.

Avoidance and mitigation measures

11.3.7 The assessment assumes the implementation of the principles and management processes set out in the draft CoCP which are:

- Best Practicable Means (BPM) as defined by the Control of Pollution Act 1974 (CoPA) and Environmental Protection Act 1990 (EPA) will be applied during construction activities to minimise noise (including vibration) at neighbouring residential properties;
- as part of BPM, mitigation measures are 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[69]; and then
  - screening: for example local screening of equipment or perimeter hoarding;
- where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary re-housing will be offered in accordance with the draft CoCP's noise insulation and temporary re-housing policy;
- lead contractors will seek to obtain prior consent from the relevant local authority under Section 61 of CoPA for the proposed construction works. The consent application will set out BPM measures to minimise construction noise, 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 will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to and be reviewed by the Nominated Undertaker and will be made available to the local authorities; and
- contractors will be required to comply with the terms of the CoCP and appropriate action will be taken by the Nominated Undertaker as required to ensure compliance.

11.3.8 In addition to this mitigation, taller screening as described in the draft CoCP[70] has been assumed along the edge of the construction site boundary in two locations: to the south of the Proposed Scheme between the Bromford tunnel east portal works and the commercial/industrial premises and the traveller site in Castle Bromwich Business Park; and in the vicinity of the Twisted Oak Riding stables, off the B4118 Birmingham Road, on the edge of Water Orton. Solid cladding will be provided to the railway protection barrier proposed to the north of the existing Birmingham and

[69] Warning signals that consist of bursts of noise.
[70] As described in the draft CoCP, provided as necessary by solid temporary hoarding, temporary earth stockpiles, screening close to the activities or other means to provide equivalent noise reduction.

Derby line in the vicinity of the Bromford tunnel east portal works to provide noise screening to the residential area in Castle Vale.

11.3.9 Noise insulation will be offered for qualifying buildings as defined in the draft CoCP's noise insulation and temporary re-housing policy. Noise insulation or ultimately temporary re-housing will avoid residents being significantly affected[71] by levels of construction noise inside their dwellings. The assessment reported in this section provides an estimate of the buildings that are likely to qualify for such measures.

11.3.10 Qualification for noise insulation and temporary re-housing will be identified as part of seeking prior consent from the local authorities under Section 61 of the Control of Pollution Act. Qualifying buildings will be identified early enough so that noise insulation can be installed, or temporary re-housing provided, before the start of the works predicted to exceed noise insulation or temporary re-housing criteria. Noise insulation, where required, will be installed as early as possible to reduce internal sound levels from construction activities and also when the Proposed Scheme comes into operation.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.3.11 Taking account of the avoidance and mitigation measures set out in the previous paragraphs, approximately 25 residential properties in Castle Vale on Cadbury Drive and Blenheim Way closest to the construction works are forecast to experience noise levels higher than the noise insulation trigger levels as defined in the draft CoCP. For daytime construction the trigger level is 75dB[72] measured outdoors. The equivalent night-time trigger level is 55dB[73].

11.3.12 The mitigation measures, including noise insulation, will reduce noise inside all dwellings including those in Castle Vale such that it does not reach a level where it would significantly affect[70] residents.

Residential receptors: direct effects – communities

11.3.13 The avoidance and mitigation measures in this area will avoid airborne construction noise adverse effects[70] on the majority of receptors and communities. Residual temporary noise or vibration effects are identified in the rest of this section.

11.3.14 With regard to noise outside dwellings, the assessment of temporary effects takes account of construction noise relative to existing sound levels.

11.3.15 In locations with lower existing sound levels[74], construction noise effects[70] are likely to be caused by changes to noise levels outside dwellings. These may be considered by the local community as an effect on the acoustic character of the area and hence be perceived as a change in the quality of life. These effects are considered to be

[71] Information is provided in the emerging National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk.
[72] $L_{pAeq,0800\text{-}1800}$ measured at the facade, outdoors, or the existing ambient if this is already above this level.
[73] $L_{pAeq,2200\text{-}0700}$ measured at the façade, outdoors, or the existing ambient if this is already above this level.
[74] Further information is provided in Volume 5: Appendix SV-001-000.

significant when assessed on a community basis taking account of the local context[75] as identified in Table 16.

Table 16: Direct adverse effects on residential communities and shared open areas that are considered to be significant on a community basis

Significant effect number (see Volume 5 Appendix SV-003-025)	Type of significant effect	Time of day	Location	Cause (construction activities)	Assumed approximate duration of impact
CSV25-C01	Construction noise	Day and night	Castle Vale. Approximately 25 dwellings on Blenheim Way and Cadbury Drive are affected at night, of which approximately 15 dwellings on Blenheim Way are also affected during the day	Day: various works including demolition, site clearance, haul road construction, re-soiling, and Dunlop Carrier Channel culvert works with typical and highest monthly noise levels of around 65dB and 75dB[76]. Night: installation of the railway protection barrier at Bromford tunnel east portal with typical and highest noise levels of around 55 and 60dB[77]	Day: 8 months Night: 1 month
CSV25-C02	Construction noise	Day	Bromford. Approximately 30 dwellings on Wanderer Walk and Chillinghome Road	Utility diversions with typical and highest monthly noise levels of around 60dB and 70dB[76]	1-2 months

11.3.16 TBMs will be used to excavate the Bromford tunnel. Each TBM is likely to generate ground-borne noise and vibration impacts but only at receptors within a close distance of the centre line of the tunnels and only for short periods of time (a few days). Overall, the deeper the tunnel is, the lower the impact. The perceptible noise and vibration will increase as each TBM approaches and diminish as it moves away from the receptor. Vibration from TBMs will present no risk of any building damage.

11.3.17 The effects of vibration from TBMs on building occupants will be short term (a matter of days) and hence they are not considered to be significant. Proactive and advanced community relations in advance of each TBM passing under properties will help manage expectations and allay possible concerns over the short term presence of vibration.

Residential receptors: indirect effects

11.3.18 Significant noise effects on residential receptors arising from construction traffic are unlikely to occur in this area.

[75] Further information is provided in SV-001-000 and SV-003-025.
[76] Daytime: equivalent continuous sound level at the facade, $L_{pAeq,\ 0700\text{-}1900}$
[77] Night-time: equivalent continuous sound level at the facade, $L_{pAeq,\ 2300\text{-}0700}$

Non-residential receptors: direct effects

11.3.19 Significant construction noise or vibration effects have been identified on a worst case basis on the following non-residential receptors:

- the closest premises in the Castle Bromwich Business Park to the Bromford tunnel east portal (CSV25-N01). Significant noise effects have been identified during the daytime with noise levels rising at times to around 80dB[76] due to a range of construction activities at the Bromford tunnel east portal. It has been assumed that the north-west façade of the buildings facing the works are in office use;
- Berwood Court Care Home on Cadbury Drive, Castle Vale (CSV25-N02). Significant noise effects have been identified during the daytime with noise levels rising at times to around 70dB[77] due to demolition and various works at the Bromford tunnel east portal;
- Air Training Corps premises on Cadbury Drive, Castle Vale (CSV25-N03). Significant noise effects have been identified during the daytime with noise levels rising at times to around 70dB[77] due to demolition and various works at the Bromford tunnel eastern portal; and
- Tame Valley Academy, Bromford (CSV25-N04). Significant noise effects have been identified during the daytime with noise levels rising at times to around 65dB[77] due to short term utility diversions along the route of Bromford tunnel.

Non-residential receptors: indirect effects

11.3.20 Significant noise effects on non-residential receptors arising from construction traffic are unlikely to occur in this area.

Cumulative effects from the Proposed Scheme and other committed development.

11.3.21 This assessment has considered the potential cumulative construction noise effects of the proposed scheme and other committed developments[78]. In this area, it is not anticipated that any developments would be built at the same time as the Proposed Scheme and accordingly, construction noise or vibration from the Proposed Scheme is unlikely to result in any significant cumulative noise effects.

Summary of likely significant residual effects

11.3.22 The avoidance and mitigation measures reduce noise inside all dwellings from the construction activities such that it is does not reach a level where it would significantly affect[71] residents.

11.3.23 The measures reduce any adverse effects from construction noise outdoors on the majority of residential communities such that they are not considered significant except at the residential communities along the following roads that are closest to the works:

[78] Refer to Volume 5: Appendix -CT-004-000.

- Blenheim Way and Cadbury Drive, Castle Vale; and
- Wanderer Walk and Chillinghome Road, Bromford.

11.3.24 On a worst case basis, noise from specific construction activities has been identified as resulting in significant residual temporary effects on the following non-residential receptors:

- Castle Bromwich Business Park;
- Berwood Court Care Home on Cadbury Drive, Castle Vale;
- Air Training Corps premises on Cadbury Drive, Castle Vale; and
- Tame Valley Academy, Bromford.

11.3.25 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 receptor, its use and the benefit of the measures. The outcome of these activities will be reflected in the Environmental Minimum Requirements.

11.4 Effects arising during operation

Local assumptions and limitations

Local assumptions – service pattern

11.4.1 The effects of noise and vibration from the operation of the Proposed Scheme have been assessed based on the highest likely train flows, including the Phase Two services. Trains are expected to be 400m long during peak hours and a mix of 200m and 400m long trains at other times.

11.4.2 The expected passenger service frequency for both Phase One, and Phase One with Phase Two services are described in Volume 1[79]. As a reasonable worst case, this assessment is based upon the service pattern for Monday to Saturday including Phase Two services. Passenger services will start at or after 05:00 from the terminal stations and in this area will progressively increase to the number of trains per hour in each direction on the main lines set out in Table 17. 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 24:00. Train speeds are shown in Table 17.

11.4.3 In addition to the passenger services there will be stock movements between Washwood Heath depot and Curzon Street at the start of the service day (from 05:00), at off-peak times during the day, and at the end of the service day (to 24:00) that will increase flows between the depot and Curzon Street station.

[79] The change in noise and vibration effects between the different passenger services is assessed in Volume 1.

Table 17: Train flows and speeds

Description of line	Time period for peak daytime flows	Number of trains per hour in each direction with Phase Two services (Phase One only trains per hour in each direction is set out in brackets)	Speed
Between Delta junction and Curzon Street station	07:00 – 21:00 hours	9(3)	230kph

Local assumptions – tunnelled sections

11.4.4 Tunnel portals are likely to include mechanical ventilation equipment. It is likely that this equipment will only operate for limited testing periods during the daytime[80], or in the event of an emergency.

Avoidance and mitigation measures

11.4.5 The development of the Proposed Scheme has, as far as reasonably practicable, kept the alignment away from main communities. This avoidance measure has protected many residential community areas from likely significant noise or vibration effects.

Airborne noise

11.4.6 HS2 trains will be quieter than the relevant current European Union specifications. The track will be specified to reduce noise, as will the maintenance regime. Further information is provided in Volume 5: Appendix SV-001-000.

11.4.7 Noise effects are reduced along the line by engineering structures such as cuttings and safety fences on viaducts. The location of these barriers is shown on Volume 2: Maps SV-05-67 to SV-05-68.

11.4.8 Tunnel portals will be designed to avoid any significant airborne noise effects caused by the trains entering the tunnel.

11.4.9 Significant noise effects from the operational static sources such as mechanical ventilation at tunnel portals and line-side equipment will be avoided through their design and the specification of noise emission requirements (for further information please see Volume 5: Appendix SV-001-000).

Ground-borne noise and vibration

11.4.10 Significant ground-borne noise or vibration effects will be avoided or reduced through the design of the track and track-bed.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.4.11 The mitigation measures will reduce noise inside all dwellings such that it will not reach a level where it would significantly affect residents.

[80] For example, HS1 vent shaft fans are tested monthly.

Residential receptors: direct effects – communities

11.4.12 The mitigation measures in this area will avoid airborne noise adverse effects on the majority of receptors, and at the following communities:

- Castle Vale;
- Castle Bromwich; and
- Bromford.

11.4.13 Taking account of the envisaged mitigation, Volume 2: Maps SV-05-67 to SV-05-68 shows the long term 40dB[81] night-time sound level contour from the operation of trains on the Proposed Scheme. The extent of the 40dB night-time sound level contour is equivalent to, or slightly larger than, the 50dB daytime contour[82]. In general, below these levels adverse effects are not expected.

11.4.14 Above 40dB during the night and 50dB during the day the effect of noise is dependent on the baseline sound levels in that area and the change in sound level (magnitude of effect) brought about by the Proposed Scheme. The airborne noise impacts and effects forecast for the operation of the scheme are presented on Volume 2: Maps SV-05-67 to SV-05-68.

11.4.15 The changes in noise levels are likely to affect the acoustic character of the area such that there is a perceived change in the quality of life and are considered to be significant when assessed on a community basis[83] taking account of the local context[84]. However, when assessed on this basis, there are no adverse effects in this area that are considered to be significant.

Residential receptors: indirect effects

11.4.16 The assessment of operational noise and vibration indicates that significant indirect effects on residential receptors are unlikely to occur in this area.

Non-residential receptors: direct effects

11.4.17 The assessment of operational noise and vibration indicates that significant direct effects on non-residential receptors are unlikely to occur in this area.

Non-residential receptors: indirect effects

11.4.18 The assessment of operational noise and vibration indicates that significant indirect effects are unlikely to occur on non-residential receptors in this area.

Summary of likely significant residual effects

11.4.19 The mitigation measures reduce noise inside all dwellings such that it does not reach a level where it would significantly affect[71] residents.

[81] Defined as the equivalent continuous sound level from 23:00 to 07:00 or LpAeq,night).
[82] With the train flows described in the assumptions section of this CFA Report, the daytime sound level (defined as the equivalent continuous sound level from 07:00 to 23:00 or LpAeq,day) from the Proposed Scheme would be approximately 10dB higher than the night-time sound level. The 40dB contour therefore indicates the distance from the Proposed Scheme at which the daytime sound level would be 50dB.
[83] Further information is contained in Volume 1.
[84] Further information is provided in SV-001-000 and SV-004-025.

11.4.20 The mitigation measures will avoid noise and vibration adverse effects[71] on all receptors and communities (including shared open areas) in this study area.

12 Traffic and transport

12.1 Introduction

12.1.1 This traffic and transport section describes the likely impacts on all forms of transport and the consequential effects on transport users arising from the construction and operation of the Proposed Scheme through the Castle Bromwich and Bromford area.

12.1.2 With regard to traffic and transport, the main issues are increased traffic as a result of the construction of the Proposed Scheme.

12.1.3 The effects on traffic and transport have been assessed quantitatively, based on baseline traffic conditions and future projection scenarios.

12.1.4 A detailed report on traffic and transport and surveys undertaken within the area is contained in the following Volume 5: Appendix TR-001-000, Transport Assessment.

12.1.5 Figure 2 shows the location of the key transport infrastructure in this area.

12.1.6 Engagement has been undertaken with the key transport authorities, including Birmingham City Council (BCC), Solihull Metropolitan Borough Council (SMBC), Centro (the West Midlands Integrated Transport Authority), the Highways Agency (HA) and Network Rail.

12.2 Scope, assumptions and limitations

12.2.1 The assessment scope, key assumptions and limitations for the traffic and transport assessment are set out in Volume 1, the SMR (see Volume 5: Appendix CT-001-000/1) and the SMR addendum (see Volume 5: Appendix CT-001-000/2). This report follows the standard assessment methodology.

12.2.2 The study area includes the M6, A452, A4040 Bromford Lane, A47 Fort Parkway, A38 Tyburn Road/Kingsbury Road, and the B4118 Birmingham Road/Water Orton Road.

12.2.3 A number of transport modelling tools have been used to inform the assessment including the Department for Transport's Trip End Model Presentation Program (TEMPRO) for future forecast road traffic growth in the area. The assessment covers the morning (08:00-09:00) and evening (17:00-18:00) peak periods for an average weekday.

12.2.4 Forecast future year traffic flows with and without the Proposed Scheme are based on an approach that does not take account of wider effects, such as the redistribution and reassignment of traffic, modal shift and peak spreading. As a consequence, local traffic effects may be over-estimated.

12.3 Environmental baseline

Existing baseline

12.3.1 Existing conditions in the West Midlands have been determined through site visits, specially commissioned traffic surveys and liaison with West Midlands Transport Authorities and stakeholders to source transport data, information on public transport, public rights of way (PRoW) and accident data.

12.3.2 Traffic surveys of all roads crossing the route or potentially affected were undertaken in June 2012 and June 2013, comprising junction turning counts, queue length surveys, automatic traffic counts, automatic number plate recognition surveys and parking accumulation surveys. This was supplemented by traffic and transport data obtained from other sources where available, including from BCC, SMBC and Centro. The highway peak hours in the study area were 08:00-09:00 and 17:00-18:00 hours.

12.3.3 Surveys of pedestrian and cyclist movements were undertaken in August and September 2012 to establish the nature of the PRoW and their usage by non-motorised users (pedestrians, cyclists and equestrians). The surveys included all PRoW and roads that will cross the route of the Proposed Scheme, and any additional PRoW and roads that will be affected by the Proposed Scheme. There are no PRoWs affected by the Proposed Scheme. The route with the greatest usage was the A452 Chester Road between the A47 Fort Parkway and Tameside Drive, with approximately 300 users per day. The Proposed Scheme affects two roads with footways (B4118 Birmingham Road/Water Orton Road and A452 Chester Road).

12.3.4 There are several strategic routes that pass through the area. The M6 crosses the area in the south, and is accessed from Junction 5. The A47 Fort Parkway and A38 Tyburn Road provide routes to Birmingham city centre and run south-west to north-east through the area. The A47 Fort Parkway and A38 Tyburn Road intersect with the A4040 Bromford Lane, and the A452 Chester Road, which routes north-west to south-east through the area. The A38 Tyburn Road continues northwards towards Minworth and Lichfield. The strategic roads within the study area are busy at peak times and delays can be experienced on the M6, A47 Fort Parkway, A38 Tyburn Road, A4040 Bromford Lane and the A452 Chester Road.

12.3.5 The main local roads affected by the Proposed Scheme include the B4118 Birmingham Road/Water Orton Road, Tameside Drive, Farnborough Road, Langley Drive, Coleshill Road and Newport Road. The local road network generally operates more efficiently than the strategic roads, but it can also be busy at peak times.

12.3.6 Relevant accident data for the road network subject to assessment has been obtained from BCC, for the three year period of 2009 to 2011. This has been assessed and no significant accident clusters were identified in the area.

12.3.7 There are a number of public bus services that pass through the area, including services on key strategic routes such as the A4040 Bromford Lane and the A38 Tyburn Road. The bus services provide connections to most local destinations in the Birmingham area, including the city centre, and Solihull town centre. Services are generally in operation from Monday to Sunday, across the day and at a high frequency.

12.3.8 Local rail services are accessible via three railway stations within the area. Stechford station is located approximately 2.7km to the south of the A4040 Bromford Lane/Wolseley Drive junction, which will form the main access to the proposed Washwood Heath depot, located in the Washwood Heath to Curzon Street area (CFA26). The station is served by regular bus services which stop on the A4040 Bromford Lane close to the proposed Washwood Heath depot. Stechford station is on the Rugby to Birmingham line and provides access to regular services to Birmingham

New Street station, where national and local rail services are accessible. The other stations in the area are Lea Hall, also situated on the Rugby to Birmingham line, and Erdington, which provides access to the Cross City services on the Birmingham and Bushbury line.

12.3.9 The Proposed Scheme will not cross any PRoW. However, it will cross the footway on the B4118 Birmingham Road/Water Orton Road, near to the existing bridge over the M6 and A452, and the A452 Chester Road, north of the M6 junction 5. The B4118 Birmingham Road and the footway alongside also runs through the Coleshill Junction area (CFA19), and the boundary between the two CFAs is approximately 400m to the north-east of the B4118 Water Orton Road overbridge.

12.3.10 There are pedestrian footways on the majority of roads within the area local to the Proposed Scheme, including the A4040 Bromford Lane, from which the western tunnel portal and proposed Washwood Heath depot will be accessed, and Tameside Drive, which will provide access to the eastern tunnel portal. Generally, pedestrian crossings are provided at junctions and on pedestrian desire lines.

12.3.11 A number of formal cycle routes pass through the area and there are also a number of advisory cycle routes.

12.3.12 The nearest navigable waterway to the Proposed Scheme in this area is the Birmingham and Fazeley Canal, which is located approximately 750m north of the Bromford tunnel east portal. However, the Proposed Scheme does not affect this canal and consequently it is not considered further in this assessment.

Future baseline

12.3.13 Future baseline traffic volumes for the years of assessment 2021, 2026 and 2041 have been calculated by applying growth factors derived from TEMPRO. There are no major committed developments within the area which would generate a significant amount of traffic close to the Proposed Scheme. The Castle Bromwich Business Park is affected by the Bromford tunnel east portal, which will result in displaced businesses. The traffic associated with these businesses has not been deducted from the future year traffic flows, and as a consequence adverse traffic effects may be over-stated.

Construction

12.3.14 Construction activities have been assessed against 2021 baseline traffic flows, irrespective of when they occur during the construction period. Future baseline traffic volumes in the peak hours are forecast to grow by around 17% by 2021 compared to 2012.

Operation (2026)

12.3.15 Future baseline traffic volumes in the peak hours are forecast to grow by around 28% by 2026 compared to 2012.

Operation (2041)

12.3.16 Future baseline traffic volumes in the peak hours are forecast to grow by around 47% by 2041 compared to 2012.

12.4 Effects arising during construction

Avoidance and mitigation measures

12.4.1 The following measures (as described in Section 2) have been included as part of the engineering design of the Proposed Scheme and will avoid or reduce effects on transport users:

- creation of a haul road running east to west from the B4118 Birmingham Road/Water Orton Road through the Park Hall nature reserve to Tameside Drive and the A452 Chester Road;
- construction materials and equipment will be transported along the haul road adjacent to the Proposed Scheme alignment, where reasonably practicable, to reduce lorry movements on the public highway;
- the B4118 Birmingham Road/Water Orton Road, which crosses the route, will be kept open during construction, resulting in minimal diversions of traffic onto alternative routes;
- Heavy Goods Vehicles (HGV) routeing, as far as reasonably practicable, along the strategic road network and using designated routes for access, as shown on Volume 5: Maps TR-03-156b to TR-03-158a;
- provision of off-site worker accommodation in the Birmingham Interchange and Chelmsley Wood area (CFA24), with the potential for shared multi-occupancy travel between the accommodation and the site compounds in this area; and
- provision of on-site welfare facilities to reduce daily travel by site workers.

12.4.2 The draft CoCP (see Volume 5: Appendix CT-003-000) includes measures which seek to reduce the impacts and effects of deliveries of construction materials and equipment, including reducing construction lorry trips during peak background traffic periods. The draft CoCP includes HGV management and control measures.

12.4.3 Where reasonably practicable, the number of private car trips to and from the site (both workforce and visitors) will be reduced by encouraging alternative modes of transport or vehicle sharing. This will be supported by an over-arching framework travel plan[85] that will require travel plans to be used along with a range of potential measures to mitigate the impacts of traffic and transport movements associated with construction of the Proposed Scheme. As part of this, a construction workforce travel plan will be put into operation with the aim of reducing workforce commuting by private car, especially sole occupancy car travel. This will encourage the use of sustainable modes of transport.

[85] Construction and operational travel plans will promote the use of sustainable transport modes as appropriate to the location and types of trip. They will 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.

12.4.4 The measures in the draft CoCP include clear controls on vehicle types, hours of site operation, and routes for HGV, to reduce the impact of road based construction traffic. In order to achieve this, generic and site specific traffic management measures will be implemented during the construction of the Proposed Scheme on or adjacent to public roads, bridleways, footpaths and other PRoW affected by the Proposed Scheme as necessary.

12.4.5 Specific measures will include:

- core site operating hours will be 08:00-18:00 on weekdays and 08:00-13:00 on Saturdays and site staff and workers will therefore generally arrive before the morning peak hour and depart after the evening peak hour (draft CoCP, Section 5). However, sites associated with tunnelling works (i.e. the East portal (east) main compound and East portal (west) satellite compound) will be operational 24 hours a day. It is anticipated that shift changeover times would not coincide with the highway peak hours; and
- excavated material will be reused wherever reasonably practicable along the route of the Proposed Scheme, which will reduce the effects of construction vehicles on the public highway (draft CoCP, Section 15).

12.4.6 Where works potentially affect classic rail assets (managed by Network Rail), disruption to travelling passengers and freight movements will be minimised as far as possible. This includes measures such as:

- carefully programming works to coincide with possessions that are required and planned for the general maintenance of the railway;
- planning of the required works so that they can be undertaken in short overnight stages when passenger services are not disrupted; and
- programming longer closures at the weekend and on bank holidays to minimise the number of passengers affected.

Assessment of impacts and effects

Temporary effects

12.4.7 The following section considers the impact on traffic and transport and the consequential effects resulting from construction of the Proposed Scheme.

12.4.8 The temporary traffic and transport impacts within this area will include construction vehicle movements to and from the various worksites.

12.4.9 Construction vehicle movements required to construct the Proposed Scheme will include the delivery of plant and materials, movement of excavated materials and site worker trips.

12.4.10 Details of construction compounds are provided in Section 2. The duration of when there will be busy transport activity at each compound is shown in Table 18. This represents the periods when the construction traffic flows will be greater than 50% of the peak month flows. The estimated number of daily vehicle trips during the operation of each compound is shown, the lower end of the range shows the average

number of trips in the busy period and the upper end shows the peak month flows. The assessment scenario has assumed the peak month for the combination of activities, i.e. not necessarily the peak activity at each individual site.

Table 18: Typical vehicle trip generation for site compounds in this area

Compound Type	Compound Name	Access to/from compound	Indicative start/set up date	Estimated duration of use (Years)	Estimated duration with busy vehicle movements (Months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
Satellite site	B4118 Water Orton Road overbridge	B4118 Birmingham Road/Water Orton Road	Q3 2018	5 years and 3 months	44	45-65	20-35
Satellite site	River Tame viaduct	Main access – B4118 Birmingham Road/Water Orton Road Secondary access – A452 Chester Road/Tameside Drive	Q2 2018	3 years and 3 months	8	45 – 60	20- 20
Satellite site	Plants Brook underbridge	Main access – B4118 Birmingham Road/Water Orton Road Secondary access – A452 Chester Road/Tameside Drive	Q2 2017	4	2	20 – 20	39 – 40
Satellite site	Dunlop Carrier Channel culvert	Main access – Private Slip Road off M6 Eastbound, Secondary access – B4118 Birmingham Road/Water Orton Road	Q2 2017	4	3	20 – 20	89 – 90
Main compound	Bromford tunnel east portal (east)	Main access – A452 Chester Road/	Q2 2017	5 years and 3 months	27	15 – 20	103 – 110

Compound Type	Compound Name	Access to/from compound	Indicative start/set up date	Estimated duration of use (Years)	Estimated duration with busy vehicle movements (Months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
		Tameside Drive					
Satellite site	Bromford tunnel east portal (west)	Main access – A452 Chester Road/ Tameside Drive/ Langley Drive	Q2 2017	5 years and 3 months	26	30 – 60	130 – 200

12.4.11 Information on the indicative construction programme and methodology is provided in Section 2.3. Works will include watercourse realignments, utilities diversions, earthworks, viaduct, bridge, and tunnel portal construction. The peaks in activity at individual compounds are based on the scope, scale and programme of works and are not expected to occur simultaneously at compounds as the peak of activity for individual compounds rarely overlaps.

12.4.12 Month 36 represents the peak month of activity, when five of the six compounds will be operational, including when the Bromford tunnel east (east) main compound and the Bromford tunnel east portal (west) satellite compound portal will be at their busiest. These two compounds contribute approximately 60% of the total traffic flow in this month.

12.4.13 The construction compounds will also be the main location for advance works including utilities. It should be noted that the activity associated with the advance works (including utilities) and rail installation works which will follow on after the civils work, will be of a lower intensity and will generate a lower level of HGV activity.

12.4.14 The construction assessment considers the traffic and transport impacts and effects in three peak months of construction activity, based on the proposed phasing of the works. The peak months have been identified as Months 22 (2018 Quarter 4), 27 (2019 Quarter 1) and 36 (2019 Quarter 4). In Months 22 and 27 there will be six operational compounds, and in Month 36 there will be five compounds that would be in operation. The construction assessment considers average construction traffic levels for the peak months and outside of these peaks, activity is expected to be lower for much of the time. In considering the effects of the Proposed Scheme, where these occur in particular months assessed this is identified. In general the effects are greatest in Month 36. The assessment of these three peaks in activity has been used to ensure that all significant effects are identified. Where impacts and effects occur in particular peak periods these are identified below. Where impacts relate to specific activities these are identified.

12.4.15 The construction assessments have also considered any impacts that arise from construction in the adjoining areas.

12.4.16 In the busiest month, there are estimated to be approximately 513 vehicle movements (in/out) per day across the study area. The split of construction vehicles is expected to be 70% HGVs and 30% cars and light goods vehicles (LGV).

12.4.17 It is proposed that the M6, A452, A452 Chester Road, A47 Fort Parkway and the A38 Tyburn Road will provide the primary HGV access routes.

12.4.18 Construction of the Proposed Scheme will result in changes in traffic flows due to workers and construction vehicles accessing compounds.

12.4.19 Increases in traffic flows will lead to a minor adverse effect on severance[86] for non-motorised users in months 22, 27 and 36 in the following locations:

- Langley Drive, Castle Bromwich Business Park, as a result of increased HGV movements to the east tunnel portal and worksites, and low background traffic flows; and
- Tameside Drive, Castle Bromwich Business Park, as a result of increased HGV movements to the east tunnel portal and worksites, and low background traffic flows.

12.4.20 The effect of these increases is assessed as minor because the pedestrian demand and total forecast traffic flows are likely to be low, so opportunities for pedestrians to cross the roads will remain.

12.4.21 The construction of the Proposed Scheme will not result in increases in traffic flows on any other roads in the area that create significant effects.

12.4.22 The changes in traffic flows will not result in significant effects on congestion.

12.4.23 The construction works will require temporary traffic management measures for the replacement of the B4118 Water Orton Road overbridge, which is likely to result in reduced capacity and delays[87], but these are not expected to be significant. There are no temporary road closures or diversions proposed in the area.

12.4.24 Utilities works (including diversions) have been assessed in detail where they are major works and where traffic and transport impacts from the works separately, or in combination with other works, is greater than other construction activities arising within the area. Minor utilities works will be required but will only require short term lane or road closures. No additional significant effects from utilities works are expected.

[86] In the context of this Traffic and transport section, severance is used to relate to a change in ease of access for non-motorised users due to, for example, a change in travel distance or travel time or a change in traffic levels on a route that makes it harder for non-motorised users to cross. A reference to severance does not imply a route is closed to access.

[87] In assessing significant effects of traffic changes on congestion and delays, a major adverse effect occurs where traffic flows will be beyond or very close to capacity with the Proposed Scheme and the increases in traffic due to the Proposed Scheme will be such as to substantially increase queues and delays on a routine basis at peak times. A moderate adverse effect will occur when traffic flows will be approaching or at capacity with the Proposed Scheme and modest increases in traffic will increase the frequency of queues and more substantial delays. A minor adverse effect occurs when traffic flows are not generally exceeding capacity with the Proposed Scheme but the increase in flows will result in occasional queues and delays or small increases in existing delays.

12.4.25 There will be a loss of approximately 200 private car parking spaces at businesses in the vicinity of the eastern tunnel entrance portal, at Castle Bromwich Business Park. However, the businesses associated with the car parking spaces will be displaced to facilitate the Proposed Scheme and, therefore, the need for these spaces will not exist. No significant parking effects will therefore arise.

12.4.26 The effect on accidents and safety risks will not be significant. There are no locations where there are existing highway safety issues and where there will be substantial increases in traffic during construction.

12.4.27 It is not expected that the construction of the Proposed Scheme will require bus route diversions, as temporary road closures will not be required in this area.

12.4.28 Rail possessions will be required within this area. Disruption to rail users will be minimised by limiting possessions, where reasonably practicable, to overnight, off-peak or weekend periods. There are not expected to be any significant effects on the travelling public from rail possessions or blockades in this area. Where necessary, rail replacement services will be provided.

12.4.29 It is not expected that footways will need to be diverted or closed during the construction of the Proposed Scheme.

Cumulative effects

12.4.30 The assessment includes cumulative effects of planned development during construction by taking this into account within background traffic growth.

12.4.31 The assessment also includes in-combination effects by taking into account traffic and transport impacts of works being undertaken in the Coleshill Junction area (CFA19), Balsall Common and Hampton-in-Arden area (CFA23), Birmingham Interchange and Chelmsley Wood area (CFA24) and Washwood Heath to Curzon Street area (CFA26). Daily construction traffic flows of up to 580 cars/LGV and up to 854 HGV, as generated from compounds in the adjacent CFAs, have been assigned across various routes in this area.

Permanent effects

12.4.32 Any permanent effects of construction have been considered in the operations phase assessments for traffic and transport in Section 12.5. This is because the impacts and effects of the forecast increases in travel demand and the wider impacts and effects of the operations phase need to be considered together.

Other mitigation measures

12.4.33 The implementation of the draft CoCP (see Volume 5: Appendix CT-003-000) in combination with the construction workforce travel plan will, to some degree, mitigate the transport related effects during construction of the Proposed Scheme. The reductions in effects arising from the travel plan measures have not been included in the assessment as presented in this section, which will mean the adverse effects may be over-stated.

12.4.34 No further traffic and transport mitigation measures during construction of the Proposed Scheme are considered necessary, based on the outcomes of this assessment.

Summary of likely significant residual effects

12.4.35 The most intensive peak periods of construction will cause increases in traffic which will affect pedestrians and cyclists crossing Tameside Drive and Langley Drive.

12.4.36 The significant effects that result from construction of the Proposed Scheme are shown on Volume 5: Maps TR-03-156b to TR-03-158a.

12.5 Effects arising from operation

Avoidance and mitigation measures

12.5.1 The following measures have been included as part of the design of the Proposed Scheme and will avoid or reduce impacts on transport users:

- the route will be in a 2.9km tunnel from east of where the A452 Chester Road crosses the route to the west of where the A4040 Bromford Lane crosses the route; and
- provision of a replacement bridge on the B4118 Birmingham Road/Water Orton Road, over the M6, A452 and the Proposed Scheme.

12.5.2 The framework travel plan will set out how travel plans will be used to mitigate the impacts of traffic and transport movements associated with the maintenance and operation of the Proposed Scheme. In relation to this area, a workplace travel plan will be used to mitigate travel impacts from the proposed Washwood Heath depot (CFA26) located on the border of this CFA, and station travel plans to mitigate impacts associated with the stations at Curzon Street (CFA26) and Birmingham Interchange (CFA24).

Assessment of impacts and effects

12.5.3 The following section considers the impacts on traffic and transport and the consequential effects resulting from the operational phase of the Proposed Scheme.

12.5.4 The operational traffic and transport impacts within this CFA will be:

- increase in rail capacity and reduced rail journey times between London and Birmingham due to the close proximity of the stations at Curzon Street (CFA26) and Birmingham Interchange (CFA24) and the opportunity to use released capacity;
- passenger demands to and from the stations at Curzon Street (CFA26) and Birmingham Interchange (CFA24), and their associated access journeys; and
- staff demands to and from the Washwood Heath depot (CFA26), and their associated journeys.

12.5.5 The Proposed Scheme will generate significant major beneficial effects for rail passengers in the Castle Bromwich and Bromford area in 2026 and 2041. They will benefit from an increase in rail capacity from the Proposed Scheme services and from significantly improved journey times between Birmingham and London through convenient access to the stations at Birmingham Interchange (CFA24) and Curzon Street (CFA26).

12.5.6 There will also be significant major beneficial effects to local commuters from released capacity on the existing classic rail network, including reduced crowding and the potential for additional services.

12.5.7 In 2026 and 2041 the primary benefits will be shorter journey times, increased reliability, reduced crowding, support for options for growth and increased access to wider national rail destinations.

12.5.8 There will be no operational traffic and transport impacts as a direct result of the Proposed Scheme within this area, because the route is largely in tunnel, includes a bridge on the B4118 Birmingham Road/Water Orton Road and the maintenance of the Proposed Scheme will generate limited vehicular trips.

12.5.9 However, the Proposed Scheme includes stations at Curzon Street (in Birmingham city centre), and at Birmingham Interchange (in Solihull), both of which are located in nearby CFAs. Whilst traffic and transport effects due to passengers alighting and departing HS2 services are concentrated around the station locations, traffic will travel through this area to access the stations. As a result, there will be an increase in traffic flows on the A47 Fort Parkway, A38 Tyburn Road and A452 Chester Road. The forecast distribution of trips to the proposed stations results in vehicle trips being spread out across several routes and, therefore, the effect on the routes within this area will not be significant.

12.5.10 The proposed Washwood Heath depot (located in Washwood Heath to Curzon Street (CFA26)), will be accessed from the A4040 Bromford Lane, which is within this area. It is expected that the Washwood Heath depot will operate a shift pattern, with changeover times that do not coincide with the morning and evening peak periods on the local road network. Therefore, any traffic and transport impacts due to the depot will be during off-peak periods, and significant effects will not arise. In addition, the trips generated by the Washwood Heath depot are forecast to be less than those produced by the existing businesses that will be displaced.

12.5.11 The Proposed Scheme will result in the permanent loss of approximately 200 private car parking spaces at businesses in the vicinity of the eastern tunnel entrance portal, at Castle Bromwich Business Park. However, the businesses associated with the car parking spaces will be displaced to facilitate the Proposed Scheme and, therefore, the need for these spaces will not exist. No significant parking effects will therefore arise.

12.5.12 The Proposed Scheme in this area will have no significant effects on public transport, vulnerable road user delays, accidents and safety, severance and waterways.

Cumulative effects

12.5.13 The assessment includes the cumulative effects of planned development during operation by taking this into account within the background traffic growth.

12.5.14 The assessment also includes in-combination effects, by taking into account traffic and transport movements which pass through the area to access the proposed stations at Curzon Street (CFA26) and Birmingham Interchange (CFA24) and the proposed Washwood Heath depot (CFA26). In 2026, this equates to 86 vehicle trips from neighbouring CFAs in the morning peak hour and 126 in the evening peak hour. For 2041, traffic flows of 128 (morning peak) and 208 (evening peak) have been included in the assessments. The traffic flows are assigned across various routes in this area.

Other mitigation measures

12.5.15 The framework travel plan will require travel plans to be used to mitigate the impacts of traffic and transport movements associated with the maintenance and operation of the Proposed Scheme. The effects of the travel plan measures for the Washwood Heath depot (CFA26), and stations at Birmingham Interchange (CFA24) and Curzon Street (CFA26) have not been included in this assessment which will mean that the adverse effects may be over-stated.

12.5.16 No further mitigation measures for the operation of the Proposed Scheme are considered necessary, based on the results of this assessment.

Summary of likely significant residual effects

12.5.17 The Proposed Scheme will provide increased capacity on the Proposed Scheme train services and associated substantial reductions in journey times between Birmingham and London. The capacity released on the WCML will reduce crowding on local services and provide the opportunity to operate additional services.

12.5.18 No significant residual adverse effects have been identified during operation in this area in 2026 and 2041.

13 Water resources and flood risk assessment

13.1 Introduction

13.1.1 This section provides a description of the current baseline for water resources including surface water, groundwater and the baseline conditions for flood risk. It then reports on the likely impacts and significant effects on these aspects as a result of the construction and operation of the Proposed Scheme.

13.1.2 The main environmental features of relevance to water resources and flood risk include:

- the River Tame, Plants Brook, Dunlop Channel and their associated floodplains;
- the Permeable Superficial and Arden Sandstones Secondary A aquifers;
- the Mercia Mudstone Secondary B aquifer;
- three springs arising from the Mercia Mudstone group, at Water Orton, Castle Vale and Bromford; and
- two groundwater dependent terrestrial ecosystems (GWDTEs) at Park Hall nature reserve and Castle Bromwich Local Wildlife Site (LWS).

13.1.3 Key environmental aspects relating to water resources and flood risk include:

- the realignment of the River Tame within Park Hall nature reserve;
- the extension of Plants Brook channel to pass under the route;
- the extension and realignment of Dunlop Channel to pass under the route;
- the construction activities taking place within the floodplain;
- the potential impact on groundwater flow, including springs, within the superficial deposits; and
- the potential impact on groundwater flow to local private abstractions.

13.1.4 Volume 5: Appendix WR-001-000 contains a report on the route wide effects including:

- generic assessments on a route wide basis;
- stakeholder engagement;
- in combination effects;
- a draft operation and maintenance plan for water resources and flood risk;

- a Water Framework Directive[88] compliance assessment; and
- a route wide Flood Risk Assessment.

13.1.5 Detailed reports on water resources and flood risk within this area are also contained in the Volume 5 appendices. These include:

- Volume 5: Appendix WR-002-025 -Water Resources Assessment Report;
- Volume 5: Appendix WR-003-025 – Flood Risk Assessment;
- Volume 5: Appendix WR-004-019 – Hydraulic modelling report for the River Tame; and
- Volume 5: Appendix WR-004-020 – Groundwater modelling report for the Bromford tunnel portals.

13.1.6 Map series WR-01, WR-02, WR-03, WR-05 and WR-06 showing details referred to in this report are contained in the Volume 5 Map Book Water Resources.

13.1.7 Discussions have been held with the Environment Agency, Canal & River Trust (formerly British Waterways), Natural England, the Wildlife Trust for Birmingham and the Black Country, Severn Trent Water Ltd and Birmingham City Council (BCC).

13.2 Scope, assumptions and limitations

13.2.1 The assessment scope, key assumptions and limitations for the water resources and flood risk assessment (FRA) are set out in Volume 1 and in the Scope and Methodology Report (SMR) and its addendum presented in Volume 5: Appendix CT-001-000/1 and Appendix CT-001-000/2. This report follows the standard assessment methodology.

13.2.2 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the centre line of the route, except where there is clearly no hydraulic connectivity. For surface water features in urban areas, the extent was reduced to 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at stations and depots, professional judgement has been used in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this spatial scope is defined as the study area.

13.2.3 Site visits were carried out for locations along the route. Site visits, in June 2012 and January 2013, were carried out ate Park Hall nature reserve and the Castle Bromwich and Bromford sections of the Proposed Scheme. Surface water and flood risk site visits have been undertaken at Park Hall nature reserve to visit the proposed area of the River Tame realignment and Plants Brook extension. Due to limited access, a site

[88] *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, European Parliament and European Council, Strasbourg.*

visit to the crossing of the Dunlop Channel was not possible, though the confluence was viewed from Park Hall nature reserve.

13.2.4 Baseline surface water levels, flows and quality have not been monitored as part of this assessment. The assessment is based upon flows provided by publicly available data from the National Rivers Flow Archive[89] for the study area catchments.

13.2.5 Water Framework Directive (WFD) classification data has been made available by the Environment Agency. For surface water bodies that do not have a WFD status class shown in the relevant River Basin Management Plan (RBMP), the status class has been taken as the status class for the first downstream water body for which a status class is reported. Where groundwater does not have a WFD status class shown in the relevant RBMP, these are referred to as 'not assessed by the Environment Agency' in the summary of geology and hydrogeology (Tables 19 and 20 and Volume 5: Appendix WR-002-025).

13.2.6 The key assumptions for water resources and the FRA specific to this area are as follows:

- The River Tame, Plants Brook and Dunlop Channel have some interaction with groundwater (with groundwater providing some of the baseflow to these watercourses), where these watercourses are not significantly lined or culverted;
- the ponds within the Park Hall nature reserve are hydraulically connected with groundwater as water levels in the ponds appear to match the level in the river;
- the baseline groundwater levels and water quality will be identified through future ground investigations prior to construction, as is normal practice;
- the Park Hall nature reserve and Castle Bromwich LWS GWDTEs are at least partially groundwater dependent; and
- for the purposes of groundwater control for tunnelling it is assumed that the tunnel boring machine (TBM) will be operated in closed faced mode when tunnelling within water bearing strata. It is also assumed that the tunnel lining will be designed to minimise water ingress and any leakage rate will be negligible.

13.2.7 The main limitations for the water resources and flood risk assessment in this area are as follows:

- there are limited existing borehole records available along the route with which to understand the local geological and hydrogeological conditions likely to be encountered for areas of underground construction;
- there is limited published information available on the groundwater dependency or hydraulic functioning of the wetland areas of the Park Hall nature reserve and Castle Bromwich LWS GWDTEs which also impacts on the determination of replacement flood storage volumes;

[89] Centre for Ecology and Hydrology (2013). *National River Flow Archive* [Online]. Available at: www.ceh.ac.uk/data/nrfa; [Accessed June 2013].

- floodplain modelling is based on the Light Detection and Ranging (LiDAR) survey data. No surveys have been made of existing structures;
- hydraulic models supplied by the Environment Agency for the Rivers Tame and Rea have been further refined to enable their use relating to the Proposed Scheme. Model reports clarifying these changes, and limitations, are included with the FRA in Volume 5: Appendix WR-003-025; and
- groundwater level data from the Environment Agency and other monitored locations such as private abstractions are limited in the study area. It is assumed that groundwater levels vary in a similar fashion to topography throughout the study area, with groundwater level contours roughly parallel to topographic contours. In the absence of more detailed information, it has been generally assumed that groundwater levels are within 1m of the ground surface.

13.2.8 Notwithstanding the limitations outlined above, it is considered that an appropriate level of assessment has been undertaken and the conclusions drawn are valid.

13.3 Environmental baseline

Existing baseline – Surface water resources

Surface water features

13.3.1 All water bodies in this study area fall within the Tame, Anker and Mease Catchment within the Humber River Basin District (RBD) as set out within the River Basin Management Plan[90]. This includes the River Tame and the Plants Brook. The River Tame is the most significant watercourse in the West Midlands conurbation, draining a total catchment of 1,500km^2 before discharging into the River Trent at Alrewas. The River Tame catchment upstream of Park Hall nature reserve is approximately 402km^2.

13.3.2 The current surface water baseline is shown on Volume 5: Map WR-01-042 and all surface water features within the study area are assessed within Volume 5: Appendix WR-002-025. The western part of the study area is heavily urbanised, with a number of modified and diverted watercourses. Historically, the River Tame has been altered on numerous occasions and in a number of places for the benefit of industrial development, such as through the Park Hall nature reserve and surrounding floodplain.

13.3.3 The area is within the catchment of the River Tame, with the River Tame and a section of Plants Brook being classified as main rivers. The route will pass in tunnel underneath the River Tame at depth adjacent to the Bromford Drive area. The following watercourses will be crossed by the route:

- River Tame within the Park Hall area (see Volume 5: Map WR-01-042, G5);
- Plants Brook (see Volume 5: Map WR-01-042, G5); and

[90] Environment Agency (2009). *River Basin Management Plan Humber River Basin District*. Bristol, Environment Agency.

- Dunlop Channel (see Volume 5: Map WR-01-042, F5).

13.3.4 Table 19 provides details of surface water features potentially affected by the Proposed Scheme.

Table 19: Surface Water features potentially affected by the Proposed Scheme

Water feature	Location description (map reference[91])	Watercourse Classification[92]	WFD water body and current overall status	WFD status objective (by 2027* as per RBMP)	Receptor Value[93]
River Tame	Flowing from west to east through the study area (SWC-CFA25-001, G5)	Main river	GB104028046840 Moderate	Good potential	High
Plants Brook	Flowing south through Castle Vale to its confluence with the River Tame in the Park Hall nature reserve (SWC-CFA25-002, G5)	Main river from area of A38 Kingsbury Road downstream to confluence with River Tame.	GB104028046860 Moderate	Good potential	High as it flows into the River Tame
Dunlop Channel	Flowing eastwards on the north side of the current Birmingham and Derby lineto its confluence with the River Tame to the west of Park Hall nature reserve (SWC-CFA25-003, F5)	Ordinary watercourse	No status shown in RBMP – assumed status. Moderate	Good potential	High as it flows into the River Tame

* year may vary in different RBMPs

Water Framework Directive status

13.3.5 The Environment Agency has set the objective status under the WFD for the River Tame and Plants Brook by 2027 to be of Good Potential. This is an improvement compared to the current overall status which is Moderate.

Abstractions and permitted discharges

13.3.6 There are no licensed surface water abstractions within the study area[94].

13.3.7 The Environment Agency reports that there are 15 current consented surface water discharges within the study area. There is potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20 cubic metres per day. Details are provided in Volume 5: Appendix WR-002-025.

[91] Map reference relates to the labelled watercourse crossing, and alpha-numeric grid on Volume 5: Map WR-01-042.
[92] Environment Agency water-feature classification: The Land Drainage Act 1991 defines an Ordinary watercourse as 'A watercourse that is not part of a main river, all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows'. 'Main Rivers' are larger rivers and streams designated by DEFRA, main rivers are regulated by the Environment Agency.
[93] For examples of receptor value see Table 43 in the addendum to the SMR.
[94] Public water supply abstractions not included.

Existing baseline – groundwater resources

Geology and hydrogeology

13.3.8 The location of abstractions, geological formations and indicative groundwater levels, where available, are shown on Volume 5: Map WR-02-025.

13.3.9 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 20. Unless otherwise stated, the geological groups listed are all crossed by the route.

Table 20: Summary of geology and hydrogeology in CFA25

Geology	Distribution	Formation description	Aquifer classification	WFD body and current overall status	WFD status objective (by 2027* as per RBMP)	Receptor Value
Superficial deposits						
Alluvium	Along the lower slopes of the valley from Park Hall nature reserve to the western end of the study area.	An upper layer of clay or silt, underlain by several metres of pebbly sand and gravel.	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Head Deposits	Along the middle slopes of the River Tame valley.	Gravel or very clayey sand and gravel.	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Glacial Deposits	Isolated pockets within the study area are present at Park Hall nature reserve.	Clay and sandy clay, with lenses of clayey sand and pebbles and cobbles.	Secondary undifferentiated	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Bedrock						
Mercia Mudstone (Mercia Mudstone)	Study area wide	Mudstone and dolomitic siltstone.	GB40402G990800 Secondary B	Poor[95]	Tame, Anker and Mease – Secondary Combined[96] – Good	Moderate
Arden Sandstone (Mercia Mudstone)	Thin horizon within Mercia Mudstone.	Siltstones and sandstones; local beds of conglomerate.	GB40402G990800 Secondary A	Poor	Tame, Anker and Mease – Secondary Combined – Good	Moderate

[95] Environment Agency (2008). *The Tame, Anker and Mease Catchment Abstraction Management Strategy*. Bristol, Environment Agency.
[96] Environment Agency (2009). *River Basin Management Plan Humber River Basin District*. Bristol, Environment Agency.

Superficial deposits

13.3.10 The study area mostly encompasses developed urban and semi urban areas. Made ground has been identified in most available borehole records and is expected to have been derived locally from land raising, as part of general development, as well as highway and railway earthworks in the area. Four historic landfills have been identified – the Sports Ground off Farnborough Road landfill, the Castle Bromwich Waste Treatment Site landfill, Tameside Drive-Langley Drive landfill and the "Land Rear of Freight Rover Works" landfill. All have records of receiving industrial, commercial and household waste.

13.3.11 In addition to the landfill sites, known areas of made ground are present along the Proposed Scheme in the following locations:

- intermittent flood bund on the southern bank of the River Tame which is present throughout the study area;
- infilling of the original River Tame channels present throughout the study area;
- railway land associated with the Birmingham and Derby line throughout the study area;
- earthworks and landscape bunds associated with the construction of the M6 from the western extent of the study area;
- a series of infilled pits and ponds in the Park Hall nature reserve;
- made ground from the Medieval Park Hall Farm, following the footprint of the yard and outbuildings, in the east section of the Park Hall nature reserve; and
- a general distribution of made ground associated with industrial development adjacent to and to the north of the Birmingham and Derby line, between the Minworth Sewage Treatment Works, west of the A452 Chester Road.

13.3.12 Superficial alluvium generally overlays glacial deposits from around Park Hall nature reserve to the western end of the study area. The thickness of this layer varies but it can be up to around 6m in places. In addition, there are areas of river terrace deposits present on the northern side of the River Tame valley near Park Hall nature reserve and Castle Bromwich Business Park. These deposits also extend to Bromford between the A452 Chester Road and the Fort Shopping Centre. Head deposits have also been identified typically 1.5m in thickness, but locally 5m, within the Park Hall nature reserve, on the slopes forming the Tame River Valley, south of the Fort Industrial Park and west of the Bromford Bridge Resident's Club.

13.3.13 Superficial glacial deposits form a discontinuous covering over the solid geology and beneath the made ground, with fluvial and head deposits across the upper parts of the River Tame valley sides. Most of the glacial deposits beneath the study area are sands and gravels, which are extensive but not continuous. The geological map indicates glacial deposits to be present at the east of the study area at Parkhall Wood and again to the south of the Birmingham and Derby line within the Park Hall nature reserve, Castle Bromwich Business Park and west of the A452 Chester Road.

13.3.14 The alluvium and head deposits are classed as Secondary A aquifers, and the glacial deposits are classed as a secondary undifferentiated aquifer.

Bedrock aquifers

13.3.15 The Mercia Mudstone Group is underlain by the Bromsgrove Sandstones of the Sherwood Sandstone Group, which is the Principal aquifer of the Birmingham area. This Bromsgrove Sandstone formation is not mapped as outcropping at the surface within the study area but, based on available borehole logs, was encountered at approximately 60m below ground level towards the western end of the route within the study area. For the purposes of this assessment this aquifer is not considered to be a receptor, therefore this is not considered further.

13.3.16 The Mercia Mudstone Group underlies much of the study area to a depth of at least 60m. The Mercia Mudstone Group typically comprises weak red brown silty mudstone, with minor amounts of carbonate and gypsum when unweathered. The Arden Sandstone Formation occurs within the Mercia Mudstone as a thin horizon of siltstone and sandstone and when unweathered is a medium strong rock. The Arden Sandstone Formation is not mapped as outcropping at the surface in the study area, although British Geological Survey (BGS) borehole records have identified it at about 20m depth at the western end of the study area.

13.3.17 At its eastern limits, the study area crosses the southern side of the River Tame valley. The geology in this area (for approximately 3.8km west of the B4118 Birmingham Road along the route to directly south of the existing Birmingham and Derby line at the River Tame crossing point) comprises Triassic Mercia Mudstone with bands of dolomitic sandstone and siltstone (skerries), overlain by a thin covering of glacial deposits (sand and gravel). The occurrence of the more weathering resistant skerry bands is partly responsible for this topographic feature. Head deposits exist at the base of this feature.

13.3.18 The Mercia Mudstone is a Secondary B aquifer, and the Arden Sandstone within the Mercia Mudstone is classed as a Secondary A aquifer.

13.3.19 Groundwater is expected to be shallow and present within the superficial deposits across this study area. The Mercia Mudstone Group is water-bearing in places by virtue of the siltstones and sandstones of the skerries and the Arden Sandstones.

13.3.20 There are no groundwater source protection zones located within the study area.

13.3.21 The geological formations within this study area are described in Section 8, Land Quality, and further details are included in the Volume 5: Appendix WR-002-025.

Water Framework Directive status

13.3.22 No WFD classification has been given by the Environment Agency to the superficial deposits.

13.3.23 The overall WFD status of groundwater in the study area is summarised in Table 20 and is of Poor Status for the Tame, Anker and Mease – Secondary Combined groundwater body. The main pressures identified by the Environment Agency are

high or rising nitrate concentrations and failures for pesticides and chemicals associated with mine workings across the water body.

Abstractions and permitted discharges

13.3.24 According to Environment Agency and BCC records, there are no licensed groundwater abstractions or private groundwater users abstracting directly from the Mercia Mudstone and Arden Sandstones within the study area. However, there are three licensed groundwater abstractions, which abstract directly from the underlying Bromsgrove Sandstones aquifer. These potential receptors are considered to have a very high value. Due to the depth of the Bromsgrove Sandstones aquifer and that it is overlain by the Mercia Mudstone, these abstractions are not considered as receptors and are therefore not included further in the assessment. There is the potential for unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m^3 per day. The abstraction license details are presented in Volume 5: Appendix WR-002-025.

13.3.25 According to the Environment Agency there are no groundwater discharge consents located within the study area.

Surface water/groundwater interaction

13.3.26 The permeable deposits underlying the River Tame bed and banks would allow significant inflow of shallow groundwater[97], to the river where it is not culverted or heavily modified. The permeable deposits underlying Plants Brook are also likely to contribute to flow.

13.3.27 In order to better understand the likely effects of the proposed tunnel and the east tunnel portal on shallow groundwater and its interaction with the River Tame, a preliminary numerical groundwater model has been developed. The model describes the likely shallow groundwater flow regime in the vicinity of the proposed tunnel portal based on the limited available data. The conceptual model and details of the numerical model are outlined in Volume 5: Appendix-004-020.

13.3.28 Three springs of moderate value have been identified within the study area in close proximity to the route. These springs are considered as surface expressions of the water table. The water table is considered as a receptor and as such the springs are not considered as receptors in their own right as changes to the local water table are likely to be reflected at the springs. The springs are located at:

- works at Water Orton, approximately 190m north of the route at Water Orton;
- the Fort Route, approximately 190m north of the route in the Castle Vale area; and
- parkland, approximately 260m south of the route in the Bromford area.

[97] Knipe, C.V., Lloyd, J.W., Lerner, D.N. and Greswell, R. (1993). *Rising Groundwater levels in Birmingham and the engineering implications*, CIRIA Special Publication, No. 92; Construction Industry Research and Information Association.

Water dependent habitats

13.3.29 There are two GWDTEs, Park Hall nature reserve and the Castle Bromwich LWS, located within the study area. There is limited information available regarding the baseline hydrological condition of these wetlands. In general guidance, these habitats are reported to require "consistently high, but not above-surface, water tables" (SNIFFER, 2009) and are likely to be at least partially dependent on groundwater contributions from the underlying permeable superficial deposits[98]. Information on the ecological value of Park Hall nature reserve and the Castle Bromwich LWS is provided in Section 7, Ecology.

Existing baseline – flood risk

River flooding

13.3.30 The agreed data set for river flooding is the Environment Agency Flood Zone Mapping see Volume 5: WR-01-042.

13.3.31 The Environment Agency records show historic flooding within this study area associated with the River Tame and its tributaries. The river enters this study area within a very heavily modified two stage concrete channel, located under the M6 with piers located in the middle of the channel. As it flows eastwards it meanders south of the Castle Bromwich Business Park and then flows into the area of Park Hall nature reserve in a more natural but still modified channel.

13.3.32 Based on the Environment Agency flood risk mapping, the River Tame is predicted to inundate various areas of the study area during a 1 in 100 annual probability (1%) river flooding event. The areas at risk of flooding, and their value as receptors from a flooding perspective, during a flood event with a 1 in 100 annual probability (1%) of river flooding include: areas south of the Minworth Sewage Treatment Works (less vulnerable of moderate value), the Birmingham and Derby line (essential infrastructure of very high value), Park Hall nature reserve (water compatible of low value) from Parkhall Wood westwards to the Castle Bromwich Business Park (less vulnerable of moderate value), and to the south through a residential area of Bromford (more vulnerable of high value), south of the river. On the north side of the river, there is a small area of land inundated by the 1 in 100 annual probability (1%) river flooding event associated with Plants Brook, and an extensive area within the Bromford and Castle Vale area (Volume 5: Map WR-01-042). The Environment Agency are proposing to construct a Flood Relief Management Scheme in Bromford and HS2 Ltd will continue to liaise with the Environment Agency to consider opportunities at the detailed design stage.

13.3.33 The summary of flood risk presented above is based on the Environment Agency risk of flooding from rivers. The Environment Agency modelling (Volume 5: Appendix WR-004-019) has been refined and updated for this assessment. The flood model extents from the site specific modelling show inundation of the same areas as indicated by the existing Environment Agency flood zone mapping with the key areas

[98] SNIFFER (2009). *WFD95: A Functional Wetland Typology for Scotland*. SNIFFER.

of difference between the Environment Agency baseline model and the refined model being:

- reduced inundation in the Bromford residential area south of the River Tame;
- localised inundation of the Fort Parkway and the industrial/commercial areas to the north, including the existing Jaguar Land Rover Limited plant;
- increased inundation of the existing Birmingham and Derby line and north of the existing Tame channel in Bromford; and
- reduced inundation in Castle Vale and to the western extent for residents south of the River Tame.

13.3.34 This modelling has been used as the description of the current baseline flood risk. The updated results of the modelling are included within Volume 5: Appendix WR-003-025 Flood Risk Assessment and shown in Volume 5: Maps WR-05-157 and WR-05-158a.

Surface water flooding

13.3.35 The agreed data set for surface water flooding is the Environment Agency Flood Map for Surface Water (FMfSW), as shown on Volume 5: Map WR-01-042. Within the study area there are numerous existing overland flow routes and low points that have the potential to be inundated during intense rainfall events. These have the potential to cause localised flooding in the vicinity of the Proposed Scheme.

13.3.36 The Park Hall nature reserve is an area of open ground, and is a wetland nature reserve area. Drainage from this area would be via natural overland flow or infiltration as there is no formal drainage system.

13.3.37 The FRA in Volume 5: Appendix WR-003-025 presents the Environment Agency maps showing areas susceptible to surface water flooding from the FMfSW mapping. The areas susceptible to potential flooding from a 1 in 200 annual probability (0.5%) rainfall event occurring are shown on the Volume 5: Map WR-01-042.

13.3.38 The map shows the existing areas where surface water can collect. These are within the Park Hall nature reserve, the River Tame channel, and isolated zones within the surrounding residential and urban areas. A more significant potential accumulation is towards the eastern end of Bromford Drive, with water greater than 0.3m deep for a 1 in 200 year event being predicted.

Sewer flooding

13.3.39 The agreed data set for sewer flooding is the BCC Preliminary Flood Risk Assessment (PFRA) and the BCC Level 1 Strategic Flood Risk Assessment (SFRA).

13.3.40 The built up residential areas of Castle Vale, Bromford and the surrounding industrial areas are served by traditional urban drainage systems. Surface water from the area generally drains to surface water sewers which outfall into the River Tame. Foul sewer flow enters a combined sewer system and is discharged to the treatment works. At periods of high intensity rainfall, excess flows are discharged via the combined sewer overflows to the watercourses. Within this area there are zones with separate sewers,

private or highway or other council surface water drainage systems that take the surface water directly to the local brooks and watercourses.

13.3.41 Areas of Bromford in the River Tame valley lie below the level of the receiving trunk sewer. Foul and combined sewer networks in this area discharge to the trunk sewer via pumping stations and siphons which traverse the river valley.

13.3.42 The sewage system is predominantly combined and receives domestic and industrial flows as well as surface water. There are some surface water sewers which discharge into the River Tame, including Combined Sewer Overflows.

13.3.43 The FRA (Volume 5: Appendix WR-003-025) includes information on sewers and historic flooding records. Information from the BCC Level 1 SFRA and the BCC PFRA indicates where historic sewerage flooding has occurred. No historic flooding from sewers is shown along the proposed route in the BCC Level 1 SFRA plans.

Artificial water bodies

13.3.44 The agreed data set for flooding from reservoirs is the Environment Agency Reservoir Inundation Map[99].

13.3.45 Flooding from artificial water bodies may occur from failure of a retaining structure which impounds water. The following man-made features have been identified within the FRA (Volume 5: Appendix WR-003-025) as being a potential source of flood risk:

- the canal system; and
- reservoirs.

13.3.46 Within this study area, the route will not cross any canals. The nearest canal is the Birmingham and Fazeley Canal, which is located approximately 750m north of the Bromford tunnel east portal.

13.3.47 It is noticeable that the canal system within Birmingham sits at a low level compared to surrounding land, and therefore, it is considered that it does not pose a flood risk to adjacent land due to a breach. If overtopping occurs, the impact would be localised.

13.3.48 There are a number of water bodies that have the potential of inundating the Tame valley in the vicinity of the Proposed Scheme. These are located within Sutton Park, and drain into Plants Brook. The flooding extents show that the water would be attenuated within the Plants Brook valley upstream of the A38 Kingsbury Road.

13.3.49 In most areas, the extent of inundation will be approximately equivalent to the 1 in 1000 annual probability (0.1%) flood event. However, the Environment Agency data provided does not indicate flood depths, flow velocities or the time taken for onset of flooding after a breach takes place.

13.3.50 The likelihood of such flooding occurring is extremely low and given the distance of the route from the reservoirs and the fact that the Proposed Scheme will not increase the residual risk of reservoir failure, this source of flooding has not been considered

[99] 'Environment Agency (2012). *Reservoir Flood Mapping* [Online]. Available at: http://www.environment-agency.gov.uk/

further within this assessment. Further details can be found in Volume 5: Appendix WR-003-025 Flood Risk Assessment.

Groundwater flooding

13.3.51 The agreed data set for historical incidents of groundwater flooding is the Level 1 BCC SFRA and the PFRA.

13.3.52 Within the BCC SFRA, the risk indicator of flooding from groundwater in the city of Birmingham is high in terms of both probability and consequence.[100] The SFRA states that there is no data on groundwater flooding in the city, but that the risk from rebounding groundwater following a reduction in abstraction is thought to be high. The report contains historical flood risk locations for groundwater flooding, which are included in the flood risk mapping, but no formal investigations have been undertaken. The route will not traverse or pass within 1km of these locations.

Future baseline

13.3.53 Volume 5: Appendix CT-004-000 identifies developments with planning permission or sites allocated in the adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the operation of the Proposed Scheme. The potential cumulative effects arising from committed development in relation to water resources and flood risk have been considered as part of this assessment of the construction and operation of the Proposed Scheme.

13.3.54 All developments are required to comply with the NPPF, development plans and other legislation and guidance. As such committed developments should have a neutral effect on the water resources and flood risk baseline.

13.3.55 Within this area there are no committed developments identified that are likely to cause significant changes to the water resources and flood risk baseline prior to construction of the Proposed Scheme.

13.3.56 WFD future status objectives are set out in Table 19and Table 20. These are not considered to result in significant changes to the reported effects from the Proposed Scheme.

Climate change

13.3.57 Current projections to the 2080s indicate that climate change may affect the future baseline against which the impacts of the Proposed Scheme on surface water and groundwater resources have been assessed. There may be changes in the flow and water quality characteristics of surface water and groundwater bodies as a result of changes in climate. However, except for flood flows described below, these changes are not considered to result in significant changes to the reported effects from the Proposed Scheme changing in significance.

[100] Atkins (2012). *Birmingham City Council Level 1 Strategic Flood Risk Assessment*. Atkins.

13.3.58 Current projections indicate that there will be more frequent, higher intensity rainfall events in the future. The probability and severity of surface water flooding could therefore increase, as surface water drainage systems fail to cope with more frequent, higher intensity storms. Peak river flows during flood events are expected to increase, potentially causing greater depths and extents of flooding.

13.3.59 When considering the influence that climate change may have on the future baseline, against which impacts from the Proposed Scheme on flood risk have been evaluated, the assessment has used the recommended precautionary sensitivity ranges of key parameters, as given in Table 5 in the Technical Guidance to the NPPF[101]. The sensitivity testing undertaken allows for variations in climate change factors included in other national guidance.

13.3.60 Further information on the potential additional impacts of climate change for water resources and flood risk is provided in Sections 7 and 8 of Volume 1 and Table 13 of Volume 5: Appendix CT-009-000.

13.4 Effects arising during construction

Avoidance and mitigation measures

13.4.1 The general approach to mitigation is set out in Volume 1.

13.4.2 The following avoidance and mitigation measures will reduce potentially significant adverse effects on water resources and flood risk to levels that will not be significant. Further details are shown in Volume 5: WR-002-025 and WR-003-025.

13.4.3 Within the Park Hall nature reserve the route will be on viaduct, thus limiting the impacts on the floodplain of the River Tame. Additionally, the route enters a tunnel as it passes westwards thus avoiding impacts on the floodplain in the Bromford area.

13.4.4 The River Tame will require a permanent realignment as a result of the route alignment. The proposed realignment will be along the northern edge of the Park Hall nature reserve, running parallel to the south of the existing River Tame alignment before connecting back to the existing channel close to Minworth Sewage Treatment Works. This design mitigation will ensure that the channel is sufficiently sized, and will maintain the floodplain connection to the River Tame within the Park Hall nature reserve. Consideration will be given in the design to the objectives of the WFD as described in the River Basin Management Plan. This may include the use of soft engineering solutions for bank design, and the inclusion of natural forms such as berms or incorporation of a two-stage channel, riffles and pools and marginal planting, where reasonably practicable. Where possible WFD objectives for Dunlop Channel and Plants Brook will be considered during detailed design in consultation with the Environment Agency and the Wildlife Trust for Birmingham and the Black Country. As the River Tame is being realigned through Park Hall nature reserve the existing connections between the Dunlop Channel and the River Tame and the Plants

[101] Department for Communities and Local Government (DCLG) (2012). *National Planning Policy Framework*. London, DCLG.

Brook and the River Tame are being disrupted. Alternative connections will be provided into the realigned River Tame to match existing structures.

13.4.5 The drainage design will take into account the principles of Sustainable Drainage Systems (SuDS).It is currently envisaged that this will entail the provision of four balancing ponds. These will be located as follows:

- one located immediately north of the Park Hall Wood embankment (see Volume 2: Map CT-06-135, D5);
- one within the triangle formed by the Network Rail Castle Bromwich Curve and the Birmingham and Derby line (see Volume 2: Map CT-06-136, H5, H6, I5 and I6);
- one to the north of the route, west of Plants Brook (see Volume 2: Map CT-06-136, F6 and G6); and
- one at the eastern end of Castle Bromwich Business Park, south of the route (see Volume 2: Map CT-06-136, D7 and E7).

13.4.6 The balancing ponds will provide mitigation to ensure that rainfall run-off from the route will be released in a controlled manner to the receiving watercourses reducing the potential for adverse impact on the water quality and flow of the receiving watercourse. The balancing ponds will be designed where practicable to discharge at existing run-off rates and will accommodate events up to and including the 1 in 100 annual probability (1%) event including an allowance for climate change.

13.4.7 Measures to ensure the minimisation of any effects on groundwater during the construction of cuttings and excavations, utility diversions and permanent groundwater effects due to the presence of the east tunnel portal cutting are included within the draft CoCP (Section 16). Further details of the cuttings and excavations are summarised in Volume 5: Appendix WR-002-025. The following measures will reduce adverse potential permanent effects on groundwater flow, to levels that will not be significant. Measures will be implemented, where appropriate, following detailed pre-construction ground investigations and may include:

- installing cut-off structures around excavations, which are removed or broken through following construction;
- where practicable ensure 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;
- incorporate passive bypasses within the design, which could comprise a 'blanket' of permeable material, such as gravel, placed below cuttings or around structures allowing groundwater to bypass the foundations of the viaducts and bridges, without a rise in groundwater levels on the upstream side; and

- pumping excess groundwater from the portal area to maintain acceptable groundwater levels.

13.4.8 The Proposed Scheme has been incorporated into the refined river hydraulic model of the River Tame to produce a site specific post development model. A range of flood events has been simulated within this model to determine the impact caused by the Proposed Scheme on the performance of the River Tame during extreme flood conditions. The design elements that have a flood risk consideration associated with the Tame or its tributaries are:

- Bromford tunnel east portal;
- Dunlop Channel inflow;
- Plants Brook inflow; and
- works at Park Hall nature reserve including the realignment of the River Tame and re-grading of the floodplain.

13.4.9 For the area around the east tunnel portal, the results from the site-specific modelling show the tunnel portal location and associated infrastructure will not change the flooding extent generated during a 1 in 100 annual probability (1%) river flooding event including an allowance for climate change.

13.4.10 The earthworks of the Proposed Scheme and realignment of the River Tame will result in a loss of existing flood plain storage in the Park Hall nature reserve. The design will include two areas providing replacement flood storage. These will be located in the area of Park Hall nature reserve south of the route and the proposed River Tame realignment shown on Volume 2: Map CT-06-136. The replacement floodplain storage area will provide storage for events up to and including the 1 in 100 annual probability (1%) river flood event including allowance for climate change.

13.4.11 The results from the site specific modelling show the post development situation with the replacement floodplain storage option developed to mitigate flood risk from the Park Hall nature reserve channel realignment, including the links with the Plants Brook and the Dunlop Channel, will not cause an increase in risk to third parties for events up to the 1 in 100 annual probability (1%) river flood event including allowance for climate change. Flood levels within Park Hall nature reserve are predicted to increase by up to 30mm for the 1 in 100 annual probability (1%) river flood event including allowance for climate change. This will result a minor adverse impact but due to the water compatible value of the Park Hall nature reserve the resulting effect will not be significant.

13.4.12 To ensure no significant increase in flood risk, the design includes the provision of flood culverts and flood arches to ensure connectivity of potential flood flow routes in the study area so that there will be no significant change to surface water flow paths across the route.

13.4.13 The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme (Volume 5: Appendix CT-003-000). It will provide effective management and control of the impacts during the construction period.

13.4.14 The following measures in the draft CoCP will reduce potentially significant effects on water resources and flood risk:

- method statements for surface water crossings and realignments/diversions, in consultation with the Environment Agency and other relevant regulators, to ensure any temporary impacts on surface water and groundwater quality, and flow are acceptable. This will ensure that there will be no significant effect on surface water quality or flows associated with construction;
- implementing, in consultation with the Environment Agency and Lead Local Flood Authorities (LLFA), a surface water and/or groundwater monitoring plan as required, particularly in relation to works which may affect groundwater sensitive areas, such as within the Bromford tunnel east portal excavation area;
- undertaking further site-specific risk assessments associated with excavation work and impacts on surface water, groundwater and aquifers. For example, the Water Orton cutting as the route approaches the Bromford tunnel east portal;
- preparing further site-specific flood risk management plans for those construction areas at risk of flooding i.e. areas within the Park Hall nature reserve;
- a requirement for contractors to pay due consideration to the impacts of extreme weather events and related conditions which may affect water resources and flood risk during construction; and
- following the measures outlined for the provision of suitable site drainage at compounds and satellite compounds for the storage and control or oils and chemicals and to mitigate against accidental spillages.

13.4.15 In accordance with the draft CoCP, Section 16, monitoring will be undertaken in consultation with the Environment Agency prior to, during and post construction, if required, to establish baseline conditions for surface water and groundwater and to confirm the effectiveness of agreed temporary and permanent mitigation measures.

Assessment of impacts and effects

13.4.16 This section describes the significant effects following the implementation of avoidance and mitigation measures.

13.4.17 Further details of the potential impacts that will not have significant effects are provided in the Water Resources Assessment report in Volume 5: Appendix WR-002-025 and Flood Risk Assessment in Volume 5: Appendix WR-003-025.

13.4.18 An assessment of the impact on the WFD status is detailed within the WFD Compliance Assessment, contained within the route wide Water Resources appendix (Volume 5: Appendix WR-001-000).

13.4.19 It is not considered that projected climate change effects, combined with the effects from the construction of the Proposed Scheme, will alter the significance of any of the reported effects on surface water, groundwater and water dependent habitats (see Volume 3: Route-wide effects assessment for further information).

Temporary effects

Surface water

13.4.20 The assessment shows that there will be no significant temporary adverse effects on surface water resources during the construction period.

Groundwater

13.4.21 The assessment shows that there will be no significant adverse effects on groundwater, GWDTEs, and groundwater/surface water interaction during the construction period.

Flooding

13.4.22 The assessment has identified no significant increase in risks resulting from all sources of flooding during the construction process and therefore no significant temporary adverse effects.

Cumulative effects

13.4.23 There are no committed developments that have been identified which will result in significant cumulative temporary effects.

Permanent effects

Surface water

13.4.24 Subject to the correct implementation of all mitigation measures there are considered to be no significant adverse effects on surface water following the construction period.

Groundwater

13.4.25 The east portal for the tunnel section will be located within the Castle Bromwich Business Park. The tunnel portal will include walls constructed around the portal. These walls will extend through the superficial deposits into the underlying Mercia Mudstone bedrock. This could result in a moderate adverse impact and a significant effect to local groundwater levels and flows.

13.4.26 Further assessment will be undertaken prior to construction to better understand and verify the magnitude of this effect. Further detail is contained in Volume 5: Appendix WR-002-025 Water resources assessment report. Potential further mitigation for this is described below.

13.4.27 There are considered to be no further significant permanent effects arising during construction.

Flood Risk

13.4.28 The potential for localised increases in groundwater levels, affecting the risk of groundwater flooding, in the vicinity of the east tunnel portal has been identified. Further assessment and monitoring will be undertaken during construction.

13.4.29 The assessment shows there will be no other significant permanent adverse effects on flood risk.

Other mitigation measures

13.4.30 No other mitigation measures are considered necessary for surface water.

13.4.31 With regard to groundwater in the vicinity of the tunnel east portal and potential impact on groundwater flood risk, should the further assessment identify a significant effect on groundwater levels and flow, this permanent effect could be mitigated by a variety of measures such as the inclusion of additional bypass drainage and if deemed necessary, temporary pumping when groundwater levels are high.

13.4.32 This will allow groundwater to bypass the portal without a rise in groundwater levels on the upstream side and will reduce the effect on groundwater and groundwater flooding to not significant. No other mitigation measures are considered necessary for groundwater.

13.4.33 Discussions have been held with the Environment Agency and the Wildlife Trust for Birmingham and the Black Country regarding the restoration of Park Hall nature reserve. This engagement will continue with the aim of developing a mutually acceptable restoration plan for the site. In line with WFD aims the project will also discuss appropriate restoration decisions for extension of Plants Brook channel and the extension and realignment of Dunlop channel.

13.4.34 No other mitigation measures are considered necessary for reducing flood risk.

Summary of likely significant residual effects

13.4.35 Following mitigation, including the application of the measures outlined within the draft CoCP, no significant residual adverse effects to water resources and flood risk have been identified within the assessment.

13.5 Effects arising from operation

Avoidance and mitigation measures

13.5.1 Generic examples of design and management measures that will mitigate impacts so that there will be no significant adverse effects on the quality and flow characteristics of surface watercourses and groundwater bodies during operation and management of the Proposed Scheme are described in Volume 1 and in the draft operation and maintenance plan for water resources and flood risk included in Volume 5: Appendix WR-001-000.

13.5.2 Specific design measures that mitigate/reduce impacts to levels that are not significant in relation to water quality and pollution risk include the balancing ponds incorporated within the design of the Proposed Scheme. The locations of these are described in Section 13.4. The balancing ponds are primarily for balancing run-off, as well as providing water quality benefits. The design has included the provision of access to balancing ponds, watercourses and structures to allow for future maintenance during operation. These mitigation measures will also control discharges from the route and result in a negligible effect on water quality for the River Tame and Plants Brook.

13.5.3 Operation and management of the Proposed Scheme is not likely to have a significant adverse effect on flood risk anywhere in the catchments through which it passes. Generic examples of management measures that may mitigate flood risk are described in Volume 1 and Volume 5: Appendix WR-003-025.

Assessment of impacts and effects

13.5.4 There are considered to be no significant adverse effects on water resources or flood risk arising from operation of the Proposed Scheme.

Other mitigation measures

13.5.5 There are considered to be no further measures required to mitigate adverse effects on surface water resources or groundwater resources or flood risk.

Summary of likely significant residual effects

13.5.6 There are considered to be no significant residual effects to surface water, ground water or flood risk arising from operation of the Proposed Scheme.

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