LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA6 | South Ruislip to Ickenham

November 2013

VOL 2

ES 3.2.1.6

LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA6 | South Ruislip to Ickenham

November 2013

ES 3.2.1.6

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.

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

ARUP ATKINS CAPITA ERM

ineco Mott MacDonald PARSONS BRINCKERHOFF TEMPLE URS

High Speed Two (HS2) Limited,
Eland House,
Bressenden Place,
London SW1E 5DU

Details of how to obtain further copies are available from HS2 Ltd.

Telephone: 020 7944 4908

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.hs2.org.uk

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

recycle

Printed in Great Britain on paper containing at least 75% recycled fibre.

Contents

List of figures

List of tables

Structure of the HS2 Phase One Environmental Statement

The 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: CFA 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.
- 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 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 approximately 2023 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 2 operational frequency has been used. For further detail of the anticipated operation of the Proposed Scheme in the South Ruislip to Ickenham area (CFA7), see Section 2.4.

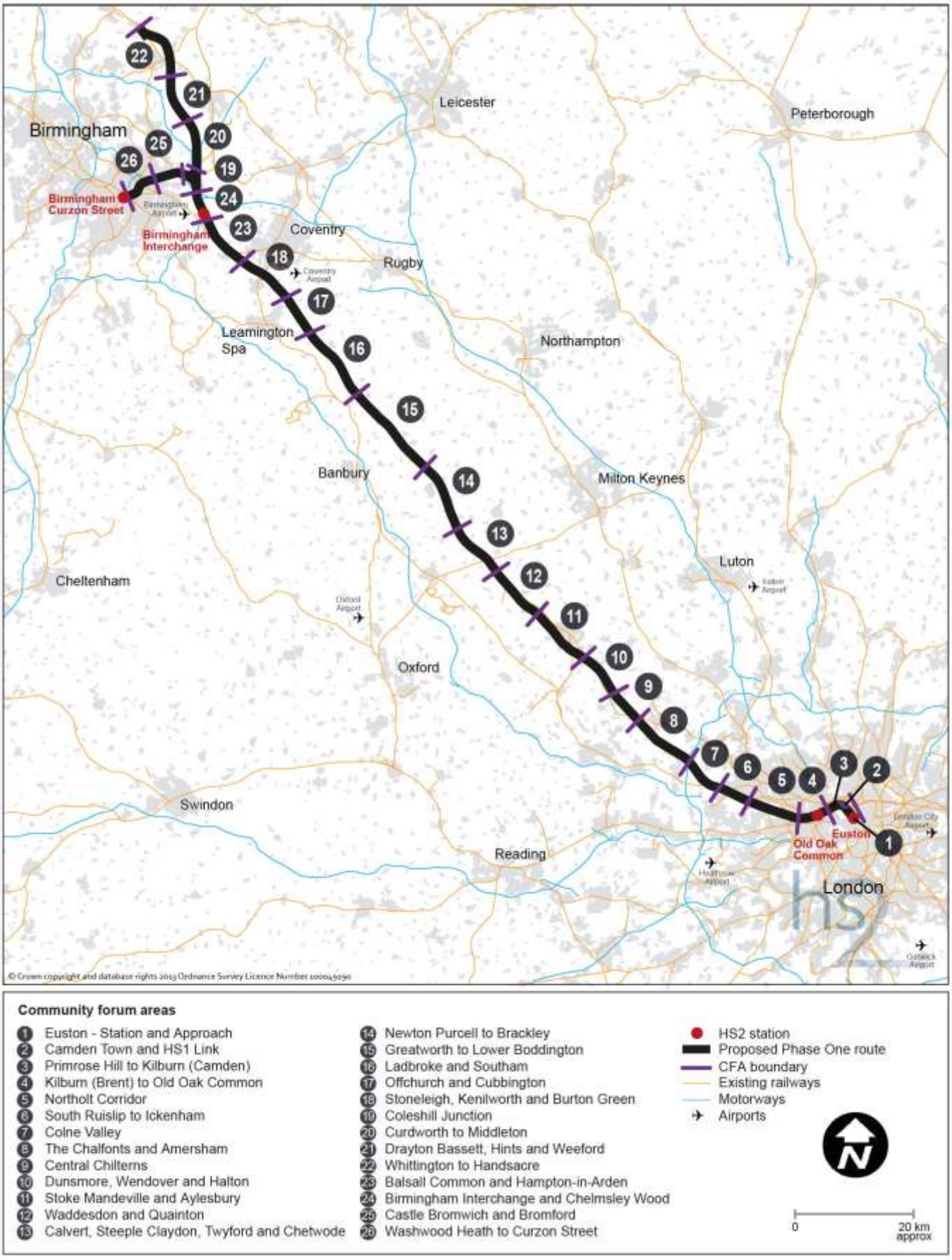
1.1.6 The Government believes that the HS2 network should link to Heathrow and its preferred option is for this to be built as part of Phase Two. However, the Government has since taken the decision to pause work on the Heathrow link until after 2015 when it expects the Airports Commission to publish 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 Proposed Scheme design and on the likely adverse and beneficial effects.

1.2 Purpose of this report

1.2.1 This report presents the likely environmental effects of the construction and operation of Phase One of HS2 (referred to throughout the ES as the 'Proposed Scheme') that have been identified within the area of South Ruislip to Ickenham (CFA6). It provides a summary of the likely environmental effects and proposed mitigation measures within the South Ruislip to Ickenham area.

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 – a summary of the 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 environmental effects arising during construction and operation of the Proposed Scheme; and proposed mitigation measures.

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 the 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 Volume 5 also include additional information about climate change adaptation and resilience, respectively.

1.3.5 The maps relevant to South Ruislip to Ickenham are provided in a separate corresponding document entitled Volume 2: CFA6 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, CFA6 Map Book) and CT-06 (operation) (Volume 2, CFA6 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, Volume 3 also covers climate (greenhouse gas emissions and carbon), electromagnetic interference and waste and material resources. As required, the assessment of some potential environmental effects beyond the CFAs has been undertaken. 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 South Ruislip to Ickenham community forum area (CFA6) covers a 6.7km section of the Proposed Scheme in the London Borough of Hillingdon (LBH). The route extends in tunnel from a point to the south of Rabournmead Drive in the east to West Ruislip portal, with a ventilation and intervention shaft (vent shaft) at South Ruislip. The route then continues on surface to Harvil Road in the west.

2.1.2 As shown in Figure 2, Northolt Corridor (CFA5) lies to the east and Colne Valley (CFA7) lies to the west.

Settlement, land use and topography

2.1.3 The area is predominantly suburban in character in the east and becomes more rural in character north and north-west of Ickenham. The area has a mixed land use pattern of residential properties, industry, open space, farmland and road and rail links. The route will pass to the south of South Ruislip and Ruislip Manor and to the north of Ruislip Gardens and Ickenham (see Maps CT-10-008b to CT-10-010, Volume 2, CFA6 Map Book).

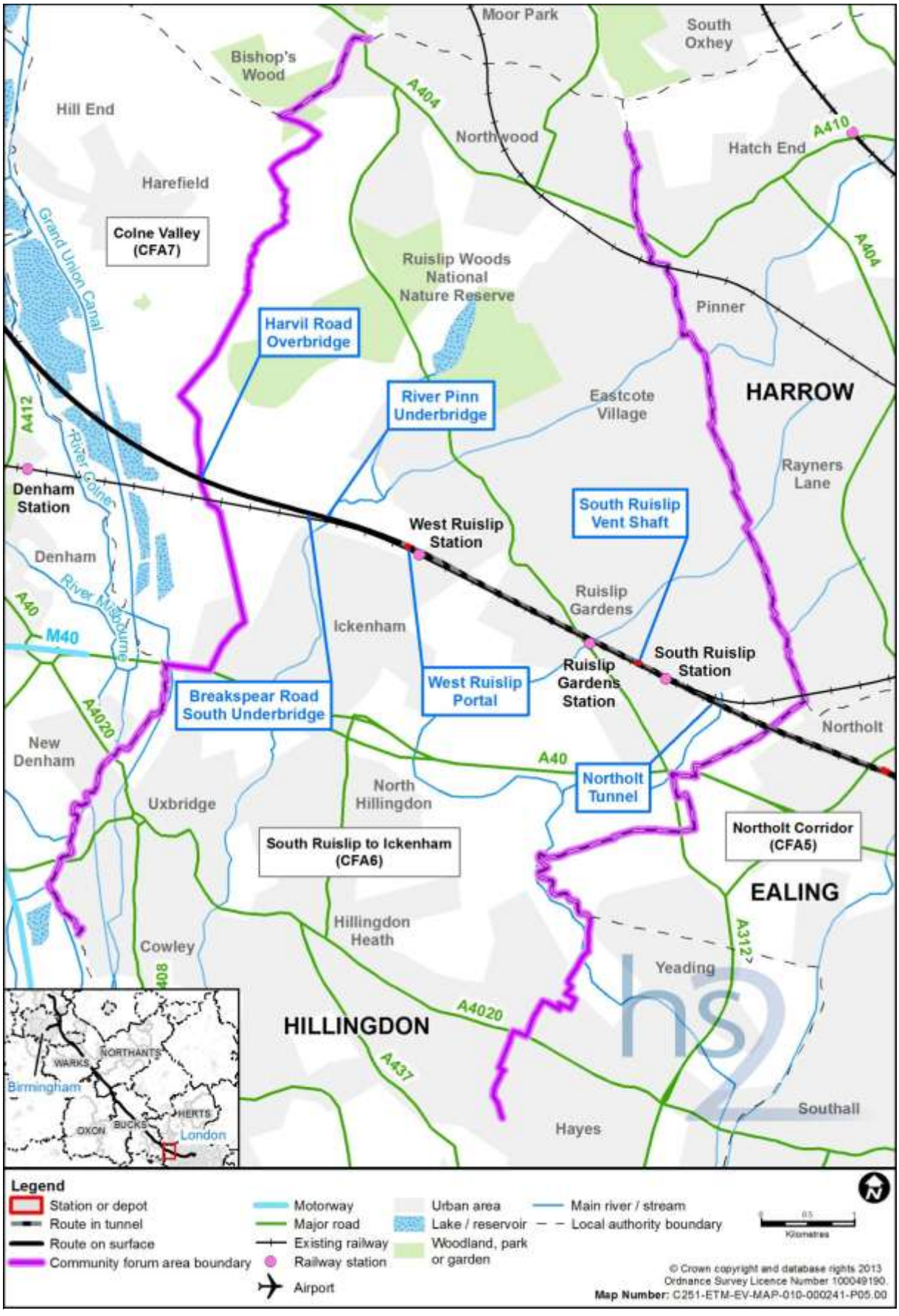
2.1.4 The area is located in a part of London that remained rural in character until the development of the Great Central Main Line in 1899. Following the arrival of the railway network the area saw steady inter-war suburban development, including the construction of residential estates at Ruislip Gardens and Ruislip Manor. A number of Royal Air Force (RAF) bases and aerodromes were also constructed between 1915 and 1920.

2.1.5 South Ruislip and Ruislip Manor are divided by Yeading Brook and comprise large areas of terraced housing with some light industry on Victoria Road. The majority of the Ruislip Gardens area is occupied by RAF Northolt and Northolt Aerodrome. Ickenham mainly comprises inter-war housing with wide streets.

2.1.6 The eastern and western arms of Yeading Brook flow in a north to south direction through the area and cross the route in the vicinity of Victoria Road/Civic Way and to the west of Ruislip Gardens station. The River Pinn also flows in a north to south direction through the area and crosses the route to the east of Breakspear Road South. The Newyears Green Bourne stream crosses Harvil Road at the western end of this section of the Proposed Scheme. Water features are shown on Map WR-01-007 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

2.1.7 The topography of the Ruislip and Ickenham area is generally flat with a small rise and fall between Breakspear Road South and Harvil Road at the western end of this section of the route.

Figure 2: Area context map



Key transport infrastructure

2.1.8 The Chiltern Main Line runs through the area in an east to west direction from the boundary with the Northolt Corridor area (CFA5, south of Rabournmead Drive). The London Underground Central Line runs east to west, parallel to the alignment of the Chiltern Main Line to the western terminus of the Central Line at West Ruislip station is. The Acton to Northolt Line also runs through this rail corridor between Old Oak Common and South Ruislip. The London Underground Metropolitan and Piccadilly Lines run northeast-southwest through the area crossing below the Central Line and Chiltern Main Line to the east of the B466 Ickenham Road.

2.1.9 South Ruislip, Ruislip Gardens and West Ruislip (Central Line) and Eastcote, Ruislip Manor, Ruislip, Ickenham and Hillingdon (Metropolitan and Piccadilly Line) London Underground stations are located in this area. South Ruislip and West Ruislip Network Rail stations are also located in the area. Ruislip London Underground Depot is located between Ruislip Gardens and West Ruislip stations.

2.1.10 RAF Northolt and Northolt Aerodrome are located to the south of the route and accommodate both military and civilian private aircraft.

2.1.11 The A40 Western Avenue runs in an east to west direction through the area to the south of the route. In addition, the A4180 West End Road runs in a south-east to north-west direction through the area and crosses the route at Ruislip Gardens. The B466 Ickenham Road runs in a north to south direction through the area and crosses the route at West Ruislip. The key transport infrastructure is shown in Figure 2: area context map.

Socio-economic profile

2.1.12 To provide a socio-economic context for the area, data for the following demographic character areas (DCA) are used[1]: Newyears Green; West Ruislip; Ickenham; South Ruislip; and Ruislip Manor and Ruislip Gardens. In total, the population of the DCA is approximately 38,800. The area's labour market outperforms England's as a whole; unemployment at 4.8% is lower than the national level of 7.4%, while 75.8% of the population aged 16-74 is economically active compared to the national figure of 69.9%. There are approximately 11,500 people who work within the area[2].

Notable community facilities

2.1.13 The main shops and services are located on Civic Way, Stonefield Way and also Ruislip High Street which is located just outside the study area. In addition, neighbourhood shops are located throughout the residential parts of the area. The Blenheim Day Care

[1] A DCA represents a community that, depending on the area, may consist of a local ward, neighbourhood or village(s). Data comes from the Office for National Statistics (ONS) (2011) Population Census. DCA unemployment rates are aggregated in this section whereas in Section 10.3 they are provided for each DCA.
[2] Data comes from the ONS (2011) Business Register and Employment Survey.

Centre is located on Ickenham Road. There are a number of churches in the area including St. Giles Church on Swakeley Road, the South Ruislip Christian Fellowship Centre Deane Avenue, and the Church of Jesus Christ and Latter Day Saints on Ickenham Road.

2.1.14 Educational facilities in the area include three early-years educational facilities, five primary schools and three secondary schools. West London Tutorial College is located in Hill Rise. There are two doctor's surgeries and one dental practice in the area.

2.1.15 Numerous bridges over the existing Chiltern Main Line and London Underground Central Line provide important community links between the residential areas to the north and south of the route.

Recreation, leisure and open space

2.1.16 There are a wide range of sports and recreational facilities in the area. These include three football grounds/clubs, a branch of the Sea Cadets, two sports and social clubs, a golf course, a rifle club, a cricket club and a fitness centre. Informal recreational space is provided by open space to the south of Ruislip High School and Ickenham Green. Playgrounds are located throughout the residential areas.

2.1.17 Public rights of way (PRoW) are mainly limited to the area around the Ruislip Golf Course. There are two PRoW which cross the Proposed Scheme from north to south. The Hillingdon Trail (Footpath U81 and R146) traverses the Ruislip Golf Course and is adjacent to the Ickenham Stream, which was originally constructed as a feeder for the Grand Union Canal and is also referred to as the 'canal feeder'. The Celandine Route (Footpath U44 and U45) runs along the east of the River Pinn and the western boundary of Ruislip Golf Course.

2.1.18 The principal open spaces in the vicinity of the Proposed Scheme comprise Ruislip Golf Course, King George V Playing Fields/Ickenham Green, Ickenham Marshes Complex (to the northwest of RAF Northolt) and Islip Manor Local Nature Reserve (LNR) which lies just beyond the eastern boundary of this section of the Proposed Scheme in the Northolt Corridor (CFA 5). Some of these areas have ecological designations which are discussed in more detail in Section 7 Ecology.

Policy and planning context

2.1.19 Given that the Proposed Scheme 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 London Plan[3] is the overall strategic plan for London. It sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031 and forms part of the development plan for Greater London. London boroughs' local plans need to be in general conformity with the London Plan and its policies guide decisions on planning applications by councils and the Mayor.

2.1.21 The area falls within the London Borough of Hillingdon (LBH). The following local policies have been considered and referred to where appropriate to the assessment:

- London Borough of Hillingdon Adopted Local Plan: Part 1 (previously the Core Strategy), (2012) [4]; and
- London Borough of Hillingdon, Unitary Development Plan Saved policies (2007)[5].

2.1.22 There are a number of key planning designations in the area, which include scheduled monuments, Grade II listed buildings and parts of three conservation areas. These are shown on Maps CT-10-008b to CT-10-010 (Volume 2, CFA6 Map Book).

2.1.23 Emerging policies are not considered in this report. However, it should be noted that during 2013 the LBH intends to prepare and consult on various components of Part 2 of the Hillingdon Local Plan which will consist of the Development Management Policies, Site-Specific Allocations and an associated Policies Map. However there are no firm timeframes provided for these emerging policy documents

Committed and proposed development

2.1.24 Developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme, are shown on Maps CT-13-008 to CT-13-010 (Volume 5, Cross Topic Appendix 1 Map Book) and listed in Volume 5: Appendix CT-004-000. Except where noted otherwise 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. No developments have been identified which are likely to be constructed at the same time as the Proposed Scheme and therefore no cumulative effects are anticipated.

2.1.25 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. The progress of these proposals is being monitored by HS2 Ltd and appropriate action will be taken, if they are approved.

[3] Greater London Authority (2011) The London Plan, Spatial Development Strategy for Greater London.
[4] London Borough of Hillingdon (2011) Hillingdon Core Strategy, Submission Draft.
[5] London Borough of Hillingdon (1998) Adopted Unitary Development Plan, Saved Policies.

2.2 Description of the Proposed Scheme

2.2.1 The following section describes the main features of the Proposed Scheme in the South Ruislip to Ickenham 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 on the permanent features Map series CT-06 (Volume 2, CFA6 Map Book). 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 south to north along the route (and east to west for features that cross HS2).

2.2.4 Since the draft ES was published the following changes have been introduced to permanent features of the Proposed Scheme:

- the proposed River Pinn and Breakspear Road South bridges will be widened (to accommodate the connection to the temporary railhead), removing the requirement for temporary construction bridges;
- there will be a permanent siding for periodic stabling of track maintenance plant west of Breakspear Road South; and
- three areas for sustainable placement of surplus excavated material, two located between Breakspear Road South and Harvil Road on either side of the existing high pressure gas main and the third on land to the north of Newyears Green Lane and south of Bayhurst Wood.

Overview

2.2.5 The Proposed Scheme through this area will be approximately 6.7km in length. It will enter the area in tunnel in the South Ruislip area at the boundary with CFA5 (Map CT-06-015b, grid reference E6, Volume 2, CFA6 Map Book). It will then proceed north-west in tunnel for approximately 4.4km at an average depth of approximately 30m below ground level. A vent shaft will be located on former industrial land at South Ruislip. The vent shaft comprises a below ground structure and a surface headhouse building.

2.2.6 A tunnel portal will be constructed at West Ruislip, approximately 70m west of Ickenham Road. After gradually returning to the surface on a ramp within the portal structure, the route will be on embankment with bridges across the River Pinn and Breakspear Road South. West of Breakspear Road South the route will initially be on embankment and then in a cutting which will extend to the boundary with CFA7 at Harvil Road, Ickenham. A temporary railhead to facilitate construction works and allow removal of surplus excavated material will be provided between Breakspear

Road South and Harvil Road. A permanent siding for maintenance equipment will be provided west of Breakspear Road South. Key features of the Proposed Scheme are shown on Maps CT-06-015 to CT-06-019, Volume 2, CFA6 Map Book.

Northolt tunnel

2.2.7 The Proposed Scheme will cross the western boundary of CFA5 in twin-bore tunnels. Key permanent features of this section will include the following (see Maps CT-06-015 to CT-06-018):

- two tunnels, of 8.8m internal diameter, of which 4.4km is in this area and with an average depth below ground level of 30m;
- cross passages, between the main tunnels at 380m intervals;
- the South Ruislip vent shaft, located on industrial land to west of the former Arla Dairy site. The structure will be approximately 20m by 35m wide, with a construction depth of 39m and foundations extending to 46m;
- the South Ruislip vent shaft headhouse which will be approximately 19m wide, 44m long and 15m in height;
- an auto-transformer station located adjacent to South Ruislip vent shaft headhouse; and
- a back-up power supply connection is required during operation. The power supply will be provided by two separate routes, one in CFA6 and one in CFA7 (see Maps CT-05-019a, CT-05-019a-L1 and CT-05-019a-L2), to ensure resilience of supply during operation of the scheme. It is intended that the power supply in this area will be delivered through existing powers held by a utility company, outside the hybrid Bill process.

West Ruislip portal and ramp structure (west of Ickenham Road)

2.2.8 The portal and approach ramp will consist of diaphragm walls forming an earth retaining box structure with an approximate length of 520m. It will include the following key permanent features (see Map CT-06-018):

- a ramp structure which will ascend to ground level and consists of diaphragm walls, a porous portal hood and portal structure;
- the covered section of the portal structure will provide a launch chamber for two Tunnel Boring Machines (TBM), with a base slab 15m below ground level;
- a surface headhouse on top of the portal structure, approximately 32m long by 30m wide and 5.5m above the portal;
- diversion of the Ickenham Stream (canal feeder), on the north side of the ramp structure, westwards to the River Pinn;
- realignment of a PRoW, the Hillingdon Trail (U81 and R146), via a footbridge over the ramp structure; and
- modifications to the existing railway adjacent to the portal.

West Ruislip portal to Brackenbury and Copthall cuttings

2.2.9 The Proposed Scheme will continue north-west predominantly on embankment, up to 10m in height, before entering the Brackenbury and Copthall cuttings. The approximate length of this section is 800m. Key permanent features of this section will include the following (see Maps CT-06-018 to CT-06-019):

- diversion of the Ickenham Stream (canal feeder) along the north of the Proposed Scheme for approximately 630m;
- a bridge over the River Pinn at a height of up to 10m;
- an approximate 150m diversion of the Celandine Route PRoW (U44, U45) between the River Pinn and Breakspear Road South to the north of the Proposed Scheme;
- a bridge over Breakspear Road South with a height of up to 7m and a minimum headroom of 5.3m;
- diversion of the access road to the pharmaceutical research facility to the north of the Proposed Scheme and west of Breakspear Road South;
- a diversion of PRoW (U42) of approximately 170m from Breakspear Road South to Newyears Green Lane along the diverted access road to the pharmaceutical research facility;
- a replacement floodplain storage area to the north of the Proposed Scheme and to the east of Breakspear Road South will be excavated and regraded to tie back into the existing ground level;
- a balancing pond to the north of the Proposed Scheme and west of Breakspear Road South for ground drainage associated with the earthworks for the Proposed Scheme;
- diversion of Scottish and Southern Energy (SSE) 11kV overhead power line routes adjacent to the River Pinn and to the north of the Proposed Scheme;
- diversion of utilities which serve the pharmaceutical research facility and run along the new access road; and
- replacement of Affinity Water mains, Thames Water sewers, National Grid gas main and British Telecom (BT) junction boxes and cables in Breakspear Road South.

2.2.10 Areas for ecological and landscape planting have been identified for locations throughout this section of the route, to provide visual screening and habitat creation. Planting areas adjacent to the railway and its associated earthworks throughout this section are illustrated on Maps CT-06-018 to CT-06-019.

Brackenbury and Copthall cuttings and surrounding area

2.2.11 The Proposed Scheme will continue west predominantly in cutting, with a maximum depth of 20m below existing ground level, before passing under the realigned Harvil Road. The approximate length of this section is 1km. Key permanent features of this section will include the following (see Map CT-06-019):

- a retaining structure so the pharmaceutical research facility off Brakespear Road south to the north of the route can be retained;
- a single track siding to allow periodic stabling of track maintenance equipment during operation;
- retaining walls between Breakspear Road South and Harvil Road to allow for future provision of the Heathrow link (referred to as the Heathrow Spur East Chord);
- landscape mitigation earthworks to the south of the Proposed Scheme and north of the Chiltern Main Line, approximately 1km in length, to provide visual screening to receptors to the south; and
- diversion (deepening) of a water main belonging to Affinity Water and National Grid (Gas) high pressure gas pipe in existing tunnels to the west of the Copthall retaining structure to allow for the construction of the cuttings.

2.2.12 Areas for ecological and landscape planting have been identified for locations throughout this section of the route, to provide visual screening and habitat creation. Planting areas adjacent to the railway and its associated earthworks throughout this section are illustrated on Maps CT-06-019 to CT-06-019 (Volume 2, CFA6 Map Book).

Copthall cutting to the western boundary of the South Ruislip to Ickenham area

2.2.13 The Proposed Scheme will continue westwards, predominantly on embankment up to 7m in height, before entering CFA7 to the west of the existing Harvil Road alignment. The approximate length of this section of the route is 100m. Key permanent features of this section will include the following (see Map CT-06-019):

- a section of Harvil Road, approximately 750m in length, will be realigned approximately 75m to the east of its current location and raised by a maximum of 10m to cross over the route of the Proposed Scheme. This will require three new bridges on the realigned Harvil Road over the Proposed Scheme, the Chiltern Main Line and Newyears Green Bourne. A balancing pond will be required to the north of the Proposed Scheme and west of the realigned Harvil Road for highway drainage. The Ickenham auto-transformer feeder station will be located just west of the realigned Harvil Road, to the south of the Proposed Scheme, with an associated access from Harvil Road. This will be located mainly in CFA7 and partly within CFA6;
- a replacement floodplain storage area directly south of Newyears Green Bourne and east of the realigned Harvil Road will be excavated and regraded to tie back into the existing ground level;
- diversion of the PRoW (U34) south along the realigned Harvil Road turning west towards the Colne Valley;
- diversion of the National Grid Electricity 275kV overhead power lines from its existing route within CFA7 to a new crossing adjacent to the re-aligned Harvil Road;

- diversion of Affinity Water main, SSE electricity cables and BT cables in the existing Harvil Road to the new alignment;
- diversion of SSE 11kV overhead power lines to the north of the Harvil Road realignment works and Proposed Scheme;
- diversion of National Grid (Gas) high pressure gas pipe to the north of the Proposed Scheme; and
- three areas have been identified for the sustainable placement of surplus excavated materials. One is located to the north of Newyears Green Lane and two are located on the land between Breakspear Road South and Harvil Road to the south of the Proposed Scheme. The latter areas are divided by the existing high-pressure gas main that splits this section of land. A fourth area is associated with these sustainable placement areas and is located to the south-east of South Harefield in CFA7 and is assessed in the CFA7 report.

2.2.14 Areas for ecological and landscape planting have been identified throughout this section of the route, to provide visual screening and habitat creation. Planting areas adjacent to the railway and its associated earthworks throughout this section are illustrated on Map CT-06-019.

Land required for the Proposed Scheme

2.2.15 The Proposed Scheme will require land on a permanent basis, as illustrated on the permanent features Map Series CT-06 (Volume 2, CFA6 Map Book). Land that will also be required, but only on a temporary basis for construction, is set out in Section 2.3 and illustrated on Map Series CT-05 (Volume 2, CFA6 Map Book).

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the strategy for construction of the Proposed Scheme in the South Ruislip to Ickenham 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
- an indicative construction programme.

2.3.2 The assessment presented in this report 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, CFA6 Map Book). 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; site restoration; and, removal of construction compounds;
- railway installation works, including: establishment of construction compounds; infrastructure installation; connections to utilities; changes to the existing rail network; and, removal of construction compounds; 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 6.4 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 4);
- working hours (draft CoCP, Section 5);
- the management of construction traffic (draft CoCP, Section 14); and
- the handling of construction materials (draft CoCP, Section 5).

Advance works

2.3.7 General information about advance works can be found in Volume 1, Section 6.4. 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

and built heritage survey and investigation;

- land possession;
- site establishment with temporary fence construction; and
- utility diversions.

Engineering works

2.3.8 Construction of the Proposed Scheme will require engineering works along the entire length of the route and within land adjacent to the route. This will comprise of the following two broad types of engineering work:

- civil engineering works, such as bored tunnel and vent shafts, earthworks, retaining structures and erection of bridges and viaducts; and
- railway installation works, such as laying ballasted tracks in open sections and slab track in tunnel sections, traction power supplies, overhead line equipment and communications features.

2.3.9 The construction of the 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 South Ruislip to Ickenham area there will be two main compounds and three satellite compounds used for both civil engineering and railway installation works.

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;
- office space for management staff, limited car parking for staff, site operatives and welfare facilities;
- plant and equipment storage and maintenance; and
- necessary operational parking.

2.3.13 Some compounds will also accommodate additional functions as listed below. Where this is the case they will be included in the description of the compound. Railheads will provide a facility for connecting with the existing railway network to enable loading and unloading to and from trains delivering material to the Proposed Scheme site or removing excavated material.

2.3.14 Further information on the function of compounds, including general provisions for their operation including security fencing, lighting, utilities supply, site drainage and codes of worker behaviour are set out in Volume 1: Section 6 and the draft CoCP, Section 5.

Construction traffic routes

2.3.15 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. Excavated material to be removed from the areas and materials and equipment to be brought into the site will be done using the railheads where practicable. 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.

2.3.16 Movements between the construction compounds and the work sites will be on designated haul roads within the site.

Figure 3: Schematic of site compounds for civil engineering works

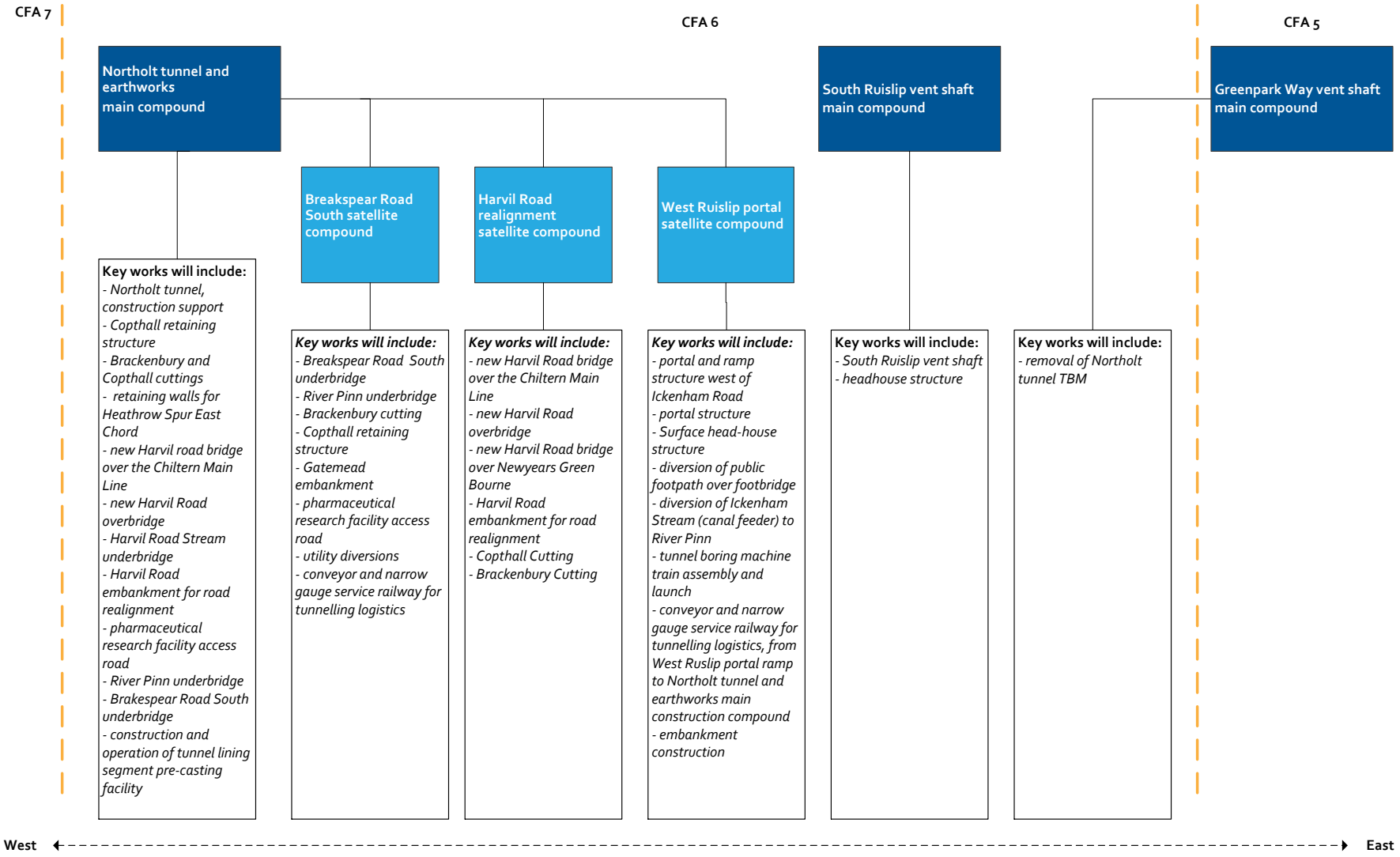
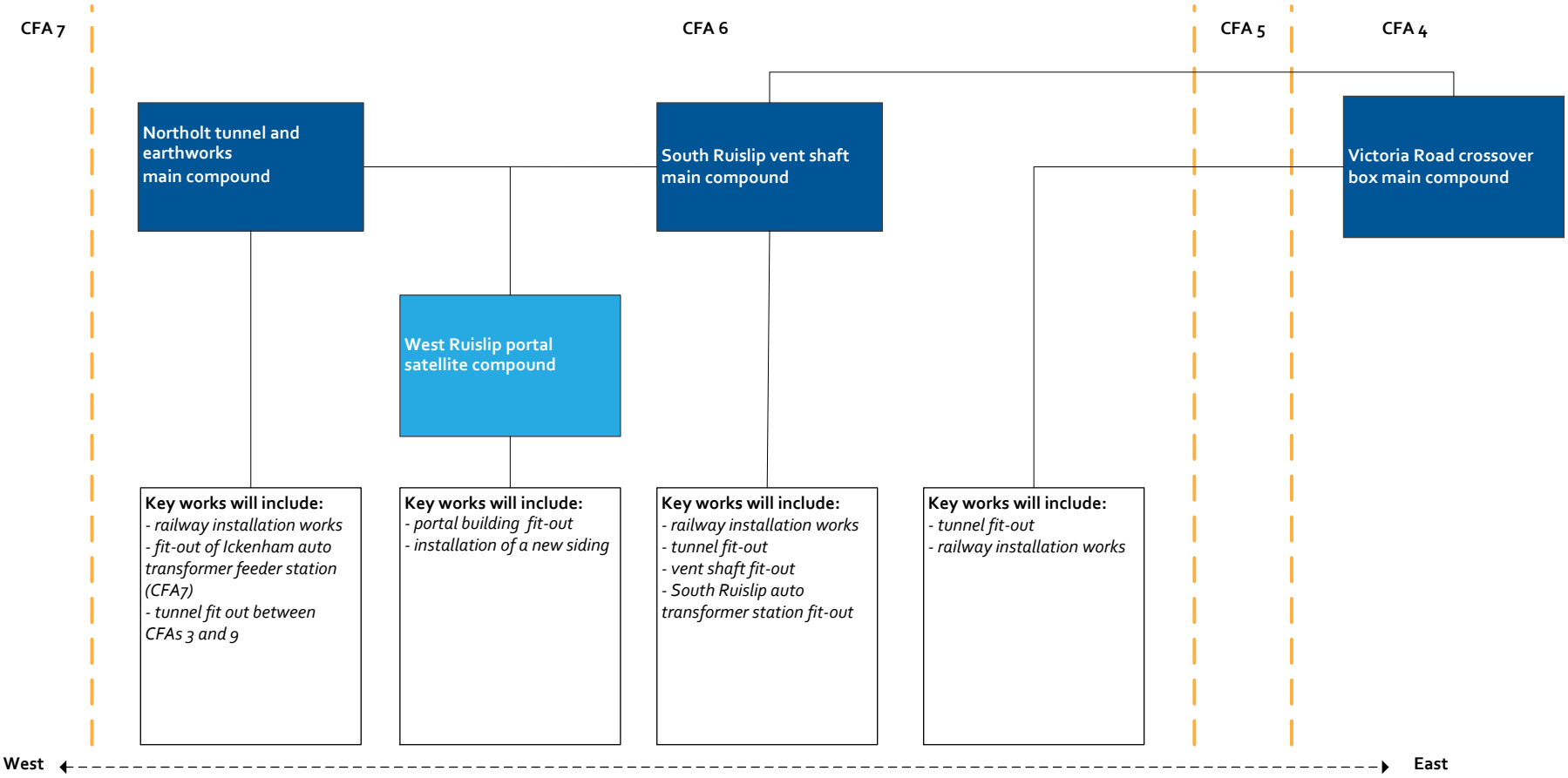


Figure 4: Schematic of site compounds for railway installation works



Victoria Road crossover box main compound

2.3.17 This compound is within the Kilburn to Old Oak Common area (CFA4) but will be used for railway installation works and tunnel fit-out within this area. It will also provide administrative and site management support for railway installation works within the Northolt tunnel and at South Ruislip vent shaft. See the CFA4 report for more information about the compound.

Greenpark Way vent shaft main compound

2.3.18 This compound is within CFA5 but it will provide the facility for the removal of the TBM used to construct the Northolt tunnel, within CFA5 and CFA6. See the CFA5 report for more information about the compound.

South Ruislip vent shaft main compound

2.3.19 This compound will be used for civil engineering and railway installation works for the South Ruislip vent shaft. The compound will:

- be in use for approximately six years starting in 2018. Civil engineering of the vent shaft will take approximately three and a half years with a two-year suspension period between phases of work. It will then be used for access and temporary ventilation of the tunnels. Towards the end of the construction programme, during a period of two and a half years, the vent shaft will be fitted with mechanical and electrical equipment and an auto-transformer station will be installed;
- support approximately 40 workers each day throughout the civil engineering works period, increasing to 42 workers per day during peak periods and support approximately 15 workers each day throughout the rail systems installation works period;
- not provide overnight worker accommodation;
- be accessed via the A40, the A312 Mandeville Road, Eastcote Lane (turning into Field End Road) and then to a private road off Victoria Road; and
- be managed from Victoria Road crossover box main compound (within CFA4) for railway installation works.

2.3.20 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- set-up diaphragm wall plant;
- install diaphragm walls;
- install de-watering system (if required);
- excavate shaft and install propping;
- construct shaft base and walls;

- tunnel breakthrough to form connection with vent shaft;
- internal reinforced concrete fit-out;
- construction of a headhouse;
- rail systems installation; and
- landscaping and planting around the vent shaft site.

2.3.21 Volume 1, Section 5 provides a description of a typical vent shaft and Volume 1, Section 6 describes the activities associated with vent shaft construction.

2.3.22 No demolitions and no road, PRoW or watercourse realignments will be required.

2.3.23 Whilst no diversions of existing utilities will be required, new utilities will be required, the key one being a permanent new 33kV supply, connecting electricity to the Proposed Scheme at the South Ruislip vent shaft and auto-transformer station. In addition, a small water supply and a foul drainage connection for the South Ruislip vent shaft will be needed.

2.3.24 Key railway systems installation works in this section of the Proposed Scheme will comprise:

- installation of the auto-transformer station adjacent to South Ruislip vent shaft headhouse; and
- fit-out of the South Ruislip vent shaft and headhouse.

West Ruislip portal satellite compound

2.3.25 This compound will be used for civil engineering works and railway installation works between Ickenham Road and the River Pinn. The compound will:

- be operational for approximately seven years, comprising civil engineering works for approximately five years, starting in 2017 followed by railway installation works for approximately three years, starting in 2021;
- support up to 120 workers each day through the civil engineering works period and approximately 15 workers each day throughout the railway installations works period;
- not provide overnight worker accommodation;
- be accessed via the A40 Western Avenue, the B467 Swakeleys Road, directly off B466 Ickenham Road or via Hill Lane; and
- be managed from Northolt tunnel and earthworks main compound for both the civil engineering works and the railway systems installation works.

2.3.26 The conveyor and temporary small gauge railway between the West Ruislip portal satellite compound and the Northolt Tunnel and Earthworks main compound will operate 24 hours a day, seven days a week.

2.3.27 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance and enabling works;
- removal of two sidings on the existing railway network adjacent to the portal;
- formation of site access road off Ickenham Road;
- building demolitions;
- diversion of the Hillingdon Trail (PRoW U81 and R146);
- construction of a sewer diversion below the portal ramp structure;
- diversion of Ickenham Stream (canal feeder) to the River Pinn;
- construction of the tunnel portal and ramp structure comprising:
  - a cut and cover earth retained structure forming the TBM launch chamber; and
  - a cut and cover earth retained structure;
- construction of a footbridge and ramp to carry the diverted Hillingdon Trail (PRoW U81) over the Proposed Scheme;
- assembly and launch of TBM for excavation of the Northolt Tunnel;
- construction of a surface headhouse on top of the portal structure;
- formation of the embankment and landscape earthworks;
- highway and PRoW reinstatement;
- fit-out within the portal headhouse building; and
- installation of a new siding on the existing railway network.

2.3.28 The construction of the West Ruislip portal will take approximately seven years. The construction of the portal will involve the provision of a diaphragm wall retaining structure and a top down construction approach will be adopted. A description of the construction methodology is provided in Volume 1, Section 6.

2.3.29 Demolitions in this area are identified in Table 1.

Table 1: Demolitions associated with the West Ruislip satellite compound

Description	Location
The Ruislip Rifle Club	Between the Ruislip Golf Course and the Chiltern Main Line
Part of the driving range shelter	Ruislip Golf Course
An outbuilding	The north-east corner of Ruislip Golf Course car park
A garage	105 The Greenway

2.3.30 The temporary realignment and widening of the private road into Ruislip Golf Course off Hill Lane will be required for a period of approximately four and a half years. The road will be permanently reinstated along the existing alignment.

2.3.31 Diversions of two footpaths will be required:

- permanent realignment of a section of public footpath U81 (Hillingdon Trail) through Ruislip Golf Course. The realignment will be to the east, across a new footbridge and re-join the existing alignment immediately north of the Chiltern Main Line underpass; and
- temporary diversion of footpaths U81 and R146 (Hillingdon Trail), for a period of approximately seven years. The route will be eastwards along Clack Lane, Hill Lane to High Street, Ickenham, southwards along High Street, Ickenham turning west at the junction with the Greenway, along The Greenway to join the southern end of footpath U81. The Hillingdon Trail diversion will continue along High Road, Ickenham before re-joining the existing alignment of the Hillingdon Trail to the south of the junction with The Greenway. Permanent reinstatement will be along the permanent realignment previously described.

2.3.32 Permanent diversions of the following utilities will be required:

- Thames Water (sewerage) Ruislip Bridge sewer at 105 The Greenway (West Ruislip);
- a telecommunications cable along the north of the Proposed Scheme; and
- utilities in Ickenham Road including a National Grid gas main, Affinity Water main, Thames Water sewer and SSE HV cable.

2.3.33 The permanent realignment of a minor watercourse will be required, known as the Ickenham Stream (canal feeder) which will be diverted west to the River Pinn.

Breakspear Road South Satellite Compound

2.3.34 This compound will be used for civil engineering works near Breakspear Road South where it is crossed by the Proposed Scheme. This compound will:

- support the construction of the bridge and embankment works for approximately eighteen months, starting in 2017;
- not provide overnight worker accommodation; and
- be accessed via the A40 Western Avenue, the B467 Swakeleys Road and Breakspear Road South.

2.3.35 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site clearance, fencing, tree removal, topsoil strip and enabling works and site offices establishment;

- construction of a new access road into the pharmaceutical research facility and diversion of all associated utilities and realignment of PRoW U42;
- formation of new site access roads off Breakspear Road South to the east and west;
- excavation and formation of River Pinn flood compensation area to the south of Dunster Cottage, followed by reinstatement of PRoW U43;
- removal of alluvium either side of the River Pinn;
- construction of bridges over Breakspear Road South and the River Pinn;
- formation of embankments either side of the River Pinn bridge and Breakspear Road South bridge with access from Breakspear Road South including embankment for temporary railhead link to Chiltern Main Line;
- installation of diaphragm walls and construction of the Copthall retaining structure for protecting the pharmaceutical research facility building with access from Breakspear Road South;
- construction of a temporary small gauge railway, conveyor and service road for the Northolt tunnel construction works; and
- reinstatement of land use and landscaping.

2.3.36 Demolitions in this area are identified in Table 2.

Table 2: Demolitions associated with the Breakspear Road South satellite compound

Description	Location
12 buildings in the south of the pharmaceutical research facility	West of Breakspear Road South
Gatemead Farmhouse	West of Breakspear Road South and east of the pharmaceutical research facility
A stable and outbuilding at Oak Farm	East of Breakspear Road South and north of the Chiltern Main Line

2.3.37 Diversions of footpaths, cycleways and bridleways will be required:

- permanent realignment of public footpath U45 (part of the Celandine Route), towards the River Pinn immediately north of the Chiltern Main Line bridge;
- permanent realignment of public footpath U46 to the north towards, Oak Farm, between the junction with footpaths U45, U47 and Breakspear Road South;
- temporary diversion of public footpaths U45 and U46 for a period of approximately seven years during bridge construction. Southbound users, along U44 (part of the Celandine Way), will be diverted along footpath U43 between the pastures and Dunster Cottage, to Breakspear Road South before heading south and joining U51;;
- temporary diversion of footpath U43 for a period of approximately 3 months during construction of replacement floodplain storage with permanent

reinstatement along the existing alignment. Users will be diverted along U45 and U46 emerging south of the existing junction of U43 and Breakspear Road South;

- public footpath U47 will be closed for a period of approximately seven years. Northbound users will be diverted south along the Celandine Route before crossing the River Pinn, heading north on Breakspear Road South and joining U46 or U43;
- the Celandine Route in this area passes along the east bank of the River Pinn and utilises PRoW U44, U45 and part of U47. Temporary diversion of the route, for a period of approximately seven years, will use the PRoW diversions outlined previously to access Breakspear Road South. It will then proceed southwards and join PRoW U51, progress along public footpaths U51 and U84 to Copthall Road West and across the footbridge over the River Pinn to re-join the Celandine Route. It will be permanently reinstated along the existing route; and
- permanent realignment of public footpath and bridleway U42 onto the proposed new access road to the north of the current junction.

2.3.38 Permanent diversions of a number of utilities will be required:

- National Grid gas main west of Breakspear Road South bridge (construction of a tunnel under the Proposed Scheme alignment and Chiltern Main Line);
- two Thames Water (sewerage) sewers, in Breakspear Road South;
- SSE 11kV overhead and buried lines, transformer and pole box, east and west of Breakspear Road South;
- BT Openreach overhead and underground lines, joint boxes and distribution points at Gatemead Farm off Breakspear Road South and the existing Harvil Road; and
- National Grid gas mains buried in Breakspear Road South.

2.3.39 Additionally, protection of an Affinity Water cast iron water main in the vicinity of the pharmaceutical facility access road and a permanent replacement of Affinity Water infrastructure in Breakspear Road South will be required.

2.3.40 No diversions of water courses will be required.

Northolt tunnel and earthworks main compound

2.3.41 The compound will initially be used to manage construction and provide logistical support for the Northolt tunnel construction as far as Greenpark Way vent shaft in CFA5 and construction of earthworks (approximately 1.9km in length). On completion of the civil engineering works, this compound will be used predominantly for railway installation works between Primrose Hill to Kilburn (CFA3) and Central Chilterns (CFA9). The compound will:

- be operational for approximately ten years. It will provide support for construction of bridgeworks, earthworks and retaining structures. The railhead will then be established and it will support the construction of the Northolt tunnel and installation of the railway;
- manage all civil engineering works in the South Ruislip to Ickenham area and provide logistics support for the Northolt tunnel (for approximately five years);
- contain a temporary factory for producing pre-cast concrete tunnel lining segments for the Northolt tunnel;
- include a temporary railhead for the removal of surplus excavated material and delivery of railway installations materials, with temporary connections to the Chiltern Main Line;
- be used for the management of sustainable placement areas;
- support up to 200 workers each day throughout the civil engineering works period, increasing to approximately 460 workers during peak periods and support approximately 170 workers each day on average throughout the railway installations works period;
- not provide overnight worker accommodation; and
- be accessed via the A40 Western Avenue, the B467 Swakeleys Road and then Harvil Road or Breakspear Road South.

2.3.42 The conveyor and temporary small gauge railway between the West Ruislip portal satellite compound and the Northolt Tunnel and Earthworks main compound will operate 24 hours a day, seven days a week.

2.3.43 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- diversion of major utilities including 275 kV overhead power lines, gas main (in existing tunnel) and a water-main;
- installation of a new power supply, south of the Chiltern Main Line, which will be used to power TBM during construction and for back-up power supply during operation;
- site clearance, fencing, tree removal, topsoil strip, enabling works and site offices establishment;
- building demolitions;
- construction of three bridges with piled foundations on the realigned Harvil Road;
- construction of retained embankment (Gatemead embankment);
- major earthworks for a length of 700m, comprising the removal of 1.6 million m^3 of material to form the Copthall and Brackenbury cuttings;

- construction and operation of tunnel lining segment pre-casting facility, south of the Chiltern Main Line and establishment of a small gauge tunnel construction railway forms an essential part of the 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 to enable two-way traffic and servicing of cross passage construction;
- construction of the temporary railhead;
- removal of excavated material by conveyor from the tunnels to the temporary railhead;
- movement of surplus excavated material to the sustainable placement sites mainly along purpose built haul routes;
- construction of the Ickenham auto-transformer feeder station west of Harvil Road (within CFA7);
- modification of the temporary railhead for railway installation work following the completion of civil engineering works;
- railway installation works and railway testing and commissioning; and
- reinstatement, landscaping and other environmental enhancements.

2.3.44 Diversions of eight footpaths will be required:

- public footpath U30 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will run north along Harvil Road to footpath U29 before following U29 to its junction with U30. The footpath will be temporarily closed from Harvil Road to footpath U29;
- public footpath U31 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will follow Harvil Road to the north before turning north-east along U29 to path U31. Routes eastwards from here will follow the diversion of U31 below. The footpath will be temporarily closed from Harvil Road to footpath U31;
- public footpath U31 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will be along an unnamed footpath northwards before running eastwards along an unnamed footpath on a farm track towards Bayhurst Wood before turning south towards U35 along another unnamed footpath. The footpath will be temporarily closed from a point approximately 100m east of Park Lodge Farm to the junction with footpaths U35 and U32;
- public footpath U32 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will be along an unnamed footpath on a farm track east towards Bayhurst Wood before turning south towards U35 along another unnamed footpath. The footpath will

be temporarily closed from a point approximately 100m east of Park Lodge Farm to the junction with footpaths U35 and U31;

- public footpath U36 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will run eastwards along Newyears Green Lane, then north along Breakspear Road North before returning south through Bayhurst Wood Country Park following the Hillingdon Trail to U35. The footpath will be temporarily closed between Newyears Green Lane and footpath U35;
- public footpath U37 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will run eastwards along Newyears Green Lane, then north along Breakspear Road North before returning south through Bayhurst Wood Country Park following the Hillingdon Trail to U35. The footpath will be temporarily closed between Newyears Green Lane and footpath U35;
- public footpath U38 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The diversion route will run eastwards along Newyears Green Lane, then northwards along Breakspear Road North. The footpath will be temporarily closed between Newyears Green Lane and Breakspear Road North; and
- public footpath U49 for a period of approximately seven years, with permanent reinstatement along its existing alignment. The footpath will be diverted south along Breakspear Road, then west along Swakeleys Road before returning north along Harvil Road. The footpath will be temporarily closed between Harvil Road and Breakspear Road South;

2.3.45 Permanent diversion of utilities and the installation of new utilities will be required:

- permanent diversion of 275 kV overhead power lines, to remove obstruction to the construction of the Colne Valley viaduct (CFA7);
- permanent diversion of a National Grid high pressure gas main (in existing tunnel);
- permanent diversion of an Affinity Water main; and
- permanent new power supply, water and drainage in the realigned Harvil Road.

2.3.46 No diversions of water courses will be required.

2.3.47 Key railway installation works in this section of the Proposed Scheme will be:

- installation of the Ickenham auto-transformer feeder station west of Harvil Road (within CFA7);
- railway installation works which will include track, overhead line equipment, communications equipment and traction power supply; and

- fit-out of all tunnels between CFAs 3 and 9.

Harvil Road realignment satellite compound

2.3.48 This compound will be used for civil engineering works for Harvil Road realignment. The compound will:

- be operational for approximately five years, starting in 2017;
- not provide overnight worker accommodation; and
- be accessed via the A40 Western Avenue, the B467 Swakeleys Road and Harvil Road.

2.3.49 Works in this section of the Proposed Scheme will be carried out in the following broad phases:

- site offices establishment, site clearance, fencing, tree removal, topsoil strip and enabling works;
- formation of new site access roads off Harvil Road;
- construction of three new bridges for the realigned Harvil Road;
- construction of new embankment supporting Harvil Road;
- diversion of major utilities into the new Harvil Road alignment;
- construction of earthworks 700m in length, Brackenbury cutting and landscape earthworks with access from Harvil Road and Breakspear Road South;
- access for passive provision works on the Heathrow Spur East Chord; and
- demolition of the existing Harvil Road bridge over the Chiltern Main Line to accommodate temporary railhead link.

2.3.50 Demolitions in this area are identified in Table 3.

Table 3: Demolitions associated with the Harvil Road realignment satellite compound

Description	Location
Harvil Road bridge	Over the Chiltern Main Line
Harvil Road bridge	Over Newyears Green Bourne

2.3.51 Diversion of two footpaths will be required:

- permanent realignment of public footpath U34, Harvil Road to Dews Farm, along the proposed access road to the auto transformer feeder station in CFA 7; and
- temporary diversion of public footpath U34 for a period of approximately seven years, with permanent reinstatement as above. The diversion route will be along Harvil Road to the north towards South Harefield.

2.3.52 Diversions of a number of utilities near Harvil Road will be required:

- permanent diversion of National Grid (gas distribution) steel LHP gas transmission main will be required as advance works;
- permanent diversion of Affinity Water cast iron water main; and
- permanent diversion of SSE 11kV overhead and buried high voltage lines.

2.3.53 No diversions of water courses will be required.

Construction waste and material resources

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

2.3.55 The majority of excavated material 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.

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

2.3.57 Sustainable placement of inert surplus excavated material will be used where the material cannot be re-used beneficially along or locally beyond the route and where it cannot be removed by either rail or along the construction corridor. Three areas of sustainable placement will be used within this area to permanently dispose of surplus excavated material generated in this area from the Proposed Scheme to avoid causing significant environmental effects associated with the road transport of that material. The sustainable placement areas of surplus excavated material are located at an area north of Newyears Green Lane and at two areas between Breakspear Road South and Harvil Road.

2.3.58 The quantity of surplus excavated material originating from this area that will require off-site disposal to landfill as excavation waste is shown in Table 4. 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 this 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.

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

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

2.3.60 The quantities of estimated construction, demolition and excavation wastes that will require off-site disposal to landfill are shown in Table 4.

Table 4: 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	5,319,182	16,617
Demolition	15,768	1,577
Construction	136,666	13,667
Worker accommodation site	0	0
TOTAL	**5,471,616**	**31,861**

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

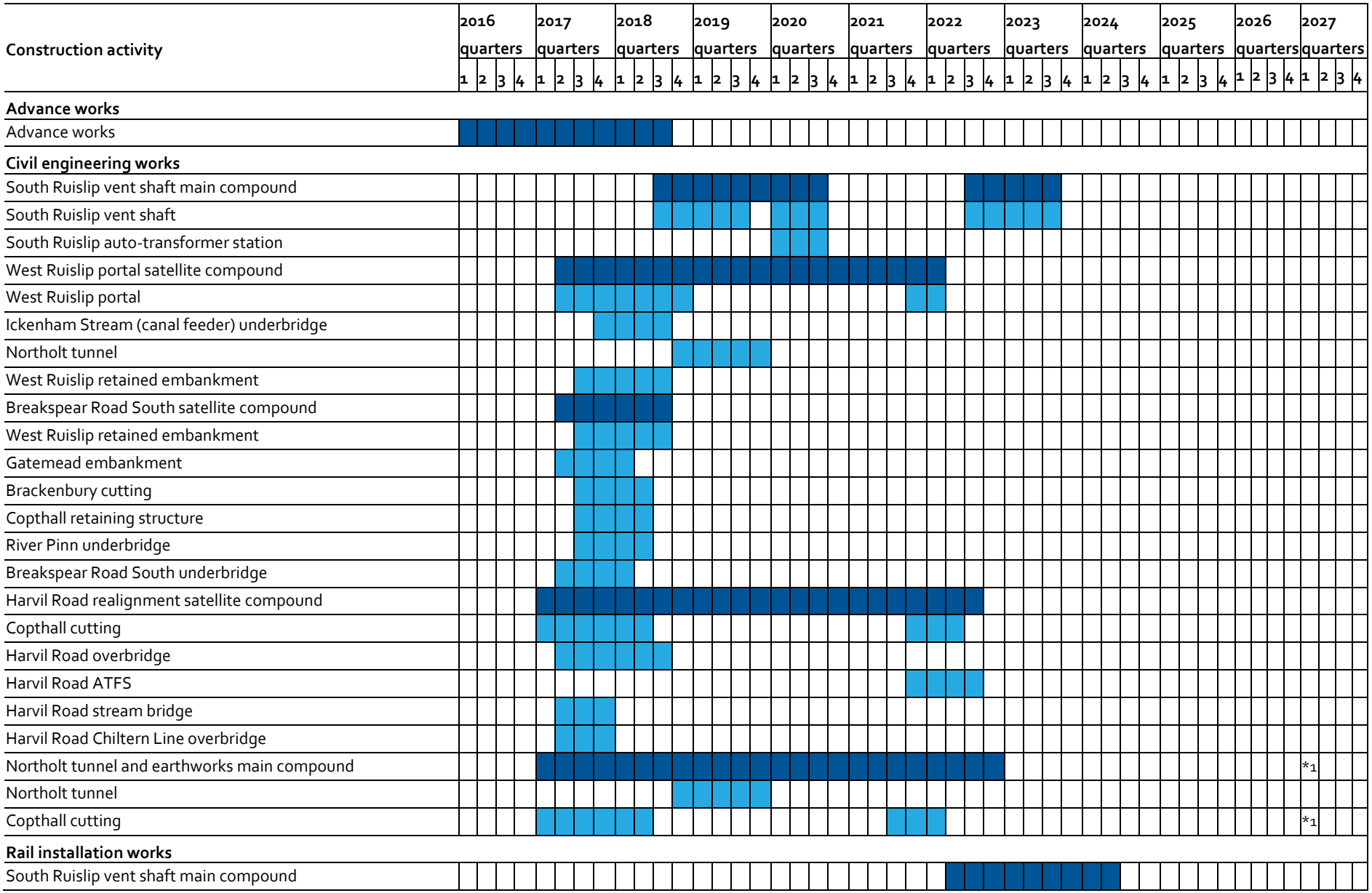
Commissioning

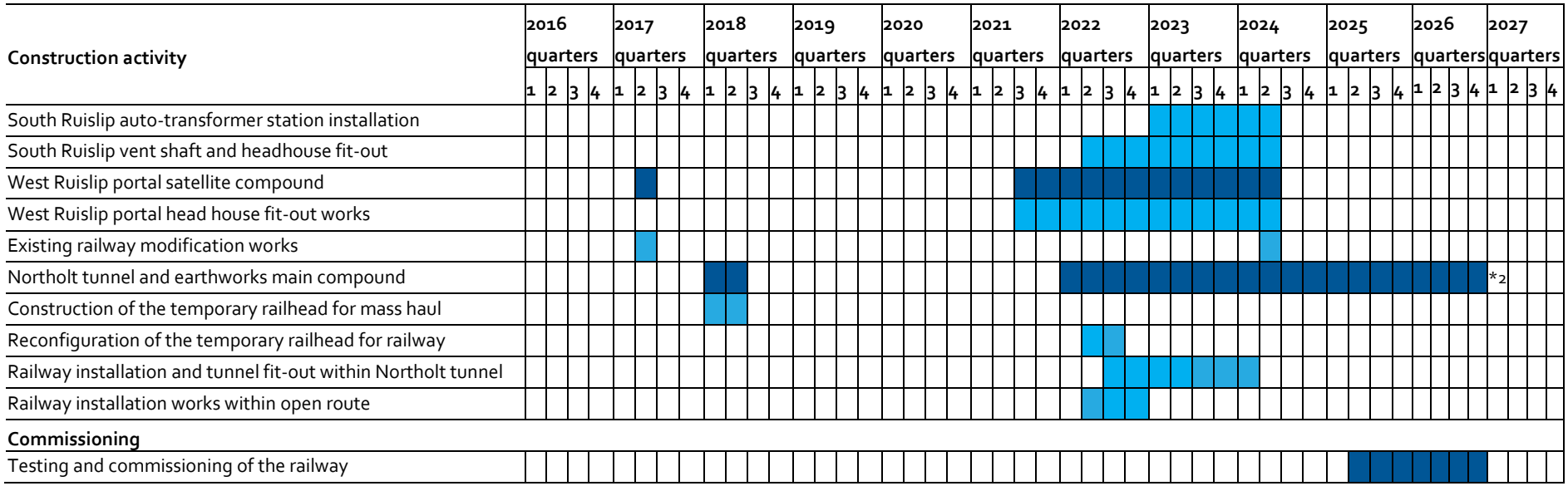
2.3.62 Commissioning is the process of testing the infrastructure to ensure that it operates as expected. This will take place in the year prior to opening. Further details are provided in Volume 1: Section 6.26.

Construction programme

2.3.63 A construction programme that illustrates indicative periods for each core construction activity in this area is provided in Figure 5.

Figure 5: Indicative construction programme





**1 Q1 2027 required for completion of earthworks bund and demobilisation of construction compound*

**2 Q1 2027 required for demobilisation of construction compound*

Key — Construction works — Compound duration

2.4 Operation of the Proposed Scheme

Operational specification

2.4.1 Volume 1, Section 4.4 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 initially there would be 11 trains per hour each way passing through the South Ruislip to Ickenham 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 One in place the frequency of services could rise to 14 trains per hour each way during peak hours and that with Phase Two in place the frequency could rise to 18 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 320kph (200mph). The trains will be either single 200m long trains or two 200m long trains coupled together, depending on demand and time of day.

Maintenance

2.4.5 Volume 1, Section 4.4 describes the maintenance regime for HS2.

2.4.6 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.

2.4.7 Railway maintenance vehicles would be parked either at the Calvert infrastructure maintenance depot, or in the defined maintenance loops along the route. The maintenance loops could also be used in the case that a passenger train could not continue unassisted to its destination.

Operational waste and material resources

2.4.8 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.

2.4.9 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.

2.4.10 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.

2.4.11 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.

2.4.12 The quantity of operational waste that will be re-used, 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%.

2.4.13 On this basis, approximately 98 tonnes of operational waste will be re-used, recycled and recovered during each year of operation of the Proposed Scheme in this area. Approximately 21 tonnes will require disposal to landfill (see Table 5).

Table 5: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste generated per annum (tonnes)	Estimated quantity of waste for disposal per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	110	17
Ancillary infrastructure	9	4
TOTAL	**119**	**21**

2.4.14 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.

2.5.2 A series of community forum meetings and discussions with individual landowners, organisations and action groups were undertaken. Community forum meetings were held on:

- 20 March 2012 at Ruislip Manor Sports and Social Club;
- 14 June 2012 at The Barn Hotel, Ruislip;
- 26 September 2012 at The Barn Hotel, Ruislip;
- 27 November 2012 at The Barn Hotel, Ruislip;
- 25 February 2013 at The Barn Hotel, Ruislip; and
- 16 September 2013 at The Barn Hotel, Ruislip.

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

2.5.4 The main themes to emerge from these meetings were:

- the relocation of services including the need to coordinate the works with third-party utilities to avoid longer than necessary localised disruption;
- the Heathrow spur location being above ground and the construction timetable associated with this;
- methods of tunnel construction;
- environmental surveys;
- the position of the tunnel portal at West Ruislip and the potential extension of the tunnel westward, under the River Pinn;
- noise and vibration during construction and operation, particularly for homes near cuttings and at the tunnel portal;
- concerns over levels of HGV movements in the area during construction; and
- the location of construction sites and a proposed sub-station.

2.5.5 As well as the engagement through the community forums, the draft Environmental Statement 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 Environmental Statement and the development of the scheme. Details of the local consultation events were provided on HS2 Ltd website, social media, posters at local venues, national and regional advertising and to properties within 1km of the Proposed

Scheme. In the South Ruislip to Ickenham area consultations on the draft Environmental Statement and on the Design Refinement were held on:

- 23 May 2013 at the GAA Sports and Social Club; and
- 17 June 2013 at the Perivale Community Centre.

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 Environmental Statement consultation have been analysed and an overview of those received and how the Environmental Statement has taken account of responses is contained in the Draft Environmental Statement 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. 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.

South Ruislip vent shaft

2.6.3 In South Ruislip the Proposed Scheme will include a single vent shaft on the disused South Ruislip 'Arla Dairy' site within a partially derelict retail park. Directly to the south is the London Underground Central Line. Access to the site will be via Victoria Road to the north. This vent shaft location is one of two locations proposed in the January 2012 announced scheme.

2.6.4 The second vent shaft location proposed in the January 2012 announced scheme was a site located in Ruislip Manor on a triangle of woodland between Herlwyn Avenue and Lawn Close. The London Underground Central Line runs directly to the south. This location was discounted at an early stage of alternatives evaluation because construction access was not practicable.

2.6.5 Three alternative sites to the two sites proposed in the January 2012 announced scheme were considered as follows:

- a site located to the west of Beechwood Avenue and Herlwyn Avenue in West Ruislip. The site is currently amenity grassland and lies to the north of the LUL

Central Line;

- a site located within a large area of public open space directly north of Ruislip Gardens station and the existing railway. Yeading Brook runs to the west of the site and existing access is from Bridgewater Road; and
- a site located in South Ruislip on a public car park directly to the south of Sainsbury's superstore and accessed from Long Drive.

2.6.6 The options for configuration that were considered as alternatives to those proposed in the January 2012 announced scheme were:

- a single vent shaft at the site located directly north of Ruislip Gardens station;
- two shafts, one each at the site located to the west of Beechwood Avenue and Herlwyn Avenue and the site located in South Ruislip south of Sainsbury's superstore;
- two shafts one each at locations west of Beechwood Avenue and Herlwyn Avenue and the Arla Dairy site; and
- three shafts, one each at the site located to the west of Beechwood Avenue and Herlwyn Avenue, the site located directly north of Ruislip Gardens station and the site located in South Ruislip south of Sainsbury's superstore.

2.6.7 Specific issues relating to the location of individual options were also considered:

- the site located to the west of Beechwood Avenue and Herlwyn Avenue is close to a primary school and is used as amenity space;
- the site located directly north of Ruislip Gardens station is close to residential property, on grassland and in an area with the potential for flooding; and
- the site located in South Ruislip south of Sainsbury's supermarket would result in a permanent loss of car parking spaces.

2.6.8 The use of one vent shaft, if sited in the appropriate location, was found to meet the engineering design specification requirements. In addition, constructing one site as opposed to two will reduce the cost.

2.6.9 Environmentally, the development of one site reduces the potential for impacts. The site identified was considered suitable as it is located on previously developed land in an industrial setting which is suitable for development.

West Ruislip portal

2.6.10 The Proposed Scheme will site the tunnel portal approximately 70m west of Ickenham Road. The tunnel portal was originally sited directly west of Ickenham Road in the January 2012 announced scheme. The revised location avoids replacement of Ickenham Road bridge and temporary closure of Ickenham Road during tunnel portal construction. Five alternatives were considered for the position of the tunnel portal as follows:

- 650m to the west of the January 2012 announced scheme location;

- 1.15km (0.7 miles) to the west of the January 2012 announced scheme location with portal ramp rising at a gradient of 1.75%;
- 1.15km to the west of the January 2012 announced scheme location with portal ramp rising at a gradient of 3.11%;
- 1.15km to the west of the January 2012 announced scheme location with portal ramp rising at a gradient of 3.35%; and
- 1.15km to the west of the January 2012 announced scheme location with portal ramp rising at a gradient of 3.5%.

2.6.11 A tunnel portal 1.15km (0.7 miles) to the west of the January 2012 announced scheme location with portal ramp rising at a gradient of 3.5% was considered to be the best performing option on environmental grounds as it reduces the effects of operational activities on the residential properties on The Greenway (south of the route). However, this option was not selected due to the significant additional cost associated with the deeper cutting and embankment works required.

2.6.12 The five options with the tunnel portal further to the west were considered to have significant engineering and cost consequences for the alignment of the route both inside this area and extending into the Colne Valley area and therefore were rejected.

Ickenham Stream (canal feeder) diversion

2.6.13 The Proposed Scheme will involve the diversion of Ickenham Stream (canal feeder) westwards towards the River Pinn. Two alternatives were considered as follows:

- diversion and pumped aqueduct over the Proposed Scheme; and
- diversion and pumped aqueduct over the Proposed Scheme and Network Rail lines.

2.6.14 Both of these alternatives would require an additional structure as well as a diversion.

2.6.15 The preferred option will not require visible above ground structures and the diversion could be integrated into the landscape mitigation options. In addition this option will not require any construction to the south of the route.

Hillingdon Trail PRoW (U81 and R146)

2.6.16 The Proposed Scheme will include a new footbridge over the Proposed Scheme level with the top of the portal structure which will link to the existing underpass beneath the Chiltern Main Line. Five alternatives were considered as follows:

- a subway under the Proposed Scheme;
- a subway under the Proposed Scheme and Chiltern Main Line;
- closure of the PRoW and diversion around existing PRoW routes;
- closure of the PRoW and diversion to new a PRoW route along the Chiltern

Main Line corridor to Ickenham Road; and

- a footbridge over the Proposed Scheme and Chiltern Main Line.

2.6.17 Construction of both subway options was not considered feasible due to the proximity to the West Ruislip portal.

2.6.18 A footbridge is the preferred option on environmental grounds as it will retain the PRoW close to the existing alignment. A footbridge over the Proposed Scheme was considered to be the preferred option when compared to a footbridge over both the Proposed Scheme and the Chiltern Main Line. The latter footbridge option has the potential to impact on habitat to the south of the Chiltern Main Line and, being raised above ground level, will create a structure with a potential visual impact.

River Pinn bridge

2.6.19 The Proposed Scheme will include a crossing over the River Pinn. This will comprise a single-span bridge, with a minimum span length of less than 8m, to accommodate the river and the adjacent PRoW (U47). This differs from the structure proposed in the January 2012 announced scheme which was a viaduct with abutments outside the area at risk of flooding. Three alternatives were considered as follows:

- a single-span bridge with a span length to allow for an 8m buffer from the banks of the River Pinn;
- a three-span bridge, to allow for an 8m buffer from banks of the River Pinn; and
- a two-span bridge with a minimum bridge length to accommodate the river and PRoW.

2.6.20 The alternative options will result in greater construction and maintenance costs when compared with the preferred option.

2.6.21 The viaduct structure with abutments located outside the area at risk of flooding was the preferred option on environmental grounds as it would reduce the footprint in the flood zone compared to other options. However, all options will require some floodplain replacement storage.

2.6.22 The Proposed Scheme was selected as the other options were considered to have significant engineering feasibility and cost consequences.

Breakspear Road South bridge

2.6.23 The Proposed Scheme will retain Breakspear Road South on the existing alignment and level, with the Proposed Scheme raised on an embankment to meet the headroom requirements, as proposed in the January 2012 announced scheme. Three alternatives were considered as follows:

- the Proposed Scheme level remaining on the same horizontal alignment and the road level lowered below existing level in order to provide the required

headroom;

- a new rail bridge over the road with the road permanently realigned to the east of the existing alignment; and
- a new rail bridge over the road with the road permanently realigned to the west of the existing alignment.

2.6.24 Specific engineering considerations included the headroom required under the bridge.

2.6.25 Specific environmental considerations included the potential disruption to traffic movements on Breakspear Road South and Chiltern Main Line operations; the size of the construction area and land requirements and the potential for the Proposed Scheme to be visible from Brackenbury Farm and residential properties.

2.6.26 The Proposed Scheme avoiding road realignment was selected as it will cause the least disruption to the road network.

Harvil Road

2.6.27 The Proposed Scheme involves a realignment of Harvil Road to the east and three new road crossings over the scheme itself, the Chiltern Main Line and Newyears Green Bourne.

2.6.28 There is a requirement to replace the Harvil Road bridge (a three-span masonry arch structure) over the Chiltern Main Line. The bridge was assessed in 2001 and found to have 40 tonne load capacity. It is expected that there will be a requirement to use the bridge for loads heavier than 40 tonnes for the construction of the Proposed Scheme.

2.6.29 Eight alternatives were considered for the new crossings and road alignment as follows:

- permanent realignment of the road to the west of the existing road and the construction of a new bridge over the Proposed Scheme and Newyears Green Bourne (retaining the current road crossing over the Chiltern Main Line);
- the road maintained on the present horizontal alignment and the construction of a new bridge over the Proposed Scheme only;
- the permanent realignment of the road to the west of the existing road and construction of new bridges over the Proposed Scheme, Chiltern Main Line and Newyears Green Bourne;
- the permanent realignment of the road to the east of the existing road and construction of new bridges over the Proposed Scheme, Chiltern Main Line and Newyears Green Bourne;
- the permanent realignment of the road to east of the existing road and construction of a new bridge over the Proposed Scheme only;
- the road maintained on the present horizontal alignment and construction of new bridges over the Proposed Scheme and Chiltern Main Line;

- the permanent realignment of the road to the west of the existing road and construction of new bridges over the Proposed Scheme and Newyears Green Bourne; and
- the road maintained on the existing alignment across the Chiltern Main Line but with a new Chiltern Main Line bridge.

2.6.30 Options retaining the existing Chiltern Main Line crossing and retaining Harvil Road on its current alignment were considered to be a major risk to the project due to the 40 tonne weight restriction on the existing bridge. Options requiring closure of Harvil Road will involve relatively short road diversions over the course of the seven year construction period. All three options requiring road realignment were considered feasible.

2.6.31 Options requiring realignment of Harvil Road were identified as having the potential for increased habitat loss, including edge habitat to the Chiltern Main Line with direct impacts on Newyears Green Site of Borough Importance (SBI) and Brackenbury Rail Cutting SBI. A road maintained on the present horizontal alignment with a new bridge over the Proposed Scheme only was the preferred option on environmental grounds due to the reduced potential for habitat loss. However, this option was not practicable due to the requirement to replace the Chiltern Main Line bridge. The proposed option replaces the Chiltern Main Line bridge with structure able to carry the loads required by the Proposed Scheme and minimises traffic impacts on Harvil Road during construction.

Harvil Road stream bridge (over Newyears Green Bourne)

2.6.32 The Proposed Scheme will include a single-span culvert. This culvert was not proposed as part of the January 2012 announced scheme. Three alternatives were considered during the option evaluation process as follows:

- single-span bridge with abutments 8m clear of the stream;
- multi-span culvert; and
- multi-span bridge crossing the floodplain.

2.6.33 The preferred option presented in the Draft ES was a single span bridge with abutments 8m clear of the stream. Since then, the design has been revised to a single span culvert as there is currently a culvert in this location and it is the lowest cost option.

2.6.34 The preferred option on environmental grounds remains a culvert although a single culvert is now considered preferable to multiple culverts. The benefit of a culvert is that it can be designed to ensure that the flood risk would remain unchanged upstream and downstream of the culvert. The ecological baseline in this location is now known to be of low value therefore a culvert of this length is considered acceptable.

The National Grid overhead power line diversion over the Colne Valley.

2.6.35 The Proposed Scheme includes a diversion to the National Grid overhead power line that currently crosses Harefield No.2 Lake used by Hillingdon Outdoor Activity Centre

(HOAC) for sailing activities (in CFA7). The scheme in January 2012 did not identify the need for diversion and this has been identified as part of the subsequent development of the scheme design.

2.6.36 The purpose of the diversion is so that the existing overhead power line does not conflict with the Colne Valley viaduct as it crosses the lake. Two options were considered:

- Option A: the Proposed Scheme, which is an above ground diversion of the National Grid overhead power line. The diversion will be from the south of the Chiltern Main Line and run eastwards across the Denham Quarry Lake, the Uxbridge Golf Course and Harvil Road. The diversion will then turn north, across the Proposed Scheme at Newyears Green Covert and then returning west across the Harvil Road. It will then rejoin the existing overhead alignment north-east of HOAC and next to the proposed National Grid feeder station; and
- Option B: a part-buried and part-overhead option that begins above ground south of the Chiltern Main Line. This option crosses Denham Quarry Lake to the aggregate storage site at the western end of Skip Lane. From here the buried cable diversion route runs northwards under the Chiltern Main Line, along the eastern side of the HOAC lake and under Dew's Lane before re-emerging north-east of HOAC, next to the National Grid feeder station where it ties into the existing overhead power line.

2.6.37 Both options would require a temporary overhead diversion approximately 80m west of the existing alignment during the construction phase of the Colne Valley viaduct.

2.6.38 Option A, being an above ground diversion, has a greater landscape and visual impact over Option B although the existing landform, the Chiltern Main Line and intervening linear vegetation along the Grand Union Canal and other water bodies goes someway to screening this within the local environment. In landscape and visual terms both options benefit from the removal of the overhead power lines that cross the HOAC lake.

2.6.39 Option A also passes close to and/or over a number of cultural heritage and ecological features.

2.6.40 Option B is shorter and has a reduced impact in terms of landscape, visual, cultural heritage and ecological impacts but it has a significantly greater cost and long-term maintenance issues in relation to the buried element of this Option.

2.6.41 In addition Option B has more safety and construction issues when compared to Option A. It also requires greater co-ordination to avoid other existing buried services in this area.

2.6.42 Due to the significant costs and construction issues associated with Option B and the relative screening provided by existing vegetation and the Chiltern Main Line it was decided to include Option A within the Proposed Scheme.

The Northolt TBM power supply

2.6.43 A power supply connection is required for the TBM used to construct the Northolt tunnel, the portal of which is located in this area. The power supply, either as an overhead power line or as a buried cable route would be required from south of the A40 at Fray's Farm, on the boundary between CFA7 and this area. The alignments of Options A to F listed below are located wholly or partially in CFA7 with short sections in this area.

2.6.44 The power supply would require two separate route options to ensure resilience of supply during construction and operation.

2.6.45 The following options were considered:

- Option A: a buried cable route running within the tow path on the eastern side of the Grand Union Canal between the A40 and the Chiltern Main Line and then diverting east to the West Ruislip portal. This option will go through Fray's Valley Local Nature Reserve (in CFA7);
- Option B: an overhead power line route following the alignment of the disused railway between the A40 and the aggregate storage site at the western end of Skip Lane and then diverting east to the West Ruislip tunnel portal. This option will go through Fray's Farm Meadow SSSI and Fray's Valley Local Nature Reserve (both in CFA7);
- Option C: an overhead power line route from the A40, across Fray's Farm Meadow SSSI and Fray's Valley Local Nature Reserve and Uxbridge Golf Course to the aggregate storage site at the western end of Skip Lane and then diverting east to the West Ruislip portal;
- Option D: the Proposed Scheme (along with Option F), a variation on Option C that avoids Fray's Farm Meadow SSSI and is buried through the Uxbridge Golf Course and under the ancient woodland at Pinnocks Wood. It passes around the edge of the Uxbridge Golf Course to the aggregate storage site at the western end of Skip Lane before diverting east to the West Ruislip portal;
- Option E: a buried cable option passing along the A40, the B467 Swakeleys Road and Harvil Road to the Chiltern Main Line then diverting east to the West Ruislip portal; and
- Option F: the Proposed Scheme (along with Option D), a buried cable option passing along the A40, the B467 Swakeleys Road and Breakspear Road South to the Chiltern Main Line then diverting east to the West Ruislip portal.

2.6.46 Option A was not included within the Proposed Scheme as it would have had an impact during construction on the tow path for the Grand Union Canal and associated

recreational activities. It would have also passed through Fray's Valley Local Nature Reserve resulting in a direct impact upon it.

2.6.47 Option B and C would also have passed through the Fray's Valley Local Nature Reserve and in addition would pass through Fray's Farm Meadow SSSI. For this reason they were not included within the Proposed Scheme. Option D would avoid these impacts although it would result in a temporary impact on Uxbridge Golf Course.

2.6.48 Option D was included as one of the two power supply routes as it will avoid the SSSI and Local Nature Reserve impacted in Option C and the buried cable section of this alignment avoids direct impacts on the ancient woodland of Pinnocks Wood. Therefore, this option was preferred compared with options A, B and C.

2.6.49 Option E was discounted due to the impacts this buried cable option would have during construction on traffic using Harvil Road, including the construction vehicles. In addition this option was longer than others and would be more costly.

2.6.50 Option F was selected as one of the two power supply routes as it will avoid traffic impacts on Harvil Road, avoid impacts to designated environmental sites, avoid use of Network Rail land and is a more direct alignment than Option E.

2.6.51 To ensure power supply and provide resilience two supplies are required during construction and operation. Option D and Option F have been included within the Proposed Scheme to achieve this. It is intended that Option F will be delivered through existing powers held by the utility company outside of the hybrid Bill process.

The rail maintenance plant siding

2.6.52 The Proposed Scheme will include a maintenance siding between Breakspear Road South and Harvil Road, to the north of the Chiltern Main Line and west of the retaining structure proposed south of the pharmaceutical research facility. Four alternatives were considered as follows:

- south of pharmaceutical research facility, east of retaining structure;
- directly west of Breakspear Road South bridge;
- east of River Pinn; and
- south of the pharmaceutical research facility, west of retaining structure.

2.6.53 Specific engineering considerations included the length of the siding and the track alignment.

2.6.54 Specific environmental considerations included the location of residential receptors (particularly on Hoylake Crescent and The Greenway), the potential for air and noise impacts, Brackenbury Farm Scheduled Monument (SM), the potential for visual impacts and the potential for impacts on water quality in the River Pinn.

2.6.55 The Proposed Scheme with the maintenance siding to the south of the pharmaceutical research facility and west of the retaining structure was selected as it provided sufficient space to allow an appropriate track alignment as well as reducing the potential for environmental impacts on residential receptors, Brackenbury Farm SM and the River Pinn.

Sustainable placement of excavated materials

2.6.56 The Proposed Scheme includes areas for the sustainable placement of excavated materials. These areas are created from material excavated from the Brackenbury and Copthall cuttings. In CFA 6, there are two sustainable placement two areas located between Harvil Road and Breakspear Road South, south of the route. A third area is located to the north of Newyears Green Lane and south east of Bayhurst Wood Country Park, to the north of the route. In CFA 7, there is one area to the south-east of South Harefield, north of the route alignment.

2.6.57 The sustainable placement of surplus excavated material has been included in the Proposed Scheme to significantly reduce HGV effects on air quality, community, landscape and visual, sound noise and vibration and traffic and transport.

2.6.58 Eight options were considered for the sustainable placement areas as follows:

- Option A: directly to the south of the Northolt tunnel and earthworks compound between Harvil Road and Breakspear Road South;
- Option B: within the south of the Northolt tunnel and earthworks compound between Harvil Road and Breakspear Road South;
- Option C: adjacent to the south west of Bayhurst Wood Country Park;
- Option D: adjacent to the south east of Bayhurst Wood Country Park;
- Option E: south-east of South Harefield and west of Bayhurst Wood Country Park (within CFA 7);
- Option F: to the north of the route and south of the River Pinn within the Ruislip golf course;
- Option G: to the west of Harvil Road and partially within Uxbridge golf course; and
- Option H to the west of Harvil Road and entirely within Uxbridge golf course.

2.6.59 All options have the potential for impacts on visual amenity, landscape quality and ecological resources. None of the options were considered likely to have significant environmental effects on nationally designated resources.

2.6.60 Options F, G and H would result in the loss of areas of golf course and were considered less suitable due to the potential for impacts on local amenity and community resource.

2.6.61 Option D, to the south west of Bayhurst Wood Country Park, was considered less suitable as much of the site was within Flood Zone 2.

2.6.62 Options A, B, C and E have been included as part of the Proposed Scheme.

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, 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 calculated 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 and biomass production, are identified in this section but the resulting function or service provided 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 area, are contained in Volume 5: Appendix AG-001-006.

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

3.2.3 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 temporarily to the original landowner and the non-replacement of capital items demolished, are set out in Volume 1.

3.2.4 In this area, the majority of agricultural land required temporarily for construction of the Proposed Scheme will be used for ecological mitigation rather than returned to agricultural use. There are no other assumptions or limitations that are specific to the assessment in this CFA.

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 are described in detail in the landscape and visual assessment (Section 9) and comprise valleys associated with the Yeading Brook and the River Pinn and the rising land around Newyears Green. The section is generally flat at around 40m above Ordnance Datum (AOD) but in the west the hills rise to around 70m AOD.

Geology and soil parent materials

3.3.3 The main geological features are described in detail in the land quality assessment (Section 8) and shown on Map WR-01-007 (Volume 5, Water resources and flood risk assessment Map Book).

3.3.4 The principal underlying geology mapped by the British Geological Survey (BGS) is that of London Clay. The underlying Lambeth Group, which is mottled sandy clay and clayey sand, outcrops to the north of the area and overlies Cretaceous Chalk. Superficial deposits of alluvium are present at the western end of this section and comprise a narrow ribbon associated with the River Pinn.

Description and distribution of soil types

3.3.5 The characteristics of the soils are described by the Soil Survey of England and Wales[6] and shown on the National Soil Map[7]. The soils are grouped into associations of a range of soil types and are described in more detail in Section 2 of Volume 5: Appendix AG-001-006. Their distribution is shown on Map AG-02-006.

3.3.6 The soils mapped in the east of the study area are of the Windsor association, which are stoneless, clayey and slowly permeable. They remain waterlogged for much of the year and are commonly assessed as being of Wetness Class[8] (WC) IV.

3.3.7 To the west of the area Wickham 4 association soils are mapped, which are similar to Windsor soils but have fine loamy or silty topsoils over clay. Wickham 4 soils are also waterlogged for long periods throughout the year and are of WC IV.

Soil and land use interactions

Agricultural land quality

3.3.8 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.

3.3.9 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 soil types within the area which are both fine textured, slowly permeable and have a wetness limitation.

3.3.10 Climate in this area does not in itself place any limitation on land quality but the interactions of climate with soil characteristics are important in determining the wetness limitation of the land. The local agro-climatic data for the area have been interpolated from the Meteorological Office's standard 5km grid point data set for four points within the area (see Volume 5: Appendix AG-001-006). The data shows the area to be relatively warm with moderate rainfall. The number of Field Capacity Days[9] (FCD) is approximately 140, which is lower than the average for lowland England (150 days) and is favourable to agricultural use.

3.3.11 Gradient and micro-relief are not limiting in this area. Potential flooding is limited to the floodplains of the Yeading Brook and River Pinn, which cross the section in the east and west respectively and is a potential localised limitation. The grade of agricultural land in this area is limited by soil wetness, which is determined according

[6] Soil Survey of England and Wales (1984) *Soils and Their Use in South East England*.
[7] Cranfield University (2001), The National Soil Map of England and Wales 1:250,000 scale.
[8] The Wetness Class of a soil is determined by the depth and duration of waterlogging in the soil profile and has six bands from WCI (driest) to WCVI (wettest).
[9] Field Capacity Day is a meteorological parameter which estimates the duration of the period when the soil moisture deficit is zero. Soils usually return to field capacity (zero deficit) during the autumn or early winter and the field capacity period, measured in days, ends in the spring when evapotranspiration exceeds rainfall and a moisture deficit begins to accumulate and opportunities for mechanised fieldwork are then possible.

to the WC, based on soil structure, evidence of waterlogging and the number of FCD, with the topsoil texture then determining its ALC Grade.

3.3.12 The deep, fine loamy or clayey soils of WC IV with 140 FCD are limited by soil wetness to no better than Subgrade 3b.

3.3.13 Defra mapping[10] shows that there is generally a low likelihood of encountering BMV land in the locality, which makes such land a resource of high sensitivity in this area.

Other soil interactions

3.3.14 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[11] and The Natural Choice: securing the value of nature[12] 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.

3.3.15 Forestry resources represent a potentially multifunctional source of productive timber, landscape amenity, biodiversity and carbon storage capacity. The value and sensitivity of the resources are assessed in Section 7, Ecology.

3.3.16 The floodplains of the Yeading Brook and River Pinn represent the functional flood environment with the soil providing a flood attenuation function. Flood zone mapping available shows there to be a low to moderate risk of flooding within this area and the value and sensitivity of these receptors is assessed in Section 13.

3.3.17 The presence of soil-borne cultural assets is detailed in Section 6. The earliest evidence is associated to prehistoric flint scatters and Bronze Age barrows and indicates human activity across the landscape although there is no evidence for significant land use or settlement until the Iron Age. The extensive land management of the medieval to post medieval period is indicated by the presence of ridge and furrow field systems still extant today within the landscape.

[10] Defra, (2005), *Likelihood of Best and Most Versatile Agricultural Land*.
[11] Defra (2009), *Soil Strategy for England.*
[12] Defra (2011), *The Natural Choice: securing the value of nature.*

Land use

Land use description

3.3.18 The area is predominantly suburban in character in the east and becomes more rural in character north and north-west of Ickenham. The area has a mixed land use pattern of residential properties, industry, open space, farmland and road and rail links. Agricultural land is mainly restricted to the western end of the study area in the locality of Breakspear Road South and Harvil Road. However, there is a small parcel of agricultural land at the extreme eastern end of the study area, near Priors Farm Lane. The agricultural land use is predominantly grassland with a few arable fields.

3.3.19 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.

3.3.20 The amount of woodland in the study is just below the national average of 10%, with forestry accounting for 9% of land use. Newyears Green Covert and Copthall Covert are the most substantial blocks.

Number, type and size of holdings

3.3.21 There are 11 holdings in the study area as set out in Table 6: Summary characteristics of holdings. These are a mixture of owner-occupation and tenancies, all of which are relatively small, with the largest extending to approximately 36ha. The boundaries of the holdings are shown on Maps AG-01-008b to AG-01-010 (Volume 5, Agriculture, Forestry and Soils Map Book) along with the location of the main farm buildings. Although no agricultural land drainage has been identified in the poorly permeable soils in the area, it is likely that historic land drains are present. No farms have been identified that undertake routine field irrigation of crops.

3.3.22 Table 6: Summary characteristics of holdings 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 determined primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, can better absorb impacts and are less sensitive. Units that rely on the use of buildings (such as intensive livestock and dairy farms and horticultural units) are less able to accommodate change and have a higher sensitivity. Smaller (less intensively used) units, such as pony paddocks associated with residential properties, have a low sensitivity. The holding/reference name provides a unique identifier and relates to Map Series AG-01 (Volume 5, Agriculture, Forestry and Soils Map Book) and Appendix AG-001-006, Volume 5.

Table 6: Summary characteristics of holdings

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA06/1 * Priors Farm	Arable and Grassland	24	Not known	None	Medium
CFA06/2 Oak Farm	Beef cattle and equine	3	None	None	Low
CFA06/3 Gatemead Farm	Grassland	6	Dwelling on long-term let	None	Low
CFA06/4 * Copthall Farm	Grassland	28	Not known	None	Medium
CFA06/5 Harvil Farm	Arable and Grassland	16	None	None	Medium
CFA06/6 * Brackenbury Farm	Arable and Grassland	12	Not known	None	Low
CFA06/7 Land owned by the pharmaceutical research facility	Grassland	36	None	None	Low
CFA06/8 * New Years Green Farm	Grassland	3	Not known	None	Low
CFA06/9 * Land south of Newyears Green Lane	Grassland	3	Not known	None	Low
CFA06/10 * Rose Farm	Arable and Grassland	25	Composting	None	Medium
CFA06/11 * St Leonards Farm	Arable and Grassland	12	Not known	None	Medium

* No Farm Impact Assessment interview conducted; data estimated.

Future baseline

Construction (2017)

3.3.23 No committed developments have been identified in this area that will materially alter the baseline conditions from 2017 for agriculture, forestry and soils.

3.3.24 The future of agri-environment schemes is uncertain at present due to ongoing reform of the Common Agricultural Policy. However, none of the holdings have thus far entered into any of these schemes and any short-term future change is unlikely to have any significant effect on the current stocking and cropping.

Operation (2026)

3.3.25 No committed developments have been identified 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 no significant measures have been required to avoid or mitigate impacts on agriculture, forestry or soils during construction other than those included in the draft CoCP.

3.4.2 In addition, there is a need to avoid or 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 This is particularly relevant to the two large areas of land identified for sustainable placement of surplus excavated materials, extending in total to some 75ha in this area (see Maps CT-06-015 to Ct-06-019, Volume 2, CFA6 Map Book). Although the long-term proposed use for the reinstated land will be for habitat-rich grassland and woodland planting, subject to the adoption of good practice techniques in handling, storing and reinstating soils, there will be no reduction in the long term capability which would 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 will avoid or reduce environmental impacts during construction. Of particular relevance to agriculture, forestry and soils are the following measures (see Volume 5: Appendix CT-003-000):

- 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. This will include any remediation measures necessary following the completion of works (draft CoCP: Section 6);

- a requirement for contractors to pay due consideration to the impacts of extreme weather events and related conditions which may affect agriculture, forestry and soil resources during construction (draft CoCP, Section 5);
- 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);
- the protection of agricultural land adjacent to construction sites, 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 land (draft CoCP, Section 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 in the area to construct and operate the Proposed Scheme. This includes not only the land on which permanent works will be sited but also that required temporarily to facilitate the delivery of those permanent works.

3.4.6 All of the land required to implement the Proposed Scheme will be affected during the construction phase. 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[13] and to incorporate small, severed parcels of 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.

[13] Structural disruption is disruption to the existing structure of farm holdings, principally from severance and the loss of key farm holdings.

Temporary effects during construction

Impacts on agricultural land

3.4.8 During the construction phase, the total area of agricultural land used will be approximately 110.6ha as shown in Table 7. Of this total some 5.9ha will be restored and available for agricultural use following construction.

Table 7: Agricultural land required for the construction of the Proposed Scheme

Agricultural land quality	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Grade 1	0	0	0
Grade 2	0	0	0
Subgrade 3a	0	0	0
BMV subtotal	0	0	0
Subgrade 3b	110.6	100	5.9
Grade 4	0	0	0
Grade 5	0	0	0
Total agricultural land	110.6		5.9

3.4.9 Although BMV land is a receptor of high sensitivity, no such land will be disturbed during construction and the effect on lower quality agricultural land is not significant.

3.4.10 Following construction the majority of the land required temporarily will be planted as part of the ecological mitigation proposals. It is estimated that there will not be any significant surplus of topsoil or subsoil material arising from the Proposed Scheme in the area. If surplus soils are generated, they will be used locally where land is to be restored to agriculture or ecological mitigation with slightly thicker topsoil and subsoil layers, where appropriate.

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 the Defra Code of Practice for the Sustainable Use of Soils[14]. These guidance materials

[14] Defra (2009) *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.*

will be followed throughout the construction period. The clayey Windsor and Wickham 4 soils are susceptible to structural damage, compaction and smearing when moved in wet conditions or by inappropriate equipment which would impede successful reinstatement; however, compliance with the CoCP will ensure that the magnitude of impact on soil is low and the significance of any effect is negligible.

Impacts on holdings

3.4.13 Land may be required from holdings both permanently and temporarily (i.e. the latter just during the construction period). In most cases the temporary and permanent land requirement will occur simultaneously at the start of the Proposed Scheme and it is the combined effect of both that will have the most impact on the holding. In due course a limited area of agricultural land will be restored and the impact on individual holdings will be marginally reduced, 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 temporary effects of the Proposed Scheme on individual agricultural and related interests during the construction period are summarised in Table 8. 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 scale of effect is based on the proportion of the holding required rather than the absolute area of land. The holding/reference name provides a unique identifier and relates to Map Series AG-01 (Volume 5, Agriculture, forestry and soils Map Book) and Appendix AG-001-006, Volume 5.

3.4.15 Where the area of land summed by ALC grade differs from the area of land summed by holding, the difference is because some holdings are affected in more than one CFA area and some holdings include non-agricultural land. Where holdings are affected in more than one CFA the combined impact has been reported in the CFA report where the main holding is located.

Table 8: Summary of temporary effects on holdings during construction

Holding ref/name	Total area required (ha)	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored (ha)
CFA06/1 Priors Farm	5.1 (21%) High	Negligible	Negligible	Major/moderate adverse due to the proportion of the holding required	0
CFA06/2 Oak Farm	1.6 (47%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required	0

Holding ref/name	Total area required (ha)	Construction severance	Disruptive effects	Scale of construction effect	Area to be restored (ha)
CFA06/3 Gatemead Farm	0.9 (15%) Medium	Negligible	Negligible	Minor adverse	0
CFA06/4 Copthall Farm	26.9 (95%) High	Negligible	Negligible	Major/moderate adverse due to the proportion of the holding required	0
CFA06/5 Harvil Farm	7.1 (44%) High	Small area of woodland severed Medium	Negligible	Major/moderate adverse due to the proportion of the holding required	0.4ha
CFA06/6 Brackenbury Farm	0.5 (4%) Negligible	Negligible	Negligible	Negligible	0
CFA06/7 Land owned by the pharmaceutical research facility	27.5 (76%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required but low sensitivity of holding	0.4ha
CFA06/8 New Years Green Farm	2.5 (89%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required but low sensitivity of holding	0
CFA06/9 Land south of Newyears Green Lane	2.8 (98%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required but low sensitivity of holding	0
CFA06/10 Rose Farm Cottage	19.4 (77%) High	Land around northern perimeter of holding severed with no access High	Negligible	Major/moderate adverse due to the proportion of the holding required and severance	0
CFA06/11St Leonards Farm	2.8 (23%) High	Land to north of holding severed High	Negligible	Major/moderate adverse due to the proportion of the holding required and severance	0

3.4.16 Overall, it is considered that nine holdings will experience moderate or major/moderate adverse 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 in the area.

Cumulative effects

3.4.18 As no committed development has been identified that will alter the agricultural, forestry or soil resource or its condition, there is no cumulative effects to assess.

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 compensation which may also retain some agricultural use; or
- used for ecological and landscape mitigation.

3.4.20 Following construction and restoration, the area of agricultural land that will be permanently required will be 104.7ha, as shown in Table 9. Approximately 75ha of this will be used for the sustainable placement of surplus excavated material. A further approximately 14.5ha of forestry land will also be permanently removed.

Table 9: Agricultural and forestry land required permanently

Agricultural land quality	Total area required (ha)	Percentage of agricultural land
Grade 1	0	0
Grade 2	0	0
Subgrade 3a	0	0
BMV subtotal	0	0
Subgrade 3b	104.7	100
Grade 4	0	0
Grade 5	0	0
Total agricultural land	104.7	
Forestry land	14.5	

3.4.21 None of the agricultural land affected is BMV and the loss of this lower quality agricultural land is not significant.

3.4.22 Areas of woodland that will be affected include Newyears Green Covert and the woodland running alongside the Chiltern Main Line. Overall, the total amount of forestry land required to implement the Proposed Scheme will be 14.5ha out of a total permanent land requirement (including non-agricultural land) of 368.8ha (4%) and is assessed as an impact of low magnitude. As the extent of the forest cover in the study area is approximately equal to the national average the resource has a medium sensitivity to change and the effect is assessed as not significant. Insofar as forestry land may have some non-commercial value, for example in ecological or landscape terms, the qualitative assessment of this loss is addressed in the relevant sections.

3.4.23 The majority of the land required temporarily for sustainable placement of surplus excavated materials will be planted as part of the ecological and landscape mitigation and this assessment assumes that none of this land will return to agriculture.

3.4.24 A small area of land extending to 1.2ha will be engineered to provide additional flood compensation capacity to the east of Breakspear Road South and the south of Dunster Cottage (AG-01-010, grid reference E5 and E6). This land will be restored for agricultural production but as this land is already assessed as lower quality Subgrade 3b there will be no further loss of BMV land.

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 10. The land required column refers to the area of land permanently lost (in absolute terms and as a percentage of the overall area farmed). The scale of effect 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 significance of effects are set out in Section 4 of Volume 5: Appendix AG-001-006.

Table 10: Summary of permanent effects on holdings from construction

Holding Ref/Name	Land required	Severance	Infrastructure	Scale of effect
CFA06/1 Priors Farm	5.1ha (21%) High	Negligible	Negligible	Major/moderate adverse due to the proportion of the holding required
CFA06/2 Oak Farm	1.6ha (47%) High	Negligible	Farm buildings demolished High	Moderate adverse due to the proportion of the holding required and demolition but low sensitivity of holding

Holding Ref/Name	Land required	Severance	Infrastructure	Scale of effect
CFA06/3 Gatemead Farm	0.9ha (15%) Medium	Negligible	Property demolition High	Moderate adverse due to property demolition and the proportion of the holding required but low sensitivity of holding
CFA06/4 Copthall Farm	26.9ha (95%) High	Negligible	Negligible	Major/moderate adverse due to the proportion of the holding required
CFA06/5 Harvil Farm	6.7ha (41%) High	Negligible	Negligible	Major/moderate adverse due to the proportion of the holding required
CFA06/6 Brackenbury Farm	0.5ha (4%) Negligible	Negligible	Negligible	Negligible
CFA06/7 Land owned by the pharmaceutical research facility	27.1ha (75%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required but low sensitivity of holding
CFA06/8 New Years Green Farm	2.5ha (89%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required but low sensitivity of holding
CFA06/9 Land south of Newyears Green Lane	2.8ha (98%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding required. but low sensitivity of holding
CFA06/10 Rose Farm	19.4ha (77%) High	Land around northern perimeter of holding severed with no access High	Negligible	Major/moderate adverse due to the proportion of the holding required and severance
CFA06/11 St Leonards Farm	2.8ha (23%) High	Land to north of holding severed High	Negligible	Major/moderate adverse due to the proportion of the holding required and severance

3.4.26 Overall, it is likely that 10 holdings will experience moderate or moderate/major permanent adverse effects from the construction of the Proposed Scheme, which are significant. Two holdings incur demolitions though only one holding has a residential property demolished (CFA06/3); the other unit loses farm buildings (CFA06/2).

Cumulative effects

3.4.27 No committed development has been identified that will alter the agricultural, forestry or soil resource condition and as such there is no cumulative effect to assess

Other mitigation measures

3.4.28 The ecological and landscape mitigation proposed in this area includes planting all the sustainable placement sites with either habitat-rich grassland or woodland and described in more detail in Sections 7 and 9. Soils from the ancient and other woodland areas that would be removed during construction of the Proposed Scheme would be utilised in this process where appropriate, as discussed in Section 7.

Summary of likely significant residual effects

3.4.29 Ten properties have been identified that will experience significant permanent effects due to the proportion of the holding required. For the majority of the holdings this effect is the result of the sustainable placement of surplus excavated materials and the proposed restoration of the land for landscape or ecological planting. Due to the relatively small size of the holdings affected the loss of this extent of agricultural land is such that they are unlikely to remain as agricultural or rural businesses. The use of compensation payments to purchase replacement land will not reduce the effect as the availability of land in this location cannot be assured. HS2 Ltd will continue to negotiate with landowners to reach a mutually beneficial solution. For Gatemead Farm, residential demolition will occur and for Oak Farm, agricultural buildings will be demolished.

3.4.30 No significant residual effects on forestry or soils have been identified for the operation of the Proposed Scheme. The loss of 14.5ha of mature forestry is not significant and will be fully mitigated over time by the proposed planting on the land proposed for sustainable placement of excavated materials.

3.5 Effects arising from operation

Avoidance and mitigation measures

3.5.1 No measures are required to mitigate the 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.

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, PM2.5)[15] and dust.

4.1.2 With regard to air quality, the main potential effects are anticipated to result from the emissions of the above pollutants from construction activities and equipment and changes in road traffic. Dust emissions will be associated with demolition and construction.

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:

- Volume 5: Appendix AQ-001-006;
- Map AQ-01-006 (Volume 5, Air Quality Map Book); and
- Map AQ-02-006-01 (Volume 5, Air Quality Map Book).

4.1.4 Maps showing the location of the key environmental features can be found in 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 Volume 1, the SMR (Appendix CT-001-000/1), the SMR Addendum (Appendix CT-001-000/2) and appendices presented in Volume 5 (AQ-001-006). 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 and from changes in the nature of traffic during construction and operation.

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)[16]. 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

15 PM2.5 and PM10 describe two size fractions of airborne particles that can be inhaled and therefore are of concern for human health. The designations refer to particles of size less than 2.5 and 10 microns in diameter.
16 IAQM (2011), Guidance on the assessment of the impacts of construction on air quality and the determination of their significance.

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 '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 are based on the highest predicted flows throughout the construction period (2017-2026). The assessment, however, assumes 2017 vehicle emission rates and 2017 background pollutant concentrations. The reason for this is that 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 main source of existing air pollutants in the study area is emissions from road traffic, as is the case for nearly all parts of London. Concentrations of road traffic-related pollutants are highest in central London and diminish towards the outer boroughs. At places very close to roads where traffic flows are high, as exemplified by locations near the A40, the airborne concentrations of the main pollutants are elevated substantially when compared to the 'urban background'.

4.3.2 Estimates for NO2, PM10 and PM2.5 concentrations have been obtained from London-wide modelled pollution maps[17] for 2008 and 2011. The 2011 maps have been used to characterise the baseline air quality in London, in addition to monitoring data and the background concentration maps[18] produced nationally by the Department for Environment, Food and Rural Affairs (Defra) that have been used in the assessment on other parts of the route outside London. The GLA maps reflect concentrations at all locations, including at the roadside, whereas the Defra national maps are background concentrations and do not include the effects of individual roads. It is therefore considered that the GLA

17 Greater London Authority (2008) London Atmospheric Emissions Inventory 2008. Available online at: http://data.london.gov.uk/laei-2008; Accessed July 2013.
18 Defra (2010) 2010 Based Background Maps for NOx, NO2, PM10 and PM2.5. Available online at: http://laqm.defra.gov.uk/maps/maps2010.html; Accessed July 2013.

maps provide a more accurate spatial indication of baseline conditions at a local level, but do not provide a forward projection to 2017 and beyond.

4.3.3 London Borough of Hillingdon (LBH) maintains several automatic monitoring stations, although most are located near Heathrow and the M4. Until 2011, one was operating in the study area at the roadside in South Ruislip. In addition, the local authority has diffusion tube sites measuring concentrations of NO2, including one at Queensmead School, located on Queens Walk 400m to the north of the route and one on Sidmouth Drive in South Ruislip, 230m to the north of the route.

4.3.4 The data collected by LBH along with the GLA mapping data show that some sections of the study area currently experience both short and long-term average concentrations[19] of NO2 that exceed air quality standards, especially in close proximity to major roads. Air quality standards for PM2.5 and PM10 are met in most parts of the borough, but monitoring and mapping data indicate that concentrations exceed standards at some major roadside locations such as the M25 and the A40. Further details regarding the air quality monitoring are shown in are shown in Volume 5: Appendix AQ-001-006.

4.3.5 An Air Quality Management Area (AQMA) is currently declared by LBH in respect of NO2 concentrations for the southern part of the borough, south of the Chiltern Main Line (see Map AQ-01-006, Volume 5, Air Quality Map Book).

4.3.6 There are numerous residential receptors in the study area, given its predominantly suburban nature. Notable receptors close to construction activity include properties at Trenchard Avenue and The Greenway. Receptors at greatest risk of dust effects are indicated in Map AQ-02-006-01 (Volume 5, Air Quality Map Book).

4.3.7 There are no ecological receptors with statutory designations in the study area.

Future baseline

4.3.8 Section 2.1 and 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 future baseline for the assessment of effects from the construction and operation of the Proposed Scheme.

4.3.9 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

19 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.

been achieved by including changes in traffic predicted as a result of any committed developments within the traffic data used for the air quality assessment for construction and operation, in which the future air quality baselines are defined as the 'without Proposed Scheme scenarios' at each stage.

Construction (2017)

4.3.10 Future background pollutant concentrations have been sourced from Defra background maps for 2017, which predict NO2 and PM10 concentrations in 2017 to be lower than in the 2012 baseline.

Operation (2026)

4.3.11 Future background pollutant concentrations have been sourced from Defra background maps for 2026, which predict NO2 and PM10 concentrations in 2026 to be lower than in the 2012 baseline.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 The following measures (as described in Section 2) have been included as part of the design of the Proposed Scheme and will reduce air quality effects associated with construction traffic:

- use of a railhead for the removal of surplus excavated material and delivery of railway installations materials;
- removal of excavated material by conveyor from the tunnels to the West Ruislip railhead; and
- movement of surplus excavated material to the sustainable on site disposal sites, mainly along purpose built haul routes.

4.4.2 Given the above measures are designed to reduce the number of HGV movements associated with major earthworks and transport of excavated material from the Northolt tunnel, air quality effects associated with construction vehicle trips on the local road network will also be reduced.

4.4.3 Emissions to the atmosphere will be controlled and managed during construction through the route-wide implementation of the draft CoCP, where appropriate. The draft CoCP includes a range of mitigation measures that are accepted by the IAQM as being suitable to reduce impacts to as low a level 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 through the implementation of specific measures required to control dust and other emissions from activities in the area.

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

- contractors being required to control 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 routes and designated vehicle waiting areas to suppress dust;
- keeping soil stockpiles away from sensitive receptors where reasonably practicable and 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, seeding and planting of completed earthworks as soon as reasonably practicable following completion of earthworks.

Assessment of impacts and effects

Temporary effects

4.4.5 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 and exposure to NO_2 and PM_{10}.

4.4.6 An assessment of construction traffic emissions has also been undertaken for two scenarios in the construction year 2017: a without the Proposed Scheme scenario and a with the Proposed Scheme scenario. The traffic data include the additional traffic from future committed developments.

4.4.7 In the South Ruislip to Ickenham area, dust-generating activities will occur at the major construction sites for the tunnel portal at Northolt and the vent shaft at South Ruislip. In addition, there will be potential for dust emissions at the TBM drive site, the railhead at West Ruislip, the Breakspear Road South/River Pinn bridge works and foundation works and works to create the embankment and cutting between Breakspear Road South and Harvil Road. Dust emissions are also likely to be associated with demolition, site preparation works, use of

haul routes within the construction site compounds and the sustainable on site disposal placement areas.

4.4.8 Given the mitigation outlined within the draft CoCP, along with use of LEMPS to manage those dust sources close to receptors, the assessment of impacts arising from dust emissions has concluded that these will be negligible in magnitude and the effect will not be significant. The basis for this conclusion can be found in Volume 5: Appendix -001-006, which describes fully the scale of emissions and their proximity to receptors.

4.4.9 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.

4.4.10 Examination of the changes in traffic flows for the construction period along the affected roads has identified some roads that meet the criteria for a more detailed assessment. This assessment found that impacts will arise as consequence of construction vehicles travelling down Swakeleys Road to the A40. These are summarised below.

4.4.11 NO2 impacts during the construction phase are predicted to be substantial adverse at receptors on:

- Swakeleys Road, between the A40 Western Avenue and Breakspear Road (multiple receptors);
- Warren Road, close to the junction with Swakeleys Road;
- Roker Park Avenue, close to the junction with Swakeleys Road; and
- Shorediche Close, at the façade closest to Swakeleys Road.

4.4.12 NO2 impacts during the construction phase are predicted to be moderate adverse at receptors on:

- Woodhall Close, at two properties with rear facades close to the A40 Western Avenue; and
- Park Road, close to the junction with the A40 Western Avenue.

4.4.13 PM10 impacts (in relation to the 24-hour standard) during the construction phase are predicted to be negligible.

4.4.14 The NO2 impacts will give rise to temporary significant effects. During the construction period, significant air quality effects are predicted at properties close to the B467 Swakeleys Road, between Harvil Road and the A40 roundabout, and at properties close to the A40, west of the roundabout. The peak effects are predicted to last for approximately one year. The construction

traffic will be associated with earthworks (including West Ruislip embankment works) and the West Ruislip tunnel portal. Vehicle movements associated with these works will travel via Harvil Road and Swakeleys Road to/from the A40. Following completion of the major earthworks and construction of the temporary railhead in 2018, air quality effects associated with construction traffic will typically reduce, as the majority of excavated material will be transported via the rail network rather than local roads.

Permanent effects

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

Cumulative effects

4.4.16 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

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

Summary of likely significant residual effects

4.4.18 The methods outlined within the draft CoCP to control and manage potential air quality effects from dust emissions are considered effective in this location and no significant residual effects are considered likely. Significant temporary residual effects from increased NO_2 concentrations will arise at properties along or adjoining Swakeleys Road and close to the A40.

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 Any impacts from the operation of the Proposed Scheme would relate to changes in the nature of traffic. There are no direct atmospheric emissions from the operation of trains (and hence also from vent shafts) that will cause an impact on air quality; these have therefore not been assessed. Tunnel sections have vent shafts to dissipate air pressure waves caused by trains. In normal operations there will be no pollutant emissions from vent shafts as there are no air pollutants emitted within the tunnels and 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: a without the Proposed Scheme scenario and a with the Proposed Scheme scenario. The traffic data include the additional traffic from future committed developments.

4.5.4 Traffic data in the South Ruislip to Ickenham area have been screened to identify roads that required further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2026. The traffic data used for this assessment include a contribution from future committed developments.

4.5.5 No roads meeting the criteria for a detailed assessment were identified for operation of the Proposed Scheme. As such, no receptors were assessed and changes in air quality are considered negligible. Therefore, there is not predicted to be any significant effect associated with the scheme during operation.

Other mitigation measures

4.5.6 No other mitigation measures are considered necessary during operation in relation to air quality in this area.

Summary of likely significant residual effects

4.5.7 No significant residual effects are anticipated for 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:

- amenity impacts on residential properties on the northern side of The Greenway during construction and on residential properties near the junction of Harvil Road and Breakspear Road South during construction;
- amenity impacts on those using Blenheim Care Centre and Church Of Jesus Christ Of Latter Day Saints, on Ickenham Road;
- the temporary and permanent requirement for land within the Ruislip Golf Course and the impact on the amenity of users;
- closure and demolition of Ruislip Rifle Club;
- temporary re-routeing of the Celandine Route and Hillingdon Trail during construction; and
- demolition of two residential properties on Breakspear Road South.

5.1.3 Further details of the community assessments and reports of open space surveys and recreational PRoW surveys undertaken within this area are contained in Volume 5: Appendix CM-001-006.

5.1.4 Significantly affected community resources are shown in maps are provided in Maps CM-01-018 to CM-01-022-R2 (Volume 5, Community Map Book).

5.1.5 The current assessment draws upon information gathered from local and regional sources including Ruislip Rifle Club and Ruislip Golf Club.

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 (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.

5.3 Environmental baseline

5.3.1 Baseline data on community resources was collected up to 500m from the centre line of the route and, additionally, for any supporting infrastructure sites up to 250m from the boundary of land required for construction.

5.3.2 The study area includes the area of land required both 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. The study area comprises land at South Ruislip, the tunnel portal at West Ruislip, Breakspear Road and Harvil Road. The area is predominantly urban fringe with dense housing estates to the north, less developed land associated with Northolt Aerodrome to the south, Ruislip Golf Course and farmland to the west.

South Ruislip

5.3.3 South Ruislip is characterised by suburban housing to the north and south with an area of warehouses, depots and retail parks including the Braintree Industrial Estate (off Braintree Road) primarily located between the Chiltern Main Line and Victoria Road. There are also clusters of shops including post offices along Long Drive and West End Road, to the east of Braintree Industrial Estate.

West Ruislip

5.3.4 The area around West Ruislip is characterised by suburban housing in the east which open up into fields and Ruislip Golf Course in the west. There is a cluster of shops on the High Road in Ickenham which includes a takeaway, a restaurant and the Soldiers Return public house. The shops extend along the road away from the land required for the construction and operation of the Proposed Scheme.

5.3.5 The key community facilities in the vicinity of West Ruislip are the Ruislip Golf Course, Ruislip Rifle Club, Ickenham Cricket Club, Ickenham Green and associated allotments, a playground off Hill Lane, the Church of Jesus Christ and Latter Day Saints and Blenheim Care Centre (both on Ickenham Road) and both the Hillingdon Trail (PRoW R146 and U81) and the Celandine Route (PRoW U44, U45, U47 and U51).

Breakspear Road South and Harvil Road

5.3.6 The area around Breakspear Road South and Harvil Road is characterised by an urban fringe environment with a large suburban housing to the south, contrasting with farmland to the north and west. The residential properties of The Lodge (within the pharmaceutical research facility) and Gatemead Farm are situated to the west of Breakspear Road South. Furthermore, the 19km long

Celandine Route) also passes through the area following the River Pinn and crossing the Chiltern Main Line.

Future baseline

Construction (2017)

5.3.7 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. The existing baseline is likely to change due to future development that may introduce new residential and community facilities to the study area. No specific developments have been identified that are likely to be completed prior to the commencement of construction in 2017 and may therefore be impacted by the construction and operation of the Proposed Scheme.

Operation (2026)

5.3.8 The review of future baseline conditions has not identified any additional committed developments within the study area, which will be completed by the first year of operation.

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 Measures have been incorporated into the scheme design as part of the design development process to avoid or minimise the adverse environmental impacts during construction.

5.4.2 The decision to extend the tunnel section of the Proposed Scheme through Northolt and into the middle part of the study area, emerging at the West Ruislip portal, avoids construction impacts. Demolitions of residential property and community facilities adjacent to the route of the existing surface rail corridor would have occurred if the route was not in a tunnel.

5.4.3 The draft CoCP includes a range of provisions that will help mitigate community effects associated with construction within the study 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);
- where reasonably practicable, maintenance of PRoW for pedestrians, cyclists and equestrians around the perimeter of construction sites and across entry and exit points (draft CoCP, Section 5);

- monitoring and management of flood risk and other extreme weather events which may affect community resources during construction (draft CoCP, Sections 5 and 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

5.4.4 Details of all assessments of community resources are included in Volume 5: Appendix CM-001-006. 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.

South Ruislip

5.4.5 No significant temporary or permanent effects have been identified.

West Ruislip

Temporary effects

Residential properties

5.4.6 Residents at (approximately 30) properties on the northern side of The Greenway are predicted to experience in-combination effects during construction:

- there will be significant construction noise effects during the tunnelling support activities; and
- there will be significant visual effects associated with views of construction activities at the tunnel portal.

5.4.7 The combination of these effects that are expected to coincide for between one and two years, will have a major adverse effect on the amenity of residents, which is significant.

Community infrastructure

5.4.8 The construction of the tunnel portal at West Ruislip will require the temporary use of part of Ruislip Golf Course, which is owned by LBH. The Proposed Scheme will require part of the land that currently forms three of the eighteen holes, an outbuilding and a small part of the driving range. There is no requirement for land that will affect the club house. The members of the golf course have identified three holes that can be repeated to maintain an eighteen-hole course during construction. The Ruislip Golf Course hosts several golf competitions a year. A course incorporating repeated holes will not

function as a competition course. The nearest golf course owned by LBH is Haste Hill Golf Course, which is approximately 4km north and this could act as an alternative for competitions. The golf course is owned by the LBH and is open to the public and therefore accessible to local residents. The temporary loss of land from the golf course for a period of seven years is considered a moderate adverse effect and is therefore significant.

5.4.9 Construction activity at the West Ruislip portal main compound is not predicted to create in-combination effects on those playing golf on the course. The club house is predicted to experience significant construction noise effects and visual effects. There are also predicted to be significant increases in HGV movements along Ickenham Road, which is the road by which the golf course is reached. These effects are predicted to affect users of the club house, which also functions as a pub/restaurant and hosts occasional community events. Overall, the combination of these effects which are expected to coincide for up to nine months, will have a major adverse effect on the amenity of users of the club house, which is significant.

5.4.10 Blenheim Care Centre is a residential care home for the elderly located on Ickenham Road. Users are predicted to experience in-combination effects resulting from a significant increase in HGV movements on Ickenham Road and visual effects. The combination of these effects is considered to result in a major adverse effect on the amenity of the residents, staff and visitors, which is a significant effect.

5.4.11 The Church of Jesus Christ of Latter Day Saints is also on Ickenham Road. Those using the facilities of the Church are predicted to experience in-combination effects as a result of a significant increase in HGV movements on Ickenham Road and significant noise effects from construction activity at the West Ruislip portal satellite compound. The combination of these effects, which will coincide for approximately one year, will result in a moderate adverse effect on the amenity of users, which is significant.

Open space and recreational PRoW

5.4.12 During construction, the Hillingdon Trail (Footpath R146 and U81) will be temporarily re-routed on to the nearby Ickenham Road overbridge and this will not have a significant effect on the users of the Trail.

Permanent effects

5.4.13 There is no residential property scheduled for demolition within this area. A garage associated with the residential property 105 The Greenway will be required but this is not considered to be a significant effect on the community.

5.4.14 The construction of the tunnel portal at West Ruislip will permanently require land currently used by Ruislip Golf Course. The Proposed Scheme will permanently require two of the eighteen holes. This means that the golf course will not be able to function as an eighteen-hole competition course. The palliative measures available in the temporary situation will not be valid and therefore the permanent loss of two holes at the golf course is considered to be a major adverse effect and is therefore significant.

5.4.15 The construction of the tunnel portal at West Ruislip will permanently require the use of the land currently occupied by Ruislip Rifle Club and it will be permanently lost from this site. There are no local alternative facilities of a similar nature. The loss of the Rifle Club will be a major adverse effect and will therefore be significant.

Breakspear Road South and Harvil Road

Temporary effects

Residential properties

5.4.16 Residents on Harvil Road (from the junction with Highfield Road, north to Harvil Farm) and on Breakspear Road South (from the junction with Swakeleys Road, north to Copthall Farm) will experience in-combination effects. Approximately 50 properties are predicted to experience in-combination effects due to:

- visual effects from views of the sustainable placement of surplus excavated materials on land between Harvil Road and Breakspear Road South; and
- increased HGV movements on both Harvil Road and Breakspear Road South.

5.4.17 Section 12, Traffic and transport describes the peak construction periods that influence HGV movements. The combination of these effects will have a major adverse effect on the amenity of residents, which is significant.

5.4.18 Residents on B467 Swakeleys Road (between the junction with the A40 and the junction with Harvil Road) are predicted to experience in-combination effects as this road will be used by construction traffic. Significant increases in HGV traffic and the associated significant effects on road traffic noise and air quality will combine. The combination of these effects will coincide for approximately nine months and affect approximately 30 properties. This will give rise to a major adverse effect on the amenity of residents, which is significant.

Open space and recreational PRoW

5.4.19 During construction, the Celandine Route (PRoW sections U45 and U46), following the River Pinn and crossing the Chiltern Main Line) will be temporarily

re-routed to the west via Breakspear Road South. This PRoW will be reinstated in its current position following completion of construction. The impact on users will be minor adverse and is not therefore considered to be significant.

Permanent effects

5.4.20 The route of the Proposed Scheme will require the demolition of residential properties at Gatemead Farm and The Lodge (which is located within the pharmaceutical research facility) on Breakspear Road South. A stable and outbuilding at Oak Farm will also be demolished. The permanent loss of these dwellings is not considered significant at a community level.

Cumulative effects

5.4.21 No significant temporary or permanent cumulative effects have been identified.

Other mitigation measures

5.4.22 The assessment has concluded that there are significant adverse effects arising during construction in relation to community resources.

5.4.23 HS2 Ltd is seeking to reach agreements with the affected parties on the following potential measures proposed to mitigate a number of the significant effects arising during construction:

- HS2 Ltd will work with Ruislip Golf Course and LBH to enable the golf course to continue to operate as an eighteen hole course throughout the construction phase and to identify a means by which it could operate as an eighteen hole competition course throughout the operational phase of the Proposed Scheme; and
- HS2 Ltd will continue to work with the Ruislip Rifle Club to assist them with the identification of suitable alternative premises, to which the affected facility could relocate on the basis that it will be eligible for financial compensation under the National Compensation Code. If suitable alternative premises could be acquired in the same locality for the timely relocation of this facility, this would mitigate the effect which would no longer be significant.

Summary of likely significant residual effects

5.4.24 The Proposed Scheme will require land temporarily and permanently at Ruislip Golf Club. During the construction phase, the amenity of users of the Golf Club House will be affected. Land used by Ruislip Rifle Club will be permanently required by the Proposed Scheme.

5.4.25 To the south of the Proposed Scheme, some residents at The Greenway are predicted to experience amenity affects during the construction period. The

amenity of residents along southern sections of Harvil Road and Breakspear Road South will be temporarily affected.

5.4.26 On Ickenham Road, the amenity of residents and visitors at Blenheim Care Centre and visitors to Church Of Jesus Christ Of Latter Day Saints is predicted to be temporarily affected.

5.5 Effects arising from operation

Avoidance and mitigation measures

5.5.1 The following measures have been incorporated into the scheme design as part of the design development process to avoid or minimise adverse environmental impacts during operation.

- the decision to extend the tunnel section of the Proposed Scheme through Northolt and into the middle part of the study area, emerging at the West Ruislip portal avoids operational impacts on community resources in the east of the study area that may have occurred if the route was not in a tunnel; and
- the provision of noise fence barriers to the above ground section of the route through this area will mitigate the effects of noise from the operation of the Proposed Scheme.

Assessment of impacts and effects

5.5.2 No significant effects have been identified.

Cumulative effects

5.5.3 No significant cumulative effects have been identified.

Other mitigation measures

5.5.4 No significant effects have been identified and therefore no mitigation measures are proposed.

Summary of likely significant residual effects

5.5.5 No significant residual effects have been identified.

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 as 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 Map Series CT-10-008b to CT-10-010-R1 (Volume 2, CFA6 Map Book). Maps showing the location of all designated and non-designated heritage assets can be found in Volume 5: Appendices map books. 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-001-006 – Baseline Report;
- Appendix CH-002-006 – Gazetteer of Heritage Assets;
- Appendix CH-003-006 – Impact Assessment Table; and
- Appendix CH-004-006 – Survey Reports.

6.1.4 Throughout this section, assets within the study areas are identified with a unique reference code, RUIXXX, further detail on these assets can be found in the gazetteer in Volume 5: Appendix CH-002-006.

6.1.5 Engagement has been undertaken with the Greater London Archaeological Advisory Service Officer and English Heritage Historic Buildings Advisor for London with regard to the nature of cultural heritage assets within this 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 excepting that the study area has been defined by the Zone of Theoretical Visibility (ZTV)[20].

6.2.2 The setting of all designated heritage assets within the Zone of Theoretical Visibility (ZTV) of the Proposed Scheme 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 or permanently, to construct the Proposed Scheme plus 500m. For the purposes of this assessment, any assets within the 10mm settlement contour[21] are included within the land required to construct the Proposed Scheme.

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 LiDAR[22] 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[23] 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-001-006.

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;

[20] The ZTV used for this purpose in Greater London was that used for the Draft ES and shown on the CH – 02 maps in Volume 5. This covers, in places, a smaller area than the ZTV shown on the Volume 5 LV – 07 and LV – 08 landscape maps. It has been concluded that there are no designated assets in the areas outside the Draft ES ZTV the setting of which could be affected by the Proposed Scheme
[21] The area in which ground settlement arising from tunnelling or other below ground works could be more than 10mm in depth
[22] LiDAR (Light Detection and Ranging) is a high resolution remote sensing technique to capture 3D data
[23] 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.

- desk-top review of remote sensing data including LiDAR, aerial photographs and hyperspectral data (see Volume 5: Appendix CH-004-006); and
- a programme of non-intrusive surveys including geophysical surveys (see Volume 5: Appendix CH-004-006).

Designated assets

6.3.3 There are no designated heritage assets located partially or wholly within the land required, temporarily or permanently, for construction of the Proposed Scheme.

6.3.4 The following designated assets are located outside of the land required, temporarily or permanently, for construction of the Proposed Scheme but within the ZTV (see maps CH-02-008b to CH-02-010-R1 in Volume 5, Cultural Heritage Map Book):

- four Scheduled Monuments including a medieval moated site at Pynchester Farm (RUI001), Brackenbury Farm moated site (RUI002), Ruislip motte and bailey (RUI003) and Pale Park, Ruislip (RUI004);
- three Grade II* listed buildings including the Church of St Giles on Swakeleys Road (RUI041), the Great Barn to the west of Manor Farm Yard, Ruislip (RUI050) and 9-15 High Street, Ruislip (RUI059);
- 65 Grade II listed buildings. 15 of these stand in the Ruislip Village Conservation Area whilst 16 are within the Ickenham Conservation Area. Highway Farm comprises a group of farm buildings. St Leonards Farm, Copthall Farm and Crows Nest Farm are more isolated buildings in the rural part of the study area; and
- three Ancient and Semi Natural Woodlands known as Bayhurst Wood (RUI038), Mad Bess Wood (RUI039) and Park Wood (RUI066).

Non-designated assets

6.3.5 The following non-designated assets of moderate value lie wholly or partially within the land required, temporarily or permanently, for construction of the Proposed Scheme (see Maps CH-01-018b to CH-02-022-R2, Volume 5, Cultural Heritage Map Book):

- deposits potentially containing Bronze Age cremation vessels (RUI021) as indicated by those excavated during a watching brief for utilities works at Copthall Covert;
- Thames Terrace gravel deposits which are likely to contain Palaeolithic stone artefacts such as those existing at the southern part of the sustainable placement area west of Breakspear Road South; and
- deposits potentially containing evidence of a Romano British settlement (RUI014) north of Newyears Green Lane as indicated by those excavated during a pipeline watching brief.

6.3.6 The following non-designated assets of low value lie wholly or partially within the land required, temporarily or permanently, for construction of the Proposed Scheme (see Maps CH-01-018b to CH-02-022-R2 in Volume 5, Cultural Heritage Map Book):

- the site of the medieval to post-medieval Bourne Bridge (RUI032);
- the site of RAF Northolt: a First World War to modern military airfield (RUI010). RAF Northolt is still an active airfield (RUI010);
- the site of RAF West Ruislip First World War to modern airfield and depot site (RUI010) now covered by modern housing estates (RUI011);
- Medieval ridge and furrow (RUI016) on Ruislip Golf Course;
- Ruislip Gardens Station (RUI031) lies within the 10mm settlement contour;
- West Ruislip Station (RUI036) lies within the 10mm settlement contour; and
- South Ruislip Station (RUI033) lies within the 10mm settlement contour.

6.3.7 All non-designated heritage assets within 250m or 500m, depending on whether in an urban or rural area respectively, of the land required to construct the Proposed Scheme are listed in the gazetteer in Volume 5: Appendix CH-002-006 and identified on Maps CH-01-018b to CH-02-022-R2 (Volume 5, Cultural Heritage Map Book). These include a number of built heritage assets, the setting of which has been considered, for example:

- Middlesex Arms, Long Drive, Ruislip (RUI067);
- Ruislip Gardens Primary School, Stafford Road (RUI068);
- South Ruislip Station (RUI033);
- 201 West End Road (Commanding Officer's House), Ruislip (RUI069);
- Glebe Farm, West End Road, Ruislip (RUI070);
- The Bell Public House, 298 West End Road (RUI071);
- Mad Bess Cottage, Breakspear Road North (RUI072);
- The Paddocks, Tile Kiln Lane, Harefield (RUI073); and
- Lantern House, Tile Kiln Lane, Harefield (RUI074).

Cultural heritage overview

6.3.8 The principal underlying geology mapped by the British Geological Survey is that of a solid geology of London Clay, a grey fissured clay that weathers to brown colour in its upper part (described more fully in Section 8 and Section 1 of Volume 5: Appendix AG-001-006).

6.3.9 The bedrock geology also comprises an outcrop of the Lambeth Group which, in this area is described as mottled sandy clay and clayey sand and is directly underlain by the Cretaceous Chalk Group in this area.

6.3.10 The eastern end of the area comprises a shallow valley cut through by the Yeading Brook, by Ruislip Gardens Station (RUI031). From the Yeading Brook the topography rises towards West Ruislip, before dropping into a shallow valley around the River Pinn.

6.3.11 The study area lies on the edge of the Colne Valley system, the terrace gravels of which have produced numerous Palaeolithic to Mesolithic artefacts and deposits; evidence of human activity. These gravels extend along the River Pinn and isolated flints and scatters have been found at Beetonswood Farm and Pinn Way, both on the River Pinn, whilst finds at Fine Bush Lane and King Edward Road indicate that these types of evidence for human activity sites may exist on the higher ground to the east of the Colne Valley within the study area. Mesolithic sites have been excavated at Dews Farm in the CFA7 on gravelly spits above the water level just west of the study area.

6.3.12 Archaeological evidence for settlement remains focused in the Colne Valley and the River Pinn. Bronze Age cremations have been recovered during a watching brief at Copthall Covert on the edge of the Colne Valley. A looped bronze axe head has been recovered near Harefield and thin walled flint tempered pottery near from Dew's Pit in CFA7. Neolithic to Bronze Age flint scatters and Bronze Age barrows have been found in the Colne Valley. Whilst this indicates a presence in the landscape there is no evidence in the study area for significant land use or settlement until the Iron Age, suggested by the Iron Age/early Romano British settlement at Newyears Green (RUI 014).

6.3.13 Evidence for settlement during the Roman period is scarce in the study area. Archaeological excavations in the Colne Valley during a watching brief for a pipeline revealed the Iron Age to Romano-British settlement to the north-west of Newyears Green Farm mentioned above. The presence of another settlement from the Roman period in the area may very tentatively be suggested by the name 'Pynchester' (RUI001).

6.3.14 The early medieval (AD 410–1066) period in the area is also poorly represented in the archaeological record; evidence for the period may have been affected by the loss of sites before identification, due to gravel extraction and suburban expansion. Ruislip, Harefield and Ickenham are all mentioned in the Domesday Survey and were in existence during the medieval period (AD 1066–1539) and may have their origins as early medieval settlements.

6.3.15 There are two medieval manorial moated sites located between the River Pinn and Colne Valley at Pynchester Farm (RUI001) and Brackenbury Farm (RUI002). In relation

to Pynchester Farm the fact that track ways leading to Pynchester Farm never became part of the network of post-medieval lanes and modern roads might suggest that this became less important in the later medieval period.

6.3.16 Further evidence of the medieval period is probably focused in and around the historic core of Ruislip and Ickenham, as these settlements are known to have existed in the medieval period and existing smaller settlements to the west of Breakspear Road.

6.3.17 A small alien priory[24] had been established at Ruislip circa 1149 by the Benedictine Priory of Ogbourne, Wiltshire, itself a cell of the Abbey of Bec-Hellouin, the land having been granted by Ernulph de Heding in 1096. The priory at Ruislip was dissolved in 1414 and the land passed to King's College Cambridge in 1461. This priory would have managed the land in the area surrounding it, as would the other manorial estates throughout the study area.

6.3.18 The widespread enclosure of the landscape to create the present arrangement of hedged fields and winding tracks which remain west of Breakspear Road South, such as Newyears Green Lane, may have begun with the dissolution of the monasteries in the 16th century and accelerated with the introduction of new farming techniques during the 17th century. Many of the farmhouses and associated agricultural buildings in the area, including St Leonards Farm (RUI074) and Crow's Nest Farm (RUI075), were built between the 17th and 19th centuries and it is buildings of these types that make up the majority of the Listed Buildings away from the centres of Ruislip and Ickenham.

6.3.19 Post-medieval cartographic evidence indicates that north-west of High Road, Ickenham there are a number of small settlements and farmsteads scattered around the area, such as Clack Farm (RUI076), Crow's Nest Farm (RUI 075) and Highway Farm (RUI006). These may have their origins in later medieval farmsteads and the numerous track ways between them suggest that small estates predominated in this area.

6.3.20 South-east of Ickenham High Road and east of Ruislip, the 1786 Carey Map[25] shows a large area with few tracks and numerous '-field' names suggesting that a much larger area of medieval 'open field' system was still present. This cartographic evidence demonstrates the extensive land management of the medieval to post-medieval period, as does the presence of ridge and furrow field systems still extant within the landscape at Ruislip Golf Course south-west of the site of Beetonswood Farm.

6.3.21 The character of settlement evidence from the post-medieval period is one which is still visibly embedded in the suburban landscape. The buildings in the historic cores of Ruislip and Ickenham date from this period whilst the main roads between them and other settlements have fossilised the alignments of the medieval lanes. The scale and

[24] An 'alien priory' refers to a religious establishment in England under the control of another religious house outside England.
[25] Cary, J. (1786) Cary's *actual survey of the country fifteen miles around London.*

pace of alteration increased during the 19th and early 20th century. The Great Western and Great Central railway companies agreed to construct a new rail line from Old Oak Common to High Wycombe in an attempt to shorten the Great Western Line to Birmingham and increase the Great Central's access to London. It opened to Park Road in 1903 and between Westbourne Park and Greenford in 1904, but only opened throughout in 1910. The Piccadilly or the Great Northern Piccadilly and Brompton Railway was finished in 1906. The Central line was completed in 1900.The Neasden and Northolt Railway Opened in 1906. These rail lines spurred the suburban development of the area.

6.3.22 Airfields were established at RAF Northolt and RAF West Ruislip during World War One. By 1935 suburban development had reached the eastern fringe of the study area and certain areas west of this were beginning to be developed. However, large areas were still farmland. By 1960 the area looked largely as it does at present with the medieval/post-medieval core of the villages east of Breakspear Road South being engulfed by suburban development and the areas between the local roads full of the residential streets and closes of suburbia.

6.3.23 RAF Northolt was first established in 1915 and has remained in active service until the present day. RAF West Ruislip was first established in 1917 with further buildings erected in 1920. This became a depot site but has since become a residential development in the 1990's.

Future baseline

Construction (2017)

6.3.24 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)

6.3.25 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 (see 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 preparation of project wide principles, standards and techniques for works

affecting heritage assets (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);
- 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 The following measures have been incorporated into the design of the Proposed Scheme to reduce impacts on assets:

- the proposed scheme is largely in twin-bored tunnel throughout this area; and
- the South Ruislip vent shaft building has been located in a modern industrial area. Its appearance will be similar to the surrounding buildings.

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 (for details on construction periods see Section 2.3). Impacts will occur to assets both within the land required to construct the Proposed Scheme and assets in the wider study area due to the visibility of plant, cranes and equipment and other construction factors.

6.4.4 Brackenbury Farm medieval moated site, Brackenbury Farmhouse and Brackenbury House, is a grouped asset of high value (RUI002). The asset has already been impacted by the Chiltern Main Line and the urban development of Ickenham, although some elements of its medieval setting remain to the west in the form of semi-rural farmland, albeit enclosed in the post-medieval period, allowing the moated site to be understood in an open context. The introduction of the Northolt tunnel and earthworks main compound, for approximately ten years and particularly the sustainable placement areas, will sever the Brackenbury Farm moated site and listed buildings from what remains of their medieval/ post-medieval setting and substantially alter the setting of the moat. The change will result in a medium adverse impact resulting in a major adverse effect.

6.4.5 Pynchester Farm moated site (RUI001) is an asset of high value situated in a wooded valley between two modern residential streets; the broader setting of the asset has therefore been severely impacted already. The moated site retains its relationship with the River Pinn. The setting therefore contributes only a small amount to its significance. The Northolt tunnel and earthworks main compound will be located

approximately 170m to the north-west for approximately ten years and construction activities will be visible at times and audible. This will be a low adverse impact resulting in a moderate adverse effect.

6.4.6 Grade II listed Highway Farmhouse and its forecourt walls (RUI006) are assets of moderate value which are located in a largely rural agricultural landscape and on the original alignment of Harvil Road. The post-medieval farmhouse and barns are therefore understandable in the context of their surrounding post-medieval enclosures and also in their relationship to the highway from which the farm may have taken its name. Its setting therefore contributes to its significance. The construction activities required for the realignment of Harvil Road over approximately five years will change the local sound environment and substantially alter the setting of the asset. The change will result in a medium adverse impact and moderate adverse effect.

6.4.7 St Leonards Farmhouse (RUI 074) is an asset of moderate value which currently lies within a semi-rural farming landscape in which the modern roads follow the line of medieval to post-medieval track ways. Construction activities lasting approximately ten years will be required to form the sustainable placement area situated north, east and west of the farm. The changes in setting resulting from these activities will result in a medium adverse impact and a moderate adverse effect.

Cumulative effects

6.4.8 It is not considered that there will be any cumulative effects from temporary impacts on heritage assets within the study area. This is because construction of the proposed scheme will not occur simultaneously with identified developments in the study area.

Permanent effects

6.4.9 Permanent significant effects can occur either as a result of physical impacts on heritage assets within the land required, temporarily or permanently, for construction of the Proposed Scheme, or through changes to the setting of heritage assets through the presence of the Proposed Scheme.

Physical Impacts

6.4.10 Deposits potentially containing Bronze Age cremations as indicted by those excavated at Copthall Covert (RUI021), an asset of moderate value, will be removed by ground works in the Northolt tunnel and earthworks compound and the construction of the Proposed Scheme northbound connection. This will be a high adverse impact and a major adverse effect.

6.4.11 The Thames Terrace (RUI015) deposits which will be removed in the Colne Valley at the southern extremity of the Northolt tunnel and earthworks compound are known to contain Palaeolithic artefacts and deposits of moderate value. This will result in a high adverse impact and a major adverse effect.

6.4.12 Evidence of a Romano British settlement, north of Newyears Green Farm was excavated during a watching brief for previous utility works in the location of the proposed sustainable placement area. Only the edge of the settlement was uncovered and there is likely to be further evidence of settlement in this area. This asset is of moderate value and will result in a high adverse impact and major adverse effect.

Impacts on the setting of heritage assets

6.4.13 Highway Farm (RUI006) and its associated structures are medieval/post-medieval assets of moderate value presently situated in a largely rural agricultural setting comprising the post-medieval enclosures with which the farm was associated and on the original alignment of Harvil Road. Its setting therefore contributes to some degree to its significance. The introduction of the National Grid feeder station and realignment of Harvil Road, will substantially alter the setting of the asset. This will constitute a medium adverse impact and moderate adverse effect.

6.4.14 Much of the infrastructure associated with the Proposed Scheme will be on the north side of the existing Chiltern Main Line which is on embankment near Brackenbury Farm. On completion, the Proposed Scheme will be partially screened by the existing rail embankment from Brackenbury Farm (RUI002) moated site, an asset of high value. However, there will be sustainable placement areas with increased ground levels, which will alter the medieval/post-medieval character of this asset provided by the post-medieval enclosures west of the farm house which are still used for agriculture. This will constitute a medium adverse impact and a major adverse effect on the moated site.

6.4.15 St Leonards Farmhouse (RUI 074) is an asset of moderate value which lies within a semi-rural landscape in which post-medieval enclosures remain and the modern roads follow the line of medieval to post-medieval track ways. The sustainable placement area is situated north, east and west of the farm and will, although landscaped when complete, partially sever the farm from its setting. This will result in a medium adverse impact and a moderate adverse effect.

6.4.16 The medieval/post-medieval setting of Copthall Farmhouse (RUI008), an asset of moderate value, has already been heavily impacted by the urban sprawl of Ickenham and modern farm buildings of the farm itself. Some vestige of the rural medieval/post-medieval landscape remains to the west as the post-medieval enclosures. The area occupied by these enclosures will be impacted by the sustainable placement area which will remove the remaining medieval/post-medieval field boundaries and therefore impact on the farm's setting. This will be a moderate adverse impact and a moderate adverse effect.

Permanent cumulative effects

6.4.17 The cultural heritage methodology includes the consideration of the intra-project effects of a number of technical assessments, for example, landscape works,

ecological mitigation and flood risk measures. Consequently, these interactions have been included in the assessment of impacts and effects.

6.4.18 There are no further intra-project effects considered to be of specific relevance to the cultural heritage topic.

Other mitigation measures

6.4.19 Opportunities for further mitigation will be considered as part of the detailed design process. Currently identified opportunities include:

- utility modifications will be confined where possible to existing service trenches; and
- design of landscape mitigation around the Northolt tunnel and earthworks main compound to minimise visual impact of cutting to the west.

Summary of likely residual significant effects

6.4.20 A range of archaeological assets will be permanently lost due to the construction of the Proposed Scheme; these assets include: Bronze Age cremations at Copthall Covert (RUI021), possible Palaeolithic artefacts in the Thames Terrace Gravels (RUI015) and a Romano-British settlement north of Newyears Green Farm. A programme of archaeological works will be prepared to investigate, analyse, report and archive these assets.

6.4.21 There will be no physical impacts to any built heritage assets.

6.4.22 The Proposed Scheme will change the setting of several heritage assets, including Highway Farm (RUI006), Brackenbury Farm moated site (RUI002), St Leonards Farmhouse (RUI074) and Copthall Farmhouse (RUI008).

6.5 Effects arising from operation

Avoidance and mitigation measures

6.5.1 No measures have been required to reduce the impacts and effects on assets.

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 here, albeit that they will endure through the operation of the Proposed Scheme.

6.5.3 There are no significant effects identified within the assessment that result from railway operation.

Cumulative effects

6.5.4 Assessment of cumulative effects on cultural heritage assets arising from the interaction of the Proposed Scheme with cumulative development projects has been undertaken. These developments are listed in Section 2 and mapped in Maps CT-13-008 to CT-13-010 (Volume 5, Cross Topic Appendix 1 Map Book). No significant cumulative effects have been identified in relation to cultural heritage.

Other mitigation measures

6.5.5 Refinements to the mitigation measures incorporated into the design of the Proposed Scheme will be considered during detailed design to reduce further the significant effects described above.

Summary of likely residual significant effects

6.5.6 No mitigation beyond that described above has been identified and consequently the residual effects are the same as those reported in assessment of impacts and effects.

6.5.7 No significant residual effects have been identified.

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:

- loss of habitat in Ruislip Golf Course and Old Priory Meadows Site of Borough Importance Grade 1 (SBI.I), Brackenbury Railway Cutting Site of Borough Importance Grade 2 (SBI.II) and Newyears Green SB.II;
- loss of terrestrial habitat and breeding ponds for great crested newt at West Ruislip Golf Course, the pharmaceutical research facility and fields south of Bayhurst wood;
- loss of 6ha of semi-natural broadleaved and secondary woodland and 3.5 km hedgerows; and
- loss of bat roosts in trees and farm buildings and foraging and commuting habitat.

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

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

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 Greenspace Information for Greater London (GiGL), London Wildlife Trust and London Bat Group.

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-001-001, EC-002-001, EC-003-001 and EC-004-001.

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 It should be noted that the baseline information provided in this section does not include descriptions of designated sites, habitats and species above the bored tunnel where no impacts on ecological receptors are expected. This is the case mainly in the eastern part of the Proposed Scheme, with the exception of South Ruislip vent shaft main compound and utilities works.

7.2.4 In this area, a deviation from the standard survey methodology for reptiles was necessary on operational railway land due to restrictions on the placing of tin artificial refugia. As a consequence, the surveys utilised roofing felt refugia only. It is not considered the deviation had any effect on the results of the survey.

7.2.5 Some species/species groups were scoped out from surveys because suitable habitat was lacking, or because the scheme design in this area could not plausibly affect them e.g. fish and birds at Ruislip Woods SSSI. A few were scoped out of the report baseline for other reasons, e.g. confirmed presence of an invasive species that commonly ousts a native species, e.g. mink predating water vole or non-native crayfish out-competing white-clawed crayfish. Further information is presented in Volume 5: EC-001-001, EC-002-001, EC-003-001 and EC-004-001.

7.2.6 Access was not obtained to all of the land area where general habitat surveys (Phase 1 habitat survey) were proposed. Partial Phase 1 habitat surveys were carried out from PRoW for areas where access for detailed surveys was not permitted at most locations. Locations with the potential to support key ecological receptors where access could not be gained for survey include a brownfield site at South Ruislip vent shaft location, Ruislip Golf Course and Ickenham Green south of the golf course, fields at the pharmaceutical research facility west of Breakspear Road South, Brackenbury Farm and Brackenbury Barn west of Breakspear Road South, Newyears Green Covert and adjacent fields to the east of Harvil Road, Bayhurst Wood and fields to the south east of Bayhurst Wood. A single visit occurred to some of these sites including the pharmaceutical research facility and Brackenbury Farm but no further access for detailed surveys of key ecological receptors was permitted with the exception of Copthall Farm. Further details are provided in Volume 5: Appendices EC-001-001, EC-002-001, EC-003-001 and EC-004-001.

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

7.2.8 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 and maps presented in Volume 5: Appendices EC-001-001, EC-002-001, EC-003-001 and EC-004-001 and Maps EC-01 to EC-12 (Volume 5: Ecology Map Book CFA6). Statutory and non-statutory designated sites are shown on Maps EC-01-008 to EC-01-010 (Volume 5, Ecology Map Book CFA6).

7.3.2 Land required for the construction of the Proposed Scheme and that adjacent to it consists of an urban environment in the eastern part (mainly in tunnel) with residential areas, recreation grounds, light industrial areas, roads, a railway depot and small undeveloped plots supporting brownfield habitats. The environment is increasingly rural west from the tunnel portal and includes the Ruislip Golf Course, the River Pinn corridor and amenity grassland and wildflower meadows to the south of the golf course. Further west the land is dominated by agriculture with farmland separated by managed hedgerows, occasional ponds and areas of woodland including Copthall Covert, Newyears Green Covert and the larger Bayhurst Wood.

Designated sites

7.3.3 There are five statutory designated sites located within 500m of the Proposed Scheme. These are:

- Ruislip Woods Site of Special Scientific Interest (SSSI) – an extensive example of ancient semi-natural woodland, including some of the largest unbroken blocks that remain in Greater London. A diverse range of oak and hornbeam woodland types occur, with large areas managed on a traditional coppice-with-standards system. The site is also unusual in Greater London for the combination of extensive woodland with other semi-natural habitats, most notably acidic grass-heath mosaic and areas of wetland. These habitats and especially the woodland contain a number of rare and scarce plant and insect species in a national and local context together with a range of breeding birds. The woodland lies in four major blocks, known as Bayhurst Wood, Mad Bess Wood, Copse and Park Wood. Bayhurst Wood is closest to the Proposed Scheme. The woodland is mostly dominated by pedunculate oak, sessile oak, hornbeam and birch. The SSSI is also a National Nature Reserve (NNR) and an SMI[26]. The site is adjacent to the pylon tower replacement works just beyond the north-western boundary and approximately 40m north-west of a sustainable on-site placement area for the Proposed Scheme and is of national value;
- Fray's Farm Meadows SSSI – located 500m west of the land required for the construction of the Proposed Scheme within the Colne Valley and is of national

[26] Ruislip Woods and Poor's Field SMI is not affected by the Proposed Scheme and therefore not included in the baseline.

value. See CFA7 for a description of this site and discussion of the related impacts;

- Ruislip Woods National Nature Reserve (NNR) – The NNR is also a SSSI and SMI (see SSSI description). The site is adjacent to the pylon tower replacement works just beyond the north-western boundary and approximately 40m north-west of the sustainable on-site placement area for the Proposed Scheme and is of national value;
- Islip Manor Local Nature Reserve (LNR) – comprises meadow grassland managed for nature conservation supporting various common grass species with a woodland understorey developing beneath planted horse chestnut, hornbeam and common lime trees. The LNR is approximately 250m south of the above ground land required for utilities associated with the construction of the Proposed Scheme and is of district/borough value; and
- Fray's Valley LNR – located 500m west of the land required for the construction of the Proposed Scheme within CFA7 and is of district/borough value. See CFA7 for a description of this site and discussion of the related impacts.

7.3.4 There are ten Sites of Metropolitan Importance (SMI) and SBI relevant to the assessment in this area. They are:

- Ruislip Wood and Poor's Field SMI – the SMI is part of Ruislip Woods SSSI and an NNR (see SSSI description). The site is adjacent to pylon tower replacement works just beyond the north-western boundary and is of county/metropolitan value);
- Ruislip Golf Course and Old Priory Meadows SBI.I – two sections on opposite banks of the River Pinn. Old Priory meadow west of the river is rich in wildflowers. A pond beside the railway embankment once supported great crested newt but the current status of the species at the pond is uncertain. The site is within the land required for the construction of the new railway alignment, a satellite construction compound and a rail siding for the Proposed Scheme and is of district/borough value;
- Newyears Green SBI.I – this covert has a canopy dominated by pedunculate oak, ash and hornbeam. Also present are the locally notable, buckthorn and in addition, the locally notable musk thistle is present. This site is partly within the land required for the construction of the new railway alignment and the diversion of Harvil Road and is of district/borough value;
- Central Line West Ruislip Branch SBI.II – this site is well vegetated and wide throughout most of its length, occurring on embankment and cutting. Habitats are varied and include woodland, scrub and grassland suitable for a range of species. The site is adjacent to land required for utilities works for the construction of the Proposed Scheme and is of district/borough value;
- Victoria Road Railway Banks SBI.II – comprises an extensive area of scrub and trees around a railway junction and surrounding a waste transfer station. More

open areas close to the railway support diverse rough grassland and ruderal habitats. The site is likely to be utilised by birds, mammals and a wide range of invertebrates. The site is partly within the land potentially required for utilities works associated with the construction of the Proposed Scheme and is of district/borough value;

- Yeading Brook between Roxbourne Park and Ruislip Gardens SBI.II – comprises the brook, riparian habitats and adjacent areas of rough grassland and native hedgerow, trees and scrub. The wetland habitats support aquatic plant species and a high invertebrate diversity. The site is partly within the land required for utilities works associated with the construction of the Proposed Scheme and is of district/borough value;
- Herlwyn Park Recreation Ground and Railway Banks SBI.II – comprises areas of amenity grassland partially divided by a line of trees with rough grassland and scrub habitats at several points. The railway embankments comprise dense trees and scrub which is likely to support a range of birds, mammals and invertebrates. The site is partly within the land required for utilities works associated with the construction of the Proposed Scheme and is of district/borough value;
- Mad Field Covert, Railway Mead and the River Pinn SBI.II – Mad Field Covert is a stand of oak and ash woodland. Railway Mead is an area of herb-rich grassland bounded by mature hedgerows. The River Pinn is shallow and slow-flowing, with a silted bed. There is a pond beside the river. Kingfishers are present, along with butterflies and dragonflies. The site is partly within land required for utilities works associated with the construction of the Proposed Scheme and is of district/borough value;
- Brackenbury Railway Cutting SBI.II – comprises a broad, wooded railway cutting. The dense tree and scrub cover is dominated by pedunculate oak, elder and English elm. An oak-dominated copse situated by the roadside to the south-west is also included in the site. The site is partly within the land required for the construction of the new railway alignment, a construction main head siding, a rail siding, a main construction compound and a storage facility for the Proposed Scheme and is of district/borough value; and
- Common Plantation and Park Wood SBI.II – two areas of woodland separated by the A40 and dominated by pedunculate oak, sycamore and ash. Damp areas support grey, crack and goat willows and the woodland floors are dominated by bramble. Park Wood lies to the east of the River Pinn and is believed to be a remnant of ancient woodland. The canopy is fairly open and unusually, dominated by ash and wych elm. The River Pinn flows through the woodland, where dense shade has limited the aquatic flora. The site is adjacent to the land required for utilities works and possible road junction improvements and is of district/borough value.

Habitats

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

Woodland

7.3.6 Bayhurst Wood is the only woodland block in Ruislip Woods SSSI that is relevant to the assessment. The woodland is varied but predominantly comprises old coppice-with-standards, with sessile oak, standards and hornbeam coppice and also a transition to areas of sessile oak-beech woodland. The ground flora includes some locally uncommon species, where not under the dense shade of the hornbeam coppice. This woodland qualifies as a Section 41 habitat of principal importance[27] lowland mixed deciduous woodland. This woodland is of national value.

7.3.7 Mature semi-natural, mainly secondary broadleaved woodland with small areas of plantation is present in small areas along the corridor of the River Pinn, Ickenham Green, within agricultural areas in the west at Copthall Covert, at Newyears Green Covert and along the railway at Brackenbury Railway Cutting SBI.II, with some remnant ancient woodland at Common Plantation and Park Wood SBI.II. Woodland is Hillingdon local BAP habitat. These woodlands are of district/borough value.

Hedgerows

7.3.8 Native species hedgerows are present in the agricultural areas in the western part of the area between Breakspear Road South and Harvil Road south of Copthall Covert, Ickenham Green, fields near the River Pinn and fields south of Bayhurst Wood. They are generally species poor, intact and well-connected with occasional trees, small ditches and few associated banks. The majority are unlikely to be considered 'Important' under the Hedgerows Regulations[28]. Hedgerows in the fields south-east of Bayhurst Wood may qualify as potentially 'Important' under the landscape and wildlife criteria in the Hedgerows Regulations. Hedgerows are a habitat of principal importance. The hedgerows at Copthall Farm and fields south-east of Bayhurst Wood form an ecological network and are of district/borough value. Other hedgerows are expected to be of no more than of local/parish value.

Grassland

7.3.9 A small area of species rich mesotrophic grassland is present at Ickenham Green. Species of local conservation interest were recorded. This comprises part of Mad Field Covert, Railway Mead and the River Pinn SBI.II. Grassland described as including species rich grazed fields comprise part of Newyears Green SBI.I. Meadows and Pastures are a Hillingdon BAP habitat. This grassland is of district/borough value.

7.3.10 An area of relatively species-rich wet grassland is present between the River Pinn and Ruislip Golf Course. This grassland falls within Ruislip Golf Course and Old Priory Meadows SBI.I. This grassland is of district/borough value.

[27] Natural Environment and Rural Communities (NERC) Act 2006. Section 41: Habitats of Principal Importance in England
[28] The Hedgerows Regulations 1997 (1997 No. 1160). London. Her Majesty's Stationery Office.

7.3.11 Rough-grassland swards have developed where agricultural grassland has been left non-grazed and uncut including fields south of the railway between the River Pinn and Breakspear Road South and in the Ickenham Green area. This grassland is of local/parish value.

7.3.12 The majority of grassland across the area is agricultural and comprises improved grassland or species-poor semi-improved grassland. This grassland is of local/parish value.

Watercourses

7.3.13 The River Pinn is a meandering river approximately 6m wide and mostly about 0.4m deep over a generally soft bed. The River Pinn has little submerged aquatic vegetation and is extensively fringed by stands of emergent aquatic vegetation. The banks have trees, some areas of secondary or plantation woodland, scrub, rough but not wet grasslands and extensive stands of invasive plants in areas. The River Pinn may qualify as a habitat of principal importance if otter are confirmed to be present. Rivers and Streams are a Hillingdon BAP habitat. The river is of district/borough value.

7.3.14 The Yeading Brook is a small stream about 2m wide and an estimated 0.3m deep. It runs in part through recreational areas, such that the bank top vegetation comprises mown grassland and in part, south of the railway, it runs through a complex of scrub and trees, tall-herb vegetation, wet grassland and rough grassland. This habitat forms part of Yeading Brook between Roxbourne Park and Ruislip Gardens SBI.II. The stream is of district/borough value.

7.3.15 A small stream, Ickenham Stream, about 1.5m wide is present at Ickenham Green. Where Ickenham Stream crosses Ruislip Golf Course it is mostly a dry depression in mown grassland, but with some small sections of shallow water and is choked with terrestrial vegetation. South of the golf course, the stream emerges as a shallow brook running over a bed of cobbles south of the railway. The stream is of local/parish value.

7.3.16 Newyears Green Bourne is a small steam which runs within a ditch through fields and passes under Harvil Road. The stream holds little water and is largely shaded by the adjacent scrub and hedgerows. The stream is of local/parish value.

Water bodies

7.3.17 There are a number of water bodies in the western part of this area, including ponds and a drain at Ruislip Golf Course, ponds at Brackenbury Farm, ponds at the pharmaceutical research facility and ponds in fields to the south and north-west of Bayhurst Wood. Access was not available for field survey; based on desk study information and habitat suitability and given the lack of field survey, these ponds are therefore assumed to support great crested newt. Ponds supporting great crested newts are a habitat of principal importance. Standing Water is a Hillingdon BAP

habitat. These ponds considered to support great crested newt are of district/borough value.

7.3.18 Ponds not considered to support great crested newt due to apparent unsuitable habitat, including a field pond near Ickenham Pumping Station, ponds within Copthall Farm and ponds at Highway Farm are of local/parish value.

Habitats within the River Pinn corridor

7.3.19 The complex of habitat around the River Pinn include areas of secondary and plantation woodland, thorn and bramble scrub, tall-herb vegetation, rough grasslands and river and water-margin habitats that, in juxtaposition to one another, are unusually extensive for outer London. This habitat is of district/borough value.

Mosaic and transition habitats

7.3.20 Three main types of mosaic and transition habitats have been identified within the railway land. The three types include varying complexes of scrub, rough grassland tall-herb ruderal vegetation and bare ground in differing proportions. Victoria Road Railway Banks SBI.II includes this habitat. These complexes are collectively of district/borough value.

Open mosaic habitat on previously developed land

7.3.21 There are extensive stands of species-rich ephemeral vegetation on crushed brick and concrete substrates at the vacant industrial site at the South Ruislip vent shaft main construction compound. This occurs in mosaic with scrub and bare ground and qualifies as the habitat of principal importance type open mosaic habitat on previously developed land. This habitat is of district/borough value.

Other habitats

7.3.22 All other habitats are of local/parish value or below. Full descriptions are provided in Volume 5: Appendices EC-001-001, EC-002-001, EC-003-001 and EC-004-001.

Protected and/or notable species

7.3.23 A summary of the species relevant to the assessment is provided in Table 11.

Table 11: Protected and/or notable species

Species/ species group	Value	Receptor	Baseline and rationale for valuation
Birds	Up to county/ metropolitan	Red kite	Present in low numbers across Ruislip Golf Course and agricultural fields west of Breakspear Road South toward the Colne Valley. Occasional individuals were recorded in flight during surveys. Red kite populations in the Chilterns and neighbouring regions are increasing, though sightings are less common in Greater London and the survey limitations mean it is not possible to preclude the chance of breeding pairs. Given the Chilterns populations is 133 pairs, two pairs would comprise a population of metropolitan importance and this precautionary valuation has been assumed.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
	County / metropolitan	Hobby	A pair of hobbies has been recorded breeding in this area during field surveys. Hobbies are scarce breeding birds in the Greater London area but are almost certainly under-recorded. Available data and estimates would indicate that any breeding pair represents over 1% of the breeding population of hobbies in the Greater London area.
	County / metropolitan	Kingfisher	Field surveys recorded a kingfisher pair breeding in a hole in the bank of the River Pinn. The Proposed Scheme overlaps the pair's territory. Kingfishers are uncommon breeding birds in the Greater London area, although widely distributed along suitable rivers and other suitable water bodies. This one territory recorded during the London surveys is at or just below the 1% the criteria for county importance.
	Up to county/ metropolitan	Barn owl	Field surveys have not recorded barn owl breeding in this area. Initial stages of field survey recorded a total of seven potential nest sites which were recorded within the area near Copthall Farm, Highway Farm and St Leonard's Farm, with four of these falling within the Proposed Scheme boundary. The value of the habitat for foraging barn owl was identified as low across the area with the exception of land south-west of Bayhurst Wood and fields to the east side of Breakspear Road South where it was described as medium value. In addition land adjacent to the PRoW north-west of Highway Farm appears to be of significantly greater value both in terms of potential nest sites and foraging habitat. Based on local knowledge up to 2-4 pairs may utilise the potential nesting sites and foraging areas during favourable conditions. These pairs represent an extension of the Colne Valley population when this is at high density and in poor years, such as that experienced during the field survey, may be absent. The estimate for Greater London's barn owl population is 5 pairs[29]. If barn owls breed in this area this population would be of county/metropolitan value.
	Up to district/borough	Winter assemblage at Bayhurst Wood	The size, quality and diversity of the habitat is likely to support a wider range of wintering species than other areas in the CFA. Desktop study indicates the presence of notable species such as lesser spotted woodpecker, hawfinch and woodcock,
	Local/parish	Breeding bird assemblage at Copthall Farm and Copthall Covert	A total of 50 bird species were recorded during field surveys. With the exception of hobby, red kite and barn owl, the assemblage is of local value comprising common and widespread species.
	Local/parish	Breeding bird assemblages at land on the east side of Breakspear Road South	Of a total of 47 bird species recorded during field surveys, 24 species were considered to be breeding with a further four species probably and seven species possibly doing so. The assemblage is of local value comprising common and widespread species.

[29] http://www.bocn.org/map.asp

Species/ species group	Value	Receptor	Baseline and rationale for valuation
	Local/parish	Breeding bird assemblages at the north-west side of Breakspear Road South, Oak Farm, Ruislip Golf course, Mad Field Covert, Highway Farm and rail land between Ickenham High Road and Harvil Road	Field survey recorded a total of between 56 and 37 species at each site, not all of which bred. Assemblages were typical of those adapted for semi-rural or rural environments and are of local value.
	Local/parish	Breeding bird assemblages at Newyears Green Covert	Whilst no field survey was undertaken due to access restrictions at Newyears Green Covert, it is considered that this woodland will comprise similar species and numbers to those recorded on the adjoining railway land and Copthall Covert.
	Local/parish	Winter bird assemblages around West Ruislip at Breakspear Road South, through Ruislip Golf Course and through Copthall Farm.	No species were present in numbers significant enough to exceed the level of local value. From the available survey data, the sites are considered to be of local value for wintering birds. Desk study data received supports this conclusion.
Bats	Up to regional	Rarer bat assemblages with maternity roosts in trees in the fields to the south of Bayhurst Wood.	It was not possible to carry out emergence surveys in these areas of habitat due to access restrictions. Rarer species such as Daubenton's, Natterer's, Leisler's, noctule, Nathusius' pipistrelle and serotine were recorded further south at Newyears Green Lane and Bayhurst Wood is likely to support rarer bats. It is therefore considered possible that maternity roosts of rarer species could be present in these trees in the fields south of Bayhurst Wood and a precautionary value has been applied.
	Up to county /metropolitan	Common pipistrelle populations and non-breeding rarer bats roosting in trees, foraging and commuting in the fields to the south of Bayhurst Wood	It was not possible to carry out emergence surveys in these areas of habitat due to access restrictions Rarer species such as Daubenton's, Natterer's, Leisler's, noctule, Nathusius' pipistrelle and serotine were recorded foraging in low numbers during the field transect surveys of the adjacent Newyears Green Lane and along the bridleway southwest of Gatemead Farm and they are considered likely to forage across these fields connecting to Bayhurst Wood. It is therefore possible that these rarer species will have non-maternity roosts in these areas as well as possible maternity roosts of common species and a precautionary value has been applied.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
	Up to county /metropolitan	Common pipistrelle populations roosting in trees along the bridleway southwest of Gatemead Farm, the pharmaceutical research facility trees and buildings, trees at Brackenbury Farm and foraging in the Gatemead Farm area	Field surveys identified several roosts for a small number of individual common and soprano pipistrelles. These are likely to be male or non-breeding female bats in transitional roosts. Although only transitional roosts were confirmed, due to the numbers of passes recorded during static and transect surveys, it is possible that maternity roosts of these species are present. Initial assessment survey recorded one building with high potential to support bat roosts at the pharmaceutical research facility and several with moderate potential at the pharmaceutical research facility, and the Breakspear Road South rail bridge and other buildings in private property. It was not possible to carry out emergence surveys of these buildings due to access restrictions. Because the possibility of maternity roosts being present cannot be ruled out this assemblage has been given a precautionary value. The activity surveys along the bridleway southwest of Gatemead Farm recorded high numbers of both commuting and foraging pipistrelles. Soprano pipistrelle is a species of principal importance[30] and all bats are London BAP species[31].
	Up to county /metropolitan	Rarer bat populations roosting in trees along the bridleway southwest of Gatemead Farm, the pharmaceutical research facility trees and buildings, trees at Brackenbury Farm and foraging in the Gatemead Farm area	Initial assessment survey recorded one building with high potential to support bat roosts at the pharmaceutical research facility and several with moderate potential at the pharmaceutical research facility, and the Breakspear Road South rail bridge and other buildings in private property. It was not possible to carry out emergence surveys of these buildings due to access restrictions. Field transect and static detector data indicated low levels of commuting and foraging in the area between Gatemead Farm and Newyears Green Covert by rarer species including noctule, Leisler's bat, serotine and *Myotis* species. It is possible that possibly non-maternity roosts of rarer species could be present in the buildings. As a consequence a precautionary value has been applied.
	Up to county/ metropolitan	Common pipistrelle populations roosting in trees at Newyears Green Covert and foraging and commuting in the area	Although activity surveys were not carried out within Newyears Green Covert, due to the habitat type and activity in adjacent areas, it is assumed that this woodland habitat would be used by both foraging and commuting bats. The bat assemblages likely to be using these features are expected to be similar to those recorded using the bridleway southwest of Gatemead Farm i.e. higher numbers of both common and soprano pipistrelles. It is considered likely that maternity roosts of common pipistrelle species may be present in the trees.

[30] Natural Environment and Rural Communities (NERC) Act 2006. Section 41: Species of Principal Importance in England.
[31] London Biodiversity Partnership. London's BAP Priority Species. http://www.lbp.org.uk/londonpriority.html. Last accessed: 2.10.13.

Species/ species group	Value	Receptor	Baseline and rationale for valuation
	Up to county /metropolitan	Rarer bat populations roosting in trees at Newyears Green Covert and foraging and commuting in the area	Although activity surveys were not carried out within Newyears Green Covert, due to the habitat type and activity in adjacent areas, it is assumed that this woodland habitat would be used by both foraging and commuting bats. The bat assemblages likely to be using these features are expected to be similar to those recorded using the bridleway southwest of Gatemead Farm i.e. smaller numbers of noctule, Leisler's bat, serotine and *Myotis* species. It is considered that there is little data to support maternity roosts of rarer species.
	County /metropolitan	Foraging and commuting pipistrelle bats along the River Pinn.	The activity surveys at this location recorded high levels of pipistrelle bats foraging and commuting. These bats are assumed to have a maternity roost in the housing estate to the south of the River Pinn bridge.
	District/borough	Rarer bats foraging and commuting along the River Pinn.	The activity surveys at this location also recorded occasional passes were recorded from a number of species other than common pipistrelle, including Nathusius' pipistrelle, noctule, Leisler's bat, serotine, brown long-eared bat and *Myotis* species.
	District/borough	Pipistrelle species populations and rarer bats foraging along the railway land between the River Pinn and Harvil Road	Transect and static detector surveys indicate moderate to high activity levels of common pipistrelle species in the rail land and lower levels of rarer bats including noctule.
	Up to local/parish	Pipistrelle species population roosting in trees at Copthall Covert.	Field surveys identified several roosts for a small number of individual common and soprano pipistrelles. These are likely to be male or non-breeding female bats in transitional roosts.
Hazel dormouse	Up to county /metropolitan	Potential dormouse population at Newyears Green Covert and Bayhurst Wood	Field survey indicates that dormouse are absent from railway land between Ickenham Road and Breakspear Road South and between Breakspear Rd South and Harvil Road. Access restrictions prevented detailed surveys in areas identified as having potentially suitable habitat at Newyears Green Covert, the southern part of Bayhurst Wood and adjoining hedgerows and so taking a precautionary approach the presence of dormice cannot be ruled out. Dormouse is a species of principal importance and a London BAP species.
Great crested newt	Up to county/ metropolitan	Great crested newt population at fields to the west of Lord Halsbury Memorial Playing Fields Great crested newt population at Ruislip Golf Course	No field surveys were undertaken at Lord Halsbury Memorial Playing fields however the desk study indicates that small numbers of great crested newt have been recorded historically. No field survey was undertaken at Ruislip Golf Course, Brackenbury Farm, the pharmaceutical research facility, fields southeast of Bayhurst Wood and fields north-west of Bayhurst Wood and there are no desk study records of great

Species/ species group	Value	Receptor	Baseline and rationale for valuation
		Great crested newt population at Brackenbury Farm and the pharmaceutical research facility	crested newt in this area. An amphibian and reptile exclusion exercise not related to this project is underway on railway embankments at Ruislip Golf Course and records indicate great crested newts are present at Ruislip Golf Course. Given the presence of suitable aquatic and terrestrial habitat viewed from PRoW or obtained from desk study, a reasonable precautionary prediction assumes a medium population of great crested newts is present at each location. Great crested newt are a species of principal importance. .
		Great crested newt population at fields south of Bayhurst Wood	
		Great crested newt population at fields north-west of Bayhurst Wood	
Terrestrial invertebrates	Up to county /metropolitan	Invertebrate assemblage at brownfield land at South Ruislip Vent Shaft	South Ruislip Shaft vent shaft Main Compound is assumed to support an invertebrate assemblage of conservation interest, due to the open mosaic habitat recorded at the brownfield site. These habitats are known to support a high diversity of invertebrate species. Due to lack of access it is assumed, in the absence of field survey, that this area may support species of conservation interest.
	Up to county /metropolitan	Invertebrate assemblage at the River Pinn corridor	Field surveys show that the River Pinn corridor includes areas of unmanaged habitats including scrub and rough grassland adjacent to the riparian habitat that collectively are of good quality for terrestrial invertebrates. Six species of conservation interest (Nationally Scarce (Nb)[32]) were recorded during surveys with further species of conservation interest expected to be present. As part of a wider green corridor in this area of London this site is considered to be of high nature conservation interest for invertebrates.
	Up to county/ metropolitan	Invertebrate assemblage at the PRoW north-west of Breakspear Road South	Field surveys show that the PRoW north-west of Breakspear Road South alongside Highway Farm includes a number of micro-habitats in a mosaic of high quality for invertebrates, including mature trees and hedgebanks. Eleven species of conservation interest (Red Data Book 2(RDB2) and Nationally Scarce (Nb and Na) were recorded during surveys and further species of conservation interest are expected to be present. This site is considered to be of interest and the invertebrate fauna of this area is considered to contribute significantly to the invertebrate interest of the wider area.
	Up to county/ metropolitan	Terrestrial invertebrate assemblage in agricultural land to the south-west of Bayhurst Wood	Fields to the south-east of Bayhurst Wood (Bayhurst Wood comprising part of Ruislip Woods SSSI and an ancient woodland) are assumed to support an invertebrate assemblage of conservation interest, due to the proximity of Bayhurst Wood which is known for its invertebrate interest, including nationally rare and nationally scarce invertebrate species[33]. Due to the proximity of Bayhurst Wood, an invertebrate assemblage is assumed, in the absence of field survey, to be as good if not better than the agricultural land further south which was surveyed.

[32]The status of species of conservation concern for terrestrial invertebrates was taken from the Joint Nature Conservation Committee (JNCC) database; http://jncc.defra.gov.uk/page-3408 first accessed in July 2013; accessed 2.10.13

[33] Natural England, Ruislip Woods SSSI Citation. http://www.sssi.naturalengland.org.uk/special/sssi/sssi_details.cfm?sssi_id=1003633

Species/ species group	Value	Receptor	Baseline and rationale for valuation
	District/borough	Terrestrial invertebrate assemblage in railway land between Ickenham Road and Breakspear Road South	Field surveys recorded three species of conservation interest (RBD 1, RDB 3 and RDBK). The railway corridor collectively forms a movement corridor and habitat feature likely to be important to invertebrate populations across this area of London.
	District/borough	Terrestrial invertebrate assemblage at Mad Field Covert, the PRoW alongside Highway Farm, and land to the south-east of Breakspear Road South	Field surveys show that individually the sites from Ickenham High Road to Harvil Road support populations of district/borough interest. Mad Field Covert, the PRoW alongside Highway Farm and land to the south-east of Breakspear Road South support invertebrate assemblages of district/borough interest due to the range of invertebrates supported including some protected/notable species.
	Local/parish	Terrestrial invertebrates assemblages in other habitats	The other habitats in the area are considered to be of low value for terrestrial invertebrate assemblages.
Otter	Up to district/borough	Otter at the Yeading Brook	Field survey indicated the Yeading Brook is suitable for otter. No evidence of otter was recorded in the limited surveys undertaken. Desk study indicates otter may use the Yeading Brook. The Yeading Brook runs through a largely suburban landscape and immediate surrounding habitat includes residential and industrial areas, woodland and recreational open space and is largely of low medium – low suitability[34] for otter. It is therefore considered that if present, otters are likely to only be commuting through this area. Otter are a species of principal importance and a London BAP species.
		Otter at the Ickenham Stream	Field survey indicated the Ickenham Stream is suitable for otter. No evidence of otter was recorded within the limited survey undertaken. The Ickenham stream runs through a largely suburban landscape and immediate surrounding habitat includes residential and industrial areas, roads, woodland and recreational open space. There are some areas of dense cover immediately adjacent to the water course where holt or couch building may be possible. It is considered that if present, despite the limited habitat for holts or couches, otters are likely to only be commuting through this area.

[34] Chanin P (2012); Highways Agency (1999); Design Manual for Roads and Bridges – Volume 10 – Section 4 Part 4 – Nature Conservation Advice in Relation to Otters. Highways Agency, London.IEEM (2011) Competencies for Species Surveys: Eurasian otter IEEM, Winchester. Downloaded at http://www.ieem.net/docs/CSS%20-%20EURASIAN%20OTTER%20%2831.8.2011%29.pdfhttp://www.ieem.net/docs/CSS%20-%20EURASIAN%20OTTER%20%2831.8.2011%29.pdf on 08/03/12

Species/ species group	Value	Receptor	Baseline and rationale for valuation
		Otter at the River Pinn	Field survey indicated the River Pinn is suitable for otter. No evidence of otter was recorded within the limited survey undertaken. The River Pinn runs through a largely suburban landscape at this location and otters could potentially use suitable areas of habitat along this water course, though there are limited holt sites and habitat connectivity is poor. It is therefore considered that if present, otters are likely to only be commuting through this area.
		Otter at the Newyears Green Bourne	Field survey indicated the Newyears Green Bourne is suitable for otter. No evidence of otter was recorded within the limited survey undertaken The Newyears Green Bourne is a small stream with very low water level and is often dry in places. Bankside vegetation could provide some cover for otter. The stream connects to the Savay Lake and the complex of water bodies of the Colne Valley. It is therefore considered that if present, otters are likely to only be commuting through this area.
Plants	Up to district / borough	Protected / Notable plants in land to the south-west of Bayhurst wood	Field margins, hedgerows and ponds to the south of Bayhurst Wood, part of Ruislip Woods SSSI and ancient woodland have not been surveyed. Taking a cautionary approach, due to the proximity of the ancient woodland, it is considered there may be protected or notable flora present in hedgerows and field margins, despite the agricultural use of the fields.
	District/borough	Protected / Notable plants including buckthorn, bearded couch and musk thistle at Newyears Green SBI.I	Desk study returned locally scarce and locally uncommon plant species including buckthorn, bearded couch and musk thistle, from the citation for Newyears Green SBI.I. Although widespread, if present, they would be of borough interest given the urban-fringe context.
	Local / parish	Protected / Notable plants including pignut in grassland at Ickenham Green.	Field surveys recorded a number of species of local conservation interest, including zig-zag clover and pignut, in an area of species rich mesotrophic grassland. These species are of local conservation interest, given the urban-fringe context.
	District/borough	Broad-leaved helleborine recorded on railway land near Breakspear Road South	Broad-leaved helleborine was recorded during surveys and is of Least Concern[35]. The species is relatively common in London, however scarce in the borough and as such is of borough interest.

[35] JNCC, Species Status; http://jncc.defra.gov.uk/pdf/pub05_speciesstatusvpredlist3_web.pdf; accessed 2.10.13

Species/ species group	Value	Receptor	Baseline and rationale for valuation
Common reptiles	District/borough	Populations of common reptiles along the railway land and adjoining grassland and agricultural land.	Field survey and desk study indicates that small populations of slow worm, common lizard and grass snake are present in habitats along the railway land and adjacent agricultural land and grassland at Victoria Road Railway Banks, South Ruislip, Ruislip Golf Course, Brackenbury Farm, the pharmaceutical research facility and land between Breakspear Road South and Harvil Road. Slow worm, grass snake and common lizard are a species of principal importance and all reptiles are London BAP priority species.
	Up to district/borough	Populations of common reptiles in fields south of Bayhurst Wood.	No field survey has been carried out in this area. Suitable habitat is present in fields south of Bayhurst wood and since no field survey was undertaken at this location a precautionary value is applied.
Badger	Local/parish	Badger populations present in fields and woodland in this area.	Signs of badger activity have been recorded on farmland in this area during field survey. These are likely to form part of the territory of main setts located in the adjacent Colne Valley area. A six-hole sett has been recorded close to the CFA7 boundary north-east of Lower Lodge Farm. There may be further activity or setts in inaccessible parts of the South Ruislip to Ickenham area but this would not change the evaluation of badgers. Badger is known to be widespread both within the UK and are known to be present in this area of Hillingdon. Given that no setts have been recorded and there are only sporadic signs of badger use, badger social groups within the study area are not likely to form a critical part of the county or even of the district population.

Future baseline

Construction (2017)

7.3.24 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 Section 2.1 of this report, with further details provided in Volume 5: Appendix CT-004-000. None of these developments will affect the character and value of ecological resources.

Operation (2026)

7.3.25 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 Where the eastern part of the route has been designed in tunnel this will reduce impacts on rail corridor and adjacent habitats and the species they support.

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

Assessment of impacts and effects

Designated sites

7.4.3 Ruislip Woods SSSI will be approximately 100m from the newly constructed haul road servicing the sustainable placement area. Due to its distance from the haul road, there will be negligible impact from dust deposition. The woodland for which the site is designated and therefore the integrity of the site will remain unaffected.

7.4.4 Construction of the new railway alignment, a satellite construction compound and a rail siding at Ruislip Golf Course will result in the loss of approximately 2.2ha of Ruislip Golf Course and Old Priory Meadows SBI.I, representing 12% of the site. These losses will result in a permanent adverse effect on site integrity significant at the district/borough level.

7.4.5 Construction of the new railway alignment, a maintenance siding, a main construction compound and diversion of the National Grid 275kV overhead power line in West Ruislip will result in the loss of approximately 3.5 ha of the Brackenbury Railway Cutting SBI.II, representing 72% of the site. The loss of over half of the woodland will devalue the remaining woodland due to direct loss of habitat and component species and increased likelihood of local extinctions related to remaining smaller populations will result in a permanent adverse effect on site integrity which will be significant at the district/borough level.

7.4.6 Construction of the new railway alignment in West Ruislip including the diversion of Harvil Road and diversion of the National Grid 275kV overhead power lines will result in the loss of approximately 5.5ha of the Newyears Green SBI.I representing 29% of the site. The loss of the southern part of the site and reduction in the extent of woodland will result in a permanent adverse effect on site integrity which will be significant at the district/borough level.

7.4.7 No significant effects are reported for the following designated sites which form part of the baseline; Ruislip Woods SSSI and NNR, Ruislip Wood and Poor's Field SMI, Islip Manor LNR, Frays Valley LNR, Victoria Road Railway Banks SBI.II, Yeading Brook between Roxbourne Park and Ruislip Gardens SBI.II, Herlwyn Park Recreation Ground and Railway Banks SBI.II, Mad Field Covert, Railway Mead and the River Pinn SBI.II and Common Plantation and Park Wood SBI.II.

Habitats

7.4.8 Construction work at Ruislip Golf Course, Newyears Green Covert and Copthall Covert will result in the loss of approximately 6ha secondary semi-natural broadleaved woodland and small areas of plantation. It will result in a permanent adverse effect on the conservation status of each of these woodland areas and in each case the effect will be significant at the district/borough level.

7.4.9 Construction works and preparation works for the sustainable materials placement areas will result in the loss of approximately 35ha grassland south of Copthall Covert

and 25ha south of Bayhurst wood, plus further small areas of agricultural and amenity grassland. It will result in a permanent adverse effect on the conservation status of each of these areas of grassland which collectively will be significant at the district/borough level.

7.4.10 The preparation works for the sustainable materials placement areas will result in the loss of approximately 3.6km of hedgerows some of which could be classified as important hedgerows under the Hedgerow Regulations, 1997. The loss will result in a permanent adverse effect on the conservation status of this habitat and local hedgerow network significant at up to the district/borough level.

7.4.11 Three ponds in Ruislip Golf Course, two ponds at the pharmaceutical research facility, three field ponds north of St Leonards Farm and south of Bayhurst Wood and two ponds at Copthall Farm will be lost within the Proposed Scheme. The loss will result in a permanent adverse effect on the conservation status of this habitat type at these locations which will in each case be significant at up to the district/borough level.

7.4.12 The construction of the new railway alignment and construction of the bridge over the River Pinn will result in the loss of less than 1ha of the complexes of habitat within the River Pinn corridor comprising mainly secondary and plantation woodland, thorn and bramble scrub, tall-herb vegetation, rough grasslands and river and water-margin habitats. The loss will result in a permanent adverse effect on the conservation status of this complex of habitats which will be significant at up to the district/borough level.

7.4.13 The diversion of the Ickenham Stream as part of the portal construction works at Ruislip Golf Course will result in the loss of open watercourse and riparian habitats. This will result in an adverse effect on the conservation status of the watercourse that is significant at the local/parish level.

7.4.14 The construction works associated with the new railway alignment, associated infrastructure, compounds and utilities works throughout this area but mainly along the western part will result in the loss of approximately 2ha of mosaic and transition habitats within the existing railway land. This cumulative loss will result in a permanent adverse effect on the conservation status of this habitat type which will be significant at the district/borough level.

7.4.15 Construction at the South Ruislip vent shaft main compound will result in the loss of approximately 0.6ha open mosaic habitat on previously developed land (a habitat of principal importance). The loss will result in a permanent adverse effect on the conservation status of this habitat that is significant at up to the district/borough level.

7.4.16 It is considered unlikely that any other effects on habitat receptors at more than the local/parish level will occur. Effects significant at the local/parish level are listed Volume 5: Appendix EC-005-001.

Species

7.4.17 Possible maternity roosts of rarer species in hedgerow trees to the south of Bayhurst Wood will be impacted by the preparation works for the sustainable materials placement area. Roosting bats in this area may use alternative trees for roosting in Bayhurst Wood. Nevertheless, the loss of potential roosts will result in an adverse effect on the conservation status of these populations that is significant at up to the county/metropolitan level.

7.4.18 The following lists the effect of the permanent loss of ponds and terrestrial habitat on great crested newt populations:

- the construction of the West Ruislip portal will result in the loss of two ponds and part of a ditch and approximately 2ha of suitable terrestrial habitat including mosaic railway habitats, grassland and small areas of woodland within 250m of assumed breeding ponds for great crested newt. This would result in a permanent adverse effect on the conservation status of this assumed medium population of great crested newt that is significant at up to the county/metropolitan level;
- the construction of the Copthall retaining structure south of the pharmaceutical research facility and the preparation works for the excavated materials laydown area nearby will result in the loss of two ponds and approximately 4.5ha of suitable terrestrial habitat including mosaic railway habitats, agricultural grassland and small areas of woodland within 250m of assumed breeding ponds. This would result in a permanent adverse effect on the conservation status of this assumed medium population of great crested newt that is significant at up to the county/metropolitan level;
- the creation of the sustainable on-site placement area to the south of Bayhurst Wood will result in the loss of three ponds which may be used for breeding by a medium population of great crested newts and temporary loss of approximately 20ha of suitable terrestrial habitat (the majority of which includes poor quality habitat such as agricultural fields) within 250m of assumed breeding ponds. This would result in a permanent adverse effect on the conservation status of this assumed medium population of great crested newt that is significant at up to a county/metropolitan level; and
- the laying of utilities just to the south the railway at Lord Halsbury playing fields will result in the loss of a small area of approximately 0.5ha of semi-improved grassland and scrub within 250m of assumed breeding ponds. This would result in a permanent adverse effect on the conservation status of this assumed medium population of great crested newt that is significant at up to a local/parish level.

7.4.19 The removal or disturbance of habitat features that are utilised by bats during breeding, hibernation or migrating between roosts are considered to have the potential to result in adverse effects on the bat populations or assemblages during construction. However, the point at which such impacts are considered likely to result

in a significant adverse effect on the conservation status of the population concerned will differ dependent on the status of the species concerned.

7.4.20 Losses of other habitat within the land required for the construction of the Proposed Scheme may require some bats to travel further, and expend more energy during day to day foraging and movement throughout their home range for the duration of construction. However, such effects alone are for all species considered unlikely to result in sufficient disturbance of the populations concerned to result in an adverse effect on their conservation status.

7.4.21 A number of potential tree and building bat roosts will be removed during construction. Roosts are important to the conservation status of bats by providing transitory, non-breeding and breeding sites. In addition the loss of connecting and surrounding habitat could affect local bat populations. The extent and continuity of the linear features are important to the conservation status of bats by providing connections between roosts and between foraging habitat. Lighting is not expected to adversely affect bats over and above the habitat loss identified and the majority of works in areas of value for bats will be limited to daylight hours.

7.4.22 Foraging areas and commuting routes with recorded high levels of common pipistrelle species recorded along the River Pinn will be affected by the construction of the new railway alignment and construction of the railway bridge over the River Pinn. The works will result in the disruption of 70m length of the foraging and commuting routes and loss of 1ha of key foraging habitat. Work will occur during the daytime and though materials haulage along the rail will be 24 hours. However, disruption to the commuting route will likely arise from changes in bank vegetation rather than direct construction disturbance. Such disruption will be only partial as most bats are likely to continue to use the river route whilst others may divert, at greater energy cost, during the works and around the cleared area. There will be a temporary loss of the commuting route. This will result in an adverse effect on the conservation status of these populations that is significant at up to the county/metropolitan level.

7.4.23 Foraging areas and commuting routes with recorded low levels of activity comprising single passes from rarer bats along the River Pinn will be affected by the construction works. The activity levels indicate that the route is not a significant resource for Nathusius' pipistrelle, noctule, Leisler's, serotine, brown long-eared bat and *Myotis* species. It is likely that bats will use alternative habitat to the north and south of the bridge. Whilst they may be forced to deviate from a short section, it is unlikely that the work would stop rarer bats commuting along the river. It is considered that the bridge works would have an adverse impact on rarer bat populations at the River Pinn. This will result in an adverse effect on the conservation status of this assemblage that is significant at up to the local/parish level.

7.4.24 Foraging areas and commuting routes with recorded high levels of activity from common pipistrelle species north of Gatemead farm will be affected by the

construction works involving the loss of 200m of the south-eastern part of the bridleway southwest of Gatemead Farm. In addition, possible common pipistrelle roosts including potential maternity roosts at the pharmaceutical research facility and in nearby trees will be impacted by the construction of the new railway alignment. The works will be timed during the day and it is likely that bats will continue to commute, although they will be forced to deviate from their typical route along the bridleway and Newyears Green Lane by joining the route further north-west and traversing the hedgerows across fields to join Breakspear Road South further north. Some buildings with the potential to support bat roosts will remain at the pharmaceutical research facility and the majority of trees with potential for bat roosts will be retained. Although total loss of assemblage is unlikely, some population losses and some commuting disruption are likely. This will result in an adverse effect on the conservation status of these populations that is significant at up to the county/metropolitan level.

7.4.25 Foraging areas and commuting routes with recorded low activity levels comprising very occasional individual passes from rarer bats including noctule, Leisler's, serotine and Natterer's bats north of Gatemead Farm will be impacted by the construction works involving the loss of 200m of the south-eastern part of the bridleway southwest of Gatemead Farm. Possible rarer non-maternity bat roosts at the pharmaceutical research facility and in trees may be lost. The works will be timed during the day and it is likely that bats will continue to commute, though will be forced to deviate from their typical route. Some buildings with the potential to support bat roosts will remain in this area and these bats are likely to use alternative retained buildings and trees for roosting. Although total loss of assemblage is unlikely, some population losses and some commuting disruption are likely. This will result in an adverse effect on the conservation status of this assemblage that is significant at up to the county/metropolitan level.

7.4.26 Foraging areas and commuting routes around Newyears Green Covert likely to be utilised by common pipistrelle and possible common pipistrelle roosts potentially including maternity roosts will be impacted by the construction works. The works will result in the loss of approximately 3ha of the southern part of the woodland. In addition part of the woodland and scrub along the railway which is a recorded key commuting route and foraging area will be lost. The works will be timed during the day and it is likely that bats will continue to forage in retained woodland habitat further north, though they will be forced to deviate from their typical routes. Further alternative trees with suitable features will be retained within the woodland to the north. It is considered that the loss of habitat, potential loss of roosts and disruption to commuting routes associated with the construction works would have an adverse impact on common pipistrelle populations at the Newyears Green Covert area. Although total loss of assemblage is unlikely, some population losses and significant commuting disruption are likely. This will result in an adverse effect on the

conservation status of this assemblage that is significant at up to the county/metropolitan level.

7.4.27 Foraging areas and commuting routes with likely low levels of activity from rarer species around Newyears Green Covert and potential roosts of rarer species (possibly including non-maternity roosts) will be impacted by the construction works. It is likely that bats will deviate around this area and use alternative trees for roosting. It is considered that the that the loss of habitat, disruption to commuting routes and potential loss of roosts associated with the construction works would have an adverse impact on rarer bat populations at the Newyears Green Covert area. Although total loss of assemblage is unlikely, some population losses and significant commuting disruption are likely. This will result in an adverse effect on the conservation status of this assemblage that is significant at up to the county/metropolitan level.

7.4.28 Foraging areas and commuting routes with recorded high levels of activity from common pipistrelle and lower activity of rarer species along the railway land between the River Pinn and Harvil Road will be affected by the construction works. The works will result in the loss of approximately 3.5ha of woodland and scrub at Brackenbury Railway Cutting and further small areas of mosaic and transition habitat along this route. The tunnel works will occur 24 hours and will involve a conveyor transporting material during this time. Bats will likely be deterred from using the route throughout construction due to the extent of works along the northern and southern sides of the railway and will be forced to forage elsewhere likely further west along the railway toward the Colne Valley. Although total loss of assemblage is unlikely, some population losses and significant commuting disruption are likely. This will result in an adverse effect on the conservation status of this assemblage that is significant at up to the district/borough level.

7.4.29 Recorded non-breeding roosts of common pipistrelle species at Copthall Covert will be impacted by the construction of a main construction compound. The works will result in the loss of a small part (approximately 0.2ha) of the woodland at the eastern extreme. This will result in the loss of a small number of roosts. Whilst alternative trees with potential for bat roosts will be retained, the extent of the works surrounding Copthall Covert is likely to force bats to move to other undisturbed habitat in the surrounding area such as west along the railway toward the Colne Valley. Although total loss of assemblage is unlikely, some population losses are likely. This will result in an adverse effect on the conservation status of this population that is significant at up to the local/parish level.

7.4.30 Foraging areas and commuting routes with possible high levels of activity from common pipistrelle species around unsurveyed fields and hedgerows to the south of Bayhurst Wood will be affected by construction works. In addition potential common pipistrelle roosts (possibly including potential maternity roosts) in the hedgerow trees will be impacted. The preparation works for the sustainable materials placement area

will result in the loss of approximately 15ha of grassland and approximately 3km of hedgerows including possible key foraging habitat and commuting routes. An unknown but likely small number of tree roosts including possible maternity roosts will be lost. It is likely that bats will continue to forage in Bayhurst Wood to the north and retained farmland to the northeast and south. Extensive alternative woodland for roosting is available at Bayhurst Wood. Although total loss of assemblage is unlikely, some commuting disruption is likely. This will result in an adverse effect on the conservation status of these populations that is significant at up to the county/metropolitan level.

7.4.31 Foraging areas and commuting routes with possible low levels of activity from rarer species around unsurveyed fields and hedgerows to the south of Bayhurst Wood and possible non-maternity roosts of rarer species will be impacted by the preparation works for the sustainable materials placement area. It is likely that bats will use alternative trees for roosting in Bayhurst Wood. Although total loss of assemblage is unlikely, some significant commuting disruption is likely. This will result in an adverse effect on the conservation status of this assemblage that is significant at up to the county/metropolitan level.

7.4.32 The construction of the new railway alignment and diversion of Harvil Road will result in the loss of approximately 2ha of woodland habitat in Newyears Green Covert and hedgerows south of Bayhurst Wood that may support hazel dormouse populations. There is little alternative habitat given the isolated situation of Newyears Green Covert. If present this would result in an adverse effect the conservation status of this species that is significant at up to the county/metropolitan level.

7.4.33 The loss of habitat suitable for terrestrial invertebrates along the railway land, the River Pinn corridor, Newyears Green Lane and the agricultural fields to the south of Bayhurst Wood would result in the localised loss of assemblages including some notable terrestrial invertebrate species and displacement to other extensive suitable alternative habitat in the area. The loss of habitat and a movement corridor along the railway would result in an adverse effect on the conservation status of each of the species assemblages concerned that is significant at up to the county/metropolitan level.

7.4.34 No evidence of breeding by either barn owl or red kite was recorded but potential foraging and breeding habitat exists. The creation of the sustainable on-site placement areas south of Copthall Covert and south of Bayhurst Wood will result in the loss of such habitat including a field south of Bayhurst Wood of medium value. In addition four potential barn owl nest sites will be lost, three to the south of Copthall Covert and one to the south of Bayhurst Wood. There is some high-quality alternative foraging habitat to the north-west of Highway Farm and around Bayhurst Wood. There are also alternative potential nest sites in fields south of Copthall Covert, at St Leonard's Farm and Highway Farm. It is considered however that the loss of the roost

site and surrounding fields south of Bayhurst Wood could result in the loss of a single barn owl territory. It is considered that this will result in adverse effects on the conservation status of this species that is significant at up to the county/metropolitan level.

7.4.35 The Northolt tunnel and earthworks main compound south of Copthall Covert will result in the loss of a small part of Copthall Covert and the construction of the new railway alignment will result in the loss of most of Brackenbury Railway Cutting Woodland and part of Newyears Green Covert (approximately 6ha in total). If present, the construction works will disturb a single breeding pair of hobby and result in them being displaced and seeking alternative nest sites. There are other alternative woodlands which would likely provide breeding sites for hobby in the area, for example to the west at the Colne Valley, to the north at Bayhurst Wood and to the northwest of Highway Farm. Given the population of hobby is expanding in the Greater London area, and as the disturbance will be temporary, it is considered unlikely that the disturbance and habitat loss will result in significant adverse effects on the conservation status of the hobby population in this area.

7.4.36 The construction of the new railway alignment and railway bridge over the River Pinn will potentially disturb hunting kingfisher known to be breeding in the banks of the Pinn south of the area of works. It is considered that the kingfisher may be deterred from hunting along this approximately 70m section of the river for the duration of the construction works, however it is considered that there is adequate alternative hunting habitat further north and south of their breeding ground. It is considered unlikely that the bridge works would result in adverse effects on the conservation status of the kingfisher in this area.

7.4.37 It is considered unlikely that any other effects on species receptors significant at more than the local/parish level will occur. Effects significant at the local/parish level are listed in Volume 5: Appendix EC-005-001.

Other mitigation measures

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

7.4.39 Mitigation measures to compensate the loss of designated sites including Ruislip Golf Course and Old Priory Meadows SBI.I, Brackenbury Railway Cutting SBI.II and New Year's Green SBI.I will focus on enhancing connectivity between the sites in this area. The loss of the southern parts of Newyears Green SBI.I will be compensated by the creation of native broadleaved woodland to the north connecting toward Bayhurst Wood and east of the current site including wide grassland rides and native scrub. These habitats will also be planted along the south eastern boundary of Newyears Green SBI bordering the new rail cutting, including approximately 6ha of woodland planting in these areas. Links will be made to the retained Copthall Covert through the planting of fingers of scrub and native hedgerows. Additional native broadleaved

woodland will be planted east of the retained part of Brackenbury Railway Cutting SBI, covering approximately 2ha. Following the implementation of these measures it is anticipated that any adverse impacts on designated sites during the construction of the Proposed Scheme will be reduced to a level which is not significant effects.

7.4.40 The Ickenham Stream (canal feeder) will be diverted as part of the portal construction works at Ruislip Golf Course which would result in the loss of open watercourse and riparian habitats. Habitat creation in the southern part of Ruislip Golf Course associated with the diversion of Ickenham Stream will create a sinuous watercourse including native planting with local species including riparian plants and trees. This will reduce the effect of the loss of part of the stream and result in overall enhancement of this habitat.

7.4.41 Compensatory habitat to address adverse effects on great crested newt populations at fields west of Lord Halsbury Memorial Playing Fields, West Ruislip Golf Course, land west of pharmaceutical research facility and fields south of Bayhurst Wood will be provided in:

- the 2ha ecological habitat creation area to the west of Lord Halsbury Memorial Playing Fields;
- the 2ha ecological habitat creation area in Ruislip Golf Course;
- the 1ha land west of the pharmaceutical research facility; and
- the 15ha in fields south of Bayhurst Wood.

7.4.42 This mitigation will be carried out in accordance with the Ecology technical note: Ecological principles of mitigation (Volume 5: Appendix CT-001-000/2). This will include the provision of replacement ponds, terrestrial habitat and hibernation habitat sufficient to maintain the favourable conservation status of the population effected.

7.4.43 The loss of any bat roosts in buildings, structures and trees will be compensated for by the provision of alternative compensatory roosts in accordance with the Ecology technical note: Ecological principles of mitigation (Volume 5: Appendix CT-001-000/2).

7.4.44 The following measures will mitigate the loss of foraging and commuting habitat for bats:

- the creation of approximately 2ha of grassland habitat including marshy grassland the east of Brackenbury Farm just to the south of the railway in between the River Pinn and Breakspear Road south will provide additional high quality foraging and commuting habitat for common pipistrelle and rarer bat populations affected by the temporary bridge works at the River Pinn.
- the creation of approximately 6ha of new semi natural broad-leaved woodland south of Newyears Green Lane in the area of Newyears Green Covert will restore and provide replacement and additional high quality foraging habitat and commuting features such as the woodland edges for common pipistrelle

and rarer bat populations affected by the construction of the new rail alignment at Gatemead Farm, Copthall Covert, railway land between the River Pinn and Harvil Road including Brackenbury Railway Cutting, Newyears Green Covert and also bat populations using fields south of Bayhurst Wood.

- the restoration and enhancement of approximately 30ha of habitat to the south of Bayhurst Wood comprising areas of native broadleaved woodland with semi-improved grassland, native hedgerows and ponds will compensate for the loss of foraging habitat and commuting features by providing additional high quality habitat such as the woodland edges and hedgerows in this area for bat populations commuting and foraging south of Bayhurst Wood.

7.4.45 Following the implementation of these 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.

7.4.46 The creation of approximately 8ha of native broadleaved woodland in the agricultural fields east of Newyears Green Covert and within fields south of Bayhurst Wood will include hazel stands and more open areas of woodland suitable for hazel dormouse. This habitat creation will provide extensive high quality habitat for this species and will reduce the county/metropolitan effect to a level that is insignificant.

7.4.47 The restoration and creation of large areas of scrub along the railway at South Ruislip, woodland, grassland, hedgerow, scrub and pond habitat south of Copthall Covert and south of Bayhurst Wood will provide extensive high quality habitat for assemblages of terrestrial invertebrates will reduce the county/metropolitan effect on these assemblages to a level that is insignificant.

7.4.48 There will be an adverse effect on the conservation status of barn owl at the county/metropolitan level due to loss of one assumed territory. To offset the likely loss of barn owls from the vicinity of the Proposed Scheme, opportunities to provide barn owl nesting boxes in areas greater than 1.5km from the route will be explored with local landowners. As the availability of nesting sites is a limiting factor for this species the implementation of these measures would be likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

Summary of likely residual significant effects

7.4.49 The permanent loss of one barn owl territory represents a residual significant effect. However, with the implementation of the mitigation measures proposed the residual effect on barn owl would be reduced to a level that is not significant. However, if the proposed mitigation measures for barn owl are implemented through liaison with landowners, the residual effect on barn owl would be reduced to a level that is not significant.

7.5 Effects arising from operation

Avoidance and mitigation measures

7.5.1 Where the eastern part of the route has been designed in tunnel this will reduce impacts on rail corridor and adjacent habitats and the species they support.

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 Where the route of the Proposed Scheme bisects, or is located in close proximity to existing features known to be utilised 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 or 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.

7.5.4 It is expected that the predicted levels of bat activity from Newyears Green Covert, south to Brackenbury Railway Cutting indicated from field survey demonstrates that bats may cross the Proposed Scheme at this location and could be at risk of being killed or injured. Along the railway at Brackenbury Railway Cutting SBI, there were regular low levels of activity for common pipistrelle and soprano pipistrelle and single passes of other rarer bats (noctule, serotine, brown long-eared and *Myotis* species) along the existing railway and this assemblage of bats is likely to be foraging around Newyears Green Covert and the conservation status of these species could be significantly adversely affected over several generations, particularly if roosts are present close to the Proposed Scheme. It is considered that this will have an adverse impact on the conservation status of these bat assemblages significant at up to the count/metropolitan level.

7.5.5 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.

7.5.6 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 utilise.

7.5.7 Given the new landscape will provide high-quality foraging habitat away from the Proposed Scheme and will deter bats from foraging directly along the new operational railway, it is considered unlikely that the increase in noise will significantly disturb bats in this area. In addition the presence of the existing Chiltern Main Line to the south of the new Copthall Cutting means it is likely that bats commuting and foraging in this area are already habituated to some railway noise.

7.5.8 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.

7.5.9 The majority of other bird species that are known to be present in the area are not considered to be particularly vulnerable to collision with trains. However, barn owls are often killed by cars and trains. This is because they hunt low over the rough grassland habitats that are associated with road verges and railway embankments and are slow moving. Evidence suggests that such mortality is likely to result in the loss of all breeding populations of barn owls within 1.5km of the Proposed Scheme. This is considered to be significant at up to the county/metropolitan level.

7.5.10 It is considered unlikely that any other effects at more than the local/parish level will occur. Effects at the local/parish level are listed in Volume5: Appendix EC-005-001.

Other mitigation measures

7.5.11 This section describes additional elements designed to reduce or compensate for significant ecological effects. These include measures (such as habitat manipulation and fencing) to discourage species from foraging close to the Proposed Scheme.

7.5.12 The creation of woodland at the top of the Copthall Cutting and adjacent to the new railway will encourage bats to fly at a safe height over the Proposed Scheme between Newyears Green Covert to the north and Copthall Covert to the south. It is expected that this measure will reduce the precautionary county/metropolitan level impact of collision mortality on commuting bats to a level that is not significant.

7.5.13 Following the implementation of the measures proposed it is anticipated that any adverse impacts on bats as a consequence of the operation 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.

7.5.14 Train strike is likely to result in the loss of barn owls which nest close to the route. As part of the precautionary assessment it is assumed all territories within close proximity to the route could be lost and therefore adverse effects are likely to remain significant at the county/metropolitan level. To offset these losses opportunities to provide barn owl nesting boxes in areas greater than 1.5km from the route will be explored with local landowners. As the availability of nesting sites is a limiting factor for this species the implementation of these measures would be likely to increase numbers of barn owls within the wider landscape and thus offset the adverse effect.

Summary of likely residual significant effects

7.5.15 The mitigation, compensation and enhancement measures described above reduce the residual ecological effects during operation to a level that is not significant, except for barn owl. Train strike is likely to result in the loss of barn owls that nest close to the route resulting in a residual significant effect. However, if the proposed mitigation measures for barn owl are implemented through liaison with landowners, the residual effect on barn owl would be reduced to a level that is not significant.

8 Land quality

8.1 Introduction

8.1.1 This section of the report presents the baseline conditions that exist along the proposed route in relation to land quality and reports the likely impacts and any significant effects as a result of the 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 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 environment and what needs to be done to prevent such contamination.

8.1.3 The main environmental features of this area include:

- surface water courses, including the Yeading Brook, Ickenham Stream and River Pinn;
- Secondary A aquifers and a principal aquifer and associated source protection zone (SPZ); and
- residential receptors.

8.1.4 The main land quality issues in this area include:

- various former works and depots that now form part of Victoria Road trading estates (at the location of the South Ruislip vent shaft);
- railway land located in the far western part of the study area;
- the pharmaceutical research facility along Breakspear Road South; and
- Newyears Green and Newyears Green Farm landfill sites.

8.1.5 Details of baseline information and the land quality assessment methodology are outlined in the following appendices (presented in Volume 5):

- Appendix CT-001-000/1: the SMR and Appendix CT-001-000/2: the SMR Addendum; and

- Appendix LQ-001-006: Land quality appendix.

8.1.6 Land contamination issues are closely linked with those involving water resources and waste. Issues regarding groundwater resources are addressed in Section 13. Issues regarding the disposal of waste materials, including contaminated soils, are addressed in Volume 3, Section 16.

8.1.7 Engagement has been undertaken with the Environment Agency, the London Fire Brigade (LFB) petroleum officer and the Ministry of Defence (MoD) regarding contaminated land.

8.1.8 Consultation was undertaken specifically with the LBH regarding Newyears Green landfill site located within the north-west of the study area.

8.1.9 Information was received from the LBH in relation to the Newyears Green landfill. A response was received from the Environment Agency, although no relevant data was available in respect of the request. No data was received from the MoD.

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 in the SMR and its addendum presented in Volume 5 (Appendices CT-001-000/1 and CT-001-000/2). This section follows the standard assessment methodology.

8.2.2 Baseline data was reviewed for the area of land required to construct the Proposed Scheme, excluding areas of utility works on the highway, together with a buffer generally extending out for a further 250m and in the case of groundwater data up to 1km. This wider area is defined as the study area.

8.2.3 Familiarisation visits to the study area were made in July 2012 where the location of the Proposed Scheme was viewed from points of public access only. Due to access constraints not all sites considered to have the greatest potential for contamination were visited. Although the purpose of site visits is to verify desktop information, the lack of complete site walkovers is considered unlikely to have substantially affected the land quality assessment. Site visit notes are presented in Volume 5 (Appendix LQ-001-006.

8.3 Environmental baseline

Existing baseline

8.3.1 Unless stated otherwise, all features in this land quality section are presented on Maps LQ-01-008b to LQ-01-010-L1 (Volume 5, Land quality Map Book).

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 Map WR-01-007 (Volume 5, Water resources and Flood Risk Assessment Map Book).

8.3.3 The presence of made ground is not indicated on British Geological Survey (BGS) mapping[36] [37], although a cover of made ground is likely to be present throughout the area due to previous cycles of development and in particular a cover of made ground may be present due to the presence of an existing rail corridor (comprising track-bed materials and existing embankments).

8.3.4 Superficial deposits are present at the western end of the study area and comprise a narrow ribbon of alluvium associated with the River Pinn.

8.3.5 The bedrock geology underlying the majority of the study area is the London Clay Formation comprising grey fissured clay that weathers to brown colour in its upper part. The underlying Lambeth Group outcrops to the north of the route at Ruislip Gardens Station and also approximately 200m either side of the River Pinn. In this area it is described as mottled sandy clay and clayey sand. It is directly underlain by the Cretaceous Chalk Group in this area being a succession of soft white limestones.

Groundwater

8.3.6 The alluvium and Lambeth Group are both designated by the Environment Agency as Secondary A aquifers, whilst the underlying Chalk is classified as a Principal aquifer.

8.3.7 The London Clay Formation is classified by the Environment Agency as an unproductive strata (i.e. is not considered to represent a usable groundwater resource).

8.3.8 The following licensed groundwater abstractions and wells have been identified in the area:

- one licensed groundwater abstraction for Public Water Supply (PWS) and associated SPZ within 1km of the route (see Map WR-02-006, Volume 5, Water Resources and Flood Risk Assessment Map Book). It abstracts water from the Chalk aquifer and further details are provided in Volume 5, Appendix WR-002-006; and
- two private licensed groundwater abstractions within 1km of the route. These also abstract water from the Chalk aquifer.

8.3.9 Further detail on the groundwater beneath the Proposed Scheme can be found in Section 13.

[36] Geological Survey of Great Britain, (2006), Beaconsfield, Sheet 255, Solid and Drift Edition, 1:50,000 series, Ordnance Survey, Southampton.
[37] Geological Survey of Great Britain, (2006), North London, Sheet 256, Solid and Drift Edition, 1:50,000 series, Ordnance Survey, Southampton.

Surface waters

8.3.10 The route crosses several surface water bodies. The main bodies include the eastern and western arms of the Yeading Brook, the Ickenham Stream (canal feeder), Newyears Green Bourne and River Pinn.

8.3.11 There are no licensed surface water abstractions within 1km of the route in the study area.

8.3.12 Further information on surface waters is provided in Section 13.

Current and historical land use

8.3.13 Current potentially contaminative land uses (in addition to the Chiltern Main Line) include a business park, small industrial estate and depot area, see Map LQ-01-009, G6, a waste transfer station which neighbours South Ruislip station, see Map LQ-01-009, I7 and a pharmaceutical research facility west of Breakspear Road South (see Map LQ-01-010, C6/D6).

8.3.14 A fuel station is also located off Ickenham Road to the north of West Ruislip station (see Map LQ-01-010, H5).

8.3.15 Two landfill sites are located in the north-west of the study area (Map LQ-01-010, B4 and A2). These are Newyears Green landfill site and New Years Green Farm landfill site. The New Years Green Farm landfill site (Map LQ-01-010, A2) has been determined as 'contaminated land' under Part IIA of the Environmental Protection Act (EPA)[38].

8.3.16 Historically, there have been relatively few potentially contaminative activities in the area with the exception of the rail corridor and associated sidings (Map LQ-01-010, I7). These were limited to small industrial sites located around South Ruislip station (Map LQ-01-009, G7) and a large depot area either side of the route at West Ruislip (Map LQ-01-010, H6).

8.3.17 Sites which may pose a contaminative risk to the Proposed Scheme, from both current and historical land uses, identified by the assessment, comprise the following (listed from east to west):

- various former works and depots that now form part of Victoria Road trading estates (at the location of the vent shaft at South Ruislip) (see Map LQ-01-009, G6/7);
- railway land in the western part of the study area (see Map LQ-01-010, G6 and F7);
- the pharmaceutical research facility along Breakspear Road South (see Map LQ-01-010, C6/D6);

[38] *Environmental Protection Act 1990*, Part IIA, Introduced in England on 1 April 2000, London, Her Majesty's Stationary Office.

- Newyears Green and New Years Green Farm Landfill sites (see Map LQ-01-10, A2); and
- A fuel station located off Ickenham Road to the north of West Ruislip station (see Map LQ-01-010, H5).

8.3.18 Potential sources of contamination in the area are largely underlain by the low permeability London Clay. The London Clay is known to provide an effective barrier to in-ground contaminant migration and any contamination present is likely to be localised. In this area which is underlain by the Lambeth Group (classified as Secondary A aquifer) land use is primarily suburban with the exception of the rail corridor and agricultural land in the west of the area.

Other regulatory data

8.3.19 Regulatory data sources reviewed include pollution incidents, radioactive and hazardous substances consents and environmental permits (previously landfill, IPC and IPPC licences). A number of these have been recorded in this study area and notable entries are discussed below.

8.3.20 A number of entries (approximately 25) are located within the study area relating to the various industries that were highlighted in previous sections including waste transfer sites and a fuel filling station. None of these are located within the main excavation works area.

Mining and mineral areas

8.3.21 There are no active mining or mineral sites or Preferred Areas (PA)[39] within the study area.

8.3.22 There are no resources shown on the mineral planning authority (LBH) maps within the study area.

Geo-conservation sites

8.3.23 There are no geological conservation resources identified within the study area.

Receptors

8.3.24 Receptors identified within the study area are listed in Table 12.

Table 12: Table of receptors for land contamination effects

Issue	Receptor type	Receptor description	Receptor sensitivity
Land contamination	People	Residents in existing properties	High
		Workers e.g. in factories or existing railway	Moderate
	Controlled	River Pinn, Yeading Brook and	High

[39] Areas where mineral deposits are known to exist and where the County Council considers there would be least planning objection to mineral extraction taking place.

Issue	Receptor type	Receptor description	Receptor sensitivity
	waters	Ickenham Stream	
		Secondary A aquifers in Lambeth Group and alluvium	Moderate/High
		Principal aquifer in underlying Chalk	High
	Built environment	Buildings and property	Low to high
		Underground structures and services	Low

Future baseline

8.3.25 There are currently no identified committed development sites within the study area which are likely to change the land quality baseline during either construction or operation of the Proposed Scheme. The sites identified are located outside of the land required to construct the scheme and are judged not to be able to affect land quality within the Proposed Scheme.

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 (see 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:

- methods to control noise, waste, dust, odour, gasses 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 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, Sections 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, Section 16).

8.4.2 The draft CoCP requires that 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 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)[40]; and
- British Standard BS10175 Investigation of Potentially Contaminated Sites (2011)[41].

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's publication A Framework for Assessing the Sustainability of Soil and Groundwater Remediation (2010)[42]. The preferred option will then be developed into a remediation strategy, in consultation with regulatory authorities prior to implementation.

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 are likely to include stabilisation methods, soil washing and bio-remediation to remove oil contaminants. Contaminated soil disposed of off-site will be taken to a soil treatment facility, another construction site (for treatment, as necessary and re-use) or to an appropriately permitted landfill.

Assessment of impacts and effects

8.4.5 Approximately 70% of the route through the study area will be in tunnel (at approximately 30m below ground level, potentially confined to the lower Lambeth Group strata). The areas of above ground works within the South Ruislip to Ickenham area include:

- a rectangular box shaft proposed to a depth of approximately 30m below ground level, situated within an area of industrial/commercial land at the former Arla Dairy site;

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

- the tunnel portal and deep cutting located to the west of West Ruislip station; and
- the cutting and embankment works between Breakspear Road South and Harvil Road.

8.4.6 The tunnel portal and much of the cutting will be located in open fields, with the exception of where the Proposed Scheme cuts through the existing railway embankment and the pharmaceutical research facility located to the west of Breakspear Road South.

8.4.7 A relatively large construction compound is proposed on open fields to the south of the Chiltern Main Line located east of Harvil Road. The compound will not coincide with any previously developed land, although part of the area was used as a construction compound for the installation of a high pressure gas main.

8.4.8 In addition a sustainable placement area is proposed to the north and west of St Leonards Farm adjacent to the Newyears Green Part IIA determined landfill site. An access road is required across the landfill site to this area.

Land contamination

8.4.9 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 any areas of current or historical contaminative use within the study area and to consider which of these areas might pose contaminative risks for the Proposed Scheme. In total, 28 areas were considered during this screening process and of these, ten areas were taken forward to more detailed risk assessments (Stages C and D) in which the potential risks were assessed in more detail. All areas assessed are shown on Maps LQ-001-008b to LQ-001-010-L1 (Volume 5, Land quality Map Book); those considered as potentially posing a risk to the Proposed Scheme are also labelled with a reference number.

8.4.10 Conceptual site models (CSM) have been produced for the ten sites taken to Stage C and D assessments. The detailed CSM are provided in Volume 5 (Appendix LQ-001-006, Section 3) and the results of the risk assessments are given in section 8.4.12.

8.4.11 Potentially contaminated areas have been grouped and considered together, where appropriate. The following factors have determined the need for Stage C and D assessments:

- whether the area 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.

8.4.12 A summary of the baseline CSM is provided in Table 13. 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 13: Summary of baseline CSM for sites which may pose a contaminative risk for the Proposed Scheme

Site ref	Site name and classification	Main potential impacts	Main baseline risk
6-08, 6-12 6-14, 6-21	Existing on-site works buildings, depots and other current or previous contaminative land uses overlying London Clay in the location of a proposed vent shaft	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters	Low
		Impact from leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater in Secondary A aquifers	Low
6-24	Existing on-site railway land overlying London Clay in the location of a proposed vent shaft	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters	Low
		Migration of hazardous gas and vapours to confined spaces via permeable strata or conduits.	Moderate/low
6-26	Existing pharmaceutical research facility overlying London Clay	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters	Moderate/low
		Potential impact on human health off-site to contamination by inhalation of volatile vapours from contaminated soil/water	Very low

Site ref	Site name and classification	Main potential impacts	Main baseline risk
6-25	Existing on-site railway land part overlying Secondary A superficial/bedrock deposits, London Clay and in proximity of surface water features	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters	Low
		Potential impact on human health on-site from contamination by inhalation of asphyxiative or explosive ground gases	Moderate/low
		Impact from lateral migration of contaminants in groundwater and discharge to surface waters as base flow	Low
6-22	Off-site fuel station overlying London Clay	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters	Moderate/low
6-28, 6-27	Newyears Green and New Years Green Farm landfill sites	Potential impact on human health on-site from inhalation of gases	Moderate to high
		Impact from leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater in Principal aquifer	High to very high

Temporary effects

8.4.13 An assessment of the effects of contamination has been undertaken by comparing the CSM developed for potential contaminated areas at baseline, construction and post construction stages. The baseline and construction CSM have been compared to assess effects at the construction stage.

8.4.14 Table 14 presents the summary of the construction effects obtained from a comparison of the baseline and construction impacts. The construction risk assessment takes into account the implementation of the mitigation measures set out within the draft CoCP. Details of these comparisons are presented in Volume 5 (Appendix LQ-001-006).

8.4.15 The baseline and construction CSM have been compared to determine the change in level of risk to 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 assessed to remain as high. 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 14: Summary of temporary (construction) effects from land contamination

Area ref	Area name	Main baseline risk	Main construction risk [43]	Construction effect and significance
6-08, 6-12 6-14, 6-21	Existing on-site works buildings, depots and other current or previous contaminative land uses overlying London Clay in the location of a proposed vent shaft	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (low risk) Impact from leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater in Secondary A aquifers (low risk)	Receptor not present Low	Negligible – not significant
6-24	Existing on-site railway land overlying London Clay in the location of a proposed vent shaft	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (low risk) Migration of hazardous gas and vapours to confined spaces via permeable strata or conduits (moderate/low risk)	Receptor not present Moderate/low	Negligible – not significant
6-26	Existing pharmaceutical research facility overlying London Clay	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (moderate/low risk) Potential impact on human health off-site to contamination by inhalation of volatile vapours from contaminated soil/water (very low risk)	Moderate/low Very low	Negligible – not significant

[43] The low/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 site risks during the construction stage are controlled. The high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high risk in the absence of site investigation a precautionary, worst case risk is reported in the table. Application of the processes and measures within the CoCP will ensure that site risks during the construction stage are controlled.

Area ref	Area name	Main baseline risk	Main construction risk [43]	Construction effect and significance
6-25	Existing on-site railway land part overlying Secondary A superficial/bedrock deposits, London Clay and in proximity of surface water features	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (low risk) Potential impact on human health on-site from contamination by inhalation of asphyxiative or explosive ground gases (moderate/low risk)	Receptor not present Moderate/low	Negligible – not significant
6-22	Off-site fuel station overlying London Clay	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (moderate/low risk)	Moderate/low	Negligible – not significant
6-28, 6-27	Newyears Green and New Years Green Farm landfill sites	Potential impact on human health on-site from inhalation of gases (moderate to high risk) Impact from leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater in Principal aquifer (high to very high risk)	Moderate to high High to very high	Negligible – not significant

8.4.16 In Table 14, the temporary effect and significance has been determined by calculating the change in risk between the main baseline risk (present risk under current conditions) and the main construction risk. Therefore, where there is no change between the main baseline risk and main construction risk, the temporary construction effect significance is deemed to be negligible even if the risk is deemed to be high. For more information see Volume 5, Appendix LQ-001-006.

8.4.17 Table 14 indicates that based upon the assessment, no significant effects have been identified during the construction phase, in relation to potential land contamination. However, on-site risks to human health where historical and current potentially contaminative uses are intersected by the Proposed Scheme have been identified; these will be dealt with through the requirements of the CoCP.

8.4.18 This would also include measures to ensure that the design, construction and use of the temporary access road across the Part IIA designated site does not result in any adverse effects to receptors (e.g. through dust generation or damage to the existing

landfill cap). Similar measures would also be required to assist with the proposed compensatory planting at the New Years Green Farm landfill site.

8.4.19 For impacts to water resources associated with the construction of the Proposed Scheme in the vicinity of the landfills, reference should be made to Section 13.

8.4.20 Construction site compounds located in this study area will include staff welfare facilities, maintenance facilities for plant and machinery and fuel storage in bunded tanks. Construction compounds will store and use potentially contaminative materials such as fuels, oils and solvents and the measures outlined in the draft CoCP will manage risks from the storage of such materials.

8.4.21 The main and satellite compounds may also be used for temporary storage of potentially contaminated soils. The measures outlined in the draft CoCP will manage risks from the storage of such materials. The location of these construction site compounds can be found in Map Series CT-06 (Volume 2, CFA6 Map Book).

8.4.22 It is considered unlikely that additional remediation works will be required over and above the mitigation measures contained as standard within the draft CoCP.

8.4.23 There are anticipated to be no significant cumulative temporary effects from construction.

Permanent effects

8.4.24 Baseline and post-construction CSM have been compared to assess the permanent (post-construction) effects. The post-construction CSM assumes that all the required remediation has been carried out and validated.

8.4.25 Table 15 includes the summary of the permanent (post-construction) effects obtained from a comparison of the baseline and post-construction impacts and whether these are significant. The details of these comparisons are presented in Volume 5 Appendix LQ-001-006, Section 3.

Table 15: Summary of permanent (post-construction) effects from land contamination

Area ref	Area name	Main baseline risk	Main post-construction risk[44]	Post-construction effect and significance
6-08, 6-12 6-14, 6-21	Existing on-site works buildings, depots and other current or previous contaminative land uses overlying London Clay in the location of a proposed vent shaft	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (low risk) Impact from leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater in Secondary A aquifers (low risk)	Very low Very low	Minor beneficial effect – not significant
6-24	Existing on-site railway land overlying London Clay in the location of a proposed vent shaft	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (low risk) Migration of hazardous gas and vapours to confined spaces via permeable strata or conduits (low/moderate risk)	Very low Moderate/low	Negligible to minor beneficial effect – not significant
6-26	Existing pharmaceutical research facility overlying London Clay	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (moderate/low risk) Potential impact on human health off-site to contamination by inhalation of volatile vapours from contaminated soil/water (very low risk)	Very low Very low	Negligible to moderate beneficial effect – not significant

[44] The low/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 site risks during the construction stage are controlled The high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high risk in the absence of site investigation a precautionary, worst case risk is reported in the table. Application of the processes and measures within the CoCP will ensure that site risks during the construction stage are controlled.

Area ref	Area name	Main baseline risk	Main post-construction risk[44]	Post-construction effect and significance
6-25	Existing on-site railway land part overlying Secondary A superficial/bedrock deposits, London Clay and in proximity of surface water features	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (low risk) Potential impact on human health on-site from contamination by inhalation of asphyxiative or explosive ground gases (moderate/low risk)	Very low Moderate/low	Negligible to minor beneficial effect – not significant
6-22	Off-site fuel station overlying London Clay	Potential impact on human health on-site from contamination by direct contact, ingestion and inhalation of contaminants in soil and soil-derived dust and contaminated waters (moderate/low risk)	Moderate/low	Negligible – not significant
6-28, 6-27	Newyears Green and Newyears Green Farm landfill sites	Potential impact on human health on-site from inhalation of gases (moderate to high risk) Impact from leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater in Principal aquifer (high to very high risk)	Moderate to high High to very high	Negligible – not significant

8.4.26 Table 15 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.

8.4.27 The permanent effect and significance have been determined by calculating the change in risk between the main baseline risk and the main post-construction risk (i.e. after remedial measures). Remedial measures will be put in place to ensure that the railway is safe to use and that there is no increase in risks to off-site receptors. 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 or high. The residual post-construction risks are not caused by the Proposed Scheme.

8.4.28 Table 15 indicates that, following remediation there will, in most instances, be overall negligible to minor beneficial effects. Depending on the type of remediation undertaken, the beneficial effect for 'on-site' potential sources will be mostly related to the removal or isolation of contaminants associated with the shaft construction at South Ruislip and railway land intersected by the Proposed Scheme. A moderate

beneficial effect associated with contaminant source removal or isolation at part of the pharmaceutical research facility site has also been derived and this is considered significant.

8.4.29 There will be a negligible effect on all sites identified as posing a contaminative risk that are located outside of the area required to build the Proposed Scheme as these will be unchanged by the Proposed Scheme. This will also include the two identified landfill sites within the study area. Whilst there is proposed to be a temporary access road across the New Years Green Farm landfill site, there will be no permanent works on the landfill in this study area. Long term remediation of this area will be dependent upon the LBH and remediation required as part of the existing Part IIA designation. The proposed works at the New Years Green Farm landfill will be limited to superficial planting for ecological purposes only.

Mining/mineral sites

8.4.30 There are no mining or mineral sites located within this study area.

Geo-conservation sites

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

Other mitigation measures

8.4.32 No additional mitigation measures are considered necessary at this stage to mitigate risks from land contamination at construction stage beyond those set out in the draft CoCP and instigated as part of required remediation strategies.

Summary of likely significant residual effects

8.4.33 With the application of the avoidance and mitigation measures detailed above, no likely significant residual effects are anticipated.

8.5 Effects arising from operation

8.5.1 Users of the Proposed Scheme (i.e. rail passengers), whilst within trains, are at all routine times 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 whereby appropriate spillage and pollution response procedures will be established.

Assessment of impacts and effects

8.5.3 Auto-transformer stations are proposed to be spread at intervals along the Proposed Scheme. An auto-transformer station is proposed at the vent shaft at South Ruislip.

8.5.4 An auto-transformer station could, in principle, be a source of contamination through accidental discharge and/or leaks of coolant. However, the proposed auto-

transformer station, in common with other modern substations, will use secondary containment appropriate to the level of risk.

8.5.5 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.

8.5.6 Due to the environmental controls that will be placed on operational procedures, it is unlikely that there will be any cumulative effects on land quality or in-combination effects on receptors.

Other mitigation measures

8.5.7 There will be on-going monitoring requirements, as appropriate following remediation works carried out during construction. Such monitoring, including monitoring of groundwater quality or ground gas, could extend into the operational phase of the Proposed Scheme.

Summary of likely significant residual effects

8.5.8 No significant residual effects are anticipated.

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 baseline conditions found within and around the route of 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 section refers 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 The Proposed Scheme is in tunnel between the eastern boundary of the area and West Ruislip portal near Ickenham Road. A vent shaft and associated headhouse will be constructed in South Ruislip, off Victoria Road. Principal landscape and visual issues in the area include:

- temporary effects to LCAs and visual receptors during construction arising from the presence of construction plant and construction compounds, demolition of buildings and the removal of existing vegetation from woodland blocks and hedgerows;
- permanent landscape and visual effects during operation arising from the presence of new structures in the landscape including the headhouse structures associated with the vent shaft and tunnel portal, road junction realignments, the relocation of overhead power lines, the presence of a cutting, noise fence barriers, overhead line equipment and the introduction of high speed trains. Permanent effects will reduce over time as planting established as part of the Proposed Scheme matures; and
- sustainable placement of surplus excavated materials in areas approximately 3m high at three sites in this area, two located between Breakspear Road South and Harvil Road on either side of the existing high pressure gas main and the third on land to the north of Newyears Green Lane and south of Bayhurst Wood. These areas will introduce significant permanent changes to the landscape character and visual quality of the area. A further site is located in CFA7 immediately adjacent to the boundary between these two areas. This latter site is reported in the CFA7 report.

9.1.4 A separate but related assessment of effects on the setting of heritage assets is included in Section 6: Cultural Heritage. Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in Volume 5: Appendix LV-001-006, which comprises the following parts:

- 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 were provided to LBH for comment. Summer field surveys, including photographic studies of LCAs and visual assessment of viewpoints, were undertaken from June to October 2012 and from May to June 2013. Winter surveys were undertaken in February 2013.

9.2 Scope, assumption 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 (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.

9.2.2 The study area has been informed by the construction and operational phase zones of theoretical visibility (ZTV), which are shown in Maps LV-07-019b to LV-07-024-L1 and LV-08-019b to LV-08-024-L1 (Volume 5, Landscape and Visual Assessment Map Book). The ZTV has been produced in line with the methodology described in the SMR Addendum (Volume 5: Appendix CT-001-000/2) 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 LCA and visual receptors.

9.2.3 LCAs and visual receptors within approximately 500m of the Proposed Scheme have been assessed. Long distance views of up to 1km have been considered at locations such as Breakspear Road South.

Assumptions

9.2.4 For the night-time assessment it has been assumed that the Proposed Scheme will not significantly change the existing conditions when viewed from residential properties for the portal. The conveyor will have continuous, but low level lighting and the Harvil Road worksite (sidings area) will require 24 hours above ground working with floodlights during construction.

Limitations

9.2.5 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 has been used to approximate the likely views from these locations.

9.2.6 Where there are no winter photographs in Volume 5, this is a result of changes to the Proposed Scheme meaning that, within seasonal constraints, it was not possible to capture a winter image.

9.3 Environmental baseline

Existing baseline

Landscape baseline

9.3.1 The study area is predominantly suburban in character in the east and becomes more rural to the west. The built environment tends to mask the gently undulating topography. The urban areas are largely two storey post war residential developments with some larger scale industrial sites at South Ruislip. However, there are also extensive green spaces within the study area, including the area associated with the RAF Northolt aerodrome and those within the West Ruislip/Ickenham area. Ruislip Golf Course forms a green wedge in the western part of the study area and the Chiltern Main Line railway corridor is well vegetated at the eastern end of the study area. The A40 Western Avenue is the primary road in this area and runs in an east-west orientation. The Chiltern Main Line and an over-ground section of the London Underground Central Line also run from east to west and A4180 West End Road runs north-south through the area. PRoW are limited to the west and north-west of the study area around the Ruislip Golf Course, between Breakspear Road South, Harvil Road and north of Newyears Green Lane.

9.3.2 The landscape character areas have been determined through on-site surveys and with reference to the London Regional Landscape Framework[45]. The Proposed Scheme crosses the Barnet Plateau and Ruislip Plateau Natural Landscape Areas.

9.3.3 The Barnet Plateau, Natural Landscape Areas 3, is an interwar urban area bisected by substantial transport routes, bordered with patches of industrial land, farmland and golf courses interspersed with blocks of native woodland.

9.3.4 Ruislip Plateau Natural Landscape Area 2, includes core settlements of Ruislip and Pinner, with the settlements of Harrow, Northwood and Ickenham, largely interwar terraces and semi-detached housing extending across the majority of the NLA. Extensive ancient woodlands, known as Ruislip Woods, fringe the Ruislip Lido. The area of countryside to the north-west includes patchworks of fields that are bordered by abundant native hedges and are interspersed by ponds, lakes and watercourses.

9.3.5 Descriptions of all LCAs are provided in Volume 5: Appendix LV-001-006 Part 2.For the purposes of this assessment the study area has been sub-divided into seven discrete LCAs, two of which are most likely to be affected. A summary of these LCAs is provided below. The LCAs are shown in Maps LV-02-019b to LV-02-024-L1 (Volume 5, Landscape and visual assessment Map Book).

[45] Natural England (2011), *London Regional Landscape Framework*.

Ruislip Golf Course LCA

9.3.6 Ruislip Golf Course is located to the west of the B466, Ickenham Road and north of the railway line. It was designed by a renowned golf course architect Sandy Heard, opened in 1922 and is a good example of its type. The golf course has limited changes in topography and is enclosed by structural planting on all sides which contributes to the high tranquillity. The course comprises well-maintained fairways, in good condition, bordered by tree and shrub planting. The existing Chiltern Main Line runs along its southern edge. The area is valued at a regional level as a result of its location within the green belt. Therefore, this area has a high sensitivity to change.

Harefield Farmland LCA

9.3.7 This well wooded farmland with gently rolling landform, located to the west of the residential edges of West Ruislip and Ickenham, has well established hedgerows enclosing largely pasture fields, together with smaller pockets of arable cultivation. Fields are generally small to medium in size and are regular in shape. The overall landscape condition is fair. Most buildings in the area are associated with farming activities. The Chiltern Main Line in this character area is elevated in sections, as well as in cutting, but in both situations is well screened by the mature vegetation on the railway corridor. The LCA is bordered by roads which reduce tranquillity locally, but overall the tranquillity of this character area is considered to be medium. The area is valued at a regional level as a result of its location within the green belt. Therefore, this area has a high sensitivity to change.

Visual baseline

9.3.8 Descriptions of the identified representative viewpoints are provided in Volume 5: Appendix LV-001-006 Part 2. A summary description of the distribution and types of receptors most likely to be affected is provided below. The viewpoints are shown in Maps LV-03-019b to LV-03-024-L1 and LV-04-019b to LV-04-024-L1 (Volume 2, CFA6 Map Book). The viewpoints are numbered to identify their locations. In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport and 6: Employment.

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

9.3.10 Residential receptors have a high sensitivity to change and are located close to and on both sides of the Chiltern Main Line, as well as around the sustainable placement areas between Breakspear Road South and Harvil Road and near Newyears Green Lane. In addition there are more isolated groups of properties to the west of the study area. Views are typically towards a vegetated railway corridor with long distance views limited by built elements and existing vegetation. Views towards the exiting railway corridor from the rising ground to the west of the study area are largely filtered by existing vegetation.

9.3.11 Recreational receptors, also with a high sensitivity to change, are located on PRoW to the west of the study area, including the Ruislip Golf Course and associated facilities, along to the River Pinn to the north of the Chiltern Main Line railway corridor and between Breakspear Road South and Harvil Road. The viewpoints include both rural agricultural locations and managed municipal landscapes, with the golf course or arable fields forming the foreground and mature vegetation bordering the golf course and the field boundaries creating enclosure.

9.3.12 Transport receptors (i.e. users of private or public transport) in the urban area have a low sensitivity to change. People travelling along Ickenham Road and users of West Ruislip station have elevated views of the Chiltern Main Line railway corridor and its associated existing tree cover on both sides of the tracks.

9.3.13 Employment receptors including workers in the pharmaceutical research facility and the Dogs Trust Harefield on Harvil Road have a low sensitivity to change. Views from the pharmaceutical research facility to the south are contained by the vegetation associated with the Chiltern Main Line railway corridor. The viewpoint from the Dogs Trust is characterised by the pasture fields in the foreground and existing woodland on the rising ground forming the skyline, limiting views of the surrounding area.

Future baseline

9.3.14 There are no known committed developments which are assumed to be under construction at the same time as the Proposed Scheme which will result in a consequential cumulative effect on LCAs or visual receptors. Cumulative developments which have been considered in the assessment are shown in Maps CT-13-008b to CT-13-010-R1 (Volume 5, CFA6 Map Book).

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 are temporary and 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, tunnelling, main earthworks and structure works. The effects associated with the peak construction phase in this area will generally be considered to be long term given the construction programme (see Section 2.3). Overall, civil engineering works in this area will be undertaken between the start of 2017 and the end of 2026. Construction activities at the South Ruislip vent shaft, including the main compound and auto-transformer station will be in place for approximately two and a half years. Construction activities at the West Ruislip portal, including the satellite compound will be in place for approximately five years.

Construction activities at the Northolt tunnel, including the main compound, earthworks, structures, tunnelling and the Harvil Road auto-transformer feeder station, will be in place for approximately five 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 includes:

- construction of the South Ruislip vent shaft building and associated auto-transformer station;
- demolition of a commercial building at Ruislip Rifle Club, partial demolition of the Ruislip Golf Course driving range shelter, demolition of an outbuilding at Ruislip Golf course north-east of the club house, demolition of the garage associated with 105 The Greenway, demolition of The Lodge west of Breakspear Road South, demolition of buildings to the west of Breakspear Road South (owned by the pharmaceutical research facility), demolition of Gatemead Farm and the stable and outbuilding at Oak Farm;
- vegetation removal along the southern boundary of the Ruislip Golf Course to accommodate the construction of the West Ruislip portal and over ground section of the Proposed Scheme to Breakspear Road South;
- construction of approach ramp, tunnel portal and associated headhouse at West Ruislip;
- removal of excavated material by conveyor from the tunnel to the temporary railhead;
- severance of the Ickenham Stream (canal feeder) and diversion into a channel to the north of the route that will flow west to the River Pinn, diversion of an existing footpath adjacent to the Ickenham Stream to a new footbridge over the tunnel portal, a new bridge over the River Pinn and construction of a new bridge over Breakspear Road South;
- works to Breakspear Road South and the existing utilities contained beneath it and a main construction site between Breakspear Road South and Harvil Road;
- construction of new access road to the pharmaceutical research facility to the north of the route off Breakspear Road South;
- realignment of Harvil Road including embankment, cutting and new bridges over the Proposed Scheme, the Chiltern Main Line and Newyears Green Bourne and a retained cutting north of the Chiltern Main Line between Breakspear Road South and Harvil Road;
- vegetation removal along the Chiltern Main Line railway corridor and partial clearance of vegetation from the Newyears Green Covert east of Harvil Road;
- diversion of the PRoW (Footpath U49) between Breakspear Road South and

Harvil Road;

- works associated with the three sustainable placement areas – two to the south of the construction compound between Breakspear Road South and Harvil Road, one either side of the gas pipeline and one to the north of Newyears Green Lane;
- diversion of the National Grid Electricity 275kV overhead power lines from its existing route within the Colne Valley area to a new crossing adjacent to the re-aligned Harvil Road; and
- creation of the new bund between the Chiltern Main Line and the Proposed Scheme, east of Harvil Road.

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):

- appropriate measures to reduce landscape, visual and other environmental impacts associated with temporary site offices, vehicles, construction plant and compounds, will be implemented (draft CoCP, Section 12);
- avoidance of unnecessary tree and vegetation removal and protection of existing trees in accordance with BS 5837: Trees in relation to design, demolition and construction[46] (draft CoCP, Section 12);
- use of well-maintained hoardings and fencing (draft CoCP, Section 5);
- prevention of damage to the landscape and landscape features adjacent to the construction site by movement of construction vehicles and machinery (draft CoCP, Section 12);
- designing lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses (draft CoCP, Section 5);
- appropriate maintenance of planting and seeding works and implementation of management measures, to continue through the construction period as landscape works are completed (draft CoCP, Section 12); and
- methods to monitor and manage flood risk and other extreme weather events which may affect landscape and visual resources during construction (draft CoCP, Section 16).

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

[46] British Standards Institute (2012) BS 5837:2012 Trees in relation to design, demolition and construction. Recommendations.

Assessment of impacts and effects

9.4.5 The key changes to landscape character and viewpoints during construction will relate to the temporary presence of construction plant and the removal of existing landscape elements including the demolition of buildings, new landform from cuttings and embankments and the removal of existing tree cover. Changes will be most notable to the west of the study area associated with the construction works and compound between Harvil Road and Breakspear Road South, the cutting and partial loss of the Newyears Green Covert and the headhouse and tunnel portal at West Ruislip, to the west of Ickenham Road.

9.4.6 The loss of existing vegetation from the Ruislip Golf Course along the northern edge of the railway corridor and from within the Golf Course itself, coupled with the close proximity of construction activity to sensitive visual receptors will result in significant visual effects during construction. The construction activity associated with the vent shaft at South Ruislip will be notable as although the work site is within an industrial setting, residential properties are also present immediately to the south of the railway corridor.

9.4.7 The temporary material stockpiles and the sustainable placement of surplus excavated materials on two sites within this area and on one site immediately adjacent to it in CFA7, on both a temporary and permanent basis, will result in changes to the landscape character and visual quality of the area. The construction works associated with the storage and sustainable placement sites will affect the rolling topography, field patterns and existing mature hedgerows which will be removed in order to accommodate the excavated material. This will locally affect the landscape of Harefield and views from receptors surrounding the sites.

Landscape assessment

9.4.8 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-001-006 Part 4.

Ruislip Golf Course LCA

9.4.9 Construction of the Proposed Scheme including the headhouse and tunnel portal will be located on the southern edge of this LCA. The construction activities will include works associated with the new West Ruislip portal serviced from a main construction site west of Breakspear Road South and a main access route via a realigned Harvil Road. An additional access from Ickenham Road will pass to the rear of residential properties backing onto the golf course car park. There will be a conveyor belt from the portal to the West Ruislip railhead west of Breakspear Road South. Commercial buildings will be removed including the Ruislip Rifle Club, partial demolition of the golf driving range shelter and demolition of an outbuilding on the golf course.

9.4.10 Most of the vegetation on the northern embankment of the Chiltern Main Line will be removed during construction. The Ickenham Stream will be diverted into a channel to the north of the route to flow into the River Pinn. The existing footpath adjacent to the Ickenham Stream will be diverted approximately 70m to the east, to a new footbridge over the route near existing ground level. Construction of the bridge over the River Pinn will be serviced from the Breakspear Road construction site and within the route corridor. The existing PRoW will be diverted to accommodate the route. The presence of large scale construction plant coupled with the removal of existing vegetation will adversely affect the character of the area creating a temporary but incongruous change to a well wooded and enclosed LCA.

9.4.11 Although the construction activity will be concentrated to the north of the existing Chiltern Main Line, the loss of vegetation and the introduction of large scale engineering works, vehicles and lighting into the area are likely to reduce tranquillity, particularly to the south of the LCA.

9.4.12 The Proposed Scheme will result in an alteration to key characteristics and will add new prominent features. The impact will, however, be contained to a relatively small area, adjacent to the existing railway corridor. The magnitude of change is considered to be high.

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

Harefield Farmland LCA

9.4.14 Construction activities within this LCA includes sidings in cutting, realignment of Harvil Road and a main construction compound to the south of the existing railway corridor between Breakspear and Harvil Road together with two areas of sustainable placement sites.

9.4.15 The works associated with construction of the section of the Proposed Scheme between Breakspear Road South and Harvil Road will take place on both sides of the existing Chiltern Main Line. The road realignments will introduce new landform elements into the landscape and result in the loss of existing hedgerow vegetation and the demolition of Gatemead Farm to the west of Breakspear Road South and the outbuilding at Oak Farm to the east. Twelve buildings within the pharmaceutical research facility will be demolished. An area of approximately 7.5ha will be removed from the Newyears Green Covert to accommodate the cutting and railhead facilities (connected to the West Ruislip portal works) creating a prominent new feature in the landscape. To the south, the main construction site will include a topsoil storage area, offices and welfare facilities, segment fabrication and storage and treatment plant for excavated material. There will be three sustainable placement sites. Two of them will be located to the south of the construction compound between Breakspear Road South and Harvil Road, one either side of the gas pipeline and one will be situated to the north of Newyears Green Lane. Diversion of the National Grid electricity 275kV

overhead power lines from its existing route within the CFA7 to a new crossing adjacent to the re-aligned Harvil Road will introduce new elements into the landscape.

9.4.16 Construction activity will introduce vehicles, disturbance and lighting into an area of medium tranquillity, reducing tranquillity locally for the duration of the works.

9.4.17 The sustainable placement of material will require the removal of existing mature hedgerows and trees and locally change the rolling topography. Most notably, an area of mature vegetation from the Newyears Green Covert and to the north of the existing Chiltern Main Line. There will be a localised high magnitude of change on the character area as a whole. The project will result in an alteration to key characteristics and will add new prominent features therefore the magnitude of change is considered to be high.

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

Visual assessment

9.4.19 This 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, would be in leaf. Where residential receptors experience significant effects at night time arising from additional lighting, these are also presented in this section. Representative viewpoints within the study area considered to experience a non-significant effect (minor adverse or negligible) are described in Volume 5: Appendix LV-001-006 Part 4.

9.4.20 The number identifies the viewpoint locations which are shown in Maps LV-03-019b to LV-03-024-L1 (Volume 2, CFA6 Map Book). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport and 6: Employment.

9.4.21 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.

9.4.22 In most cases in the urban areas, additional lighting is not considered to give rise to significant effects due to the widespread presence of existing lighting. Where there is no direct foreground visibility of additional lighting, no further assessment has been undertaken.

Viewpoint 041.2.001 View north-east from dwellings on Trenchard Avenue and Portal Close

9.4.23 The Proposed Scheme will lie immediately to the north of the existing Chiltern Main Line. Views from residential properties towards the vent shaft site at a distance of

approximately 80m will be over the existing railway corridor and will be substantially filtered by the mature evergreen vegetation in the foreground, to the south of the tracks. The removal of existing vegetation to the north of the tracks is unlikely to substantially affect the view. Cranes and other tall machinery will be visible from the houses, mainly from upper floors, in the background of the view. Other plant and construction activity will be mostly screened by the existing vegetation. The magnitude of change is therefore considered to be medium.

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

Viewpoint 045.4.003: View north and north-west from West Ruislip station and Ickenham Road bridge

9.4.25 There will be uninterrupted foreground and middle ground views from Ickenham Road Bridge and the entrance of West Ruislip station towards the Proposed Scheme. The removal of trackside vegetation will open up views of the construction activities associated with the tunnel portal, headhouse and the new railway tracks from this elevated viewpoint on the bridge. Middle and background views from the approach to the bridge on Ickenham Road will be partially screened by the existing vegetation to the west of the bridge. However, cranes and other tall plant will be visible from this location. The works will be of a large scale and will take place adjacent to pedestrian receptors. The magnitude of change is considered to be high.

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

9.4.27 The view of the Proposed Scheme from this location during construction is illustrated on the photomontage shown in Figure LV-01-180 (Volume 2, CFA6 Map Book).

Viewpoint 045.2.004 View west from tower block on Josiah Drive at Ickenham Park, south of the West Ruislip station (up to 6 storeys)

9.4.28 The middle and background views (approximately 130m away) from apartments in the tower block on Josiah Drive over the Ickenham Road will be direct and open of the extensive construction area with cranes and other plant. The removal of trackside vegetation will open up views of the construction activities associated with the tunnel portal, headhouse and the railway tracks across Ickenham Road. The magnitude of change is therefore considered to be high, as although the construction works will be viewed over the busy Ickenham Road, the works will be highly visible in the middle ground of the view.

9.4.29 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

9.4.30 At night, continuous lighting is associated with the conveyor is proposed. However, since the foreground is already well lit by existing street lighting and light spill from

buildings, effects at night will not be significant and are therefore reported in Volume 5: Appendix LV-001-006, Part 4.

Viewpoint 045.2.005 View north from residential properties on The Greenway

9.4.31 Construction activity will be partially screened by mature vegetation in back gardens and on the property boundaries from The Greenway. The Proposed Scheme (approximately 35m away), including the removal of vegetation to the north of the existing railway, the tunnel portal site plant and conveyor linking West Ruislip site with the main worksite, will be visible in the background of the view from residential properties on The Greenway. Views from the bungalows to the north of The Greenway will be partially screened by intervening vegetation. However, views of the construction activities will be possible from the upper levels of the two storey houses (Buckland Court) and mainly oblique views from the three storey flats off Ickenham High Road. The works will be of a relatively large scale within and adjacent to the existing railway corridor and will take place within 35m of the closest residential receptors but views will be partially filtered by intervening vegetation. Therefore the overall magnitude of change is considered to be high.

9.4.32 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

9.4.33 At night, continuous lighting is associated with the conveyor is proposed. However, since the foreground is already well lit by existing street lighting and light spill from buildings, effects at night will not be significant and are therefore reported in Volume 5: Appendix LV-001-006, Part 4.

Viewpoint 046.2.002 View south and west from the Blenheim Care Centre, residential properties on Ickenham Close, from business units on Ickenham Road and from Ickenham Road

9.4.34 Construction activity associated with the tunnel portal will be visible in the middle and background views from the residential properties and businesses. Views will be partially screened by mature vegetation in back gardens, sparse planting within West Ruislip station, the Blenheim Care Home building and the road bridge. The closest property, the Blenheim Care Centre, is located immediately east of the road bridge approximately 50m from the construction boundary and 110m from the headhouse structure. As a 'worst case' it has been assumed that the road bridge embankment may require stabilisation works and therefore the existing trees will be removed. Therefore views from the upper floors of Blenheim Care Centre towards the construction site will be open over the existing vegetation to the east of the Ickenham Road Bridge embankment. For the residential properties on Ickenham Road and Ickenham Close, the cranes and other tall machinery will be visible in the background view but mainly from upper floors. Other plant and construction activity will be screened by the existing vegetation and built elements in the foreground. The works

will take place within and adjacent to the existing railway corridor but they will be of a relatively large scale and close to receptors. Therefore, the magnitude of change is considered to be high.

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

9.4.36 At night, continuous lighting is associated with the conveyor is proposed. However, since the foreground is already well lit by existing street lighting and light spill from buildings, effects at night will not be significant and are therefore reported in Volume 5: Appendix LV-001-006, Part 4.

Viewpoint 046.3.004: View looking south from Ruislip Golf Course club house

9.4.37 Loss of the existing vegetation to the south and west of the club house will result in discernible changes to the view through the opening of views towards the railway. Construction activity will be visible in the foreground and middle ground including views of cranes and other plant used to construct the tunnel portal, headhouse and railway tracks from this location. Low-level construction activity will be largely screened by hoardings. The works will be of a significant scale and will take place adjacent to recreational receptors. Therefore, the magnitude of change is considered to be high, since there will be substantial changes to the view within the direct frame of view for the visual receptors.

9.4.38 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

Viewpoint 046.3.006 View south for users of Ruislip Golf Course and from PRoW (Footpath R146) across Ruislip Golf Course and from Ruislip Golf Course

9.4.39 Loss of the existing vegetation to the west of the club house and to the north of the existing Chiltern Main Line railway corridor will result in discernible changes to the view through the opening up of views towards the railway and the construction activity. Views from the PRoW (Footpath R146) that runs through the golf course and from the golf course itself are contained and framed until relatively close to the Proposed Scheme. During the construction the PRoW will be diverted to Clack Lane and Hill Lane, across Ickenham Road overbridge to The Greenway. However, it has been assumed that the golf course will continue to be in use during the works. The construction activity will be of a large scale and will take place between 250m and immediately adjacent to recreational receptors but with some vegetation screening in places. Therefore, the magnitude of change is considered to be high.

9.4.40 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

Viewpoint 047.2.002 View north from dwellings on Hoylake Crescent, from King George V Playing Field, from PRoW (Footpaths U47 and U48, Celandine Route) north-east from Hoylake Crescent and Ickenham Cricket Club Ground

9.4.41 Construction activity will be partially screened by mature vegetation in rear gardens, on the property boundaries, along the Chiltern Main Line railway corridor and surrounding the open spaces. From the two-storey residential properties, the works to the north associated with construction of the Northolt tunnel portal and the Proposed Scheme corridor, will be largely screened by vegetation and the existing railway corridor from the ground floor. However, from the upper floors views of cranes, other tall machinery and the conveyor will be possible. The works will be of a significant scale and will take place relatively close to residential receptors (the closest being approximately 100m away). Views from open spaces and PRoW will be partially screened by the mature vegetation enclosing the green areas. 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.

9.4.43 At night, continuous lighting is associated with the conveyor is proposed. However, since the foreground is already well lit by light spill from buildings, effects at night will not be significant and are therefore reported in Volume 5: Appendix LV-001-006, Part 4.

Viewpoint 047.2.004 View west from dwellings on Breakspear Road South and Swakeleys Road (close to junction with Harvil Road)

9.4.44 The construction site will be visible in the middle and background of the views from residential properties across the gently rising agricultural fields and through dense hedgerow vegetation along Breakspear Road South and field boundaries. The main construction site will include storage areas, offices and welfare, segment fabrication and storage and treatment plant for excavated material and will be operational 24hours per day. The site will be partially screened by the roadside hedgerows and scattered trees. The closest residential properties to the outer extent of the main construction compound are located approximately 450m away. The sustainable placement of material will extend to Breakspear Road South and works will be partially screened by the existing intervening hedgerows and trees. However, the activities located on the rising ground will be prominent in the view. The magnitude of change is considered to be medium, due to the proximity of the residential properties though changes to the view will be partially filtered by intervening vegetation.

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

9.4.46 At night, the use of lighting associated with the construction compound will be visible in the background of the view. However, since the foreground is already well lit by

existing street lighting and light spill from buildings, effects at night will not be significant and are therefore reported in Volume 5: Appendix LV-001-006, Part 4.

Viewpoint 047.2.005 View north and north-west from Brackenbury House, Farm and associated properties off Breakspear Road, Ickenham

9.4.47 There will be glimpsed middle ground views from the properties to the north of Brackenbury House and Farm, partially screened by the intervening mature vegetation and the railway embankment, of cranes and the conveyor associated with the construction of the new railway tracks and bridge over Breakspear Road. Views to the west of the construction compound the sustainable placement will be largely screened by existing vegetation within the property boundary. With the exception of the road, bridge works and cranes, the construction activities will be largely screened by the existing railway embankment and existing vegetation. Overall, the magnitude of change is considered to be medium, since views of the cranes will represent changes a relatively short distance from the receptors (the closest being approximately 65m to the south) but viewed over the railway embankment as one of the series of components in the middle ground of the view.

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

9.4.49 At night, the use of lighting will be intrusive within the largely unlit context to the west of the properties, associated with the construction compound, although largely filtered by intervening vegetation. Therefore, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 047.2.006 View west from residential properties on Breakspear Road South

9.4.50 Construction activity will be visible in the middle ground views from residential properties on Breakspear Road South and Copthall Farm and adjacent properties. Direct views of the Northolt tunnel and earthworks main construction compound including material stockpile, offices and welfare, segment fabrication and storage and treatment plant will be partially screened by the roadside vegetation and buildings (where present) for properties to the east of Breakspear Road South and field boundary hedgerows, scattered trees and outbuildings (where present) for properties to the west of the road. There will be glimpsed and oblique background views, partially screened by the intervening mature vegetation, of cranes associated with the construction of the new railway tracks and the sustainable placement of surplus excavated material. Activities associated with the construction compound and the sustainable placement of material, approximately 230m to the west will be partially screened by existing hedgerows. Therefore, the magnitude of change is considered to be medium, since changes to the view will be largely filtered by intervening vegetation.

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

9.4.52 At night, the use of lighting associated with the construction compound will be visible in the background of the view. However, since the foreground is already well lit by existing street lighting and light spill from buildings, effects at night will not be significant and are therefore reported in Volume 5: Appendix LV-001-006, Part 4.

Viewpoint 048.3.003 View south-west from PRoW (Footpath U45 Celandine Route)

9.4.53 The PRoW follows the periphery of the golf course and sections of the River Pinn so views of the Proposed Scheme will be largely screened or framed by existing mature vegetation. During construction, the PRoW will be diverted from the route along the River Pinn to Breakspear Road South between the fields and Dunster Cottage (PRoW Footpath U43). It will then follows Breakspear Road South and join the existing section of the PRoW (Footpath U51) opposite Brackenbury Farm. The removal of vegetation to the north of the Chiltern Main Line will represent a discernible change to the views from the PRoW as it passes close to the railway and will open up views of the construction of new landform associated with the new tracks and Breakspear Road South overbridge. The works will be of a large scale and will take place between 340m and 70m away from recreational receptors but with some intervening vegetation. Therefore, the magnitude of change is considered to be high.

9.4.54 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

Viewpoint 048.2.005 View south from Oak Farm, Square Orchard and associated residential properties (Breakspear Road South, north of the Chiltern Main Line) and PRoW (Footpath U43)

9.4.55 The closest property at a distance of approximately 50m, Oak Farm, will have direct and close views of the construction activity through the demolition of its stable and the outbuilding to the south of the property and the close proximity of works associated with the embankment and new bridge over Breakspear Road South. Views of the construction works from the residential properties associated with Square Orchard will be largely screened by existing vegetation but cranes may be visible. Dunster Cottage residents may have middle to background views of construction activity to the east but existing vegetation along the River Pinn will filter views and users of the PRoW between Breakspear Road and River Pinn will have views to the south. Grays Cottages, to the west of Breakspear Road South will have views of the construction activities relating to the new access road to pharmaceutical research facility and loss of vegetation at Gatemead Farm.

9.4.56 There will be framed background views from the residential properties within Square Orchard and Dunster Cottage, partially screened by existing vegetation, of cranes

associated with the construction of new railway tracks and the bridge over Breakspear Road South. Loss of the existing vegetation on the railway embankment, at Gatemead Farm and the stable and outbuilding at Oak Farm will result in significant changes to the views from Oak Farm and Grays Cottages through the opening up of foreground and middle ground views towards the railway. Therefore, the magnitude of change is considered to be high, since there will be an addition of new components which will be continuously visible and incongruous with the existing view.

9.4.57 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

9.4.58 At night, the use of lighting associated with the conveyor will be intrusive within the largely unlit context to the south of the properties, although filtered by intervening vegetation. Therefore, the magnitude of change to this receptor at night is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 048.2.007 View west and south-west from Rose Farm House and PRoW (Footpath U38) connecting Breakspear Road South with Newyears Green Lane

9.4.59 There will be partial filtered views of the construction activities associated with the sustainable placement of surplus excavated material areas east of Bayhurst Wood and west of Breakspear Road North from Rose Farm House, filtered by the intervening trees and hedgerows on the property boundary. During construction, PRoW will be diverted away from the field boundaries and along Breakspear Road North and Newyears Green Lane towards St. Leonard's Farm complex, affecting views. The presence of large scale earth moving plant close to residential property where views are filtered by existing vegetation is considered to be a medium magnitude of change.

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

Viewpoint 049.3.006 View east from the PRoW (Footpath U49) between Harvil Road and Breakspear Road, to the south of the Chiltern Main Line

9.4.61 There will be open and direct foreground and middle ground views from the PRoW of the Northolt tunnel and earthworks main site compound including temporary material stockpile, offices and welfare, segment fabrication and storage and treatment plant for excavated material located in the arable fields between Harvil Road and Breakspear Road South. Loss of the existing vegetation within Newyears Green Covert and along the railway corridor will result in discernible changes to the view through the opening up of views towards the railway and construction activity. There will be views of the conveyor linking West Ruislip portal with the railhead in West Ruislip and views of the temporary overbridge to the Chiltern Main Line for HGVs from the PRoW. There will be open middle ground views of the works associated with the diversion of the overhead power lines from the eastern section of the PRoW.

During construction the PRoW will be diverted towards Harvil Road. There will be views possible from the diverted PRoW of the activities associated with the sustainable placement of material areas located between Breakspear Road South and Harvil Road. Therefore, the magnitude of change is considered to be high, since there will be substantial changes to the visual receptor within the direct frame of view.

9.4.62 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

Viewpoint 049.2.007 View north and east from dwelling on Harvil Road and from Harvil Road

9.4.63 There will be open and direct foreground and middle ground views from the single residential property on Harvil Road and from Harvil Road itself of the hoarding fencing off the construction worksite adjacent to Harvil Road. There will views over the hoardings of cranes and other plant associated with the construction of new railway cutting and sidings, the construction compound east of Harvil Road, partial loss of Newyears Green Covert on the skyline, tall elements associated with the construction works associated with the new viaduct over the Colne Valley and diversion of the overhead power lines. The prominence of construction activity in close proximity to the viewpoint, with limited intervening screening, will result in a high magnitude of change.

9.4.64 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect.

9.4.65 The view of the Proposed Scheme from this location during construction is illustrated on the photomontage shown in Figure LV-01-181 (Volume 2, CFA6 Map Book).

9.4.66 At night, the use of lighting associated with the Northolt Tunnel and earthworks main compound will be intrusive within the largely unlit context to the north of the property, although filtered by intervening vegetation. Therefore, the magnitude of change to this receptor at night is considered to be high, resulting in a major adverse effect.

Viewpoint 050.6.002 View south from the pharmaceutical research facility

9.4.67 There will be open and direct foreground and middle ground views of construction activities from the commercial units at the pharmaceutical research facility. The demolition of a number of buildings, the construction of the retaining wall structure and the presence of the temporary bridge over the Chiltern Main Line for HGVs will be immediately apparent to the users of the site. The removal of existing vegetation to the north of the railway corridor will open up views of the construction works and the railway in the middle ground of the view to the south. In the background of the views to the west, activities associated with the construction compound east of Harvil Road, the partial loss of Newyears Green Covert and diversion of the overhead power lines will be visible. Therefore, the magnitude of change is considered to be high.

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

Viewpoint 050.2.004 View west and north-west from four dwellings on Newyears Green Lane and from two PRoW (Footpaths U36 and U37) connecting Bayhurst Wood with Newyears Green Lane

9.4.69 There will be open views to the north and west from the residential properties on Newyears Green Lane at a distance of approximately 30m, of the activities associated with the sustainable placement area accentuated by the removal of existing hedgerows and trees. The two PRoW connecting Newyears Green Lane with Bayhurst Wood Country Park will be temporarily diverted. Views from the diverted PRoW will be partially screened by the existing vegetation along Newyears Green Lane. Therefore, the magnitude of change is considered to be medium.

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

Viewpoint 052.6.003 View south from Dogs Trust Harefield including Highway Farmhouse grade II listed

9.4.71 From this elevated location the construction activities will be visible in the middle ground views at a distance of approximately 70m of the Colne Valley viaduct southern approach embankment which will be approximately 90m long and approximately 12m high and is located within CFA7. There will be vegetation removal along Harvil Road opposite the Dogs Trust in order to accommodate the works. This will open up views to the south-west of the construction works. The background views will be of the location of the southern approach site compound and associated plant within CFA7. There will be views of the construction traffic on the access track leading to the sustainable placement area through the Dog Trust grounds. Also within the view there will be diversion of the overhead power lines which formerly crossed the Harefield No 2 Lake used by HOAC. Therefore, the magnitude of change is considered to be high.

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

Cumulative effects

9.4.73 There are no known developments which will have combined effects with the Proposed Scheme on landscape character or visual receptors within this area.

Other mitigation measures

9.4.74 To further reduce the significant effects described previously, consideration of where planting can be established early in the construction programme will be given during the detail design stage. This may include consideration of early planting in ecological mitigation sites which would have the additional benefit of providing some visual screening. 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 residual significant effects

9.4.75 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, users of PRoW and main roads within 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 include:

- the vent shaft building at South Ruislip on an unoccupied industrial site (former Arla Dairy) will be approximately 44m by 19m and approximately 15m high. An auto-transformer substation and an area of hard standing will be located adjacent to the headhouse;
- the tunnel portal and associated headhouse, 30m by 32m approximately 5.5m high at West Ruislip west of the Ickenham Road Bridge;
- sustainable placement of surplus excavated materials areas approximately 3m high at three sites in this area – two located between Breakspear Road South and Harvil Road on either side of the existing high pressure gas main (approximately 3.8ha and 18ha in size) and the third on land to the north of Newyears Green Lane and south of Bayhurst Wood (approximately 24.8ha in size);
- diversion of an existing footpath adjacent to the Ickenham Stream to a new footbridge over the tunnel portal at a location approximately 135m to the east of the existing underpass;
- a new bridge over the River Pinn and PRoW, approximately 25m north of the existing Chiltern Main Line crossing;
- introduction of a new bridge over Breakspear Road South, approximately 50m north of the existing Chiltern Main Line crossing and road realignment;
- realignment of Harvil Road to the east of the existing alignment including embankment, cutting and new bridges over the Proposed Scheme, the Chiltern Main Line and Newyears Green Bourne stream;
- a retained cutting north of the Chiltern Main Line between Breakspear Road South and Harvil Road;
- the relocation of overhead power lines; and
- the introduction of regular high speed trains.

Avoidance and mitigation measures

9.5.2 The operational assessment of impacts and effects is based on year 1 (2026), year 15 (2041) and year 60 (2086) 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:

- diverted water courses and proposed balancing ponds will be integrated into the landscape, provide opportunities for biodiversity and be designed to alleviate flooding;
- planting, including native broad-leaved woodland, shrubs and hedgerows will be implemented along the northern side of the tunnel portal, to the north of Copthall Covert, between Chiltern Main Line and the Proposed Scheme, on the upper slopes of the cutting near Harvil Road and partially on the sustainable placement area to the north of Newyears Green Lane to replace lost vegetation and to screen the Proposed Scheme from neighbouring residential properties and users of adjacent PRoW and to aid integration of the Proposed Scheme into the landscape. 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;
- designing the appearance of the above ground structures such as the South Ruislip vent shaft, including the headhouses to be in keeping with the existing character and scale of the surrounding properties by using local materials where practicable;
- designing the appearance of the West Ruislip portal headhouse to reduce visual intrusion onto the surrounding landscape and visual amenity. The overall dimensions of the West Ruislip headhouse have been substantially reduced to respect the sensitivity of the location;
- designing fencing and other boundary treatments to reduce adverse effects on the landscape character and setting of visual receptors in the immediate surroundings of the tunnel portal;
- reinstating planting along the southern boundary of Ruislip Golf Course and west of the River Pinn where reasonably practicable and exploring the possibility of changing the landform on the southern edge of the Ruislip Golf Course using excavated material from the construction in order to create a more natural embankment profile and varied landform for the golf course. New areas will be planted where reasonably practicable, in line with the golf course layout;
- reinstating planting adjacent to Newyears Green Covert particularly on the cutting, where reasonably practicable;
- integrating the sustainable on site disposal sites into the existing landscape by tying the contours in, smooth profiles following the existing contours – 1:5 maximum slope for returned grazing land and 1:8 for agricultural land;

- planting of the sustainable placement area with native broad-leaved woodland where appropriate (area to the north of Newyears Green Lane) and replanting hedgerows (area between Breakspear Road South and Harvil Road) in order to re-create the field patterns where appropriate; and
- planting of the bund between the Chiltern Main Line and the Proposed Scheme in order to screen the cutting and the Copthall retaining structure.

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 landscape character and viewpoints in operation will relate to the presence of new structures/elements in the landscape including the vent shaft headhouse, the realignment of Harvil Road, the relocation of overhead power lines, the presence of a large cutting to accommodate the route and the introduction of regular high speed trains. At a number of locations, views of the Proposed Scheme will be obscured by the intervening existing vegetation and buildings along the existing Chiltern Main Line. Furthermore, effects will decline over time as planting established as part of the Proposed Scheme matures.

Landscape assessment

9.5.5 This section describes the significant effects on LCAs during year 1, year 15 and year 60 of operation. Non-significant effects on LCAs are presented in Volume 5: Appendix LV-001-006 Part 4.

9.5.6 The assessment of effects in year 15 assume proposed planting has grown by approximately 450mm a year (i.e. trees would be 7-7.5m high). The assessment of effects in year 60 assumes all planting has reached its fully mature height.

Ruislip Golf Course LCA

9.5.7 Within this LCA, the Proposed Scheme will include the tunnel portal and the headhouse. After gradually returning to the surface on a ramp within the portal structure, the route will continue westwards on embankment, with the bridge across the River Pinn marking the end of this LCA. Effects on landscape character in year 1 of operation within this LCA will include:

- introduction of the West Ruislip portal together with an approximately 32m by 30m headhouse, up to 5.5m high, located at ground level close to the Ruislip Golf Course club house. The elements will be incongruous with the surrounding suburban areas and Ruislip Golf Course. The large scale of the elements will result in prominent new elements being introduced into the LCA but located close to existing infrastructure;
- introduction of noise fence barriers, overhead line equipment and trains visible on the proposed embankment, which although adjacent to the Chiltern Main Line corridor, introduces additional infrastructure within a highly managed

recreation facility;

- introduction of a new embankment to accommodate the Proposed Scheme as it diverges north away from the Chiltern Main Line and associated bridge structure over the River Pinn and Footpath U47 (Celandine Route); and
- the presence of noise fence barriers on top of the embankment introducing new linear features and emphasising the presence of a large scale engineered structure along the periphery of an established golf course.

9.5.8 There will be a localised reduction in tranquillity of the LCA derived from the visual presence and noise of trains in the suburban area adjacent to the Ruislip Golf Course.

9.5.9 Overall, the presence of the large scale engineering elements will affect a relatively small part of the LCA and the Proposed Scheme will be largely accommodated adjacent to existing railway infrastructure, so the magnitude of change is considered to be high in year 1 of operation.

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

9.5.11 By year 15 and beyond to year 60 of operation, the maturity of planting established as part of the Proposed Scheme will result in greater landscape integration and reduce effects to be non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Harefield Farmland LCA

9.5.12 Between the River Pinn and Harvil Road the Proposed Scheme will be on embankment in the eastern part of the LCA and in a deep cutting to the west of the LCA. New diverted overhead power lines will be located to the western end of the LCA. There will be three sustainable placement areas, two located between Breakspear Road South and Harvil Road, one either side of the gas pipeline and one situated between Newyears Green Lane and Breakspear Road North. Effects on landscape character in year 1 of operation within this LCA will include:

- introduction of a new bridge over Breakspear Road South, approximately 50m north of the existing Chiltern Main Line. Noise fence barriers on top of the embankment will introduce prominent new linear elements into a relatively rural setting but located close to existing infrastructure;
- realignment of Harvil Road including new landform elements and new bridges over the Proposed Scheme, the Chiltern Main Line and Newyears Green Bourne will introduce new engineering structures into the relatively rural character area;
- a retained cutting north of the Chiltern Main Line between Breakspear Road South and Harvil Road will introduce an engineered landform, cutting across the natural landform, incongruous in the context of the adjacent landscape and emphasised through the partial loss of vegetation within the Newyears

Green Covert during construction;

- the relocation of the overhead power lines will introduce prominent new elements within the character area that falls within this area and that of CFA7;
- the site between Breakspear Road South and Harvil Road and to the south of the Proposed Scheme used as a construction compound with associated activities will be reinstated to its previous condition;
- introduction of a new landform created from sustainable placement areas for surplus excavated material; and
- loss of field patterns and hedgerows due to the sustainable placement areas for surplus excavated material.

9.5.13 There will be a localised reduction in tranquillity of the character area derived from the visual presence and noise of trains in the predominantly rural context.

9.5.14 Overall, due to the presence of the incongruous elements in the natural landscape affecting a relatively small part of the LCA, the magnitude of change is considered to be medium in year 1 of operation.

9.5.15 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.

9.5.16 By year 15 and beyond to year 60 of operation, the maturity of planting established as part of the Proposed Scheme will result in greater landscape integration and reduce effects to be non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Visual assessment

9.5.17 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-001-006 Part 4. The view of the Proposed Scheme from viewpoint 045.4.003 (illustrated in the photomontage shown in Figure LV-01-024 (winter view, year 1 of operation) and Figure LV-01-223 (summer view, year 15 of operation) (Volume 2, CFA 6 Map Book) would not be significantly affected due to the new elements being of similar character of the existing railway line and their location adjacent to the Chiltern Main Line.

9.5.18 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.

9.5.19 Where significant effects have been identified, an assessment of effects at night time arising from additional lighting has also been undertaken.

9.5.20 The number identifies the viewpoint locations which are shown in Maps LV-04-019b to LV-04-024-L1 (Volume 2, CFA6 Map Book). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport and 6: Employment.

9.5.21 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 045.4.003: View north and north-west from West Ruislip Station and Ickenham Road bridge

9.5.22 There will be uninterrupted foreground and middle ground views from Ickenham Road Bridge and the entrance of West Ruislip Station towards the Proposed Scheme. The loss of trackside and road embankment vegetation will open up views of the tunnel portal, headhouse and associated hard standing from the elevated bridge location. The headhouse, approximately 5.5m in height, will be of similar footprint and scale to the golf course club house but larger than most of the residential buildings surrounding the site. The lack of screening will make the structures prominent in the view and replacement planting adjacent to the Ickenham Road and the golf course club house will not be sufficiently established in year 1 to provide screening. The magnitude of change is therefore considered to be medium, as although the Proposed Scheme will be viewed over the busy Ickenham Road, the works will be highly visible in the foreground and middle ground of the view.

9.5.23 The medium 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.

9.5.24 In summer of year 1 of operation, the effect will be unchanged as replacement planting between the Proposed Scheme and the Ickenham Road.

9.5.25 By year 15 and beyond to year 60 of operation, the limited mitigation planting opportunities between the receptor and the tunnel portal means that the effect will be unchanged

9.5.26 The view of the Proposed Scheme from this location during year 1 of operation is illustrated on the photomontage shown in Figure LV-01-024 and during year 15 of operation on Figure LV-01-223 (Volume 2, CFA6 Map Book).

Viewpoint 045.2.004 View west from tower block on Josiah Drive at Ickenham Park, south of the West Ruislip station (up to 6 storeys)

9.5.27 There will be open middle and background views of the tunnel portal, headhouse and associated hard standing from the upper floors of the tower block on Josiah Drive. The approximately 30m by 35m headhouse, approximately 5.5m in height, will be of

similar footprint and scale to the golf course club house but larger than most of the residential buildings surrounding the site. However, the lack of screening will make the structures prominent in the view. Security fencing and hard standing associated with headhouse and substation will be incongruous within the golf course setting, resulting in the introduction of an industrial element into the landscape. The magnitude of change is therefore considered to be medium, as although the built elements will be viewed over the busy Ickenham Road, the works will be highly visible in the middle ground of the view.

9.5.28 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.29 In summer of year 1 of operation, the effect will be unchanged due to the limited planting opportunities between the Proposed Scheme and the Ickenham Road.

9.5.30 By year 15 and beyond to year 60 of operation, the limited mitigation planting opportunities between the receptor and the tunnel portal means that the effect will be unchanged.

Viewpoint 045.2.005 View north from residential properties on The Greenway

9.5.31 Glimpsed views of the headhouse next to the tunnel portal as well as the overhead lines and retaining walls will be possible from rear of properties on the Greenway. Views will, however, be partially screened by the existing vegetation in back gardens and on property boundaries. The noise fence barriers, located between the Chiltern Main Line and the Proposed Scheme, at approximately 40m away from the nearest properties will create a new linear element in the view from properties on the western end of The Greenway. The removal of vegetation to the north of the existing railway will be noticeable in the background of the view. Views of the tunnel portal structures and head houses will be possible from the upper levels of the two storey houses (Buckland Court) and mainly oblique views from the three storey flats off Ickenham High Road. There will be a change in the view at a relatively short distance from the receptor, partially filtered by intervening vegetation therefore the magnitude of change is considered to be medium.

9.5.32 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.

9.5.33 In summer of year 1 of operation, the effect will be unchanged due to the limited planting opportunities between the Proposed Scheme, the Chiltern Main Line and the receptors on The Greenway.

9.5.34 By year 15 and beyond to year 60 of operation, the limited mitigation planting opportunities between the receptor and the tunnel portal means that the effect will be unchanged.

Viewpoint 046.2.002: View south and west from the Blenheim Care Centre, residential properties on Ickenham Close, from business units on Ickenham Road and from Ickenham Road

9.5.35 Some glimpsed views of the headhouse and the electricity substation next to the tunnel portal as well as the overhead lines and retaining walls will be possible from this location, however, they will be partially screened by the existing vegetation in the foreground along the road. There will be views of the tunnel portal will be possible from the upper floors of the Care Centre. The headhouse will be of similar footprint and scale to the golf course club house but larger than most of the residential buildings surrounding the site. However, the lack of screening will make the structures and associated areas of hard standing prominent in the view. Security fencing associated with headhouse and substation will be incongruous within the golf course setting. The magnitude of change is therefore considered to be medium, as although the built elements will be viewed over the busy Ickenham Road, the works will be highly visible in the middle ground of the view.

9.5.36 The medium magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.37 In summer of year 1 of operation, the effect will be unchanged due to the limited planting opportunities between the Proposed Scheme and the Ickenham Road.

9.5.38 By year 15 and beyond to year 60 of operation, the limited mitigation planting opportunities between the receptor and the tunnel portal means that the effect will be unchanged.

Viewpoint 046.3.004: View looking south from Ruislip Golf Course Club House

9.5.39 Loss of the existing vegetation to the south and west of the club house will result in noticeable changes to the view through the opening of views towards the railway, headhouse and electricity substation from this location. The opportunities for screening views from the club house towards the Proposed Scheme will be limited due to the proximity of the built elements and the security fencing. The scale of the headhouse will be similar in size to the club house. However, the relatively industrial style of the building and the security fencing associated with headhouse will be incongruous with the golf course and club house setting, resulting in the introduction of an industrial element into the view. Therefore, the magnitude of change is considered to be high, since there will be substantial changes within the direct frame of view for the visual receptors.

9.5.40 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.41 In summer of year 1 of operation, the effect will be unchanged due to the limited opportunities for planting between the elements of the Proposed Scheme and the viewpoint.

9.5.42 By year 15 and beyond to year 60 of operation, the effect will be unchanged due to the limited opportunities for planting between the elements of the Proposed Scheme and the viewpoint.

Viewpoint 046.3.006 View south from PRoW (Footpath R146) across Ruislip Golf Course and from Ruislip Golf Course

9.5.43 The PRoW runs through the golf course across a series of golf holes and as such views will be screened and framed until relatively close to the Proposed Scheme. The approximately 5.5m high headhouse which will be located at ground level will be mostly screened by the existing intervening vegetation. The retaining walls of the tunnel portal together with the footbridge with the diverted PRoW over the railway line will be visible from the section of the PRoW within the golf course. Noise fence barriers, overhead line equipment, security fencing and the retaining walls associated with the tunnel portal will be incongruous with the golf course setting resulting in the introduction of linear urban/industrial elements into the landscape. Replacement planting, where agreed, will not be sufficiently established in year 1 to contribute to screening the railway. Therefore, the magnitude of change is considered to be high.

9.5.44 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.45 In summer of year 1 of operation, while existing vegetation will provide some additional screening, the magnitude of change is considered to remain high meaning the overall effect will remain unchanged.

9.5.46 By year 15 of operation, the planting along the retaining wall of the tunnel portal will have matured, providing screening. However, the diverted and extended route over the Proposed Scheme will result in the deterioration in the quality of the views from the PRoW when crossing the scheme. Therefore the effect will be unchanged and is therefore significant.

9.5.47 By year 60 of operation, the further growth and maturity of the proposed planting along the retaining wall will provide substantial screening of the Proposed Scheme. Overall the maturing of this screen planting will lead to an improvement in the quality of views from the majority of this PRoW and means there will be a slight reduction in the magnitude of the overall impact to moderate adverse in year 60. This is however still significant.

Viewpoint 048.3.003 View south-west from PRoW (Footpaths U45 and U46 Celandine Route)

9.5.48 Views of the Proposed Scheme will be largely screened or framed by existing mature vegetation. However, the loss of vegetation to the north of the Chiltern Main Line will represent a discernible change to the views from the PRoW as it crosses under the railway and will open up views of the new embankment, noise fence barriers and overhead line equipment. There will be oblique views of the River Pinn overbridge possible from approximately 80m away. Replacement tree and shrub planting along the new embankment will not be sufficiently established in year 1 to contribute to screening of the Proposed Scheme and visually softening the embankments. Therefore, the magnitude of change is considered to be high.

9.5.49 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.50 In summer of year 1 of operation, the effect will be unchanged due to the low height of the proposed planting.

9.5.51 By year 15 of operation, the planting along the northern embankment of the Proposed Scheme will have matured, providing some screening resulting in a slight reduction in magnitude of overall impact to moderate adverse in year 15.

9.5.52 By year 60 of operation, planting established along the embankment as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Viewpoint 048.2.005 View south from Oak Farm, Square Orchard and associated residential properties (Breakspear Road South, north of the Chiltern Main Line) and PRoW (Footpath U43)

9.5.53 The closest property, Oak Farm, will have direct and close views of the railway embankment, noise fence barriers and overhead line equipment through the demolition of the barn to the south of the property and loss of existing vegetation. Views of the construction works from the residential properties associated with Square Orchard will be largely screened by existing vegetation. Dunster Cottage residents and users of PRoW will have foreground views of the flood storage area. Replacement tree and shrub planting on the new embankment will not be sufficiently established in year 1 to contribute to screening of the Proposed Scheme and visually softening the embankments, particularly from Oak Farm. Therefore, the magnitude of change is considered to be high.

9.5.54 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.55 In summer of year 1 of operation, the effect will be unchanged due to the low height of the proposed planting.

9.5.56 By year 15 and beyond to year 60 of operation, planting established along the embankment as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Viewpoint 048.2.007 View west and south-west from Rose Farm House and PRoW (Footpath U38) connecting Breakspear Road South with Newyears Green Lane

9.5.57 There will be filtered views of the sustainable placement area approximately 3m high visible from Rose Farm House at a distance of approximately 60m, partially screened by the intervening trees and hedgerows on the property boundary. The surplus excavated material will be integrated with the existing topography. Views from PRoW which will cross the sustainable placement area, will be elevated, which would allow further views across the surrounding countryside emphasised by the immaturity of the replacement hedgerows and woodland planting. Therefore, the magnitude of change is considered to be medium.

9.5.58 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.

9.5.59 In summer of year 1 of operation, the effect will be unchanged due to the low height of the proposed planting on the sustainable placement area.

9.5.60 By year 15 and beyond to year 60 of operation, planting established on the slopes of the cutting as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Viewpoint 049.3.006 View east from the PRoW (Footpath U49) between Harvil Road and Breakspear Road

9.5.61 There will be oblique views of the new cutting located to the north of the PRoW, partially screened by the retained existing Copthall Covert. The new railway tracks will be located predominantly in the cutting. However, the lack of mature screening planting along the embankment and the cutting and the presence of the diverted overhead power lines will result in open but oblique, middle ground views of those elements from this location. The new Colne Valley viaduct in CFA 7 will be visible from this location in the background, partially screened by the existing planting along the Chiltern Main Line. Replacement planting, where agreed, will not be sufficiently established in year one to screen views. Therefore, the overall magnitude of change is considered to be medium.

9.5.62 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.

9.5.63 In summer of year 1 of operation, the effect will be unchanged due to the low height of the proposed planting in the cutting.

9.5.64 By year 15 and beyond to year 60 of operation, planting established on the slopes of the cutting as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Viewpoint 049.2.007 View north and east from dwellings on Harvil Road and from Harvil Road

9.5.65 The new railway tracks will be located predominantly in the cutting. However, the lack of mature screening planting along the embankment and the cutting and the presence of the diverted overhead power line will result in views of these elements on the skyline from the viewpoint at a distance of approximately 500m. The new Colne Valley viaduct will be visible from this location in the background, partially screened by the existing planting along the Chiltern Main Line. Replacement planting, where agreed, will not be sufficiently established in year 1 to screen views. The site between Breakspear Road South and Harvil Road used as a construction compound with associated activities will be reinstated to its previous condition. Therefore, the magnitude of change is considered to be high.

9.5.66 The view of the Proposed Scheme in the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-025(Volume 2, CFA 6 Map Book).

9.5.67 The high magnitude of change, assessed alongside the high sensitivity of the receptor, will result in a major adverse effect in the winter of year 1 of operation.

9.5.68 In the summer of year 1 of operation, the effect will be unchanged due to the low height of the proposed planting in the cutting.

9.5.69 By year 15 and beyond to year 60 of operation, planting established on the slopes of the cutting as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

9.5.70 The view of the Proposed Scheme in the summer of year 15 of operation is illustrated on the photomontage shown in Figure LV-01-224 (Volume 2, CFA 6 Map Book).

Viewpoint 050.6.002 View south from pharmaceutical research facility

9.5.71 There will be clear views of the Proposed Scheme immediately adjacent to the pharmaceutical research centre. The lack of mature screening planting along the railway line and the presence of the security fence will result in open but oblique,

middle ground views of the railway embankment, noise fencing and cutting from the viewpoint. Therefore, the magnitude of change is considered to be medium.

9.5.72 The medium 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.

9.5.73 In summer of year 1 of operation, the effect will be unchanged due to the lack of planting in front of the Proposed Scheme.

9.5.74 By year 15 and beyond to year 60 of operation, the lack of mitigation planting in front of the Proposed Scheme, between the receptor and the pharmaceutical research facility retaining structure means that the effect will be unchanged and is therefore significant.

Viewpoint 050.2.004 View west and north-west from four dwellings on Newyears Green Lane and from the two PRoW (Footpaths U36 and U37) connecting Bayhurst Wood with Newyears Green Lane

9.5.75 There will be open views of the sustainable placement areas approximately 3m high visible from the residential properties on Newyears Green Lane at a distance of approximately 30m. The surplus excavated material will be integrated with the existing topography. Views from two PRoW which will cross the sustainable placement site, will be elevated, which would allow further views across the surrounding countryside. Therefore, the magnitude of change is considered to be medium.

9.5.76 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.

9.5.77 In summer of year 1 of operation, the effect will be unchanged due to the low height of the proposed planting on the sustainable placement area.

9.5.78 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Viewpoint 052.6.003 View south from Dogs Trust Harefield including Highway Farmhouse Grade II listed building

9.5.79 There will be filtered middle and background views through roadside hedgerows and field boundaries to the southern approach embankment and Colne Valley viaduct in CFA 7. Mitigation planting on the field to the west of Harvil Road will not be sufficiently established in year 1 to screen views. Therefore, the magnitude of change is considered to be medium.

9.5.80 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.

9.5.81 In the summer of year 1 of operation, while the existing intervening vegetation will provide some additional screening, the magnitude of change is considered to remain medium meaning the overall effect will be unchanged.

9.5.82 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to being non-significant. These are reported in Volume 5: Appendix LV-001-006 Part 4.

Cumulative effects

9.5.83 There are no known developments which will have combined effects with the Proposed Scheme on landscape character or visual receptors within this area.

Other mitigation measures

9.5.84 The permanent effects of the Proposed Scheme on landscape and visual receptors have been substantially reduced through incorporation of the measures described previously. Effects in year 1 of operation may be further reduced by establishing planting early in the construction programme, which will be considered during the detail design stage. This would provide additional screening and greater integration of the Proposed Scheme into the landscape. However, no other mitigation measures are considered practicable due to the high visibility of elements of the Proposed Scheme and the sensitivity of the surrounding receptors

Summary of likely residual significant effects

9.5.85 In the more rural areas to the west of the area, significant effects will reduce over time as the proposed mitigation planting matures and reaches its designed intention. However, the following residual effects will remain following year 15 of operation:

- effects on views from properties on Josiah Drive and Ickenham Road, users of Ickenham Road and the Ruislip Golf Course club house arising from visibility of the tunnel portal, the headhouse and associated hardstanding accentuated by the loss of trees (viewpoints 045.4.003, 045.2.004, 046.2.002 and 046.3.004);
- effects on users of PRoW on the Ruislip Golf Course and of PRoW along River Pinn, arising from visibility of respectively the retaining walls of the tunnel portal, noise fence barriers and embankment as well as the diversion of the footpath (viewpoint 045.3.006); and
- effects on workers at pharmaceutical research facility, arising from visibility of the retaining structure located adjacent to the facility (viewpoint 050.6.002).

10 Socio-economics

10.1 Introduction

10.1.1 This section reports the likely significant economic and employment effects during 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 within 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 the following 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;
- effects on the amenity (e.g. air quality and construction dust, noise and vibration, construction traffic and visual impacts) of an area which could affect a business's operations. Any resulting effects on employment are reported at a route-wide level (Volume 3); and
- potential employment opportunities arising from construction in the local area (including in adjacent areas).

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 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 arising from engagement with stakeholders and community organisations.

10.3 Environmental baseline

Existing baseline

Study area description

10.3.1 Section 2.1 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 availability within the area[47].

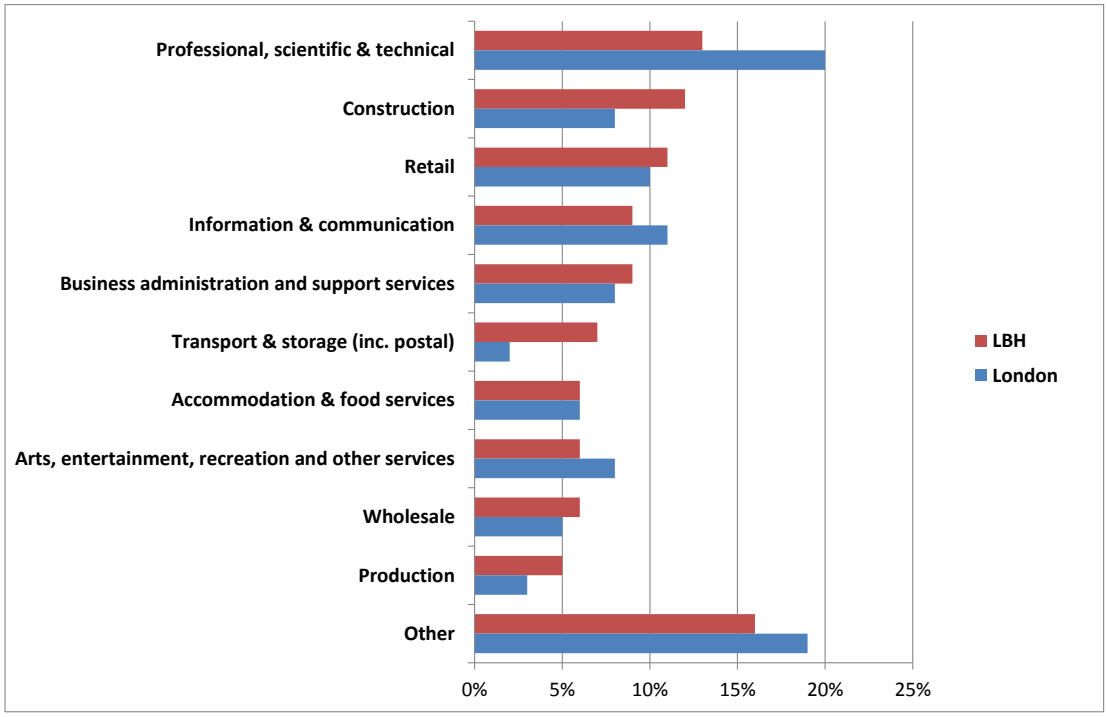
10.3.2 The study area is entirely within the LBH. Where possible, baseline data has been gathered on demographic character areas (DCA)[48] to provide a profile of local communities. Volume 5: Appendix SE-02-007 shows the location of these DCA. The area contains five DCA – Ickenham, West Ruislip, Newyears Green, South Ruislip and Ruislip Manor and Ruislip Gardens.

Business and labour market

10.3.3 Within the LBH, the professional, scientific and technical services sector accounts for the largest proportion of businesses (13%), with the construction (12%) and retail (11%) sectors also accounting for relatively large numbers of businesses. This is shown in Figure 6[49]. For comparison, within the London region the professional, scientific and technical services sector accounts for the largest number of businesses (20%), with the information and communication (11%), retail (10%) and arts, entertainment, recreation and other services (8%) sectors also accounting for relatively large numbers of businesses[50].

[47] Further information on the socio-economics baseline within the area, including a business and labour market profile, is contained in Volume 5 (Appendix SE-001-006).
[48] DCA 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 borough but not the proportion of employment by sector
[50] Office for National Statistics (ONS) (2011), *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 in LBH and London [51] [52]



10.3.4 Approximately 186,000 people worked in LBH while 2,000 people worked within the Ickenham DCA, 3,000 within West Ruislip DCA, 4,000 within South Ruislip and 2,000 worked within the Ruislip Manor and Ruislip Gardens DCA. Fewer than 100 jobs are located in Newyears Green[53].

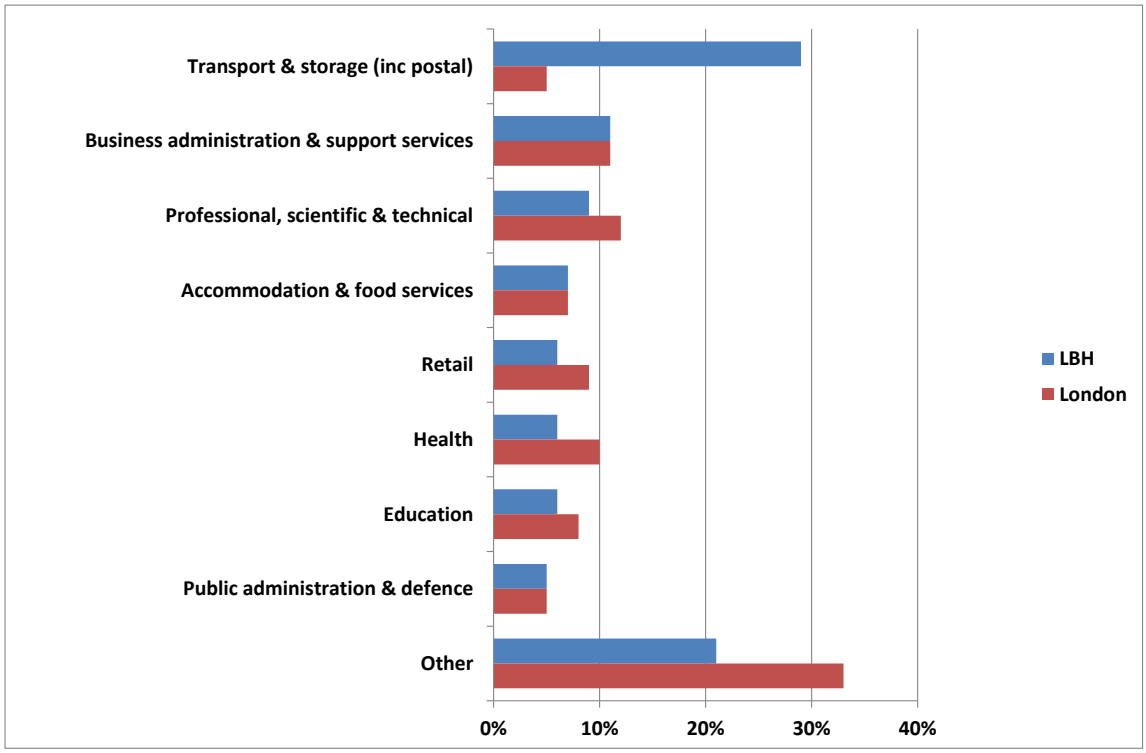
10.3.5 According to the ONS Business Register and Employment Survey 2011, the sector with the highest proportion of employment in the borough is transport and storage (including postal) accounting for 28%, which is considerably higher than that recorded for London and England (both 5%) and is partly due to the area's proximity to Heathrow Airport. The business, administration and support services sector accounts for 11% of employment, in line with that recorded for London (10%) and higher than in England (8%). Also important, the professional, scientific and technical services sector accounted for 9% of employment, lower than that recorded for London (13%) and higher than England (8%). Further information is shown in Figure 7.

10.3.6 Key employment sectors for Ickenham DCA are education (26%), arts, entertainment, recreation and other services (12%) and wholesale (10%). For West Ruislip DCA, key sectors are accommodation and food services (26%) and retail (23%). In Newyears Green DCA key sectors are health (22%), wholesale (16%) and construction (12%). Key sectors for South Ruislip DCA are wholesale (22%) and retail (20%). For Ruislip Manor and Ruislip Gardens DCA, key sectors are construction (19%), education (13%),

[51] ONS (2012), *UK Business: Activity, Size and Location 2011*, ONS, London
[52] 'Other' includes agriculture, forestry and fishing, motor trades, finance and insurance, property, public administration and defence, education and health sectors
[53] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London

transport and storage (including postal) (11%) and accommodation and food services (10%).

Figure 7: Employment by industrial sector in LBH and London [54] [55]



10.3.7 According to the 2011 Census[56], the employment rate[57] within LBH in 2011 was 65% (which represents 130,000 people), in line with London and England figures (65%). The borough has very high levels of commuting into the area as shown by the discrepancy between the number of jobs in the borough and the number of residents in employment. The employment rate in the Ickenham DCA was 69%, 74% in West Ruislip DCA, 62% in Newyears Green DCA, 72% in South Ruislip DCA and 74% in Ruislip Manor and Ruislip Gardens DCA.

10.3.8 In 2011, the unemployment rate for LBH stood at 8% which was slightly above the England average of 7%. Whilst in the five DCA the unemployment rate varied from 3% in Newyears Green, 4%, in Ickenham, 5% in West Ruislip and Ruislip Manor and Ruislip Gardens to 6% in South Ruislip[58]

10.3.9 According to the 2011 Census, 28% of LBH residents aged 16 and over were qualified to National Vocational Qualification Level 4 (NVQ4), compared to 38% in London and 27% in England, while 19% had no qualifications, slightly higher than that recorded for

[54] Other' includes construction, wholesale, information and communication, motor trades, property, financial and insurance, production, forestry and fishing sectors.
[55] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London
[56] ONS (2012), *Census 2011*, ONS, London
[57] The proportion of working age (16-74 years) residents in employment. Employment comprises of the proportion of total resident population who are 'in employment' and includes full-time students who are employed.
[58] 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.

London (18%) and lower than for England (23%). In 2011 36% of Ickenham DCA residents aged 16 and over were qualified to NVQ4, compared to 39% in West Ruislip DCA, 27% in Newyears Green and South Ruislip DCA and 30% in Ruislip Manor and Ruislip Gardens DCA. The proportion of residents with no qualifications was 15% in Ickenham DCA, 13% in West Ruislip DCA, 22% in Newyears Green DCA, 18% in South Ruislip DCA and 17% in Ruislip Manor and Ruislip Gardens DCA.

10.3.10 Ickenham DCA, West Ruislip DCA and Ruislip Manor and Ruislip Gardens DCA are predominantly residential suburban areas with high rates of employment and good qualifications attainment. Newyears Green DCA has a small village character with low rates of unemployment. South Ruislip DCA is relatively less prosperous compared to the other DCA in the area, experiencing relatively high unemployment and lower skills levels, although these figures are better than the averages for both LBH and London.

Property

10.3.11 Data for quarter 3 of 2012 indicated that 10% of the 7.6 million square metres of industrial and warehousing floorspace in West London was vacant[59].

10.3.12 Vacancy levels for industrial and warehousing property in LBH in July 2013 has been assessed as 16% based on marketed space against known stock[60]. Overall this suggests there is good availability of local alternative business accommodation.

Future baseline

Construction (2017)

10.3.13 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. There are no consents or allocations in this local area which are expected to accommodate significant additional employment by 2017.

Operation (2026)

10.3.14 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2026. There are no consents or allocations in this local area which are expected to accommodate significant additional employment between 2017-2026.

10.4 Effects arising during construction

Avoidance and mitigation measures

10.4.1 In order to avoid or minimise the environmental impacts during construction, the Proposed Scheme design includes provisions to reduce impacts on the operation of the pharmaceutical research facility through the construction of retaining structures.

[59] Jones Lang LaSalle (2012), *The Western Corridor Industrial and Warehouse Market Report* (September 2012)
[60] 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)

10.4.2 The draft CoCP includes a range of provisions that will help 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 minimise noise (including vibration) at sensitive receptors (including local businesses) (draft CoCP Section 13);
- 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

10.4.3 No non-agricultural[61] businesses have been identified within the area that are expected to experience significant amenity effects as a result of the Proposed Scheme.

Isolation

10.4.4 No non-agricultural businesses have been identified within the area that are expected to experience significant isolation effects as a result of the Proposed Scheme.

Construction employment

10.4.5 There are plans to locate construction compounds for the Proposed Scheme at the following locations within the area:

- South Ruislip vent shaft main compound;
- West Ruislip portal satellite compound;
- Breakspear Road south satellite compound;
- Northolt tunnel and earthworks main compound; and
- Harvil Road realignment satellite compound.

[61] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level.

10.4.6 The use of these sites could result in the creation of 3,300 person years of construction employment opportunities[62], or approximately 330 full-time equivalent jobs, that, 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 direct construction employment creation has been assessed as part of the route wide assessment (Volume 3).

10.4.7 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 the indirect construction employment creation has been assessed as part of the route wide assessment (Volume 3).

Cumulative effects

10.4.8 No committed developments have been identified that are considered to interact with the Proposed Scheme.

10.4.9 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 (Volume 3).

Permanent effects

Businesses

10.4.10 Businesses directly affected (i.e. those that lie within the 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.

10.4.11 In all, 14 business accommodation units within the area will be directly impacted upon by the Proposed Scheme. These together form four defined resources. These comprise the pharmaceutical research facility (where some ancillary outbuildings will be displaced to other areas of the business site but the core buildings will remain operational throughout the construction works), a rifle range, a driving range at Ruislip Golf Course and a composting site (where impacts would be limited to the use of a small tract of land resulting in no effect on business operations).

10.4.12 From an employment perspective, no significant direct effects on non-agricultural employment have been identified within this area[63].

[62] 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.
[63] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level.

10.4.13 It is estimated that the Proposed Scheme will result in the displacement or possible loss of a total of 10 jobs[64] within this area. Taking into account total employment within the area, the impact on the local economy from 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 and is not considered to be significant.

Cumulative effects

10.4.14 No committed developments have been identified that are considered to interact with the Proposed Scheme.

10.4.15 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

10.4.16 The assessment has concluded that there are no significant adverse effects arising during construction in relation to businesses directly affected by the Proposed Scheme.

10.4.17 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.

10.4.18 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the line of route in terms of supplying good 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.

Summary of likely residual significant effects

10.4.19 There are no significant effects identified in this assessment that will arise during construction.

10.5 Effects arising during operation

Avoidance and mitigation measures

10.5.1 No mitigation measures are required during operation within this area.

[64] Employment within businesses has been estimated through a combination of sources, for example, surveys of businesses, the Experian employment dataset, employment floorspace and the Homes and Communities Agency (HCA) Employment Densities Guide (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.

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 project within this area.

Change in business amenity

10.5.3 No non-agricultural businesses have been identified within the area that 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 could be accessed by residents within the area, particularly given its proximity to Old Oak Common and Euston.

10.5.5 Indirect employment opportunities will also arise through the ability for local businesses to supply the project, local spending arising from local businesses requiring more services and supplies arising from increased foot traffic or through local businesses benefitting from the expenditure of directly employed workers on goods and services.

10.5.6 Some of these employment opportunities will be accessible to residents in the locality and, given the transport accessibility of the area within the London travel to work area (TTWA), residents living further afield.

10.5.7 The impact of operational employment creation has been assessed as part of the route wide assessment (Volume 3).

Cumulative effects

10.5.8 No committed developments have been identified that are considered to interact with the Proposed Scheme.

Other mitigation measures

10.5.9 The assessment has concluded that operational effects within the area will be either negligible or beneficial and therefore mitigation is not needed.

Summary of likely residual significant effects

10.5.10 There are no significant effects identified in this assessment that will arise during operation.

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 this area on:

- people, primarily where they live ('residential receptors') in terms of individual dwellings and on a wider community basis, including any shared community open areas[65]; 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'[66].

11.1.2 The assessment of likely significant effects from noise and vibration on agricultural, community, ecological or heritage 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 Section 8 of Volume 1 and scope and methodology are defined in the following documents:

- Scope and Methodology Report (SMR) (Appendix CT-001-000/1); and
- SMR addendum (Appendix CT-001-000/2).

[65] '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.

[66] 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 this area is available in the relevant appendices in Volume 5:

- sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000);
- sound, noise and vibration baseline (Appendix SV-002-006);
- sound, noise and vibration construction assessment (Appendix SV-003-006);
- sound, noise and vibration operation assessment (Appendix SV-004-006); and
- Map Series SV-01, SV-02, SV-03 and SV-04 (Volume 5, Sound, noise and vibration Map book).

11.2 Environmental baseline

Existing baseline

11.2.1 A large proportion of the Proposed Route in this area is in tunnel. Consequently, the description of the existing sound environment concentrates on the areas around the South Ruislip vent shaft, West Ruislip portal and locations adjacent to the surface sections of the line.

11.2.2 The baseline sound environment around the vent shaft site at South Ruislip is typical for an urban situation, with existing sound levels determined by passenger and freight services on the nearby Chiltern Main Line, the London Underground Central line (which is above ground here) and local road traffic movements. Aircraft movements associated with nearby RAF Northolt can also be heard.

11.2.3 To the west of the study area, road traffic from Harvil Road, Breakspear Road South and the B466 Ickenham Road and railway traffic from the Chiltern Main Line and London Underground Central line are the principal sound sources giving rise to daytime sound levels of typically around 65dB[67].

11.2.4 In Ickenham, to the south of the Central line, the area is mainly residential. Close to the B466 Ickenham Road and Breakspear Road, traffic on these roads dominates the soundscape and daytime sound levels are typically around 60dB. Close to the Central line, the sound of trains adds to that of road traffic that has been screened by interstitial buildings, resulting in similar daytime sound levels of around 60dB. Further into the residential area, lower levels of sound are audible from the distant busier roads. This is added to by sounds from traffic on local roads (Hoylake Crescent and The Greenway, for example). Intermittent sound from aircraft is audible in most of these locations and daytime sound levels are typically 50 to 55dB.

11.2.5 In West Ruislip, to the north of the Central line, road traffic is the dominant sound at the majority of locations. Close to the B466 Ickenham Road daytime sound levels are

[67] Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,16hr}$.

typically around 75dB. Further away from this busy road in the residential area around Hill Lane, Glenhurst Avenue and Woodville Gardens, the constant sound of distant road traffic adds to intermittent local road traffic and occasional contributions of birds, high-altitude aircraft, distant trains and community activities, resulting in typical daytime sound levels of around 55dB.

11.2.6 There are some relatively isolated properties along Harvil Road and traffic on this route is the dominant sound source at these properties. Properties closer to the road experience higher sound levels (typically around 75dB), than properties set further back from the road (55 to 60dB).

11.2.7 The sound from large vehicles travelling to and from the waste transfer station at Newyears Green are noticeable at properties on Newyears Green Lane, adding to the sound of distant road traffic. Typical sound levels in this location are 55 to 60dB.

11.2.8 At night, the same sound sources generally contribute and in residential areas away from the major roads sound levels are approximately 5 to 10 dB[68] lower than daytime. The equivalent reduction for the more remote residential areas (further from the main roads) is approximately 10 to 15dB.

11.2.9 Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for this area in Volume 5: Appendix SV-002-006.

11.2.10 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[69], save for those receptors closest to existing railways. On a precautionary 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

11.2.11 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[70], tyre sound dominates and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

Construction (2017)

11.2.12 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

[68] Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr.}$
[69] Further information is available in the Volume 5: Appendix SV-001-000, the SMR and its Addendum.
[70] Tyre noise typically becomes the dominant sound source for steady road traffic at speeds above approximately 30mph

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.

Operation (2026)

11.2.13 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.

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 will need to be undertaken during the evening and night-time for reasons of safety, engineering practicability or to reduce the impact on existing transport:

- continuous surface tunnelling support activities at the West Ruislip portal satellite compound and Northolt tunnel and earthworks main compound;
- continuous operation of conveyors, pumping equipment and essential generators; and
- movement of trains into and out of the railhead in the Northolt tunnel and earthworks main compound during the day, evening and night.

11.3.3 TBM will be used to excavate the tunnels. Materials (including tunnel lining segments), people and equipment will be transported from the surface 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. It has been assumed that significant ground-borne noise and vibration effects arising from use of the temporary railway will be avoided through appropriate design and maintenance specification. Similarly, where the temporary railway will operate on the surface (between West Ruislip portal and the Northolt tunnel and earthworks main compound) the adverse effects will be avoided or reduced by the design of the temporary railway, its maintenance and as necessary temporary screening. Other

methods of material movement may be employed; however, these would result in lower ground-borne noise and vibration.

11.3.4 In addition to the above, although it is anticipated that there may be some night-time working during works to cross or tie into existing roads and railways, it is expected that the noise effects would be limited in duration and would hence not be considered significant. Any noise effects arising from these short-term construction activities will be controlled and reduced by the management processes set out in the draft CoCP.

11.3.5 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.

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-002-006.

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[71]; 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 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

[71] Warning signals that consist of bursts of noise.

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 draft 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[72] has been assumed along edge of the construction site boundary adjacent to the residential communities at the B466 Ickenham Road, The Greenway, Hoylake Crescent, Breakspear Road South, Copthall Road West, Harvil Road, Hill Rise, Field Way, Glenhurst Avenue and the pharmaceutical research facility site. In addition taller screening has been assumed around the South Ruislip vent shaft site.

11.3.9 Noise insulation will be offered for qualifying buildings as defined in the draft CoCP Noise insulation and temporary re-housing policy. Noise insulation or ultimately temporary re-housing will avoid residents being significantly affected[73] 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, one residential building (Oak Farm on Breakspear Road South) is 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[74] measured

[72] 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
[73] Information is provided in the emerging National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk.
[74] $L_{pAeq,0800\text{-}1800}$ measured at the facade

outdoors, or the existing ambient if this is already above this level. The equivalent night-time trigger level is 55dB[75].

11.3.12 The mitigation measures, including noise insulation, will reduce noise inside all dwellings, including the dwelling at Oak Farm, such that it does not reach a level where it would significantly affect9 residents.

Residential receptors: direct effects –communities

11.3.13 The avoidance and mitigation measures in this area will avoid airborne construction noise adverse effects[73] on the majority of receptors and communities. Residual temporary noise or vibration effects are identified later in 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[76], construction noise adverse effects 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. The temporary adverse effects on the residential community areas identified in Table 16, including shared open areas, are considered to be significant:

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-003-006)	Type of significant effect	Time of day	Location	Cause (construction activities)	Assumed approximate duration of impact and details
CSV06-C01	Construction Noise	Daytime	Approximately 25 dwellings in Cottesmore House, Perkins Gardens	West Ruislip portal construction with typical and highest monthly noise levels of approximately 65dB and 70dB	17 months
CSV06-C02	Construction Noise	Daytime	Approximately 45 dwellings on The Greenway, Ickenham	West Ruislip portal and Ickenham Stream (Canal Feeder) overbridge construction with typical and highest monthly noise levels of approximately 60-65dB and 70-75dB	12–22 months

[75] $L_{pAeq,2200-0700}$ measured at the façade, outdoors, or the existing ambient if this is already above this level.
[76] Further information is provided in Volume 5: Appendix SV-001-000.

Significant effect number (see Volume 5 Appendix SV-003-006)	Type of significant effect	Time of day	Location	Cause (construction activities)	Assumed approximate duration of impact and details
		Evening	Approximately 30 dwellings on The Greenway, Ickenham	Northolt Tunnel – TBM launch and drive with typical and highest monthly noise levels of around 55dB	24 months
CSV06-C03	Construction Noise	Daytime	Approximately 10 dwellings on Breakspear Road South, Harefield	Construction of the Breakspear Road South Underbridge, River Pinn Underbridge and West Ruislip retained embankment with typical and highest monthly noise levels of 58dB and 66dB at the southernmost property and 71dB and 78dB for the northern properties	13 months

11.3.16 TBM will be used to excavate the tunnels. 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 TBM will present no risk of any building damage.

11.3.17 The effects of vibration from TBM 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 Construction traffic is likely to cause adverse noise effects on residential receptors along the B467 Swakeleys Road where it passes through Ickenham (CSV06-04). Approximately 30 dwellings located immediately adjacent to the road are forecast to experience an increase in outdoor noise levels of around 1dB during the peak months (further information on traffic flows is provided in Section 12: Traffic and transport).

11.3.19 The small increase in sound level at effect CSV06-C04 is considered to be significant at the identified receptors as they are already exposed to high ambient noise levels[77].

11.3.20 This adverse effect[73] would be a change in the acoustic character of the area such that there is a perceived change in the quality of life and is considered significant when assessed on a community basis taking account of the local context.

Non-residential receptors: direct effects

11.3.21 TBM will be used to excavate the tunnels. 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 TBM will present no risk of any building damage.

11.3.22 The effects of vibration from TBM 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.

11.3.23 Adjacent to the surface works, significant construction noise or vibration effects have been identified on a reasonable worst case basis on the following non-residential receptors:

11.3.24 Ruislip Golf Club, Ickenham Rd (CSV06-N01). Significant noise effects have been identified on the buildings of this facility during the daytime. Noise level could rise at times to around 80dB over a period of approximately nine months commencing in 2017 during the construction of the West Ruislip portal; and

11.3.25 The Church of Jesus Christ of Latter Day Saints, Ickenham Rd (CSV06-N02). Significant noise effects have been identified during the daytime with noise levels rising at times to around 60dB over a period of approximately 14 months commencing in 2017 during the construction of the West Ruislip portal.

Non-residential receptors: indirect effects

11.3.26 Significant noise effects on non-residential receptors arising from construction traffic are unlikely to occur in this area.

11.3.27 Cumulative effects from the Proposed Scheme and other committed development.

11.3.28 This assessment has considered the potential cumulative construction noise effects of the proposed scheme and other committed developments[78]. In this area, there are no developments that would be built at the same time as the Proposed Scheme and

[77] E.g. 65 dB LpAeq,0700-2300 during the day.
[78] Refer to Volume 5: Appendix CT-004-000

accordingly, construction noise or vibration from the Proposed Scheme is unlikely to result in any significant cumulative noise effects.

Summary of likely residual significant effects

11.3.29 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[73] residents.

11.3.30 The measures avoid adverse effects from construction noise outdoors on the majority of residential communities. Despite the measures, the adverse effects on the local acoustic character are considered to be significant in the following residential community areas that are closest to the works:

- Cottesmore House (comprising 25 dwellings), Perkins Gardens, West Ruislip;
- Ickenham in the vicinity of The Greenway; and
- South Harefield in the vicinity of Breakspear Road South.

11.3.31 On a reasonable worst-case basis, noise from specific construction activities has been identified as resulting in significant residual temporary effects on the buildings at the Ruislip Golf Club and The Church of Jesus Christ of Latter Day Saints.

11.3.32 Construction traffic on the B467 Swakeleys Road is likely to cause significant noise effects on adjacent residential and non-residential receptors where it passes through Ickenham.

11.3.33 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

[79] The change in noise and vibration effects between the different passenger services is assessed in Volume 1

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.

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
Main line between London and the north	0700 - 2100 hours	18 (14)	320kph

Local assumptions – tunnelled sections

11.4.3 Tunnel portals and ventilation shafts 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

11.4.4 The development of the Proposed Scheme has, as far as reasonably practicable, kept the alignment away from main communities and low in the ground. These avoidance measures have protected many communities from likely significant noise or vibration effects.

Airborne noise

11.4.5 HS2 trains will be quieter than the relevant current European Union specifications. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia. The track will be specified to reduce noise, as will the maintenance regime. Overall these measures would reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on the new track. Further information is provided in Volume 5: Appendix SV-001-000.

11.4.6 To avoid or reduce significant airborne noise effects, the Proposed Scheme incorporates noise barriers in the form of landscape earthworks, noise fence barriers and/or 'low-level' barriers on viaducts and underbridges. Noise barrier locations are shown on Volume 2: Map Book – Sound, noise and vibration Map series SV-05.

[80] For example, HS1 vent shaft fans are tested monthly.

11.4.7 Generally, the assessment has been based on noise barriers having a noise reduction performance equivalent to a noise fence barrier with a top level 3m above the top of the rail, which is acoustically absorbent on the railway side and which is located 5m to the side of the outer rail. In practice, barriers may differ from this description, but will provide the same acoustic performance. For example, where noise barriers are in the form of landscape earthworks they will need to be higher above rail level to achieve similar noise attenuation to a 3m barrier because the crest of the earthwork will be further than 5m from the outer rail.

11.4.8 The Proposed Scheme incorporates 'low-level' noise barriers into the design of viaducts and underbridges. Where needed to avoid or reduce significant airborne noise effects, these barriers are designed to provide noise reduction that is equivalent to a 2m high absorptive noise barrier located on the parapet of the viaduct. Locating these 'low-level' barriers close to the rail also reduces visual impact and limits the mass of the viaduct itself.

11.4.9 The Proposed Scheme also includes a taller, 5m above rail, noise fence barrier on the west side of the route to reduce the adverse effects at Ickenham.

11.4.10 Noise effects are reduced in other locations along the line by landscape earthworks provided to avoid or reduce significant visual effects and engineering structures such as cuttings and safety fences on viaducts and underbridges (where noise barriers are not required).

11.4.11 The location of all barriers is shown on Volume 5: Map Book – Sound, noise and vibration, Map series SV-05.

11.4.12 Tunnel portals will be designed to avoid any significant airborne noise effects caused by the trains entering the tunnel.

11.4.13 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

11.4.14 Significant ground-borne noise or vibration effects at receptors above the tunnels will be avoided through the design of the track and track-bed.

Assessment of impacts and effects

Residential receptors: direct effects –individual dwellings

11.4.15 The mitigation measures will reduce noise and vibration inside all dwellings such that it will not reach a level where it would significantly affect residents.

Residential receptors: direct effects –communities

11.4.16 The mitigation measures in this area will avoid noise adverse effects on the majority of receptors and at the following communities:

- South Ruislip;
- Ruislip Gardens;
- West Ruislip;
- Ickenham (except as noted in Table 18); and
- Newyears Green.

11.4.17 Taking account of the envisaged mitigation, Map Series SV-05 (Volume 2 Map book) 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.

11.4.18 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 Map Series SV-05 (Volume 2 Map Book).

11.4.19 The changes in noise levels are likely to adversely affect the acoustic character of the area such that there is a perceived change in the quality of life. When on a community basis taking account of the local context[83], the direct adverse effects[73] on the areas of the residential communities identified in Table 18 are considered to be significant.

Table 18: Direct adverse effects on residential communities and shared open areas that are considered significant on a community basis

Significant effect number (see Map series SV-05)	Source of significant effect	Time of day	Location and details
OSV06-C01	Airborne noise increase from new train services	Daytime and night-time	Ickenham. Approximately 200 dwellings and associated shared community open areas in the vicinity of the Greenway, Hoylake Crescent, Pynchester Close, Bushey Road and Copthall Road West. Forecast increases in sound due to the railway are likely to cause a moderate adverse effect on the acoustic character of the area around the closest properties. The effect on the acoustic character of residential areas that are located further from the railway would be a minor effect.

[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 provided in SV-001-000 and SV-004-006.

Residential receptors: indirect effects

11.4.20 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

11.4.21 The assessment of operational noise and vibration indicates that significant effects are likely on the non-residential receptors identified in Table 19.

11.4.22 The assessment of effects on non-residential receptors has been undertaken on a worst case basis taking account of public available information about each receptor. Further information can be found in Volume 5: Appendix SV-004-006.

Table 19: Likely significant noise or vibration effects on non-residential receptors arising from operation of the Proposed Scheme

Significant effect number (see Map series SV-05)	Type of significant effect and source	Time of day	Location and details
OSV06-N01	Ground-borne vibration effect[84] inside laboratory buildings due to the operation of train services on surface section of line.	Daytime and night-time	pharmaceutical research facility, west of Breakspear Road South

Non-residential receptors: indirect effects

11.4.23 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

11.4.24 The mitigation measures reduce noise and vibration inside all dwellings such that it does not reach a level where it would significantly affect[73] residents.

11.4.25 The avoidance and mitigation measures in this area will avoid all ground-borne vibration adverse effects[9] and will avoid airborne noise adverse effects[73] on the majority of receptors and communities including their shared open areas.

11.4.26 Taking account of the avoidance and mitigation measures and the local context the residual permanent airborne noise adverse effects on the acoustic character of the community in the north-western edge of Ickenham closest to the route are considered significant on a community basis.

11.4.27 On a worst case basis a significant ground-borne vibration effect has been identified on the pharmaceutical research facility[84], located near Ickenham.

11.4.28 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.

[84] Potential risk of disturbance of any vibration-sensitive research that may be undertaken at these premises. If equipment or operations are vibration sensitive then it is likely that vibration reduction measures are already employed at the facility. This would avoid the significant adverse effect.

The outcome of these activities will be reflected in the Environmental Minimum Requirements.

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 this area.

12.1.2 With regard to traffic and transport, the main issues are increased traffic as a result of construction of the Proposed Scheme, road diversions, temporary road closures, temporary and permanent diversions and realignments or closures of PRoW.

12.1.3 The effects on traffic and transport are assessed in a quantitative fashion, 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 Volume 5 Appendix: TR-001-000, Transport Assessment.

12.1.5 Figure 2 shows the location of the key transport infrastructure in this area. Engagement has been undertaken with the key transport authorities including Transport for London (TfL).

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 and in 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 extends from Raebournmead Drive to the east of South Ruislip station to Harvil Road and it includes the A40, B466 Ickenham Road, B467 Swakeleys Road, Breakspear Road South and the east-west running A40 Western Avenue which forms part of the Transport for London Road Network (TLRN).

12.2.3 A number of transport modelling tools have been used to inform the assessment including TfL's West London Highways Assessment Model (WeLHAM) . The assessment covers the morning (08:00-09:00) and evening (17:00-18:00) peak periods for an average weekday.

12.3 Environmental baseline

Existing baseline

12.3.1 Existing transport conditions have been determined through site visits, specially commissioned transport surveys and liaison with TfL to source transport models, information on public transport, PRoW and accident data.

12.3.2 Traffic data of roads crossing the route or potentially affected was provided through specially commissioned surveys, data from TfL and, where required, WeLHAM model data. The highway peak hours in the study area were 08:00-09:00 and 17:00-18:00.

12.3.3 PRoW surveys were undertaken in August 2012 to establish the nature of the PRoW and their usage by pedestrians and cyclists (non-motorised users). The surveys included all PRoW, footpaths, permissive paths and roads that will be crossed by the route of the Proposed Scheme. The Proposed Scheme affects 12 PRoW in the vicinity of the Proposed Scheme in this area and crosses PRoW in two locations. In general, the surveys recorded very low levels of pedestrian activity over weekday periods, suggesting there were fewer than 10 users per day in every case.

12.3.4 The M25 motorway is located around 4.5km to the west of the study area and the M40 junction 1 lies a little over 2km to the south. East of Junction 1, the M40 becomes the A40 Western Avenue. The strategic roads within the area are busy at peak times and delays can be experienced on the M25, A40 and on the approach to connecting junctions.

12.3.5 The main local roads affected by the Proposed Scheme are Harvil Road and Breakspear Road South which both lead to the A40 via B467 Swakeleys Road, High Road Ickenham, Ickenham Road, High Street, Breakspear Road and Ladygate Lane. Traffic counts and model data suggests that Ickenham Road is the busiest of these roads, followed by Breakspear Road South, Harvil Road and Victoria Road. The majority of the highway network in the area is adjacent to residential areas, with the exception of Breakspear Road South and Harvil Road which are semi-rural in nature.

12.3.6 Safety and accident data has been obtained from TfL for the period from March 2009–March 2012. This has been assessed and no significant accident clusters were identified within the area. Victoria Road adjacent to the South Ruislip vent shaft site has a single daytime bus route (Route 114) between Mill Hill Broadway and Ruislip which runs at a frequency of up to five buses per hour in each direction. The U10 bus route connects Uxbridge, West Ruislip station and Ruislip. There are no bus routes in the Breakspear Road South area and route U9 operates along Harvil Road at a frequency of 3 buses per hour in each direction.

12.3.7 Rail services are accessible via West Ruislip National Rail and London Underground (LU) station located on the B466 Ickenham Road. To the eastern end of the area, South Ruislip National Rail and London Underground station is located on Long Drive/Station approach and Ruislip Gardens Underground station is located on West End Road.

12.3.8 Parking demand surveys suggest that weekday morning peak demand in the South Ruislip area during 09:00-10:00 is over capacity on Victoria Road. Demand for parking at West Ruislip over the same period remained within capacity except for The Greenway which was over-capacity.

12.3.9 A private off-street car park with a capacity for some 190 cars is located within the grounds of the Ruislip Golf Course.

12.3.10 A car park with a capacity for some 130 cars is located at the pharmaceutical research facility, which is located immediately north of the existing Chiltern Main Line railway and on the western side of Breakspear Road South.

12.3.11 There are no footways along the section of Breakspear Road South in the study area and footway provision along Harvil Road is minimal. Footways are provided in the built up areas of Ickenham, Ruislip and West Ruislip.

12.3.12 Ickenham Road has advisory cycle lanes in each direction in the vicinity of the site and mandatory lanes in each direction over the railway bridge. Hill Lane provides cycle access across Ruislip Golf Club via a shared pedestrian and cycle path.

12.3.13 There are no navigable waterways in the area and consequently they are not considered further in this assessment.

Future baseline

12.3.14 The forecast future baseline traffic volumes have been incorporated within the WeLHAM model for the future construction and operational years of 2021, 2026 and 2041 and include allowance for planned growth based on the London Plan, including any major locally consented schemes. No other changes to the traffic and transport baseline are anticipated in this area.

Construction

12.3.15 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 typically 2.5-3.0% by 2021 compared to 2012.

Operation (2026)

12.3.16 Future baseline traffic volumes in the peak hours are forecast to grow by typically 4.5-5.5% by 2026 compared to 2012.

Operation (2041)

12.3.17 Future baseline traffic volumes in the peak hours are forecast to grow by typically 8.5-9.5% 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 2.3) have been included as part of the design of the Proposed Scheme and will avoid or reduce effects on transport users:

- limiting road closures for the establishment of site accesses and road construction to overnight and/or weekends wherever reasonably practicable

including maintaining a limited traffic flow (e.g. through one-way or shuttle working);

- HGVs will be routed as far as reasonably practicable along the strategic road network and using designated routes for access, as shown in Map TR-03-009 (Volume 5, Map Book, Traffic and transport);
- use of a railhead for the removal of excavated material and delivery of railway installations materials;
- removal of excavated material by conveyor from the tunnels to the West Ruislip railhead;
- provision of sustainable placement sites within this area and CFA7 to substantially reduce HGV movements on local roads;
- movement of surplus excavated material to the sustainable placement sites along purpose built haul routes; and
- the provision of alternative pedestrian and cycle routes during temporary PRoW closures.

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.

12.4.4 The measures in the draft CoCP will 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 construction of the Proposed Scheme on or adjacent to public roads, footways 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

[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.

Saturdays, with tunnelling activities occurring on a 24 hour a day basis during the construction period, although this will not affect vehicle movements on local roads outside the core hours. Site staff and workers will therefore generally arrive before the morning peak hour and depart after the evening peak hour (although the assessment has assumed that some work journeys to construction sites will take place within the morning and evening peak hours which is a reasonable worst case scenario) (draft CoCP, Section 5); and

- excavated material will be reused wherever reasonably practicable along the alignment of the Proposed Scheme which is expected to reduce the effects of construction vehicles on the public highway (draft CoCP, Section 15).

Assessment of impacts and effects

12.4.6 The following section considers the impacts on traffic and transport and the consequential effects resulting from construction of the Proposed Scheme.

12.4.7 The temporary traffic and transport impacts within this area are expected to be:

- construction vehicle movements to/from the construction compounds;
- partial road closures and associated traffic management related to utilities diversions and bridge reconstruction works in the area;
- removal of private off-street parking; and
- PRoW diversions.

12.4.8 The key construction activities will include bridge replacement works, construction of a vent shaft and a tunnel portal. 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.

12.4.9 Details of construction compounds are provided in Section 2.3. The estimated duration of when there will be busy transport activity at each site is shown in Table 20.

12.4.10 This represents the periods when the construction traffic flows are expected to be greater than 50% of the peak flows. Also shown is the estimated number of daily vehicle trips during the peak month of activity, the lower end of the range shows the average number of trips in the busy period and the upper end 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 20: Typical vehicle trip generation for construction compounds in this area

Compound type	Location	Access to/from compound	Indicative start / set up date	Estimated duration of use (years)	Estimated duration with busy vehicle movements (years)	Typical daily number of combined two way trips	
						Cars/ LGVs	HGVs
Main compound and facilities	South Ruislip vent shaft	Victoria Road	2018	6 years	2 years	10-20	90-100
Main compound and facilities	Northolt tunnel and earthworks (including Gatemead embankment works)	Harvil Road	2017	10 years	1 year	102 - 136	1,020-1,360
Satellite compound and facilities	Breakspear Road (including West Ruislip embankment works)	Breakspear Road South	2017	18 months	6 months	15-20	150-200
Satellite compound and facilities	Harvil Road realignment	Harvil Road	2017	5 years	1 year	8-10	75-100
Satellite compound and facilities	West Ruislip portal	Ickenham Road / Hill Lane	2017	7 years	1 year 6 months	22-30	225-300

12.4.11 Details of the construction phasing are provided in Section 2.3. Construction phasing of works will mean that not all the movements shown in Table 20 will occur at the same time and the programme of peak construction works at each site will in practice not be simultaneous.

12.4.12 In order to ensure the different combinations of road closures and construction activity and, in particular, interactions with other areas were fully assessed, two distinct temporal phases were considered. A first scenario (late 2017-early 2018) with major mass haul underway but railheads at Willesden in CFA4 and Harvil Road not yet fully operational and Old Oak Common Lane, also in CFA4 still open; and a second scenario (2023/2024) with railheads operational but Old Oak Common Lane closed. Analysis identified that these different scenarios resulted in very similar impacts within this area, although the impacts in CFA4 did change. Given this, this following assessment does not separately identify impacts from the two scenarios.

12.4.13 Access to the compounds will include:

- South Ruislip vent shaft: no changes to the existing highway network in Victoria Road;
- West Ruislip portal: new site access constructed on Ickenham Road for HGVs to access the compound directly from Ickenham Road. Access for other

vehicles from Ickenham Road and Hill Lane via the grounds of Ruislip Golf Club – both are expected to need to be signalised; and

- Breakspear Road: access from the A40 Western Avenue, Swakeleys Road and Breakspear Road South, passing under the Chiltern Railway underbridge (headroom 4.4m).

12.4.14 Harvil Road will be realigned to accommodate the Proposed Scheme and require three new bridges and will provide a more direct alignment.

12.4.15 For the busiest month construction traffic associated with the Northolt tunnel and earthworks are expected to generate around 1,360 combined two-way trips per day, which will be mostly HGVs.

12.4.16 Levels of traffic generated by construction activities at the proposed South Ruislip vent shaft site throughout the construction period are not expected to exceed 100 HGV combined two way trips per day.

12.4.17 It is envisaged that the A40/M40 and M25 will provide the primary HGV access routes.

12.4.18 Most HGV movements associated with the compounds in the Breakspear Road South area will be to and from the A40. There will also be movements crossing Newyears Green Lane between the areas of the main Northolt tunnel and earthworks site to the north and south of the road, with peak movements of around 660 combined two way HGV trips per day. With the low levels of baseline traffic on Newyears Green Lane, the effect of these crossing movements on delays and congestion will not be significant.

12.4.19 Utilities works (including diversions) have been considered in detail where works are expected to be major and where the traffic and transport impacts from the works separately or in combination with other works, is greater than other construction activities arising within the area. More minor utilities works and associated traffic management measures are expected to result in only localised traffic and pedestrian impacts and be of short duration. They are not expected to result in significant additional adverse effects.

12.4.20 Construction of the Proposed Scheme will result in changes in traffic flows and delays to vehicle users primarily due to construction vehicles accessing compounds. Changes in traffic flows will lead to an increase in delay and congestion[86] to vehicle users in the following locations:

- B467 Swakeleys Road/Harvil Road – moderate adverse effect;
- B467 Swakeleys Road/Woodstock Drive – minor adverse effect; and

[86] In assessing significant effects of traffic changes on congestion and delays, a major adverse effect occurs where traffic flows at a junction 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 at a junction 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 at a junction 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.

- Swakeleys Roundabout (A40 junction) – moderate adverse effect.

12.4.21 Construction of the Proposed Scheme is forecast to result in increases in daily traffic flow (HGV or all traffic) causing a significant increase in traffic related severance[87] in the following locations in scenarios CW1 and CW2:

- B467 Swakeleys Road – major adverse effect (HGV);
- Ickenham Road – major adverse effect (HGV);
- Breakspear Road South – major adverse effect (HGV);
- Harvil Road – major adverse effect (HGV);
- Swakeleys Drive/Woodstock Drive – moderate adverse effect (all traffic);
- Swakeleys Roundabout (A40 junction) – major adverse effect (HGV);
- Ladygate Lane – major adverse effect (HGV);
- A40 eastbound off-slip to Swakeleys Roundabout – major adverse effect (HGV); and
- A40 westbound on-slip from Swakeleys Roundabout – major adverse effect (HGV).

12.4.22 The use of Ruislip Golf Club for access during the construction phase will entail the loss of around 45 private off street parking spaces and will constitute a moderate adverse effect.

12.4.23 There will be a permanent loss of parking at the pharmaceutical research facility, which is reported in Section 12.5 under operations effects.

12.4.24 The effect on accident and safety risks will not be significant. There are no locations where there are existing highway safety issues which will be subject to substantial increases in traffic during construction.

12.4.25 Construction activity is not expected to impact on passenger interchange at any local rail station.

12.4.26 Apart from the general impact of congestion, the Proposed Scheme will have little impact on bus routes, as full road closures are not expected. Any delays resulting from partial road closures are expected to be not significant.

Cumulative effects

12.4.27 The assessment includes the cumulative effects of planned development during construction by taking this into account within the background traffic growth.

[87] 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.

12.4.28 The assessment also includes in-combination effects by taking into account traffic and transport impacts of works being undertaken in CFA4. Specifically, the assessment includes the impact of works in CFA4 but these are confined to a small increase in traffic on the M40 / A40 Western Avenue.

Permanent effects

12.4.29 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

12.4.30 The implementation of the draft CoCP (see Volume 5: Appendix CT-003-000) in combination with the framework travel plan and 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, which will mean that the adverse effects may be over-stated.

12.4.31 Based on the outcomes of this assessment, no further traffic and transport mitigation measures during construction of the Proposed Scheme are considered necessary.

Summary of likely significant residual effects

12.4.32 During construction of the proposed scheme, there will be increases in traffic flows on local roads in the area due to construction traffic accessing the site compounds. Changes in traffic flows will lead to congestion, increasing delays at: B467 Swakeleys Road/Harvil Road; B467 Swakeleys Road/Woodstock Drive and Swakeleys Roundabout (A40 Junction).

12.4.33 Changes in traffic flows will affect non-motorised users, making it more difficult to cross the road at: B467 Swakeleys Road; Ickenham Road; Breakspear Road South; Harvil Road; Swakeleys Drive/Woodstock Drive; Swakeleys Roundabout (A40 junction); Ladygate Lane; A40 eastbound off-slip to Swakeleys Roundabout and A40 westbound on-slip from Swakeleys Roundabout.

12.4.34 There will be a temporary loss of private off-street parking provision at Ruislip Golf Course.

12.4.35 There will be temporary closures with associated local diversions of 10 PRoW (Footpaths U36, U37, U38, U43, U45, U46, U47, U49, U81 and an unrecorded section of The Celandine Route Footpath) and a single Bridleway (U42) in the area.

12.4.36 The significant effects that result from construction of the Proposed Scheme are shown in Map TR-03-009 (Volume 5, Map Book, Traffic and transport).

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:

- a new road alignment at Harvil Road that creates a more direct road alignment;
- reconstructed railway underbridge over Breakspear Road South with improved headroom; and
- pedestrian and equestrian links will generally be reinstated, except where permanent realignment is necessary.

Assessment of impacts and effects

12.5.2 The following section considers the impacts on traffic and transport and the consequential effects resulting from the operational phase of the Proposed Scheme (as described in Section 2.4 of this report).

12.5.3 The operational traffic and transport related impacts during operation of the Proposed Scheme will be:

- loss of parking; and
- realignment of PRoW.

12.5.4 Occasional servicing traffic will access areas of the Proposed Scheme for maintenance purposes but this traffic is expected to be infrequent and small in comparison to general traffic flows. The route passes through the area on bridge and embankment structures and there will be no stations or depots that generate any additional traffic. No other changes in traffic are expected and traffic flows in both 2026 and 2041 are expected to be the same with the Proposed Scheme as in the future baseline and there will be no significant effects of traffic flows.

12.5.5 The new, more direct alignment of Harvil Road will reduce the journey distance by around 0.4km and will be a minor beneficial effect. The improved headroom at Breakspear Road South as it passes under the rail lines will provide potential benefits but these are not considered significant.

12.5.6 The Proposed Scheme will require the realignment of three PRoW:

- Bridleway U42 from west side of Breakspear Road South connecting to Newyears Green Lane – 145m diversion (minor adverse effect);
- Footpath U46 from east side of Breakspear Road South connecting with Footpath U45 and U47 – 25m diversion (not significant); and
- Footpath U81 from north side of The Greenway to Footpath R146 in Ruislip Golf Course – 140m diversion (minor adverse effect).

12.5.7 The Proposed Scheme will require the permanent loss of around 90 off-street parking spaces at the pharmaceutical research facility, which will be a moderate adverse effect.

12.5.8 The effects in 2041 will be the same as those 2026.

Cumulative effects

12.5.9 The assessment includes the cumulative effects of planned development during operation by taking this into account within the background traffic growth.

12.5.10 The assessment also considers in-combination effects by taking into account transport impacts as a result of the Proposed Scheme in neighbouring areas. Specifically, the assessment includes the effects of traffic accessing the Old Oak Common Station in CFA4 but these effects are small and confined to an increase in traffic on the A40 Western Avenue.

Other mitigation measures

12.5.11 No further mitigation measures for the operation of the Proposed Scheme are considered necessary based on the outcomes of this assessment.

Summary of likely significant residual effects

12.5.12 Upon opening of the Proposed Scheme in 2026, traffic and highway conditions are expected to return to their pre-construction conditions. There will be a small improvement in journey times on Harvil Road.

12.5.13 Pedestrian and equestrian links will be reinstated but there will be a significant increase in travel distance for two PRoW (U42 and U81).

12.5.14 There will be a permanent loss of parking at the pharmaceutical research facility. The significant effects that result in this area from the Proposed Scheme in 2026 and 2041 are shown in Map TR-04-009 (Volume 5, Map Book, Traffic and Transport)

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 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 Yeading Brook (east and west arms), the River Pinn, Newyears Green Bourne which are all main rivers;
- the Ickenham Stream, which is a main river south of the existing Chiltern Main Line and was originally constructed as a feeder for the Grand Union Canal. It is referred to elsewhere as the 'canal feeder';
- the Chalk Principal aquifer and the Lambeth Group Secondary A aquifer; and
- one licensed groundwater abstraction for public water supplies (PWS) which has an associated Source Protection Zone (SPZ) within 1km of the route. This abstracts water from the Chalk aquifer.

13.1.3 Key environmental issues relating to water resources and flood risk include:

- channel diversions on the Ickenham Stream and the Newyears Green Bourne;
- the potential impact to groundwater flows as a result of construction of the tunnel and associated underground structures;
- the potential for impacting groundwater quality in the Chalk aquifer as a result of construction activities associated with underground structures such as tunnelling, piling and retaining walls;
- the route will pass through SPZ1 and thus there is potential for an impact on the abstraction used for public water supplies;
- potential for an increased risk of flooding from the Yeading Brook, Ickenham Stream, River Pinn and Newyears Green Bourne; and
- potential for an increased risk of surface water and groundwater flooding.

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] (WFD) compliance assessment; and
- a route-wide Flood Risk Assessment (FRA).

13.1.5 Detailed reports on water resources and flood risk within this area are also contained in the Volume 5 Appendices. These include:

- Appendix WR-002-006: Water Resources Assessment report; and
- Appendix WR-003-006: Flood Risk Assessment.

13.1.6 Map series WR-01-007 to WR-03-007 showing some of the details, environmental baseline and design features referred to in this report and those in Volume 5 are all contained in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

13.1.7 Where there is a residual impact to water resources and following mitigation there is a consequent effect on ecology, this is discussed further in Section 7 (Ecology) of this report.

13.1.8 Discussions have been undertaken and will continue, with the Environment Agency and Affinity Water[89], with regard to the PWS abstractions and the water resources management plan within this and adjacent areas (CFA7 and CFA8).

13.2 Scope, assumptions and limitations

13.2.1 The assessment scope, key assumptions and limitations for the water resources and flood risk assessment are set out in Volume 1 and in the SMR and its addendum and appendices presented in Volume 5 (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 undertaken at the following locations along the route:

- the proposed River Pinn crossing;

[88] Water Framework Directive – 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, Strasbourg, European Parliament and European Council
[89] Affinity Water Limited

- the Ickenham Stream; and
- the Newyears Green Bourne at Harvil Road.

13.2.4 WFD classification data has been made available by the Environment Agency. For water bodies that do not have a WFD status class shown in the relevant River Basin Management Plan (RBMP) the status class for those water courses 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'.

13.2.5 The assessment uses existing data with regard to groundwater levels. No monitoring of groundwater levels has been undertaken as part of this assessment. Groundwater level data includes information received from the Environment Agency and Affinity Water. Maximum groundwater levels have been used, where appropriate, to provide an indication of the potential impact from the Proposed Scheme. In general, maximum groundwater levels were observed in most locations in early 2001, as stated in the baseline discussion.

13.2.6 There is little data available regarding existing groundwater quality, although the assessment for this area considers any degradation in water quality rather than absolute water chemistry conditions.

13.2.7 The exact tunnelling method has not been selected, however, it is assumed for the purpose of assessment that the tunnel boring machine will be operated in a closed face mode when tunnelling within water bearing strata and the tunnel lining will be designed to reduce leakage rates to a minimum, thereby minimising the requirements for dewatering and drainage.

13.2.8 The Flood Zone Maps and existing hydraulic modelling made available from the Environment Agency have been used for the assessment of flood risk from rivers. The limitations associated with flood risk within this study area are described in detail in the flood risk assessment in Volume 5: Appendix WR-003-006.

13.3 Environmental baseline

Existing baseline – surface water resources

Surface water features

13.3.1 The water bodies within this area are the Yeading Brook, a tributary of the River Crane and a feeder to the Grand Union Canal and the River Pinn that is a tributary of the River Colne. Both catchments fall within the Thames River Basin District (RBD) as set out within the RBMP[90].

[90] Environment Agency (2009) River Basin Management Plan, Thames River Basin District.

13.3.2 Map WR-01-007 (Volume 5, Water Resources and Flood Risk Assessment Map Book) shows the current surface water baseline and all surface water features within the study area are assessed within Volume 5: Appendix WR-002-006. Table 21 includes features potentially affected by the Proposed Scheme.

Table 21: Summary of surface water features potentially affected by the Proposed Scheme

Water feature	**Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book map reference)**	**Watercourse classification[91]**	**WFD water body and current overall status**	**WFD status objective (by 2027 as in RBMP)**	**Receptor value[92]**
One small pond	Lord Halsbury Memorial Playing Fields (CFA06-P01)	Not applicable	Not applicable	Not applicable	Low
Yeading Brook (East Arm)	South-east of South Ruislip Station (SWC-CFA6-01)	Main river	Yeading Brook (East Arm) GB106039023050 Moderate	Good Potential	High
Two drains and one small pond	Recreation ground at Ruislip Manor (CFA06-P02)	Ordinary watercourse	No status class shown in RBMP – assumed status Moderate	No status class shown in RBMP – assumed status Good Potential	Moderate
Yeading Brook (West Arm)	North-west of South Ruislip Station (SWC-CFA6-04 and 05)	Main river	Yeading Brook (West Arm) GB106039023060 Moderate	Good Potential	High
One small pond and drains	Ruislip Golf Course (SWC-CFA6-06) (CFA06-P05)	Not applicable	No status class shown in RBMP – assumed status Moderate	No status class shown in RBMP – assumed status Good Potential	Moderate
Ickenham Stream and tributary	Ruislip Golf Course (SWC-CFA6-03 and 07)	Main river (south of existing rail line) Ordinary watercourse (north of the rail line)	No status class shown in RBMP – assumed status Moderate	No status class shown in RBMP – assumed status Good Potential	Moderate

[91] Water-feature classifications: Section 113 of the Water Resources Act 1991 defines a Main river as a watercourse that is shown as such on a Main river map. Section 72 of the Land Drainage Act 1991 defines an Ordinary watercourse as "a watercourse that is not part of a Main river". Section 221 of the Water Resources Act 1991 defines a watercourse as including " 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 on the Main river map and are regulated by the Environment Agency.

[92] For examples of receptor value see Table 43 in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book map reference)	Watercourse classification[91]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[92]
River Pinn	West of Ruislip Golf Course (SWC-CFA6-02)	Main river	Pinn GB106039023070 Moderate	Good Potential	High
Small drain and pond	South-east of Newyears Green covert. (SWC-CFA6-08 and 09)	Not applicable	Not applicable	Not applicable	Low
Nine ponds, generally very small and isolated in fields	Individual ponds located in arc from west of Newyears Green north around to St Leonards Farm, the largest is associated with drainage from an industrial composting site. (CFA06-P06)	Not applicable	Not applicable	Not applicable	Low
Newyears Green Bourne	North-west of Newyears Green Covert (SWC-CFA6-10)	Main river	No status class shown in RBMP – assumed status Poor	No status class shown in RBMP – assumed status Good Potential	Moderate

Water Framework Directive status

13.3.3 The Environment Agency have assessed the current status and predicted overall quality under the WFD for the following water bodies in the study area:

- the River Pinn and the Yeading Brook East and West Arms are classified as heavily modified water bodies with a current overall WFD status of Moderate, with an objective of Good Potential by 2027;
- the Ickenham Stream is not classified by the Environment Agency under the WFD and enters Yeading Brook (West Arm) at North Hillingdon and therefore assumes the Moderate status of the Yeading Brook (West Arm); and
- the Newyears Green Bourne is also not classified by the Environment Agency under the WFD. The Newyears Green Bourne enters Harefield No. 2 Lake, one of the Colne Valley lakes in the adjacent area. The Newyears Green Bourne therefore assumes the Poor Status of the River Colne. See CFA7, Volume 2 Report, Section 13 for assessment relating to this section of the watercourse.

Abstractions and permitted discharges

13.3.4 There are no licensed surface water abstractions within 1km of the route in the study area[93]. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

13.3.5 The Environment Agency reports that there are 20 current consented surface water discharges within 1km of the route in the study area (see Volume 5, Appendix WR-002-006).

Existing baseline – groundwater resources

Geology and Hydrogeology

13.3.6 The location of private abstractions, geological formations and indicative groundwater levels are shown on Map WR-02-006 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.7 The geological formations within this area are described further, with a schematic geological cross-section in Volume 5: Appendix WR-002-006.

13.3.8 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 22. Unless otherwise stated, the geological groups listed are all crossed by the route.

Table 22: Summary of geology and hydrogeology in the study area

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Superficial deposits						
Alluvium	Restricted to the base of the valley of the River Pinn.	Mainly sand, silt and clay.	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Bedrock						
Thames Group (London Clay Formation)	Across entire area, with the exception of the valley of the River Pinn and the Yeading Brook.	Stiff grey heterogeneous clay.	Unproductive Strata	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low

[93] Surface water abstractions for public supply are not included.

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Lambeth Group (Harwich, Reading and Woolwich Formations	Assumed to underlie London Clay Formation throughout this area apart from in the valley of the River Pinn and the Yeading Brook, where the Lambeth Group crops out at the surface.	Lenses and interbedded layers of clay, silty sand and shelly silty clay at the top, sand and gravel towards the base.	Unproductive (top) / Secondary A (base)	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low/ Moderate
Cretaceous Chalk Group (White Chalk Subgroup)	Underlies the Lambeth Group throughout the area (not penetrated by route).	Firm white chalk with marl seams and flint bands.	Principal	Mid Chilterns Chalk GB40601G601200 Poor	Good	High/Very High (where route crosses SPZ1)

Superficial deposits

13.3.9 A cover of made ground may be present due to the presence of an existing rail corridor (comprising track-bed materials and existing embankments) as well as previous cycles of development along the edge of the railway.

13.3.10 Superficial deposits are present at the western end of this section of the Proposed Scheme and comprise a narrow ribbon of alluvium associated with the River Pinn.

Bedrock aquifers

13.3.11 The bedrock geology comprises an outcrop of the Lambeth Group present to the north of the route at Ruislip Gardens Station and also approximately 200m either side of the River Pinn. In this area it is described as mottled sandy clay and clayey sand. The bedrock geology underlying the remainder of the study area is the London Clay Formation. The Lambeth Group is directly underlain by the Cretaceous Chalk Group in this area.

13.3.12 Groundwater level data for the Chalk indicates the Chalk groundwater is under pressure or 'confined' beneath the overlying formations. Groundwater flow within the Chalk is generally towards the east and south-east and this is reflected in the groundwater level data which indicates that water levels decline from north-west to south-east.

13.3.13 Environment Agency borehole monitoring data from a monitoring location near Perivale Wood in CFA5 indicates that groundwater levels have been rising since the records began in January 1989. The minimum groundwater level was recorded in May 1989 at -3m AOD, with the maximum groundwater level as approximately 17m AOD in April 2012 which is the latest date for which data are available at this location. In general, the seasonal variations in groundwater elevation are around 0.5m. Groundwater levels appear to be stabilising at around 17m AOD. Monitoring data available from a location near Denham are more representative of the general trend in this area and do not show the continuously rising trend but fluctuate seasonally. The maximum groundwater level was recorded in early 2001. Further details are provided in Volume 5: Appendix WR-002-006.

13.3.14 These water levels indicate that the Proposed Scheme (in the tunnel section) is below the groundwater level for the majority of the route from the CFA5/6 boundary to the West Ruislip portal. At the West Ruislip portal the elevation of the Proposed Scheme rises out of tunnel and above the maximum recorded groundwater levels. This interchange between the parts of the route below and above the water level is unlikely to be significantly different during periods of minimum groundwater levels.

13.3.15 LBH report[94] states that there is an area of groundwater contamination in the Chalk aquifer associated with a closed landfill north of the route near Ickenham at the former Newyears Green Lane landfill site. The spatial extent of groundwater contamination indicates that the direction of groundwater flow may have been towards the south-west locally.

Water Framework Directive status

13.3.16 No WFD classification has been given to the superficial deposits.

13.3.17 The Environment Agency has classified the overall WFD status of the Mid Chilterns Chalk groundwater body as Poor with an objective to achieve Good Status by 2027.

Abstractions and permitted discharges

13.3.18 The Environment Agency reports that there is one PWS abstraction with a Source Protection Zones (SPZ) in this area (refer to Map WR-02-006, Volume 5, Water Resources and Flood Risk Assessment Map Book for locations of the SPZ) as discussed in more detail in Volume 5: Appendix WR-002-006. The route will pass through the SPZ1[95].

13.3.19 The Environment Agency reports that there are two private licensed abstractions within this area as set out in Volume 5: Appendix WR-002-006.

[94] London Borough of Hillingdon (2011). Environmental Protection Act 1990, Part 2A – Section 78B, Record of Determination of the Land at the Former Landfill Site at Newyears Green Lane, Harefield, Middlesex

[95] This source is currently not operational but has been included as a precautionary assessment.

13.3.20 No data on unlicensed abstractions has been provided by the LBH. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

Surface water/groundwater interaction

13.3.21 There are no springs and seepages shown on ordnance survey maps within this area.

13.3.22 It is likely that limited shallow groundwater will be present in the superficial Alluvium deposits. The shallow groundwater in the Alluvium is considered likely to be in hydraulic connectivity to surface water in the River Pinn.

Water dependent habitats

13.3.23 The route will not cross any areas with statutory ecological designations in relation to surface water or groundwater.

Existing baseline – flood risk

River flooding

13.3.24 The agreed data set for river flooding is the Environment Agency Flood Zone Mapping (see Map WR-01-007, Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.25 The Proposed Scheme will cross the floodplain of both arms of the Yeading Brook, the Ickenham Stream, the River Pinn and the Newyears Green Bourne.

13.3.26 Environment Agency records show historic flooding within the study area, predominantly along the River Pinn (Map WR-01-007 in Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.27 The Yeading Brook is a small heavily urbanised watercourse that rises in North Harrow and is a tributary of the River Crane. In the upper reaches, the Yeading Brook is comprised of two arms, which converge to the immediate south of RAF Northolt. The route will cross both branches to the south-east (Map WR-01-007 SWC-CFA6-01) and north-west (Map WR-01-007 SWC-CFA6-04 and 05) of South Ruislip Station. However, the route will be in tunnel beneath the crossings of both arms of the Yeading Brook. The South Ruislip vent shaft will be located between these two arms outside of the floodplain. There will be no above ground infrastructure that could affect the risk of flooding from rivers at this location. Therefore the Yeading Brook is not considered in further detail in the ES.

13.3.28 The Ickenham Stream (Map WR-01-007 SWC-CFA6-03 and 07) was originally constructed as a feeder for the Grand Union Canal from Ruislip Lido and is shown to flow through Ruislip Golf Course. It is no longer used as an active canal feeder from Ruislip Lido. Within the golf course, the Ickenham Stream has been integrated into the land drainage features. During a walkover survey for this assessment it was observed to flow towards the River Pinn to the north and west. To the south of the

existing Chiltern Main Line railway the Ickenham Stream becomes a designated Main River and, after approximately 100m, the watercourse flows in a southerly direction to the Yeading Brook and Grand Union Canal. The route will be in retained cutting at this location and will not cross the floodplain of the Ickenham Stream, as this is shown to commence immediately to the south of the existing railway embankment.

13.3.29 The River Pinn, to the west of Ruislip Golf Course (Map WR-01-007 SWC-CFA6-02), has a catchment size of 29km² at the location of the proposed crossing. The route will be above ground and will cross approximately 180m of Flood Zone 3 perpendicular to the natural flow direction.

13.3.30 The Newyears Green Bourne, to the south of Highway Farm (Map WR-01-007 SWC-CFA6-10) has an upstream catchment size of 5km² at the location of the proposed crossing of the Harvil Road diversion. The realignment of Harvil Road to a raised bridge structure will cross approximately 70m of Flood Zone 3 perpendicular to the natural flow direction.

Surface water flooding

13.3.31 The agreed data set for surface water flooding is the Environment Agency Flood Map for Surface Water (FMfSW)[96].

13.3.32 According to surface water flood risk datasets, parts of this study area have a high risk of surface water flooding for both the 1 in 30 annual probability (3.33%) and 1 in 200 annual probability (0.5%) rainfall events. As the Proposed Scheme is within tunnel for some of this area, the surface water flood risk has only been considered where there will be above-ground construction.

13.3.33 The areas currently at risk of surface water flooding close to above-ground infrastructure are isolated topographic depressions in South Ruislip, Ruislip Golf Course and the track beds of the Chiltern Main Line close to Copthall Covert.

Sewer flooding

13.3.34 The agreed data sets for sewer flooding are the LBH[97] Preliminary Flood Risk Assessment (PFRA) and the LBH Strategic Flood Risk Assessment (SFRA)[98].

13.3.35 According to the LBH SFRA, a total of 164 properties have flooded in the borough from overloaded sewers in the past ten years, 63 from foul water drainage systems, 93 from surface water sewers and eight properties are affected by flooding from combined systems. Those areas with the highest frequency of sewer flooding incidents are located where the route will be in tunnel with no above ground works or potential water ingress points.

[96] Environment Agency (2010) Flood Map for Surface Water (FMfSW): http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/dataLayers_FMSW.xml. Accessed 1 February 2013.
[97] Capita Symonds (2011), *London Borough of Hillingdon Preliminary Flood Risk Assessment.*
[98] Scott Wilson (2008), *London Borough of Hillingdon Strategic Flood Risk Assessment.*

Artificial water bodies

13.3.36 The agreed data set for flooding from artificial water bodies is the Environment Agency Reservoir Inundation Map[99].

13.3.37 There is one artificial water body that is listed in the Environment Agency Reservoir Inundation Map as posing a flood risk within this area. After the proposed route exits the West Ruislip portal it will cross an area with a residual risk of flooding from Ruislip Lido. This reservoir historically fed the Grand Union Canal and is owned and maintained by LBH.

13.3.38 The mapping indicates that in the event of a catastrophic failure of Ruislip Lido, the flood waters will follow the course of the River Pinn (Map WR-01-007 SWC-CFA6-02) and not the Ickenham Stream.

13.3.39 The Environment Agency Reservoir Inundation Map shows the largest area that might be flooded if a reservoir were to fail. The extent of inundation within the floodplain of the River Pinn will be similar to the 1 in 100 annual probability of river flooding (1%) including an allowance for climate change. However, the data provided does not indicate flood depths, flow velocities or the time taken for onset of flooding after a breach takes place.

13.3.40 The likelihood of reservoir failure is extremely low and is therefore not considered within this assessment.

Groundwater flooding

13.3.41 The agreed data set for groundwater flooding is the LBH PFRA.

13.3.42 The LBH PFRA identifies two historical incidents of groundwater flooding within the study area. One location is identified from Environment Agency records within the Herlwyn Avenue estate to the north of the Proposed Scheme where it is in tunnel and one from other records close to West Ruislip Station to the east of the West Ruislip portal.

13.3.43 The LBH PFRA shows isolated areas at the River Pinn and at Ruislip London Underground Depot to have an increased potential for elevated groundwater in the permeable superficial deposits.

Future baseline

13.3.44 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 baseline for the operation of the Proposed Scheme. The potential cumulative effects arising from

[99] Environment Agency (2012) Reservoir Inundation Map: http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=reservoir#x=485528&y=240060&lg=1,&scale=10. Accessed: 1 February 2013.

committed developments 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.

13.3.45 All developments are required to comply with the National Planning Policy Framework (NPPF)[100], development plans and other legislation and guidance. As such committed developments should have a neutral effect on the water resources and flood risk baseline.

13.3.46 WFD future status objectives are set out in Table 21 and Table 21. These are not considered to result in the reported effects from the Proposed Scheme changing in significance.

Climate change

13.3.47 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 the reported effects from the Proposed Scheme changing in significance.

13.3.48 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 flood events are expected to increase, potentially causing greater depths and extents of flooding.

13.3.49 When considering the influence that climate change may have on the future baseline, against which the 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. The sensitivity testing undertaken allows for variations in climate change factors included in other national guidance.

13.3.50 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.

[100] Department for Communities and Local Government, (2012), National Planning Policy Framework Technical Guidance

13.4.2 The following are examples of avoidance and mitigation measures that will reduce potential adverse effects on surface water and flood risk. Further details are given in Volume 5: Appendix WR-002-006 and WR-003-006.The following measures will reduce potential impacts to surface water that could arise from construction.

13.4.3 The detailed design of all watercourse realignments and crossings will be completed in consultation with the Environment Agency to meet their objectives with respect to hydraulic capacity, flood risk, ecology and hydromorphology. Where culverts are required these will be kept as short as possible. Where reasonably practicable, the permanent channel realignments will be constructed in advance of other activities associated with the construction of the Proposed Scheme. The consideration will be given at detailed design to features that are aligned with the objectives of the WFD (for example use of soft engineering solutions, aquatic marginal planting and the inclusion of natural forms) and will ensure that the channels and structures are sufficiently sized to avoid a permanent impact on flow. The surface water crossings at the Harvil Road crossing of the Newyears Green Bourne, Map WR-01-18, SWC-CFA06-10) will be dealt with in this way, as discussed further in Volume 5: Appendix WR-002-006.

13.4.4 Drainage from the Proposed Scheme has been designed to reduce the rate and volume of run-off in order to prevent an increase in flood risk. Drainage, including drainage from associated access roads and hard standings, will discharge, to sustainable drainage systems (SuDS) balancing ponds, prior to subsequent discharge to watercourses or if necessary in sewer. 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, shown on Maps CT-06-015 to CT-06-019 (Volume 2, CFA6 Map Book), will be designed where practicable to discharge at existing run-off rates and will accommodate for events up and including the 1 in 100 annual probability (1%) including an allowance for climate change.

13.4.5 The Proposed Scheme includes a substantial area for sustainable placement to the north of Newyears Green Lane. In this area there are four ponds (Map WR-01-007 CFA06-P06) which are within the land required for construction of the Proposed Scheme. The largest pond is within the grounds of a large industrial-scale composting site and is likely to be part of the drainage arrangements for the site. The other three ponds are small isolated ponds in the edge of fields. Aerial photographs show these are largely overgrown with vegetation. Ecological mitigation ponds will replace those lost, as shown on Maps CT-06-016 to CT-06-019 (Volume 2, CFA6 Map Book) and discussed further in Section 7, Ecology.

13.4.6 The following measure will reduce potential impacts to groundwater that could arise from construction.

13.4.7 The TBM will be operated in a closed face mode when tunnelling within water bearing strata and the tunnel lining will be designed to reduce leakage rates to a minimum, thereby reducing the requirements for dewatering and drainage.

13.4.8 The following measures will reduce potential impacts on flood risk elsewhere that could arise from construction.

13.4.9 Where there is an existing susceptibility to groundwater flooding, the Proposed Scheme will be in tunnel (Ruislip London Underground Depot) or on a bridge (River Pinn). There are no anticipated effects to groundwater from the tunnel at Ruislip London Underground Depot. Therefore the Proposed Scheme will not have a significant effect on the risk of groundwater flooding in CFA6. Volume 5: Appendix WR-002-006 contains further details.

13.4.10 Replacement floodplain storage areas will be provided at the edge of the River Pinn and Newyears Green Bourne floodplains to mitigate loss of floodplain storage resulting from permanent structures in the floodplain such as the embankments on the approach to the River Pinn underbridge and the Harvil Road overbridge, as shown on Map CT-06-18 and CT-06-19 (Volume 2, CFA6 Map Book). The replacement floodplain storage will mitigate for temporary loss of floodplain storage resulting from the construction works in the floodplain.

13.4.11 The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme (see Volume 5: Appendix CT-003-000). These will provide effective management and control of the impacts during the construction period.

13.4.12 With regard to surface water, Section 16 of the draft CoCP stipulates that works in or near the watercourses at the crossings of the River Pinn and Newyears Green Bourne will be designed in consultation with the Environment Agency so that sediment mobilisation is managed, the potential for contamination from fuel spills is minimised and the works are timed to minimise the impact on water quality and water dependent habitats and species.

13.4.13 With regard to groundwater, the potential for groundwater contamination from surface infiltration at construction sites, such as the Harvil Road and West Ruislip portal, will be minimised through the requirements of the draft CoCP, Section 16.

13.4.14 The areas identified for sustainable placement and temporary material stockpiles are underlain by London Clay Formation or Lambeth Group strata to reduce the potential for infiltration into the Chalk aquifer. Suitable quality criteria will be defined prior to material being placed to ensure that the existing groundwater quality is not adversely affected by the quality of the placement material. The draft CoCP (Sections 11, 15 and 16) defines appropriate measures that will be followed to ensure any impacts to groundwater quality are minimised.

13.4.15 Tunnelling and piling will have the potential to impact on groundwater quality due to the introduction of bentonite and fluids for tunnelling and piling prior to completion with in situ concrete and cement grouts and their associated additives. In compliance with the draft CoCP (Section 16) any potential contaminants will be controlled at source to minimise impacts to the high value groundwater in the Chalk aquifer or shallow groundwater in the superficial Alluvium.

13.4.16 Section 16 of the draft CoCP sets out the requirements for dewatering of shallow groundwater for excavation works to ensure that changes to local groundwater levels, hydrogeological regime and quality are minimised. Dewatering will be needed to construct the base slab within the vent shaft at South Ruislip.

13.4.17 Although unlikely to be necessary, if depressurisation of the underlying Chalk aquifer is required to stabilise the portal in cutting during construction, this will be undertaken by short term use of temporary, shallow dewatering wells built within the portal walls. De-watering abstraction will only occur to maintain groundwater levels in the chalk to just below the working levels and will be in accordance with the draft CoCP, Section 16.

13.4.18 Specific monitoring to determine the potential impact to PWS (Affinity Water) and private abstractions will be undertaken. The monitoring schedule (to be agreed with the Environment Agency and in consultation with Affinity Water) will include monitoring before, during and after construction until the groundwater quality has stabilised within acceptable limits. The monitoring data will be assessed and used to define appropriate mitigation, should it be required.

13.4.19 With regard to flood risk, temporary excavated material stockpiles, construction compounds and site offices will be located outside of areas at risk of flooding where practicable, to avoid having an impact on the risk of flooding elsewhere (Section 16 of the draft CoCP). Where these cannot be located outside flood risk areas, there will be a site specific flood risk management plan prepared prior to construction to manage the potential risks.

Assessment of impacts and effects

13.4.20 This section describes the significant effects following the implementation of avoidance and mitigation measures.

13.4.21 Details of the potential impacts that will not have significant effects are provided in the Water Resources Assessment report in Volume 5: Appendix WR-002-006 and Flood Risk Assessment in Volume 5: Appendix WR-003-006.

13.4.22 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).

13.4.23 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 and groundwater resources (see Volume 3 for further information).

Temporary effects

Surface Water

13.4.24 The assessment shows that there will be no significant temporary adverse effects on surface water resources during the construction period.

Groundwater

13.4.25 Tunnelling and piling has the potential to impact on groundwater quality due to the migration of fluids or suspended bedrock particles giving rise to raised turbidity. At the scale of the classified Mid Chilterns Chalk groundwater body any turbid groundwater will be attenuated within the Chalk and diluted in regional flow and the overall impact on the groundwater body as a whole is deemed to be negligible, which for this high value receptor would be a neutral effect and therefore not significant.

13.4.26 Any migration of turbid groundwater to surface water is likely to be a slow process allowing natural attenuation within the chalk and dilution, to reduce turbidity to levels that are unlikely to significantly affect surface water quality. Therefore, the impact of any change in groundwater quality in the wider groundwater body on surface water will be negligible. Surface water features in the area are of high value leading to a neutral effect.

13.4.27 Although effects on wider water body receptors are considered to be neutral, if rapid pathways through the Lambeth Group and fissures in the Chalk connect the working area of the Proposed Scheme directly to high value receptors such as PWS or private boreholes the impact of even low levels of turbidity could cause the closure of a source due to the high quality required to be met for potable use. Where the route passes through the SPZ1 TH174 the groundwater elevation will be below the route by approximately 8 to 14m.

13.4.28 In the area where there will be work in cuttings there could be rapid pathways through the unsaturated layers to the water table to the source protected by SPZ TH174 (Map WR-02-006 Volume 5, Water resources and flood risk Map Book)[101], although the risk of turbid water entering groundwater is considered to be low. In the unlikely event that there are rapid pathways through the unsaturated zone to the groundwater then the impact would be major resulting in a very large adverse effect on public water supplies, which would be a significant effect.

[101] This source is currently not operational but has been included as a precautionary assessment.

Flood risk

13.4.29 The assessment has identified no significant temporary effects on the risk of flooding.

Cumulative effects

13.4.30 The assessment has identified no significant cumulative temporary effects from committed developments in this area.

Permanent effects

Surface water

13.4.31 The assessment has identified no significant permanent effects on surface water resources.

Groundwater

13.4.32 The assessment has identified no significant permanent effects on groundwater resources.

Flood risk

13.4.33 The assessment has identified no significant permanent effects on the risk of flooding.

Cumulative effects

13.4.34 The assessment has identified no significant cumulative permanent effects from committed developments in this area.

Other mitigation measures

13.4.35 No further mitigation measures are envisaged for surface water resources or flood risk.

13.4.36 The Proposed Scheme could give rise to a significant adverse effect on water supplies that depend on the groundwater. As a result, the programme of monitoring to be undertaken in the study area, prior to, during and following completion of the construction works, will be integrated with monitoring undertaken by the Affinity Water to address these receptors. The programme will be structured taking into account all the construction processes that could have an impact on the quantity and quality of surface water and groundwater resources and the interaction between the water resources and water supplies. The monitoring programme scope and duration will be developed in consultation with the Environment Agency and Affinity Water. Such a programme and appropriate mitigation measures will ensure no adverse significant effects occur.

13.4.37 Consultations on the other mitigation measures needed to avoid adverse effects on the public water supply are ongoing with Affinity Water and the Environment Agency. HS2 Ltd will agree a management strategy with the Environment Agency in consultation with Affinity Water that will cover timing of any physical mitigation, the scale and nature of monitoring and the thresholds at which actions are invoked, the

nature of other intervention measures and the responsibilities for ensuring agreed actions occur. These mitigation options could include:

- minimising construction durations in areas of risk for groundwater impacts;
- treatment of water at abstractions;
- reduced amounts, or suspension, of abstraction at specific periods of construction. Reduction or suspension of abstraction will result in groundwater rebound occurring around the source in question but since this is permitted under the existing abstraction licence, the rebound will have negligible impact;
- importing water from another source such as those in the Colne Valley where piling and tunnelling are expected to be complete prior to tunnelling in this study area. Since these other sources will be operating within their abstraction licence limits, there will be negligible impacts;
- use of scavenger wells to intercept poor quality groundwater between the works and the PWS abstraction points. Since higher levels of turbidity are acceptable in most watercourses compared to the standard required by the Drinking Water Inspectorate, the discharge from scavenger wells will usually be suitable for discharge to the appropriate watercourse with minimal additional treatment; and
- regulatory and management initiatives such as demand reduction, leakage control or, less desirably, variations to conditions for licence abstractions in the area. These initiatives would provide Affinity Water with enhanced flexibility of operations across its sources and additional supplies in the event of an extreme drought or outage.

Summary of likely residual significant effects

13.4.38 No significant residual effects on surface water, the Mid-Chilterns Chalk groundwater body and flood risk have been identified within the assessment.

13.4.39 Until a management strategy is agreed with the Environment Agency in consultation with Affinity Water, a potentially significant temporary residual effect on Affinity Water groundwater abstractions remains.

13.4.40 Tunnelling and piling construction has the potential to impact on groundwater quality. If fissures connect the working area of the Proposed Scheme directly to the Affinity Water groundwater abstraction which is protected by SPZ TH174 and in the unlikely event that the abstraction is operational during the construction works, the impact of low levels of turbidity will be major due to the high quality required to be met for potable use, resulting in a very large and significant temporary adverse effect during the construction works.

13.5 Effects arising from operation

Avoidance and mitigation measures

13.5.1 Generic examples of design measures that will mitigate impacts so that there will be no significant adverse effects on the quality and flow characteristics of surface water courses and groundwater bodies during operation and management of the Proposed Scheme are described in Volume 1, Section 8.

13.5.2 Site specific examples of design measures that will mitigate impact include the drainage arrangements for the Proposed Scheme in the study area include balancing ponds for either railway or highway drainage and land drainage areas. These ponds and their associated access tracks are shown in Maps CT-06-015 to CT-06-019 (Volume 2, CFA6 Map Book).

13.5.3 Generic examples of management measures during operation and management of the Proposed Scheme that will mitigate impacts so that there are no significant adverse effects on the quality and flow characteristics of surface water courses and groundwater bodies are described in Volume 1, Section 9 and in the draft operation and maintenance plan for water resources and flood risk included in Volume 5 Appendix WR-001-000.

13.5.4 As noted in the generic assessment in Volume 3, the risk of pollution from accidental spillage is considered to be extremely low. Incorporation of appropriate spillage control measures within the drainage will reduce this risk further.

13.5.5 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.

Assessment of impacts and effects

13.5.6 There are considered to be no significant adverse effects to surface water, groundwater or flooding arising from operation of the Proposed Scheme.

Other mitigation measures

13.5.7 There are considered to be no further mitigation measures required for surface water, groundwater or flooding features.

14 References

British Standards Institute (2011) British Standard (BS10175) Investigation of Potentially Contaminated Sites

British Standards Institute (2012), British Standard (BS5837:2012) Trees in relation to design, demolition and construction. Recommendations.

Cary, J. (1786) Cary's actual survey of the country fifteen miles around London.

Capita Symonds (2011) London Borough of Hillingdon Preliminary Flood Risk Assessment.

Cranfield University, (2001), The National Soil Map

Defra, (2005), Likelihood of Best and Most Versatile Agricultural Land

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

Defra (2009), Soil Strategy for England

Defra, (2010), 2010 Based Background Maps for NOx, NO2, PM10 and PM2.5. Available online at: http://laqm.defra.gov.uk/maps/maps2010.html; Accessed July 2013.

Defra (2011), The Natural Choice: securing the value of nature

Department for Communities and Local Government, (2012), National Planning Policy Framework Technical Guidance

Directive 200/60/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, Strasbourg, European Parliament and European Council

Environment Agency (2004) CLR11 Model Procedures for the Management of Land Contamination

Environment Agency (2009) River Basin Management Plan, Thames River Basin District

Environment Agency (2010) Flood Map for Surface Water (FMfSW): http://www.geostore.com/environment-agency/WebStore?xml=environment-agency/xml/dataLayers_FMSW.xml. Accessed 1 February 2013.

Environment Agency (2012) Reservoir Inundation Map: http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=reservoir#x=485528&y=240060&lg=1,&scale=10. Accessed: 1 February 2013.

Environmental Protection Act 1990, Part IIA, Introduced in England on 1 April 2000, London, Her Majesty's Stationary Office.

Geological Survey of Great Britain, (2006), Beaconsfield, Sheet 255, Solid and Drift Edition, 1:50,000 series, Ordnance Survey, Southampton

Geological Survey of Great Britain, (2006), North London, Sheet 256, Solid and Drift Edition, 1:50,000 series, Ordnance Survey, Southampton.

Greater London Authority, (2008), London Atmospheric Emissions Inventory 2008. Available online at: http://data.london.gov.uk/laei-2008; Accessed July 2013.

Greater London Authority (2011) The London Plan – Spatial Development Strategy for Greater London

Homes and Communities Agency (HCA) (2010) Employment Densities Guide

IAQM (2011), Guidance on the assessment of the impacts of construction on air quality and the determination of their significance.

JNCC, Species Status; http://jncc.defra.gov.uk/pdf/pub05_speciesstatusvpredlist3_web.pdf; accessed 2.10.13

Joint Nature Conservation Committee (JNCC) (2011) Conservation Designations for UK Taxa. http://jncc.defra.gov.uk/page-3408 first accessed in July 2013

Jones Lang LaSalle (2012), The Western Corridor Industrial and Warehouse Market Report (September 2012)

London Biodiversity Partnership. London's BAP Priority Species. http://www.lbp.org.uk/londonpriority.html. Last accessed: 2.10.13

London Borough of Hillingdon, (1998), Adopted Unitary Development Plan, Saved Policies.

London Borough of Hillingdon (2011). Environmental Protection Act 1990, Part 2A – Section 78B, Record of Determination of the Land at the Former Landfill Site at Newyears Green Lane, Harefield, Middlesex

London Borough of Hillingdon, (2011), Hillingdon Core Strategy, Submission Draft.

National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk

Natural England, Ruislip Woods SSSI Citation. http://www.sssi.naturalengland.org.uk/special/sssi/sssi_details.cfm?sssi_id=1003633

Natural England (2011), London Regional Landscape Framework

Natural Environment and Rural Communities (NERC) Act 2006. Section 41: Habitats of Principal Importance in England.

Office for National Statistics (2011), UK Business: Activity, Size and Location. Please note 2011 data has been presented to provide an appropriate comparison with 2011 Census data.

Office for National Statistics (2012), Business Register and Employment Survey 2011

Office for National Statistics (2012), Census 2011

Reservoirs Act 1975 (c.23). London, Her Majesty's Stationery Office.

Scott Wilson (2008) London Borough of Hillingdon Strategic Flood Risk Assessment.

Soil Survey of England and Wales (1984) Soils and Their Use in South East England: Harpenden.

Sustainable Remediation Forum UK (2010) A Framework for Assessing the Sustainability of Soil and Groundwater Remediation

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

Water Resources Act 1991. London, Her Majesty's Stationery Office.