LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA3 | Primrose Hill to Kilburn (Camden)

November 2013

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Department for Transport

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

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Structure of the HS2 Phase One Environmental Statement

The Environmental Statement (ES) documentation comprises:

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

1 Introduction

1.1 Introduction to HS2

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

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

1.1.3 During Phase One, beyond the dedicated high-speed track, high-speed trains will connect with and run on the existing 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 Two operational frequency has been used. For further detail of the anticipated operation of the Proposed Scheme in the Primrose Hill to Kilburn (Camden) area (CFA3), 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.

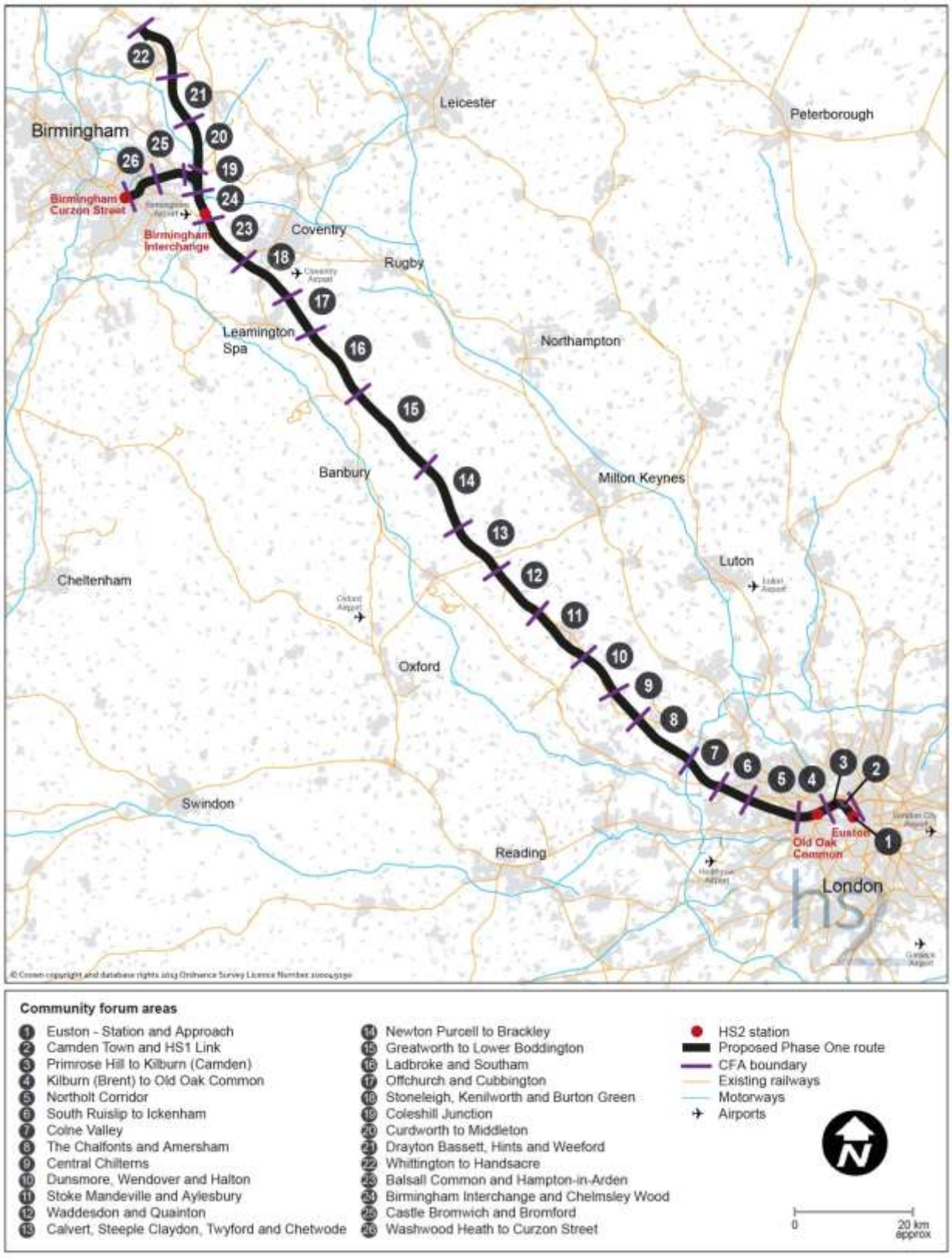
1.1.7 For consultation and environmental assessment purposes, the proposed Phase One route has been divided into 26 community forum areas (CFA), as shown in Figure 1. This has enabled wider public engagement on the Proposed Scheme design and on the likely adverse and beneficial effects.

1.2 Purpose of this report

1.2.1 This CFA report presents the likely significant effects of the construction and operation of the Proposed Scheme on the environment within CFA3 (Primrose Hill to Kilburn (Camden)). The report describes the mitigation measures that are proposed

for the purpose of avoiding, reducing or managing the likely significant adverse effects of the Proposed Scheme on the environment within CFA3.

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

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

1.3.3 Environmental effects have been assessed in accordance with the methodology set out in Volume 1, the Scope and Methodology Report (SMR) (see Volume 5: Appendix CT-001-000/1) and 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 Section 6A of the SMR Addendum also include additional information about climate change adaptation and resilience.

1.3.5 The maps relevant to Primrose Hill to Kilburn (Camden) are provided in a separate corresponding document entitled Volume 2: CFA3 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, CFA3 Map Book) and CT-06 (operation) (Volume 2, CFA3 Map Book). There is some flexibility during detailed design to alter the horizontal and

vertical alignments and other details within the limits of deviation 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 impact assessment. Further explanation is provided in Volume 1, Section 1.4.

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

2 Overview of the area and description of the Proposed Scheme

2.1 Overview of the area

2.1.1 The Primrose Hill to Kilburn (Camden) CFA (CFA3) covers a 3.6km section of the Euston tunnel (twin-bore tunnel) and a 2.7km section of the HS1-HS2 Link tunnel (a single-bore tunnel). The route of these tunnels passes to the west of Camden Town, to the north of Primrose Hill and south of Swiss Cottage. The route through this area will be entirely in tunnel with two associated ventilation and intervention shafts (vent shafts).

2.1.2 The Primrose Hill to Kilburn (Camden) CFA (CFA3) is bounded by the A4201 Parkway in the south, Regent's Park Road in the east and the A5 Kilburn High Road in the west (see Maps CT-06-003b to CT-06-006a, Volume 2 CFA3 Map Book).

2.1.3 As shown in Figure 2, the Euston – Station and Approach area (CFA1) lies to the south, the Camden Town and HS1 Link area (CFA2) lies to the east, and the Kilburn (Brent) to Old Oak Common area (CFA4) lies to the west.

Settlement, land use and topography

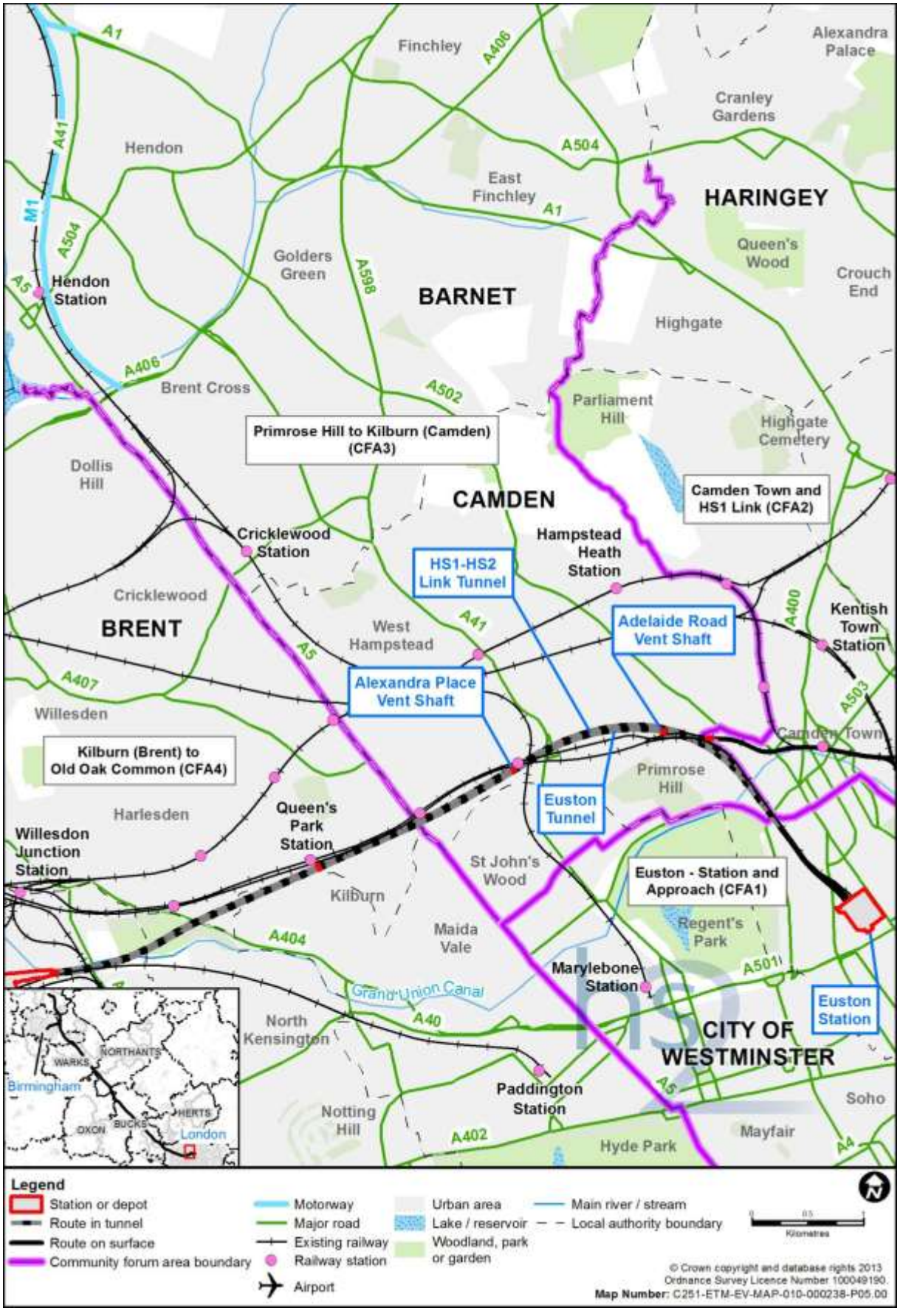
2.1.4 The area is urban in character and includes the areas of Primrose Hill and St John's Wood with Georgian and Victorian terraces around Primrose Hill (see Maps CT-10-003c and CT-10-004a in Volume 2, CFA3 Map Book). To the north of the route there are predominantly streets of tree-lined Victorian terraced housing in South Hampstead, and Hampstead and the Heath beyond.

2.1.5 There are estates originally built by local authorities distributed throughout the area. The most notable of these is the Grade II* listed Alexandra Road Estate[1] on Loudoun Road located adjacent to the Proposed Scheme at South Hampstead station.

2.1.6 Primrose Hill Park, which provides approximately 25ha of open space, is located approximately 225m to the south of the Proposed Scheme. It has panoramic views across central London from its highest point at 64m above Ordnance Datum (AOD). Elsewhere, the land rises gradually towards the north-west but the topography is largely masked by the overlying urban development. West of the A41 Finchley Road, the land slopes steeply in the area where the route of the Proposed Scheme approaches Alexandra Place and South Hampstead station.

[1] This is known locally as the Alexandra and Ainsworth Estate, although the Grade II* listing is for the Alexandra Road Estate. Throughout this report it will be described as the Alexandra Road Estate.

Figure 2: Area context map



Key transport infrastructure

2.1.7 The West Coast Main Line (WCML) from Euston runs in a north-west and westerly direction through the area. The London Overground network[2], runs in an east to west direction between the boundary of CFA2 (Regent's Park Road bridge) and CFA4 (A5 Kilburn High Road) with stations at Kilburn High Road and South Hampstead. The London Underground Metropolitan and Jubilee lines also run through the area, with stations at Finchley Road, Swiss Cottage and St John's Wood.

2.1.8 The principal highways through the area are the A41 Finchley Road, which runs in a north to south direction crossing the route south of Swiss Cottage, and the B509 Adelaide Road/Belsize Road, which runs in an east to west direction parallel to the route between Chalk Farm and Kilburn High Road stations.

2.1.9 The Grand Union Canal (Regent's Canal) forms a linear corridor running in a north-east to south-west direction from Fitzroy Bridge to Prince Albert Bridge. It is used by recreational craft and has regional historical significance for London. The adjacent canal towpath is used by walkers and cyclists.

2.1.10 A number of London Cycle Network routes are located within the area and include:

- Route 5: Edgware – West Hendon – Kilburn – Maida Vale;
- Route 6a: Highgate – Camden Town;
- Route 50: Mill Hill East – Swiss Cottage – St James's Park;
- Boundary Road – Elsworthy Road; and
- Swiss Cottage – Parkway.

Socio-economic profile

2.1.11 To provide a socio-economic context for the area data for the following demographic character areas (DCA) is used: Primrose Hill; Belsize and Chalk Farm; and Kilburn and Swiss Cottage[3]. In total, the population of the DCA is approximately 44,500. The area's labour market slightly outperforms England's as a whole; unemployment at 6.4% is slightly lower than the national level of 7.4%, while 73.4% of the population aged 16-74 is economically active compared to the national figure of 69.9%[4]. There are approximately 15,400 people who work within the area[5].

Notable community facilities

2.1.12 The main shops and services in the area are located at A400 Camden High Street, A41 Finchley Road (at Swiss Cottage) and A5 Kilburn High Road. There are also neighbourhood shops distributed throughout the area. There are six community/ youth centres within the area including the Abbey and Swiss Cottage centres, and a community hall on the Alexandra Road Estate.

[2] The London Overground network in this area comprises the North London Line (NLL) in the east and the Euston to Watford Line (EWL) in the west.
[3] A DCA represents a community that, depending on the area, may consist of a local ward, neighbourhood or village(s).
[4] Data comes from the 2011 population census.
[5] Data comes from the 2011 business register and employment survey.

2.1.13 The area includes 15 religious facilities and/or places of worship, seven within 500m of the route. In addition, the London Jewish Museum is located on Albert Road.

2.1.14 Educational facilities in the study area include 10 early-years educational facilities, 17 primary schools (the closest being Primrose Hill Primary School on Princess Road approximately 40m from the Proposed Scheme), six secondary schools, one arts college (Hampstead Fine Arts College) and one university (University of London Central School of Speech and Drama).

2.1.15 There are four doctors' surgeries, five health centres and 15 dental practices within 500m of the route.

Recreation, leisure and open space

2.1.16 The main open space in the area is Primrose Hill Park, which provides approximately 25ha of open space approximately 225m south of the route. Adelaide Local Nature Reserve (LNR)[6] (see Map CT-10-003c, Volume 2 CFA3 Map Book) also lies adjacent to a vent shaft site south of the B509 Adelaide Road (see Section 2.2). Public access to Adelaide LNR is permitted at weekends only between 08:00 and 16:00.

2.1.17 Local play spaces are interspersed throughout the housing estates and residential areas (eight in total within 500m of the Proposed Scheme) and there is a hard surfaced sports court on the Alexandra Road Estate.

Policy and planning context

Planning framework

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

2.1.19 The London Plan, 2011[7] is the regional spatial strategy that is relevant to this area. 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.

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

- London Borough of Camden (LBC) Adopted Core Strategy (2010)[8];
- LBC Adopted Camden Development Policies (2010)[9];

[6] The LNR is part of a larger Local Wildlife Site, the Chalk Farm Embankment and Adelaide Nature Reserve Site of Borough Importance (SBI), which is described in more detail in Section 7.
[7] Mayor of London (2011), *The London Plan – Spatial Development Strategy for Greater London*.
[8] Camden Council, (2010), *London Borough of Camden Adopted Core Strategy*.
[9] Camden Council (2010), *London Borough of Camden Adopted Camden Development Polices*.

- City of Westminster (CoW) Adopted Core Strategy (2010)[10]; and
- CoW Adopted Unitary Development Plan, Saved Policies (2010)[11].

2.1.21 There are a number of key planning designations in the area, which include an air quality management area (AQMA), conservation areas, listed buildings, a scheduled monument, an archaeological priority area, a Grade II registered park and garden and a local nature reserve. These are shown (with the exception of the AQMA) on the Maps CT-10-003c and CT-10-004a (Volume 2, CFA3 Map Book).

2.1.22 Emerging policies are not generally considered within this report, unless a document has been submitted to the Secretary of State for approval. However, it should be noted that Westminster City Council (WCC) approved minor changes to its adopted Core Strategy in light of the National Planning Policy Framework; and submitted the revision to the Secretary of State in January 2013 for examination, which has now concluded. A second revision will insert detailed policies (and supporting text) into the Core Strategy. A single consolidated local Plan called Westminster's City Plan will go forward to Council for adoption in November 2013.

Committed development

2.1.23 Developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme, are shown on Maps CT-13-003b and CT-13-004a (Volume 5, Cross Topic 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 have been taken into account for the purpose of assessing the likely significant environmental effects of 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.

2.1.24 There is one major committed development of potential relevance to the Primrose Hill to Kilburn (Camden) area as shown on Maps CT-13-INDEX-CFA3 (Volume 5, Cross Topic Map Book). This is the CFA3/48: Brent Cross Cricklewood Regeneration Area, which was granted outline planning permission in October 2010.

2.1.25 The comprehensive mixed use redevelopment of the Brent Cross Cricklewood Regeneration Area will involve the construction of residential, commercial, leisure, waste handling, open spaces, landscaping and recreational facilities. Interaction between the Proposed Scheme and the Brent Cross Cricklewood development is likely to be limited by virtue of the distance between them (approximately 4.9km).

2.1.26 Construction of the Brent Cross Cricklewood Regeneration Area scheme is expected to take place over approximately 20 years, commencing in 2016. It has the potential to give rise to cumulative construction transport impacts with the Proposed Scheme but this is unlikely to be significant given the location of Brent Cross Cricklewood, which has direct access to the M1 and M25.

[10] Westminster City Council, (2011), *City of Westminster Adopted Core Strategy 2011.*
[11] Westminster City Council, (2007), *City of Westminster Adopted Unitary Development Plan, Saved Policies*.

2.1.27 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.

2.2 Description of the Proposed Scheme

2.2.1 The following section describes the main features of the Proposed Scheme in the Primrose Hill to Kilburn (Camden) 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 Maps CT-06-003b, CT-06-004b, CT-06-005 and CT-06-006a (Volume 2, CFA3 Map Book). Land that will also be required, but only on a temporary basis for construction, is set out in Section 2.3 (and identified on Maps CT-05-003b, CT-05-004b, CT-05-005 and CT-05-006a).

2.2.3 In general, depending upon the orientation of the route in this part of the Proposed Scheme features are described from east to west along the route (and north to south for features that cross HS2).

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

- the location of Adelaide Road vent shaft (and associated headhouse) has been moved eastwards and will no longer be situated in the Adelaide LNR. Furthermore, the revised location means that demolition and use of land occupied by the MOT garage on the B509 Adelaide Road is also no longer required;
- the Adelaide Road vent shaft headhouse was previously a two storey structure (approximately 8m high) and will now be a single storey structure (approximately 4.5m high in relation to the adjacent road level), it also has a smaller footprint compared to that assessed in the draft ES;
- changes to the design of the Adelaide Road vent shaft now require a full, but temporary, closure of the B509 Adelaide Road for approximately four months and a partial closure for approximately four months during construction. This compares to the draft ES, which stated that only a single lane closure would be needed;
- the alignment of the Euston tunnel has been revised in the Gloucester Avenue area to locate it closer to the existing railway corridor, reducing the number of residential properties that could potentially be affected. However, this change in alignment will move the Euston tunnel closer to the Grade II* listed Camden

Incline Winding Engine House vaults[12] and will increase the risk of ground settlement affecting these features; and

- the revised alignment of the Euston tunnel will require the installation of a replacement sewer along Princess Road to St Mark's Square.

Overview

2.2.5 The Proposed Scheme through this area will be entirely in tunnel comprising the twin-bore Euston tunnel and the single-bore HS1-HS2 Link tunnel.

2.2.6 The route of the Euston tunnel through the area will commence from the boundary of the Euston – Station and Approach area (CFA1) south of A4201 Parkway, between Mornington Terrace and Park Village East. The route will then proceed north-west connecting with the new vent shafts at the B509 Adelaide Road, just east of the junction with Primrose Hill Road; and at Alexandra Place, located immediately west of Loudoun Road. The route will leave the area to the west in tunnel at the A5 Kilburn High Road.

2.2.7 The HS1-HS2 Link tunnel will also run through the Primrose Hill to Kilburn (Camden) area (CFA3). The single-bore tunnel will commence at the boundary with the Camden Town and HS1 Link area (CFA2), beneath Regent's Park Road bridge. The tunnel will continue west for approximately 330m before aligning with the Euston tunnel at the Adelaide Road vent shaft. From here the HS1-HS2 Link tunnel will run parallel with and between the twin-bore Euston tunnel before leaving CFA3 at the A5 Kilburn High Road.

2.2.8 Camden carriage sidings, existing sidings located off Gloucester Avenue[13], will be extended as part of the Proposed Scheme to increase the number of classic railway 12-car trains that can be stabled there during the construction period and during operation. Reconfiguration of the existing classic railway tracks north of the A4201 Parkway is also required as well as the removal and partial realignment of some of the tracks serving the NLL west of Regent's Park Road bridge.

Euston tunnel

2.2.9 The Euston tunnel is approximately 7.4km in overall length, of which approximately 3.6km passes beneath the Primrose Hill to Kilburn (Camden) area. The Euston tunnel will comprise a twin-bore tunnel with one track in each bore with:

- an approximate internal diameter of 7.6m;
- a rail depth below ground level varying between 12m and 64m[14]; and
- cross passages linking the three tunnel bores (i.e. the twin-bore Euston tunnel and single HS1–HS2 Link tunnel) at approximately 380m intervals.

[12] This feature is located at the boundary between the Primrose Hill to Kilburn (Camden) area (CFA3 and the Camden Town and HS1 Link area (CFA2) although it is mainly in CFA2.
[13] These sidings are used by London Midland.
[14] This is due to substantial variations in ground levels in the area and the fact that the tunnels slope downwards from the portals.

HS1-HS2 Link tunnel

2.2.10 The HS1-HS2 Link tunnel is approximately 6.3km in overall length carrying a single track, of which 2.7km passes beneath the Primrose Hill to Kilburn (Camden) area. The single-bore tunnel will have:

- an approximate internal diameter of 7.6m;
- a rail depth below ground level varying between 12m and 64m; and
- cross passages linking with the Euston tunnel bores at approximately 380m intervals.

Up Empty Carriage Tunnel

2.2.11 Approximately 100m of a disused tunnel, the Up Empty Carriage Tunnel[15], will be demolished as part of the works to construct the HS1-HS2 Link tunnel portal, to the east of Regent's Park Road bridge, in the Camden Town and HS1 Link area (CFA2). Live electricity cables in the Up Empty Carriage Tunnel will be diverted above ground. In addition, sections of the Up Empty Carriage Tunnel, on either side of the demolished part, will be backfilled and sealed. Whilst the majority of these works will be undertaken in CFA2, parts of these works will be undertaken in CFA3 and this is discussed in more detail in Volume 2, CFA Report 2, Camden Town and HS1 Link and Section 2.3.

Adelaide Road vent shaft

2.2.12 The vent shaft is required to provide pressure relief from the tunnels and a dedicated intervention point and access for emergency services. It will be located south of the B509 Adelaide Road on an existing wooded slope and will be circular with an internal diameter of approximately 23m, and a total depth from road level of approximately 50m.

2.2.13 The vent shaft will be constructed from a level working area cut into the existing slope (known locally as the Chalk Farm Embankment and part of the Chalk Farm Embankment and Adelaide Nature Reserve Site of Borough Importance Grade 1 (SBI)). This will require a piled retaining wall approximately 44m long to be installed along the southern edge of the B509 Adelaide Road to an average depth of 6m below road level.

2.2.14 Key features at this location will include a permanent fenced compound (see Map CT-06-004b, Volume 2, CFA3 Map Book), which will surround the following:

- a single storey vent shaft headhouse building, which will be approximately 20m by 30m and approximately 4.5m high (in relation to road level). It will provide access to the tunnels via ventilation and intervention/evacuation passages connecting the base of the shaft to the tunnels. The headhouse will also contain fans and related equipment to control smoke in the event of a fire;

[15] The Up Empty Carriage Tunnel connects with the Western Horse Tunnel and the Grade II* listed Camden Incline Winding Engine House vaults in the Gloucester Avenue area.

- an area of hardstanding next to the headhouse building, which will be approximately 20m by 16m, will allow for maintenance and emergency access and egress from the tunnel; and
- below ground drainage tanks and utility connections will also be provided for fire fighting and drainage of the tunnel buildings.

2.2.15 Materials and finishes on the headhouse will be subject to detailed design and agreement with the local planning authority.

2.2.16 The slope east of the Adelaide Road vent shaft headhouse and associated hardstanding will be replanted with native trees and shrubs. In addition, approximately half of the embankment cleared for construction at the vent shaft site will be replanted.

Alexandra Place vent shaft

2.2.17 The Alexandra Place vent shaft is required to provide pressure relief from the tunnels and a dedicated intervention point and access for emergency services. It will be located north of Alexandra Place to the west of Loudoun Road and will be circular with an internal diameter of approximately 23m, and a total depth from road level of approximately 57m.

2.2.18 Key features at this location will include the following (see Map CT-06-005, Volume 2, CFA3 Map Book):

- a two-storey[16] shaft headhouse building, which will be approximately 25m by 27m and approximately 9.7m high (in relation to road level). It will provide access to the tunnels, approximately 12m to 64m below ground level via ventilation and intervention/evacuation passages connecting the base of the shaft to the tunnels. The headhouse will also contain fans and related equipment to control smoke in the event of a fire;
- a strip of hardstanding area next to the headhouse building, approximately 4m wide, which will be fenced, will allow for maintenance and emergency access and egress from the tunnel; and
- below ground drainage tanks and utility connections will also be provided for fire fighting and tunnel buildings drainage.

2.2.19 Construction of the vent shaft and associated features will require the demolition of a building containing 12 commercial (light industrial) units (61 to 83 Loudoun Road (odd numbers only)) and six commercial (retail/services) units and two residential units (1 to 8 Langtry Walk).

2.2.20 Materials and finishes on the headhouse will be subject to detailed design and agreement with the local planning authority.

[16] Equivalent to three to four domestic storeys.

2.2.21 The concrete ramp and integral planting bed on Langtry Walk, which are part of the original design for the Grade II* listed Alexandra Road Estate, will be rebuilt in the same style.

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the strategy for the construction of the Proposed Scheme in the Primrose Hill to Kilburn (Camden) area including:

- overview of the construction process;
- description of the advance works;
- description of the engineering works to build the railway in conjunction with realigning and refurbishing the existing NR railway infrastructure;
- construction waste and material resources;
- commissioning the railway; and
- indicative construction programme (see Figure 5).

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

2.3.3 In addition to the land that will be required permanently by the Proposed Scheme (see Section 2.2), land will be required on a temporary basis for construction. Key temporary construction features are illustrated on the construction Map Series CT-05 (Volume 2, CFA3 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 6.4. 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 (including construction of tunnels by tunnel boring machine (TBM)) and structure works (including vent shaft and headhouse construction); and site restoration;
- 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;

- 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 2);
- working hours (draft CoCP, Section 5);
- the management of construction traffic (draft CoCP, Section 14); and
- the handling of construction materials (draft CoCP, Section 5).

Advance works

2.3.7 General information about advance works can be found in Volume 1, Section 6. 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 built heritage survey and investigation;
- site establishment with temporary fence construction; and
- utility diversions.

2.3.8 Where utility works are linked to the construction of vent shafts, they are discussed in relation to each vent shaft compound in the following sections. Utility works not linked to vent shaft sites that will involve intrusive works requiring excavation in roads include: the A4201 Parkway water mains; the Middle Level No.2 Sewer[17] in the Gloucester Avenue area; the sewer replacement between Princess Road and St Mark's Square and a water main diversion at B507 Abbey Road.

Engineering works

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

[17] This sewer is discussed in more detail in Section 13 as it is a culverted section of the River Fleet.

- civil engineering works, such as vent shaft and headhouse construction, and the construction of main railway tunnels by TBM operating from dedicated tunnelling sites; and
- railway installation works, such as concrete slab track (in the tunnels) and installing power supply, ventilation and smoke control equipment and communications features.

2.3.10 There are also locations where the existing railway network will need to be modified, which could also involve a combination of civil engineering and/or railway installation works.

2.3.11 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 connection 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.

2.3.12 In the Primrose Hill to Kilburn (Camden) area there will be two main compounds used for both civil engineering works and railway installation works and one satellite compound for railway installation works.

2.3.13 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. Compounds that will support construction in the Primrose Hill to Kilburn (Camden) area but which are located in other sections of the Proposed Scheme are also described.

General overview of construction compounds

2.3.14 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:

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

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

2.3.16 Further information on the function of compounds, including general provisions for their operation, including security fencing, lighting, utilities supply, site drainage, codes of worker behaviour are set out in Volume 1, Section 6.3, and the draft CoCP, Section 5 (see Volume 5: Appendix CT-003-000).

Construction traffic routes

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

Figure 3: Schematic of site compounds for civil engineering works

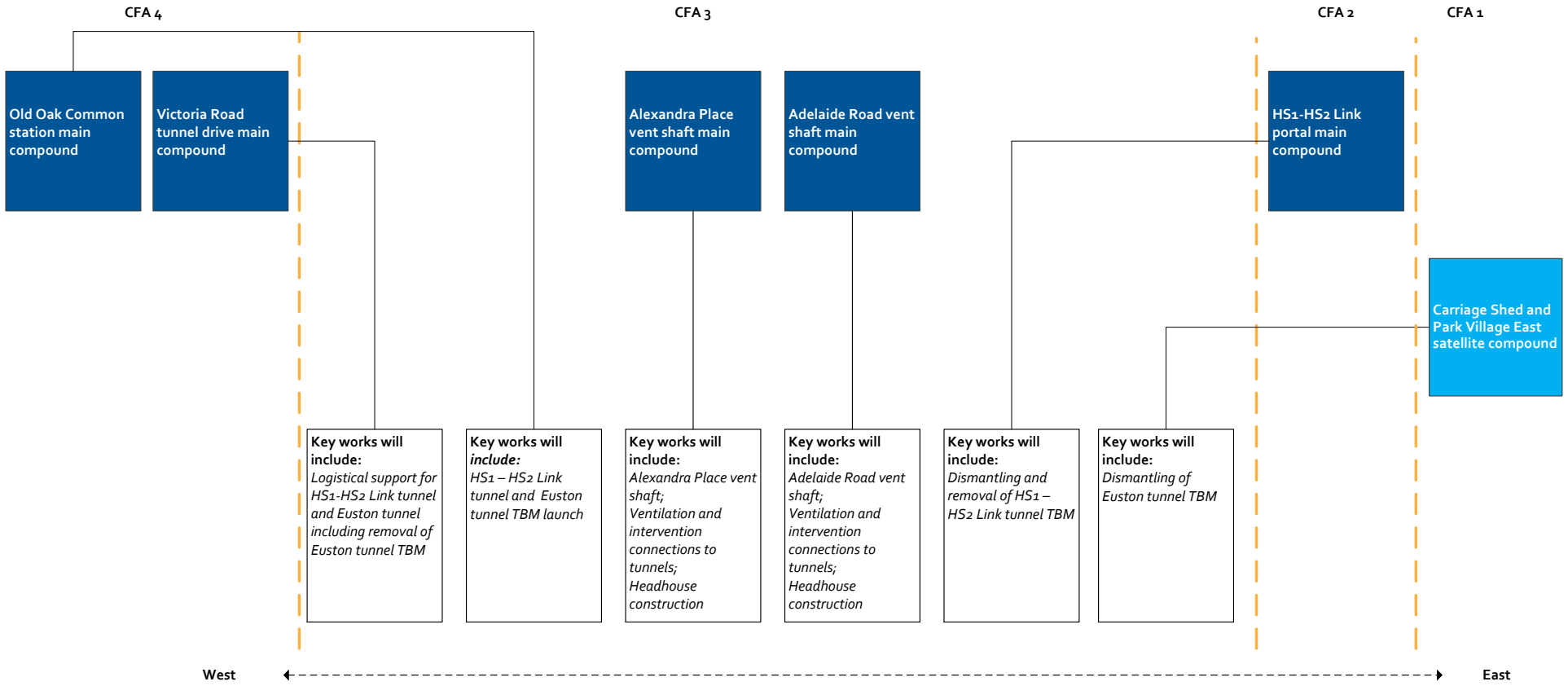
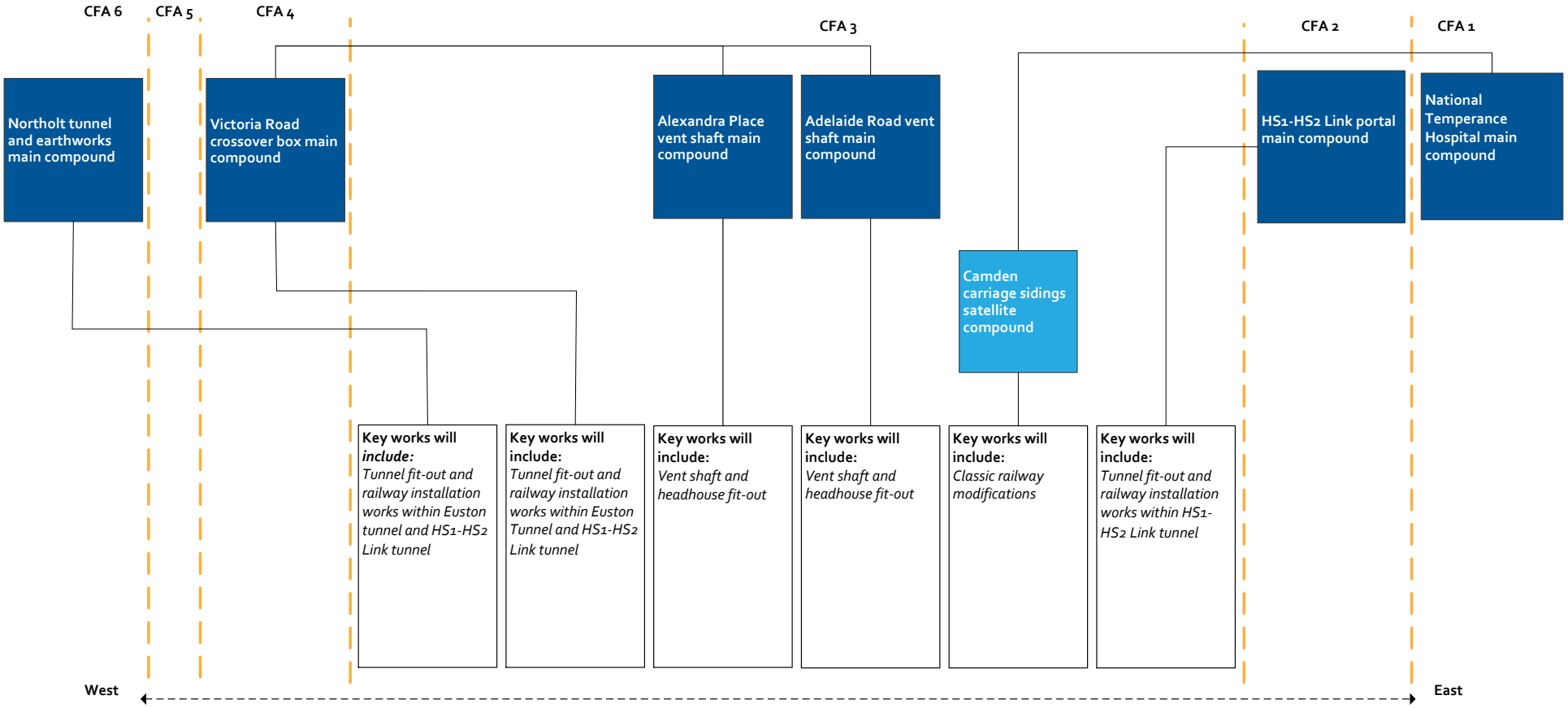


Figure 4: Schematic of site compounds for railway installation works



Camden carriage sidings satellite compound

2.3.18 This compound will be used for modifications to the existing railway network into Euston. The compound will:

- be operational for approximately one year, starting in 2016;
- support approximately 10 workers each day throughout the existing railway modification works period;
- be used for work required to take place at night, weekends or during bank holidays;
- be accessed via an existing Network Rail (NR) entrance off Gloucester Avenue; and
- be managed from the National Temperance Hospital main compound[18].

2.3.19 Demolition of a railway equipment building located within the NR Camden carriage sidings will be required.

2.3.20 Key works to the existing railway network in this section of the Proposed Scheme will comprise alterations to the existing railway sidings within NR Camden carriage sidings and realignments of the WCML to the north of Park Street Tunnels.

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

- site clearance and enabling works;
- NR building demolition; and
- modifications to the existing railway.

Adelaide Road vent shaft main compound

2.3.22 The compound will be used to manage the construction of the Adelaide Road vent shaft. It will also be used to support railway installation works. The compound will:

- be operational for approximately five years in total. Construction will be undertaken in two phases with a six-month work suspension period at the end of the third year (see the indicative construction programme in Figure 5 for more information). Construction of the vent shaft and connection of the vent shaft to the Euston and HS1-HS2 Link tunnels will take approximately three years, starting in 2019. During this period, there will a three-month work suspension period to allow the TBM to pass through the area[19]. At the beginning of 2023, the railway installation works will commence and continue for approximately one year and six months. Headhouse construction will

[18] See Volume 2, CFA Report 1, Euston - Station and Approach for more information about this compound.
[19] The TBM will move through the area at a rate of approximately 100m per day.

commence in 2023 and continue for approximately one year;

- support approximately 50 workers each day throughout the civil engineering works period and support approximately five workers each day throughout the railway installations works period;
- provide worker welfare facilities (but no accommodation) for up to 60 personnel for a period of approximately three years during the civil construction period and for up to five personnel for a period of two years during the railway installation works;
- provide access to the western end of the Up Empty Carriage Tunnel during its demolition/sealing as part of the HS1-HS2 Link tunnel portal works in CFA2[20];
- be used for railway installation works, which will be managed from Victoria Road crossover box main compound within the Kilburn (Brent) to Old Oak Common area (CFA4)[21]; and
- be accessed via the B509 Adelaide Road, which connects to either the A41 Finchley Road or the A502 Haverstock Hill.

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

- site clearance and enabling works;
- boundary wall demolition;
- bored piling, excavation and construction of the earth retaining structure adjacent to the B509 Adelaide Road;
- vent shaft construction;
- construction of connections from the vent shaft to the Euston and HS1-HS2 Link tunnels;
- civil/structural engineering works within the vent shaft;
- headhouse construction;
- vent shaft and headhouse fit-out; and
- landscaping.

2.3.24 See Volume 1, Section 5.8 for more information about vent shafts, and Volume 1, Section 6.14 for typical construction activities associated with vent shaft sites.

2.3.25 No permanent diversions of roads, footways, cycleways or watercourses will be required.

[20] See Volume 2, CFA Report 2, Camden Town and HS1 Link for more information about these works.
[21] See Volume 2, CFA Report 4, Kilburn (Brent) to Old Oak Common for more information about this compound.

2.3.26 There will be a temporary diversion of traffic for approximately four months in late 2019 when the retaining wall is constructed and initial earthworks are undertaken on the B509 Adelaide Road. Traffic, including buses, will be diverted along England's Lane and the A502 Haverstock Hill. Pedestrian access will be maintained on the north side of the B509 Adelaide Road only. During subsequent vent shaft construction works, the B509 Adelaide Road will operate with reduced width but maintaining two-way traffic flows. Further information is provided in Section 12.

2.3.27 Diversion of two utilities and the installation of three new utilities will be required, as follows:

- permanent realignment of a Thames Water Utilities Limited (TWUL) sewer, a combined waste water gravity sewer on Eton Road;
- permanent realignment of a TWUL water main on Eton Road; and
- installation of power, water and drainage to the Adelaide Road vent shaft.

2.3.28 During finalisation works, the embankment east of the Adelaide Road vent shaft headhouse and associated hardstanding and approximately half of the embankment cleared for construction at the vent shaft site will be replanted.

Alexandra Place vent shaft main compound

2.3.29 The compound will be used to manage the construction of the Alexandra Place vent shaft. It will also be used to support railway installation works. The compound will:

- be surrounded by a 10m high hoarding;
- be operational for approximately five years with a works suspension period of approximately one year at the end of the second year of construction (see the indicative construction programme in Figure 5 for more information). This will comprise construction of the vent shaft for approximately two years, starting in 2019. During this period, there will be a three-month work suspension period to allow the TBM to pass through the area. The railway installation works will commence in 2023 and continue for approximately one year. Headhouse construction will commence in 2023 and continue for approximately one year;
- support approximately 50 workers each day throughout the civil engineering works period and support approximately five workers each day throughout the railway installations works period;
- provide worker welfare facilities (but not accommodation) for up to 60 personnel for a period of approximately two years and three months during the civil construction period and for up to five workers for a period of two years during the railway installation works;
- be used for railway installation works, which will be managed from Victoria

Road crossover box main compound in the Kilburn (Brent) to Old Oak Common area (CFA4)[22]; and

- be accessed from the A41 Finchley Road via Boundary Road or the B509 Hilgrove Road to Loudoun Road and onto Alexandra Place.

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

- site clearance and enabling works;
- building demolition;
- erection of enclosed construction compound;
- shaft construction;
- construction of connections from the vent shaft to the Euston and HS1-HS2 Link tunnels;
- civil/structural engineering works within the vent shaft;
- headhouse construction above ground level;
- vent shaft and headhouse fit-out; and
- landscaping.

2.3.31 See Volume 1, Section 5.8 for more information about vent shafts, and Volume 1, Section 6.14 for typical construction activities associated with vent shaft sites.

2.3.32 Demolition of a building containing 12 commercial units at 61 to 83 Loudoun Road (odd numbers only) and six commercial units and two residential units at 1 to 8 Langtry Walk will be required.

2.3.33 The temporary closure of the northern entrance to Alexandra Place will be required for approximately one year. During this period, the existing southern one-way section of Alexandra Place will be converted to a two-way operation. A temporary vehicle turning area will be provided in the Dinerman Court car park.

2.3.34 During construction, pedestrian access will be maintained through the northern section of Alexandra Place. These are described in more detail in Section 12.

2.3.35 No permanent alternative vehicular, pedestrian routes or cycleways will be required.

2.3.36 Diversions of two key utilities and the installation of three new utilities will be required as follows:

- permanent realignment of a TWUL sewer, a combined waste water gravity sewer on Alexandra Place;

[22] See Volume 2, CFA Report 4, for more information about this compound.

- permanent realignment of a TWUL water distribution main on Loudoun Road; and
- installation of power, water and drainage supplies to the Alexandra Place vent shaft.

2.3.37 No watercourse diversions will be required.

2.3.38 Landscaping will be reinstated along Langtry Walk in the form of trees and shrubs.

HS1-HS2 Link portal main compound

2.3.39 This compound is located in the Camden Town and HS1 Link area (CFA2) and will provide the facility for removing the TBM used to construct the HS1-HS2 Link tunnel. It will also be used for railway installation works and fit out of the HS1-HS2 Link tunnel. The removal of approximately 100m of the Up Empty Carriage Tunnel and diversion of associated power cables within the railway corridor will also be required. Further details on these works and this compound are provided in the CFA Report 2.

Carriage Shed and Park Village East satellite compound

2.3.40 This worksite is located in the Euston – Station and Approach area (CFA1) and will provide the logistical and management support for the dismantling of the TBM used to construct the Euston tunnel through the Primrose Hill to Kilburn (Camden) area (CFA 3). Once the TBM has been dismantled it will be sent back up the tunnel to Old Oak Common for removal. See CFA Report 1 for more information about this compound.

National Temperance Hospital main compound

2.3.41 This compound is located in the Euston – Station and Approach area (CFA1) and will provide administrative and site management support to the Camden carriage sidings satellite compound for existing railway modification works. See CFA Report 1 for more information about this compound.

Main compounds to support tunnel construction

2.3.42 The following main compounds in the Kilburn (Brent) to Old Oak Common area (CFA4) will support tunnel construction through the Primrose Hill to Kilburn (Camden) area (CFA3)[23]:

- the Old Oak Common station main compound will be used for the launch and initial logistical support of the TBM used to construct the HS1-HS2 Link and the Euston tunnels;
- the Victoria Road tunnel drive main compound will be used for the logistical support of the TBM used to construct the HS1-HS2 Link and Euston tunnels; and
- the Victoria Road crossover box main compound will be used for the launch

[23] For further details on these compounds, please refer to CFA Report 4.

and logistical support of the TBM used to construct the Northolt tunnel and for the railway installation works and tunnel fit out within the HS1-HS2 Link and Euston tunnels. It will also provide administration and site management support for the railway installation works within CFA3.

Northolt tunnel and earthworks main compound

2.3.43 This compound is located in the South Ruislip to Ickenham area (CFA6) and will provide support for railway installation works within the Euston and HS1-HS2 Link tunnels. The railway installation works will include track, overhead line equipment (OLE), communications equipment and traction power supply. The installation of track within the tunnels will be concrete slab track. This compound, containing the West Ruislip railhead, will also support the fit out of the Euston and HS1-HS2 Link tunnels. See Volume 2, CFA Report 6, South Ruislip to Ickenham (CFA Report 6) for more information about this compound and for details of railway installation works via the West Ruislip railhead.

Construction waste and material resources

2.3.44 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 the Primrose Hill to Kilburn (Camden) area have been prepared and are presented in Volume 5: Appendix WM-001-000.

2.3.45 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.

2.3.46 Based on the mitigation earthworks design approach adopted for the Proposed Scheme, local excess or shortfall of excavated material within the Primrose Hill to Kilburn (Camden) 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.

2.3.47 The quantity of surplus excavated material originating from the Primrose Hill to Kilburn (Camden) area that will require off-site disposal to landfill as excavation waste is shown in Table 1. This is the forecast quantity of contaminated excavated material that is chemically unsuitable for reuse within the Proposed Scheme and which will be taken from the vent shaft sites from the Primrose Hill to Kilburn (Camden) 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.

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

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

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

Table 1: Estimated construction, demolition and excavation waste

Waste type	Estimated material quantities that will be generated (tonnes)	Estimated quantity of waste for off-site disposal to landfill (tonnes)
Excavation	1,855,281	2,049
Demolition	3,310	331
Construction	72,091	7,209
Worker accommodation[24]	0	0
TOTAL	1,930,682	9,589

2.3.50 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 of the railway

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

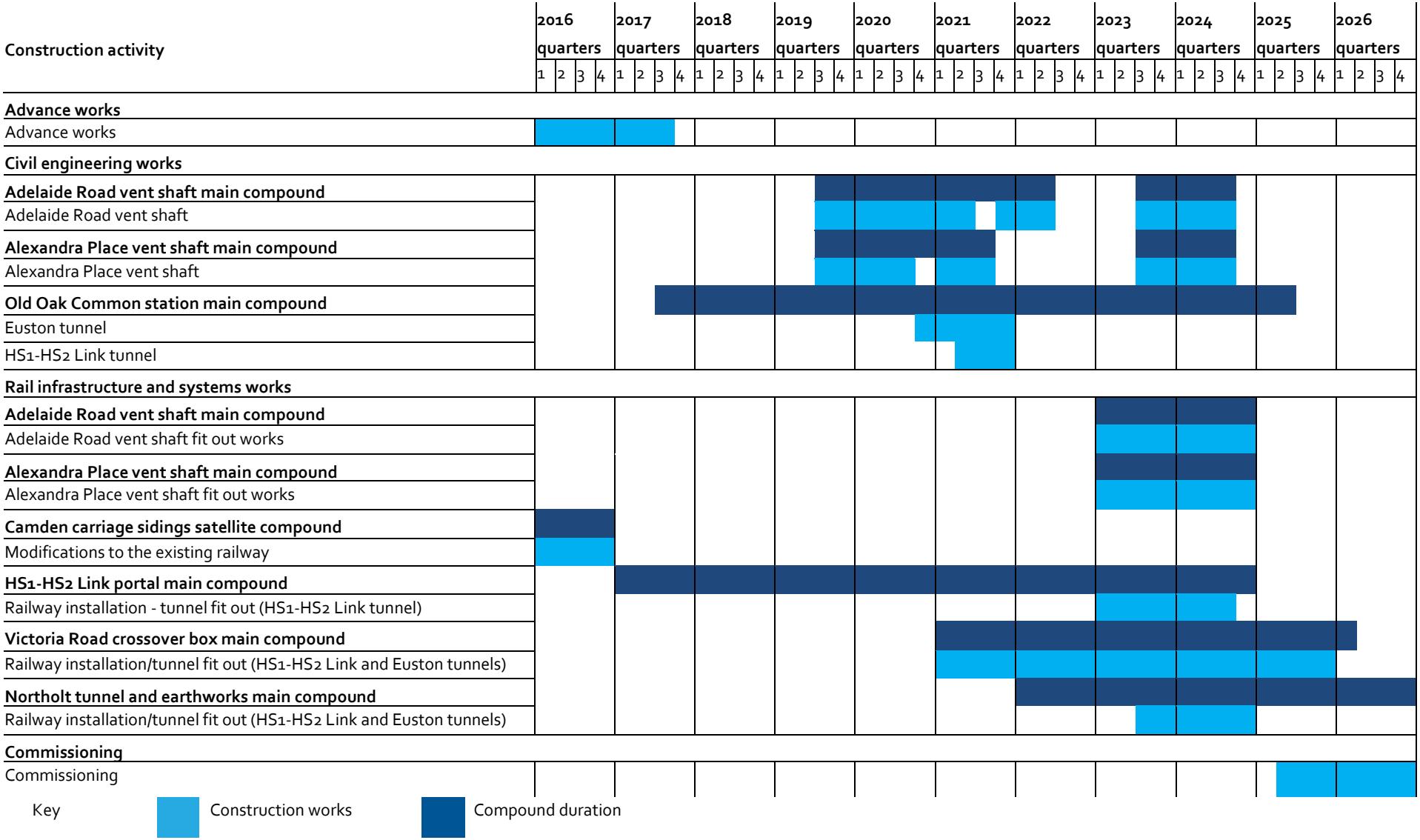
Construction programme

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

2.3.53 In addition to what is shown in Figure 5, the Northolt Tunnel and Earthworks main compound will be demobilised in January 2027 following completion of commissioning.

[24] There is no worker accommodation in this CFA.

Figure 5: Indicative construction programme



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 will be 11tph each way passing through the Primrose Hill to Kilburn (Camden) area in the morning and evening peak hours, and fewer during other times. The first trains of the day will leave the terminus stations no earlier than 05:00 Monday to Saturday (and 08:00 on Sundays) and the last will arrive no later than midnight.

2.4.3 The frequency of services could rise to 14tph each way during peak hours, and that with Phase Two in place the frequency could rise to 18tph 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, the route is entirely in tunnel and trains will run at speeds up to 230kph (140mph). 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 maintenance staff will access the tunnels via the vent shafts to carry out inspections and maintenance on a regular basis. This will be at night when the railway is not operating. There will 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 Should an emergency situation arise, emergency services will use the vent shafts to access the railway below.

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 reused, recycled and recovered (i.e. diverted from landfill) has been based on landfill diversion performance information from Network Rail and other sources as follows:

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

2.4.13 On this basis, approximately 75 tonnes of operational waste will be reused, recycled and recovered during each year of operation of the Proposed Scheme in the Primrose Hill to Kilburn (Camden) area. Approximately 15 tonnes will require disposal to landfill (see Table 2).

Table 2: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste generated per annum (tonnes)	Estimated quantity of waste for disposal to landfill per annum (tonnes)
Railway station and trains	0	0
Rolling stock maintenance	0	0
Track maintenance	83	12
Ancillary infrastructure	7	3
TOTAL	90	15

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 Section 3.

2.5.2 Following an initial meeting on the 28 March 2012 at Swiss Cottage Library. At a public meeting held on the 12 June 2012, forum members in the LBC decided not to engage further with HS2 Ltd through the community forum structure. HS2 Ltd has continued engagement with stakeholders and forum members through bi-lateral meetings to provide up to date information and feedback.

2.5.3 The main themes to emerge from this engagement were:

- queries regarding the locations and necessity of vent shafts;

- concerns regarding noise impacts, and impacts on ecology and local regeneration;
- queries regarding London Clay geology and timing of geological surveys;
- concerns over the effects on property, including structural effects associated with piling, amenity and visual effects and effect on property values;
- concerns over effects on many Grade II listed buildings, particularly at Alexandra Road Estate and Regent's Park;
- concerns over effects on properties along Gloucester Avenue and the alignment of tunnels there; and
- concerns regarding transport of excavated material and request for confirmation of potential lorry routes.

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

2.5.5 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 the local area are set out within 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.

Adelaide Road vent shaft

2.6.3 The Proposed Scheme includes a vent shaft, headhouse and an area of hardstanding, which will be constructed to the south of B509 Adelaide Road. These will be located to

the east of Adelaide LNR on a sloping wooded area to the north of an existing retaining wall adjacent to the former Up Empty Carriage Line[25].

2.6.4 Ten options were considered for the extent of the land required to construct and operate the Proposed Scheme (i.e. the extent of the area required during construction as well as the ultimate position of the vent shaft and associated features (the headhouse and adjacent hardstanding)) as follows:

- Option A: January 2012 announced route, which is similar to the Proposed Scheme for the location of the vent shaft but did not indicate the precise location of a headhouse building or hardstanding;
- Option B: Extension of the site, described in Option A, to take more land to the east and the western part of the Adelaide LNR and the MOT garage[26];
- Option C: The vent shaft located in the January 2012 announced route position but with additional land being taken from the MOT garage, part of the northern part of the Adelaide LNR (minimising the amount of the south facing grassland that would be affected) and land occupied by a disused railway line (known as the Up Empty Carriage Line) to the south of the southern retaining wall;
- Option D: The scheme described in the draft ES with the vent shaft in a location where gradient of the embankment is less steep with the shaft located further away from the existing retaining wall;
- Option E: Similar to Option D, but with the hardstanding moved to the eastern side of the vent shaft and the headhouse repositioned to be outside the MOT garage driveway;
- Option F: Similar to Option E, but with the vent shaft moved further north to increase the distance away from the retaining wall adjacent to the former Up Empty Carriage Line at the base of the slope;
- Option G: The Proposed Scheme, which will locate the vent shaft and its headhouse approximately 20m to the east of the location described in the draft ES (Option D) within an area of existing woodland on a slope that is managed by NR. In addition, the hardstanding associated with the vent shaft and headhouse will be located to the east of these features, avoiding the MOT garage and Adelaide LNR and located in the eastern part of the Chalk Farm Embankment and Adelaide Nature Reserve Site of Borough Importance Grade 1 (SBI.I)[27]. The proposed layout will maintain ecological connectivity between the LNR and with the woodland habitat to the east of the headhouse by maintaining a green corridor to the south of the headhouse structure;

[25] The Up Empty Carriage Line enters the Up Empty Carriage Tunnel approximately 175m east of the Adelaide Road vent shaft site. To the south of the Up Empty Carriage Line lie the NLL and WCML.
[26] Land occupied by the MOT garage is part of LBC's development proposals.
[27] The statutory designated Adelaide LNR is located within the western part of a Local Wildlife Site (LWS), the Chalk Farm Embankment and Adelaide Nature Reserve Site of Borough Importance Grade 1 (SBI.I).

- Option H: Location of the vent shaft and associated headhouse to the east of Adelaide LNR and partly under the southern pavement of B509 Adelaide Road;
- Option I: Location of the vent shaft and associated headhouse to the east of Adelaide LNR (as per Option H) but with additional land being required to the south, which is currently occupied by the disused Up Empty Carriage Line to allow realignment of the WCML retaining wall; and
- Option J: Location of the vent shaft and associated headhouse to the east of the Adelaide LNR, with the ventilation fans located outside the shaft structure and arranged horizontally on terraces on the existing slope. This would decrease the external diameter of the shaft. The land occupied by the disused Up Empty Carriage Line would be used to construct the realigned southern retaining wall.

2.6.5 Option A was progressed during design and became the basis for Option G.

2.6.6 Options B and C were rejected due to significant adverse impacts on the Adelaide LNR and LBC's development proposals, which also require land occupied by the MOT garage.

2.6.7 Option D would have resulted in direct impacts upon the Adelaide LNR including vegetation loss and disturbance to wildlife during the construction period. The location of the headhouse structure would have caused a permanent loss of part of the LNR and hardstanding associated with the MOT garage (i.e. land that also forms part of LBC's development proposals).

2.6.8 Options E and F would have required parts of the Adelaide LNR on a permanent basis and were rejected for this reason.

2.6.9 Options H and I would have caused greater disturbance to utilities under B509 Adelaide Road and more prolonged and extensive road closures during the construction period.

2.6.10 Option J would have had a significant visual impact on occupiers of residential properties on King Henry's Road and would also have reduced the connectivity between areas of the SBI.I, which would have been permanently separated by the vent shaft and its associated structures.

2.6.11 The Proposed Scheme (Option G) was adopted because the location of the vent shaft, headhouse, hardstanding and associated construction works will be wholly outside the statutory designated Adelaide LNR. It also avoids the use of land occupied by the MOT garage and its driveway. This option is considered to be the preferred engineering solution. The overall size of the area of the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I that will be disturbed during the construction works and lost permanently to accommodate the vent shaft is similar to that proposed in Option D. However, the Proposed Scheme does require the installation of a deeper and more substantial retaining wall adjacent to B509 Adelaide Road. This will require a full closure of B509 Adelaide Road during the construction period for approximately four months, whilst previously only a single lane closure was required for Option D.

Alexandra Place vent shaft

2.6.12 The Proposed Scheme contains the vent shaft at Alexandra Place between Loudoun Road and Langtry Walk, requiring demolition of 1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only). It will also require the northern third of the public highway at Alexandra Place, the pavement area fronting Loudoun Road and the courtyard of 9 Langtry Walk for the whole construction period. Nine options were considered for the extent of the land required to construct and operate the Proposed Scheme (i.e. the extent of the area required during construction as well as the ultimate position of the vent shaft and associated features (the headhouse and adjacent hardstanding)) as follows:

- Option A: January 2012 announced route, with a site location incorporating the demolition of 1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only) and the use of the courtyard of 9 Langtry Walk (during the construction period);
- Option B: January 2012 announced route, as well as the demolition of 2 to 62 Alexandra Place and 49 to 59 Loudoun Road and use of this area during construction. It would include closure of the whole of Alexandra Place (road) to traffic during the construction period;
- Option C: January 2012 announced route, as well as the inclusion of all/part of the Dinerman Court car park into the construction site;
- Option D: January 2012 announced route and demolition of 2 to 62 Alexandra Place and 49 to 55 Loudoun Road to create a construction site. The pavement area fronting Loudon Road would be used during construction. Closure of the northern half of the Alexandra Place public highway to traffic would also be required;
- Option E: January 2012 announced route and demolition of 9 Langtry Walk to create a construction site;
- Option F: January 2012 announced route and demolition of 154 Loudon Road, consisting 42 residential apartments, to create a construction site;
- Option G: January 2012 announced route , as well as decking over a portion of the WCML and the Euston to Watford Line (EWL)[28] to create a construction site;
- Option H: Move the location of the vent shaft onto land within the Alexandra and Ainsworth Estate (with no use of the areas described in Option A); and
- Option I: The Proposed Scheme, consisting of the January 2012 announced route with the inclusion of the pavement area fronting Loudon Road with the northern third of Alexandra Place (road).

[28] The EWL uses the same set of tracks as the NLL but the name changes from NLL to EWL west of B509 Adelaide Road (i.e. NLL at Adelaide Road, EWL at Alexandra Place).

2.6.13 The Proposed Scheme (Option I) was selected because, in comparison to the other options that were considered, it will minimise the number of demolitions required whilst providing sufficient space to carry out the construction works safely.

Middle Level No.2 Sewer (Euston to Old Oak Common)

2.6.14 The works for the Proposed Scheme will include internal strengthening of the Middle Level No.2 Sewer in Gloucester Avenue, with temporary diversion of the flow during the strengthening works. The following alternative options were also considered during discussions with TWUL:

- January 2012 announced route with no physical protection of the existing sewer, but with installation of monitoring equipment;
- temporary diversion of flow during construction (one option was considered);
- physical protection or strengthening of the sewer internally or externally (two options were considered, one of which was adopted for the Proposed Scheme);
- ground treatment between the sewer and the tunnel to limit the impacts of settlement on the sewer during tunnelling (three options were considered);
- permanent diversions of the sewer to the north and south (three options were considered, a 1.4km diversion 250m north, a diversion 800m south and a diversion adjacent to the existing sewer);
- modification of the tunnelling technique for a 250m section of the Euston tunnel north of the Euston tunnel portal (one option was considered);
- altered position of the Euston tunnel portal (three options were considered involving moving the portal north, south and west to avoid the Middle Level Sewer No.2);
- modified track alignment and layout in the approach to Euston station (a single option to allow the tracks to be deeper at the Euston tunnel portal); and
- adjustment of the platform depth or angle of approach at Euston station (two options that would have allowed the tracks to be deeper at Euston station and at the Euston tunnel portal).

2.6.15 The Proposed Scheme, internal strengthening with temporary diversion during construction, was selected primarily on the grounds of engineering benefits, cost implications and minimal impact on the construction programme or route alignment. In environmental terms, it would lead to no greater environmental effects than a number of the other alternatives considered. Options involving the diversion of the sewer along an alternative route would involve more works at the surface. This, in turn, would require disturbance of a larger area for construction leading to impacts upon landscape and visual amenity, noise and vibration, traffic and transport and community over a more extensive period than will be required for the Proposed Scheme.

Euston tunnel alignment beneath Gloucester Avenue

2.6.16 The Proposed Scheme includes a twin-bored tunnel between the Euston tunnel portal and the Adelaide Road vent shaft. The alignment of the tunnel is mainly below the route of the WCML. This reduces the number of properties on Gloucester Avenue that the tunnel passes beneath when compared to the alignment reported in the draft ES although some buildings still sit directly above or close to the tunnel. The alignment of the Euston tunnel was revised from that described in the draft ES in order to reduce the number of properties and structures that may be affected by settlement.

2.6.17 The revised alignment of the Euston tunnel has brought it closer to the Grade II* listed Camden Incline Winding Engine House vaults that are located beneath the WCML north of the Regent's Canal. The edge of the most easterly Euston tunnel will pass beneath the western edge of the vaults. There will be a vertical clearance between the Euston tunnel crown and the base of the vaults of approximately 18m. The implications of the tunnel alignment on listed structures are discussed in more detail in Section 6.

3 Agriculture, forestry and soils

3.1 Introduction

3.1.1 This environmental topic has been scoped out of the assessment for CFA3 as there are no agricultural activities, forestry activities or soils affected by the Proposed Scheme in this urban area.

4 Air quality

4.1 Introduction

4.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality arising from the construction and operation of the Proposed Scheme, covering nitrogen dioxide (NO_2), fine particulate matter (PM10 and PM2.5)[29] and dust.

4.1.2 With regard to air quality, the main potential effects are anticipated to result from the emissions of these pollutants from construction activities and equipment, road traffic and dust emissions associated with demolition, site preparation works and construction of the vent shafts.

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

- Appendix AQ-001-003;
- Map AQ-01-003 (Volume 5 Air Quality Map Book); and
- Map AQ-02-003-01 (Volume 5 Air Quality Map Book).

4.1.4 Maps showing the location of the key environmental features can be found in the Map Series CT10, Volume 2, CFA3 Map Book.

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-001-003). 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 may occur from construction activities and from changes in the nature of traffic during construction and operation. This means that in this section of the Proposed Scheme, the study area extends north to Hampstead.

4.2.3 The assessment of impacts arising from construction dust emissions has been undertaken using the methodology produced by the Institute of Air Quality Management (IAQM)[30]. It is important to note that this methodology provides a means of assessing the scale and significance of effects that is partly dependent on the approximate number of receptors within close proximity to the dust-generating activities. In doing so, it assigns a lower scale of effect to cases where the number of properties is small, e.g. fewer than 10 properties within 20m of dust-generating activities. Thus, a single property very close to a construction site cannot experience a 'significant effect' as defined by this methodology. The assessment presented here reaches a conclusion that incorporates this concept of significance being dependent

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

on the number of receptors affected. However, in cases where less than 10 properties are within 20m of the construction activity, it will still be the case that mitigation in accordance with the CoCP will be applied.

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

4.2.5 Engagement with local authorities in the Primrose Hill to Kilburn (Camden) area regarding air quality has included some discussions on air quality during meetings with LBC officers.

4.3 Environmental baseline

Existing baseline

4.3.1 The environmental baseline reported in this section represents the environmental conditions identified within the study area. The main source of existing air pollution 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. On roads where traffic flows are high, the airborne concentrations of the main pollutants are elevated substantially when compared to the 'urban background'. This is exemplified by locations near the A41 Finchley Road.

4.3.2 Estimates for NO2, PM10 and PM2.5 concentrations have been obtained from London-wide modelled pollution maps for 2008 and 2011, published by the Greater London Authority (GLA) in 2010[31]. The 2011 map has been used to characterise the baseline air quality in London, in addition to monitoring data and the background concentration maps produced nationally by the Department for Environment, Food and Rural Affairs (Defra)[32]. 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 maps provide a more spatially accurate indication of baseline conditions at a local level, although they do not go beyond 2015.

4.3.3 The Primrose Hill to Kilburn (Camden) area lies within LBC, adjoins the LBB to the west and is close to the WCC area. There are three automatic monitoring stations located in LBC and 24 diffusion tube sites measuring annual average concentrations of NO2. Neighbouring boroughs also have extensive monitoring networks, which

[31] Greater London Authority (2010), *London Atmospheric Emissions Inventory 2008*; http://data.london.gov.uk/laei-2008; Accessed July 2013.
[32] Defra (2012), Based Background Maps for NOx, NO2, PM10 and PM2.5; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed July 2013.

provide air quality data for potential receptors affected by changes in traffic flows. Full details of all pollutant concentrations measured are provided in Volume 5: Appendix AQ-001-003.

4.3.4 Data collected by the local authorities show that parts of the Primrose Hill to Kilburn (Camden) area currently experience long-term average concentrations[33] of NO2 that are above 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 study area, but monitoring and mapping data indicate that PM10 concentrations are in excess of the air quality standard at some major roadside locations.

4.3.5 LBC has designated the whole borough as an AQMA, in recognition of the widespread NO2 concentrations being above the annual average air quality standard (40µg/m^3) (see Map AQ-01-003 (Volume 5, Air Quality Map Book)).

4.3.6 There are a large number of human receptors in the study area, given its urban nature. These include the occupants and users of the many residential properties, commercial businesses and community facilities located in close proximity to either site compounds and/or roads where traffic flows will change.

4.3.7 The assessment of air quality has identified two ecological receptors within this study area. The Adelaide LNR is located immediately adjacent to the Adelaide Road vent shaft site (see Section 7) and is sensitive to dust deposition. Further away from the route, but potentially affected by construction traffic, is the Hampstead Heath Woods Site of Special Scientific Interest (SSSI)[34], which borders the B519 Hampstead Lane. This SSSI is a broad-leaved and mixed woodlands habitat, sensitive to dust and nitrogen deposition.

Future baseline

4.3.8 Volume 5: Appendix CT-004-000 identifies developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the future baseline for the assessment of effects from the construction and operation of the Proposed Scheme.

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

[33] 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.
[34] The SSSI lies outside of the study area discussed in Section 7.

Construction (2017)

4.3.10 Future background pollutant concentrations have been sourced from Defra background maps for 2017, which predict NO2 and PM10 levels 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[35] which predict NO2 and PM10 levels in 2026 to be lower than in the 2012 baseline.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 Emissions to the atmosphere will be controlled and managed during construction through the route-wide implementation of the CoCP, where appropriate. The draft CoCP includes a range of mitigation measures that are accepted 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 (LEMP), 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.

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

- contractors being required to manage dust, air pollution, odour and exhaust emissions during construction works;
- inspection and visual monitoring after consultation with the local planning authority (LPA) to assess the effectiveness of the measures taken to prevent 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 , 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.

[35] Defra (2012), Based Background Maps for NOx, NO2, PM10 and PM2.5; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed July 2013.

Assessment of impacts and effects

Temporary effects

4.4.3 Impacts from the construction of the Proposed Scheme could arise from dust-generating activities and emissions from construction traffic. As such, the assessment of construction impacts has been undertaken for human receptors sensitive to dust and exposure to NO_2 and PM10, as well as Adelaide LNR, which is sensitive to dust deposition and the Hampstead Heath Woods SSSI, which is sensitive to nitrogen deposition.

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

4.4.5 In the Primrose Hill to Kilburn (Camden) area, dust-generating activities will occur at the vent shaft construction sites at Adelaide Road and Alexandra Place. Dust emissions are most likely to be associated with demolition, site preparation works and construction of the vent shafts.

4.4.6 Given the mitigation contained within the draft CoCP, the assessment of impacts arising from dust emissions has concluded that they will be slight adverse or negligible in magnitude and that the effect on all receptors will not be significant. Further information is provided in Volume 5: Appendix AQ-001-003, which describes the scale of emissions and their proximity to receptors.

4.4.7 Construction activity could also affect local air quality through the addition of construction traffic on local roads as a result of the routeing of construction traffic and changes to traffic patterns arising from temporary road diversions. Examination of the changes in traffic flows for the construction period along the affected roads has identified numerous roads that meet the criteria for assessment. This assessment found negligible impacts at all of the 184 receptors assessed, for PM10 and PM2.5.

4.4.8 The main traffic impacts in the area arise from both construction traffic and road diversions. The A41 is used as a construction traffic route for movement of excavated material from Euston, to the M1, to sites to the north of London. Significant temporary road closures, where the diversions contribute to significant traffic impacts, include the B509 Adelaide Road, lasting for 4-6 months, and the A502 Chalk Farm Road. Whilst it is possible that the A502 Chalk Farm Road bridge works full road closure will extend for over four weeks, it is more likely to be less than four weeks. However, for the purposes of the air quality assessment, it is assumed that the closure will last for over four weeks. For NO_2, there will be some receptors along the affected roads where impacts are predicted to be moderate or substantial adverse, given the magnitude of change and the fact that the air quality standard is exceeded at these locations without the Proposed Scheme. These effects will be significant. It should be noted that these effects are predicted based on several conservative assumptions: assuming 2017 emissions; assuming the peak flows in the construction programme; and assuming that these flows are constant over the assessment period. On the roads where there are temporary closures, there will be temporary beneficial impacts on air

quality, but these have not been quantified. There are no significant effects predicted for PM10.

4.4.9 There are three areas where there are stretches of road where there will be significant temporary adverse effects. The first is associated with the transport of excavated materials, and the affected receptors are on the A41 Finchley Road between Circus Road and Boundary Road, as well as at the junction of the A41 Finchley Road and A41 Hendon Way. The second area is associated with the temporary closure of the B509 Adelaide Road, and the affected receptors are on England's Lane and on the A502 (Haverstock Hill) between the B509 (Adelaide Road) junction and the England's Lane junction. The third area is also associated with the closure of the B509 Adelaide Road and the significantly affected receptors are on the A502 Rosslyn Hill between its junction with Pond Street and Heath Street.

4.4.10 Nitrogen deposition from changes in traffic flows during construction along the B519 Hampstead Lane, close to the Hampstead Heath Woods SSSI, is predicted to be above 1% of the relevant threshold only within 10m of the road. This impact is very small, temporary and affects only a very small fraction of the SSSI. The effect will not be significant for the integrity of the site.

4.4.11 The assessment supporting these conclusions can be found in Volume 5: Appendix AQ-001-003.

Permanent effects

4.4.12 No permanent effects are anticipated to arise as a result of construction of the Proposed Scheme.

Cumulative effects

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

Other mitigation measures

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

Summary of likely significant residual effects

4.4.15 The methods outlined within the draft CoCP to control and manage potential air quality effects are considered effective for dust emissions in this location and no significant residual effects are considered likely from areas of construction activity. The construction traffic will give rise to significant temporary adverse residual air quality effects for human receptors on some routes due to increases in NO_2 concentrations at the following locations:

- A502 Haverstock Hill/Chalk Farm Road;
- England's Lane;
- at the junction of A502 Rosslyn Hill and Heath Street;

- the A41 Finchley Road (south of junction with B509 Adelaide Road); and
- at the junction of the A41 Finchley Road and Hendon Way.

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 the Primrose Hill to Kilburn (Camden) area.

Assessment of impacts and effects

4.5.2 Impacts from the operation of the Proposed Scheme will relate to changes in the volume, composition and distribution of road traffic. There are no direct atmospheric emissions from the operation of trains that will cause an impact on air quality and 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 includes the additional traffic from future committed developments (see Section 12).

4.5.4 Traffic data in the Primrose Hill to Kilburn (Camden) area have been screened to identify roads that required assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2026.

4.5.5 Two roads, the A4201 Parkway and Prince Albert Road, are predicted to have sufficiently large changes in traffic flows to meet the criteria for assessment. This assessment identified that that there will be negligible impact at receptors on the intersection of these two roads assessed for NO2, PM10 and PM2.5, with concentrations decreasing by an imperceptible amount. Further details of this assessment are provided in Volume 5: Appendix AQ-001-003.

4.5.6 Therefore, it is predicted that there will be no significant air quality effects associated with operation of the Proposed Scheme.

Cumulative effects

4.5.7 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

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

Summary of likely significant residual effects

4.5.9 No significant residual air quality effects are anticipated for air quality in this area during the 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 assessment for this study area comprise:

- impacts on residential amenity for dwellings on and around the B509 Adelaide Road;
- impacts on residential amenity for dwellings around Alexandra Place;
- demolition of a building containing 12 commercial units[36] at 61 to 83 Loudoun Road (odd numbers only) and six commercial units and two residential units at 1 to 8 Langtry Walk;
- impacts on residential amenity for dwellings on A502 Haverstock Hill/Rosslyn Hill and A41 Finchley Road; and
- impacts on amenity for users of Haverstock School and Hampstead Seventh Day Adventist Church.

5.1.3 Further details of the community assessments undertaken within the study area are contained in Volume 5: Appendix CM-001-003.

5.1.4 Significantly affected community resources are shown on Maps CM-01-007b, CM-01-008 and CM-01-009a (Volume 5, Community Map Book).

5.1.5 The current assessment draws upon information gathered from local and regional sources including LBC.

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.

5.2.2 Due to the large number and relatively high density of cafes, restaurants and public houses in the study area, impacts on these resources are only considered where the nearest alternative resources are over 1km away.

5.3 Environmental baseline

Existing baseline

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

[36] Impacts on businesses are dealt with in Section 10.

5.3.2 The study area includes the area of land required, both temporarily or 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 that could be affected by the Proposed Scheme. Overall, the study area is taken as the area of land which encompasses the likely significant effects of the Proposed Scheme. This area includes the locations where vent shafts are to be constructed on Adelaide Road and at Alexandra Place (see Map CT-05-005,Volume 2, CFA3 Map Book).

5.3.3 The study area is urban with a high density of residential dwellings interspersed with community facilities such as schools and shops. Primrose Hill open space is located to the south providing a large expanse of open space characterised by trees and grass.

5.3.4 There is a dense network of roads and an extensive rail network in the area which are described in Section 2 and Section 12.

Adelaide Road

5.3.5 The Adelaide Road vent shaft site is located south of the B509 Adelaide Road on land that slopes down to the existing operational WCML railway. It is a densely populated area. There are a number of neighbourhood centres with a wide range of convenience stores and local services in the area including health care facilities, places of worship, schools and other education facilities and Chalk Farm Branch Library on Sharpleshall Street.

5.3.6 Adelaide LNR is located immediately to the west of the land required for construction and operation of the Proposed Scheme (i.e. adjacent to the Adelaide Road vent shaft site). Adelaide LNR provides a recreational and educational resource, which is valued by the community. It comprises a summer meadow, pond, areas of scrub and a small area of woodland, and is open to the public at weekends.

Alexandra Place

5.3.7 The Alexandra Place vent shaft site is located south-west of South Hampstead station on land currently occupied by a number of commercial properties on Loudoun Road and residential dwellings and commercial properties at 1 to 8 Langtry Walk. Several of these commercial properties provide services to the community, such as a laundrette, hairdressers and a dry cleaning operation. In the vicinity of the land required for the construction and operation of the Proposed Scheme at Alexandra Place is All Souls Church on Alexandra Place, which has been converted into residential flats although the community hall is still used as a community facility, and the Ready Steady Go nursery. In addition, George Eliot Primary School on Marlborough Hill and St John's Care Centre on Boundary Road are nearby.

Future baseline

Construction (2017)

5.3.8 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. However, the existing baseline in the study area is unlikely to change as there are no committed developments that are

likely to introduce new residents or community facilities prior to commencement of construction in 2017.

Operation (2026)

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

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 Measures have been incorporated into the Proposed Scheme design as part of the design development process to avoid or minimise the adverse environmental impacts during construction. This includes moving the location of the Adelaide Road vent shaft to the east and reconfiguration of the vent shaft layout to avoid impacts on the Adelaide LNR.

5.4.2 The draft CoCP includes a range of provisions that will help mitigate community effects associated with construction within this 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 Public Rights of Way (PRoW)[37] for pedestrians, cyclists and equestrians around the perimeter of construction sites and across entry and exit points (draft CoCP, Section 5);
- a requirement for contractors to pay due consideration to the impacts of extreme weather events and related conditions which may affect community resources during construction (draft CoCP, Section 5);
- 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); and
- where practicable, the avoidance of large goods vehicles operating adjacent to schools during drop off and pick up periods (draft CoCP, Section 14).

Assessment of impacts and effects

5.4.3 Details of all assessments of community resources are included in Volume 5: Appendix CM-001-003. 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.

[37] For ease of discussion, PRoW has been used throughout the document to describe pavements alongside public highways.

5.4.4 Access rights over land are also required but will not result in loss of land from any properties in this area.

Adelaide Road

Temporary effects

Residential properties

5.4.5 The construction of the Adelaide Road vent shaft is expected to take approximately five years in two phases. Residents of approximately 145 properties at King Henry's Road, Beaumont Walk and the B509 Adelaide Road, around the construction site at Adelaide Road, are predicted to experience the following in-combination effects during construction of the Adelaide Road vent shaft:

- significant noise associated with construction activities on the site; and
- significant visual effects associated with views of construction activities.

5.4.6 The combination of these effects, which will coincide for approximately one year and three months, will have a major adverse effect on the amenity of residents, which is considered to be significant.

5.4.7 The construction of the HS1-HS2 Link tunnel portal in the adjacent Camden Town and HS1 Link area (CFA2) will result in effects on (approximately 20) residential properties at the eastern end of Adelaide Road and on Regent's Park Road. The in-combination effects will be:

- significant noise associated with construction activities over a three year period; and
- significant visual effects associated with views south-east of construction works at the HS1-HS2 Link tunnel portal.

5.4.8 The combination of the effects will coincide for approximately five months and will have a moderate adverse effect on the amenity of residents and is considered significant.

5.4.9 There is predicted to be an increase in traffic as a result of construction activities. On the A502 Haverstock Hill (between the junction of the B509 Adelaide Road and England's Lane) residential properties along the road are predicted to experience in-combination effects from a significant increase in HGV movements and significant noise and air quality effects from road traffic. Approximately 400 properties will experience these effects. Section 12 describes the periods of peak HGV movements. The combination of these effects will have a major adverse effect on the amenity of residents, which is significant.

5.4.10 Further north on the A502, the increase in traffic navigating the junction of Rosslyn Hill and Hampstead High Street/Heath Street is predicted to generate in-combination effects on residential properties near the junction. The significant increase in HGV movements will combine with significant air quality effects. Section 12 describes the periods of peak HGV movements. The combination of these effects will have a major adverse effect on the amenity of residents, which is significant.

Community infrastructure

5.4.11 The design of the Adelaide Road vent shaft has been developed to ensure its location will be outside the Adelaide LNR, on private land to the east of the LNR. Therefore, the recreational and educational resources that the LNR provides are not affected by the land required for the Proposed Scheme.

5.4.12 The construction activity at the Adelaide Road vent shaft site is expected to result in significant noise and visual effects on Adelaide LNR over a one year and three month period. The resource is currently open to the public at weekends and therefore visitors to the LNR are expected to experience these effects over the short period of their visits. Therefore any disturbance caused by construction activity is not considered significant.

5.4.13 Along the A502 Haverstock Hill (between the junction of the B509 Adelaide Road and England's Lane) significant noise effects are predicted at Haverstock School and Hampstead Seventh Day Adventist Church, combined with a significant increase in HGV movements and significant air quality effects. The majority of the activities held at the Church are at the weekend (when levels of traffic will be reduced) and the Church does run some weekday activities. The combination of effects is predicted to result in a moderate adverse effect on the amenity of users of the Church. The combination of effects on the children, staff and parents using Haverstock School is predicted to result in a major adverse effect on their amenity. The amenity effects on both the School and the Church are considered significant.

Permanent effects

5.4.14 No significant permanent effects have been identified for this area in the assessment.

Alexandra Place

Temporary effects

Residential properties

5.4.15 The construction of Alexandra Place vent shaft is expected to take approximately five years in two phases. Residents of approximately 20 properties on Loudoun Road (opposite the construction site at Alexandra Place), are predicted to experience the following in-combination effects during construction of the Alexandra Place vent shaft:

- significant construction noise associated with demolitions and construction activities; and
- significant visual effects associated with views of construction activities.

5.4.16 The combination of these effects, which will coincide for approximately eight months, will have a major adverse effect on the amenity of residents, which is considered to be significant.

5.4.17 Properties along the A41 Finchley Road, but principally near the A41 Finchley Road junction with Hendon Way and south of the junction with the B509 Adelaide Road toward St John's Wood, could experience combined effects from a significant increase in HGV movements and significant air quality effects (from vehicle emissions). The

intensity of HGV movements varies over the construction period and Section 12 provides more information on HGV movements. The combination of these effects will have a major adverse effect on the amenity of residents, which is considered to be significant.

Community infrastructure

5.4.18 There are not considered to be any significant effects on the community uses of All Souls hall on Alexandra Road.

Permanent effects

5.4.19 The construction of the Alexandra Place vent shaft will require the demolition of a building containing two residential dwellings at Langtry Walk. The permanent loss of these residential properties is not considered significant at the community level.

5.4.20 In addition, the construction works at Alexandra Place will require the demolition of a local parade of six shops at Langtry Walk, providing local services. Several of these units provide services to the community, namely a launderette, hairdressers and a dry cleaning business. Alternatives to all these services can be found on Fairhazel Gardens/Fairfax Road. Although this is within approximately 500m of Langtry Walk, launderettes are usually accessed at least weekly and the removal of this service will have an impact on the local community, particularly for those without access to private transport. Therefore, the loss of this service in this location will result in a moderate adverse effect on the community and is considered to be significant.

Cumulative effects

5.4.21 No significant temporary or permanent cumulative effects have been identified for any of the areas during construction.

Other mitigation measures

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

5.4.23 HS2 Ltd will work closely with Haverstock School and LBC to identify reasonable practicable measures to mitigate the residual significant amenity effects, including discretionary, measures identified in the draft CoCP.

Summary of likely significant residual effects

5.4.24 The permanent requirement for land at the Alexandra Place vent shaft will result in the loss of the launderette, which will affect the local community. The construction activity will also affect the amenity of residents opposite the vent shaft, on Loudoun Road.

5.4.25 Construction activity at the Adelaide Road vent shaft site will result in effects on the amenity of residents at Beaumont Walk, King Henry's Road and the B509 Adelaide Road. The amenity of residents further east on the B509 Adelaide Road and on Regent's Park Road, is also predicted to be affected.

5.4.26 The increase in traffic in the area is expected to adversely affect the amenity of residents on sections of Haverstock Hill and Rosslyn Hill, and also of those using Haverstock School and Hampstead Seventh Day Adventist Church. In addition,

residents around the A41 Finchley Road junction with Hendon Way and along the section south of the junction with B509 Adelaide Road (toward St John's Wood), are also predicted to experience adverse amenity effects.

5.5 Effects arising from operation

Avoidance and mitigation measures

5.5.1 The measures incorporated into the scheme design as part of the design development process to avoid or minimise adverse environmental impacts during operation are reported in the topics that inform the assessment of amenity.

Assessment of impacts and effects

5.5.2 No significant effects have been identified during operation.

Cumulative effects

5.5.3 No significant temporary or permanent cumulative effects have been identified for any of the areas during operation.

Other mitigation measures

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

Summary of likely significant residual effects

5.5.5 There will be no significant residual effects.

6 Cultural heritage

6.1 Introduction

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

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

6.1.3 Maps showing the location of the key environmental features can be found in Volume 2: Community Forum Area (CFA) map books. Maps showing the location of all designated and non-designated heritage assets can be found in Volume 5 Map Books: Cultural Heritage. 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-001-003 – Baseline report;
- Appendix CH-002-003 – Gazetteer of heritage assets; and
- Appendix CH-003-003 – Impact assessment table.

6.1.4 Throughout this section, assets within the study areas are identified with a unique reference code, PRMXXX; further detail on these assets can be found in the gazetteer in Volume 5: Appendix CH-002-003.

6.1.5 Engagement has been undertaken with the Greater London Archaeological Advisory Service and English Heritage historic buildings advisor for London with regard to the nature of the cultural heritage assets within the local area. In addition, engagement has also been undertaken with: the LBC conservation officer; conservation area advisory committees; and the Camden Railway Heritage Trust.

6.2 Scope, assumptions and limitations

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

6.2.2 The setting of all designated heritage assets in 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 250m. In addition, any cultural heritage assets within the 10mm settlement contour[38] are included within the assessment.

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

6.2.4 In undertaking the assessment not all areas of survey as identified in the archaeological risk model[39] were available for survey.

6.2.5 However, information from other sources of data, including the historic environment record 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-001-003.

6.3.2 In addition to collating this baseline data, walkover and site reconnaissance was undertaken 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.

Designated assets

6.3.3 The following designated heritage assets are located partially or wholly within the land required, temporarily or permanently, for the construction of the Proposed Scheme (see Volume 5, Cultural Heritage Map Book):

- two Grade II* listed buildings: Alexandra Road Estate (PRM021); and Camden Incline Winding Engine House (PRM024);
- Grade II listed buildings within the land required to construct the Proposed Scheme: 15 to 31 Gloucester Avenue (only 27 to 31 are within land required to construct the Proposed Scheme) and 1 to 15 Prince Albert Road (only 8 and 9 are within the land required to construct the Proposed Scheme);
- Grade II listed buildings within the Primrose Hill Conservation Area (PRM001);
  - Swiss Cottage Library and the Hampstead Figure Sculpture, which form a group listing (PRM029);
  - the Primrose Hill Tunnels, western entrance (PRM030), and
  - Regency Lodge (PRM069); and

[38] The area in which ground settlement arising from tunnelling or other below ground works could be more than 10mm in depth.
[39] 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.

- four conservation areas; Primrose Hill (PRM001); Eton (PRM002); Belsize (PRM003); and Alexandra Road (PRM004). For the purpose of this report these conservation areas have formed the basis of asset groupings. Details of which assets have been grouped are within Volume 5: Appendix CH-002-003.

6.3.4 The following designated assets are located within the ZTV (see Maps CH-02-003b, CH-02-003b-R1 and to CH-02-004a, Volume 5, Cultural Heritage Map Book):

- four Grade I listed buildings: Isokon Flats, which are located within Parkhill Conservation Area (PRM009); the Church of St John and the Church of St Stephen, which are both located within the Hampstead Conservation Area (PRM013); and the Church of St Martin (PRM019);
- 12 Grade II* listed buildings:
  - Belsize Fire Station in the Belsize Conservation Area (PRM003);
  - the Roman Catholic Priory Church of St Dominic in the Parkhill Conservation Area (PRM009);
  - the Church of All Hallows in the Mansfield Conservation Area (PRM010);
  - numbers 1 and 3 and attached boundary wall, Lyndhurst Terrace in the Fitzjohns/Netherall Conservation Area (PRM012);
  - number 66 Frognal, Cloth Hill, number 5 'The Mount', the Old Mansion and attached wall, railings and lamp holder and number 94 Frognal, which are all located within the Hampstead Conservation Area (PRM013); and
  - Hampstead Synagogue (PRM017); numbers 2 and 4 Redington Road (PRM018); the Primrose Hill Tunnels, eastern portals (PRM020); Church of St Silas the Martyr (PRM022); and the Black Lion Public House (PRM023).
- there are a further 220 Grade II listed buildings in most cases these are included within groupings of assets. The following eight assets are Grade II listed buildings and not grouped: Kent House (PRM025); 131 to 149 Prince of Wales Road (PRM026); Chalk Farm Underground station (PRM027); the London Drama Centre (PRM028); the Church of All Souls (PRM031); Dunboyne Road estate (PRM032); The National Club (PRM033); and the Mecca Social Club Carlton Rooms (PRM035);
- 12 conservation areas: Harmood Street (PRM006); West Kentish Town (PRM007); Elsworthy Road (PRM008); South Hampstead (PRM014); Priory Road (PRM016); St Johns Wood (PRM015); West End Green (PRM017); Redington / Frognal (PRM018); Hampstead (PRM013); South Park Hill (PRM011); Mansfield (PRM010); and Parkhill (PRM009); and
- there is one Grade II registered park and garden: Primrose Hill (PRM005).

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 the construction of the Proposed Scheme:

- Regent's Canal (PRM047); and
- Kilburn archaeological priority area and associated group of assets relating to medieval archaeology (PRM064).

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

- nine non-designated buildings of low heritage value:
  - 36 and Electricity Sub Station, Gloucester Road, Gloucester Avenue bridge and 44-46 Gloucester Avenue, which are within the Primrose Hill Conservation Area (PRM001);
  - 68-78 Adelaide Road (PRM039); 129-139 Fellows Road located within the Belsize Conservation Area (PRM003);
  - the Swiss Cottage Odeon, which forms part of an asset grouping (PRM040);
  - South Hampstead station (PRM041); 1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only) located within the Alexandra Road Conservation Area (PRM042); and
  - Kilburn High Road station, which forms part of an asset grouping (PRM045);
- the Iron Age to Roman Watling Street (PRM058), now Kilburn High Road;
- the routes of seven historic rail lines: North London Railway (PRM049); Bakerloo Line (PRM052); Metropolitan Railway (PRM055); Jubilee Line (PRM051); Great Central Railway, London extension (PRM053); London to Birmingham Railway (PRM048); the Up Empty Carriage Line (PRM056); and
- Camden Goods Depot (PRM046).

6.3.7 All non-designated heritage assets within 250m of the land required, temporarily or permanently, for the construction of the Proposed Scheme are listed in the gazetteer in Volume 5: Appendix CH-002-003 and identified on map CH-01-007b, CH-01-008 and CH-01-009a (Volume 5, Cultural Heritage Map Book). There are a number of built heritage assets, the settings of which have been considered, for example:

- the Church of All Souls (PRM031)
- the corner of B509 Adelaide Road and Regent's Park Road (PRM038);
- numbers 68 to 78 Adelaide Road (PRM039);
- numbers 17 to 18 Mortimer Crescent (PRM043);
- the Hillsborough Court (PRM044); and

- Chalk Farm station and surrounds (PRM045).

Cultural heritage overview

6.3.8 The geology underlying this part of the Proposed Scheme comprises the London Clay with no superficial deposits recorded within British Geological Survey (BGS) data. Glacial and periglacial erosion means that early prehistoric remains are not preserved in the London Clay. The land required for the construction and operation of the Proposed Scheme is located in an area extensively developed from the 19th century onwards. This is likely to have resulted in localised truncation of surface levels (ground disturbance) resulting in a loss of potential archaeology.

6.3.9 The oldest known evidence of settlement is associated with the A5 Kilburn High Road, identified as the course of Watling Street (PRM058), a major Roman road that is likely to follow the route of an earlier Iron Age trackway. The alignment of the A502 Haverstock Hill (PRM057), also possibly originates in the Roman period but generally there is very little evidence for Roman occupation. The area is likely to have remained as a rural periphery of London throughout this period.

6.3.10 The study area is located within what was Middlesex Forest during the early medieval period. Much of the forest would have been cleared throughout the medieval period in order to serve developing agricultural demands although records also indicate parts of Primrose Hill (PRM005) formed a deer park established in 1532 by Henry VIII. The park remained until the 17th century by which time the land was largely under pasture and formally given over to the public by Charles II in 1668 [40].

6.3.11 In the medieval period a priory was founded in 1130 (PRM064) on Kilburn High Road where it crossed the Kilburn Brook. The location became an established stopping point on the pilgrimage from London to St Albans. The site of Kilburn Priory is still represented on the 1746 Rocque map[41]. There was a high degree of truncation of the priory site in 1837 during the construction of a cutting for the London to Birmingham Railway (PRM048).

6.3.12 The priory was dissolved in 1535 and was replaced as a stopping point by an inn on Kilburn High Road. Through the post-medieval period a linear settlement with buildings fronting the street developed on Kilburn High Road. The Greater London Historic Environment Record lists tile production in the 15th century and brick production in the 18th century on Kilburn High Road (PRM064).

6.3.13 An analysis of historic maps indicates that the study area remained largely rural until the 19th century. The London to Birmingham Railway (PRM048) was completed in 1838 and terminated in Euston Square with the lines passing to the east of Gloucester Avenue. The gradient of the track from Primrose Hill to Euston was thought too severe for the early locomotives to ascend. To tackle the incline a steam powered apparatus (the winding house) to haul the trains out of Euston was constructed underground in a vaulted chamber to the north of the Regent's Canal. As larger, more powerful locomotives were developed, the winding engine house (PRM024) became

[40] Oswald A., (1994), *Regents Park and Primrose Hill, London Borough of Camden and City of Westminster: An archaeological assessment and field evaluation.* Royal Commission on the Historical Monuments of England.
[41] Rocque, J. (1746), *Map of London: A plan of the cities of London and Westminster, and borough of Southwark*.

obsolete and ceased operating in 1844. The vaulted chambers are still present underneath the modern electrified railway.

6.3.14 The Eton Conservation Area (PRM002) was in an area of farmland owned by Eton College (LBC 2002), which was developed by Samuel Cuming in 1845 into the Eton Estate (PRM002). Large stuccoed houses were constructed along the south of Adelaide Road but these were later demolished to enable widening of the railway (LBC 2002). The groundwork associated with the widening of the railway resulted in a high degree of truncation to the land to the south of the B509 Adelaide Road. This would have removed any potential archaeological deposits.

6.3.15 The Alexandra Road Estate Conservation Area was first developed in 1863 into a residential area of detached and semi-detached houses[42]. The land was purchased for redevelopment by LBC (formerly as Camden Borough Council) in 1966. The prominent development, which characterises the conservation area, is the Alexandra Road Estate (PRM021) a low rise, high density estate. The LBC commissioned two mixed-use blocks of housing, shops and workshops including 1 to 8 Langtry Walk/61 to 83 Loudoun Road (PRM042), which were completed in 1981. The mixed use blocks are located to the south of Alexandra Road Estate and although utilising different materials the design reflects the tiered levels characteristic of the Alexandra Road Estate.

6.3.16 New electric trains arrived into Euston in 1911 connecting suburban lines to the north. To separate the electric lines from the main line railway traffic, improvements were made to the Euston approaches. This included new twin tunnels through Primrose Hill and a system of below ground junctions at Chalk Farm. In addition, a single-track tunnel that passed under all of the other lines and the Regent's Canal was completed in 1922 and is now named the Up Empty Carriage Line (PRM056).

Future baseline

Construction (2017)

6.3.17 Volume 5: Appendix CT-004-000 provides details of the committed developments which are assumed to have been implemented by 2017.

6.3.18 None of the identified future developments affect the assessment of the Proposed Scheme's likely construction impacts on heritage assets.

Operation (2026)

6.3.19 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.

[42] Camden Council, (2000), *Conservation Area Statement: Alexander Road,* Camden Design and Print, London

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

6.4.2 The following measures have been incorporated into the design of the Proposed Scheme to reduce impacts on the character of the Eton (PRM002) and Primrose Hill (PRM001) Conservation Areas:

- a reduction of the footprint of the vent shaft at Adelaide Road; and
- the headhouse at Adelaide Road is proposed as a single storey[43] building.

Assessment of impacts and effects

Temporary effects

6.4.3 The construction works, comprising excavations and earthworks and including temporary works such as construction compounds, storage areas, and diversion of existing roads and services, have the potential to affect heritage assets during the construction period. Impacts will occur to assets both within the land required for the construction of the Proposed Scheme and assets in the wider study area due to the visibility of plant, cranes and equipment; and other construction factors.

6.4.4 Significant effects will occur as a result of temporary impact on the setting of designated heritage assets at the Alexandra Road Estate (PRM021), an asset of high value. The Alexandra Place vent shaft construction site will be surrounded by a hoarding[44], which will be visible from parts of the estate over a period of approximately five years. This hoarding will change the setting, which currently contains a mixed residential and commercial building that is consistent with the design of the estate. This will constitute a low adverse impact and moderate adverse effect.

[43] This will be 4.5m high in relation to Adelaide Road.
[44] This will be approximately 10m high in relation to the adjacent road level.

Cumulative effects

6.4.5 It is not considered that there will be any cumulative effects from temporary impacts on heritage assets within the study area.

Permanent effects

6.4.6 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

6.4.7 The non-designated asset 1 to 8 Langtry Walk/61 to 83 Loudoun Road (odd numbers only) (PRM042), an asset of low value, will be demolished during the construction of the Alexandra Place vent shaft. This will constitute a high adverse impact and moderate adverse effect.

6.4.8 A section of the non-designated Up Empty Carriage Line (PRM056)[45], an asset of low value, will be demolished during construction of the HS1-HS2 Link tunnel portal (located within the Camden Town and HS1 Link area (CFA2)). This will constitute a high adverse impact and moderate adverse effect.

Impacts on the setting of heritage assets

6.4.9 The Alexandra Place vent shaft headhouse will replace a building which is designed in a style in keeping with the character of the conservation area. The loss of this building will constitute a medium adverse impact and moderate adverse effect on the setting of the Alexandra Road Conservation Area (PRM004), an asset of moderate value.

6.4.10 The Alexandra Place vent shaft headhouse[46] will be visible from areas of the estate. The vent shaft headhouse site is currently occupied by a residential and commercial building that is consistent with the design of the estate and its replacement will change the setting. This will constitute a low adverse impact and moderate adverse effect on the setting of the Alexandra Road Estate (PRM021), an asset of high value.

6.4.11 The Adelaide Road vent shaft headhouse will not significantly affect the setting of heritage assets.

6.4.12 The remainder of the Proposed Scheme is in tunnel, with limited surface features, and will not result in a significant permanent construction effect on the setting of heritage assets.

Permanent cumulative effects

6.4.13 There are no cumulative effects on cultural heritage.

[45] The Up Empty Carriage Line is in tunnel where it will be affected by the Proposed Scheme and some of these works extend into CFA3.
[46] This will be approximately 9.7m high in relation to the adjacent road level.

Other mitigation measures

6.4.14 Refinements to the mitigation measures already incorporated into the design of the Proposed Scheme or included in the draft CoCP will be considered during detailed design to reduce further the significant effects described previously.

6.4.15 In addition, other mitigation measures to further reduce the significant effects described previously will be considered during the detailed design and will take account of heritage assets. Currently identified opportunities include:

- detailed design of the Alexandra Place vent shaft headhouse, which could retain architectural features that are characteristic of the Alexandra Road Conservation Area (PRM004). The use of materials and style could be designed to be in keeping with the Alexandra Road Estate (PRM021); and
- the scale and mass of the Alexandra Place vent shaft headhouse will be similar to 1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only) (PRM042). This would ensure no significant impacts to: The Church of All Souls (PRM031); Primrose Hill Tunnel (PRM020); and Belsize (PRM003), Alexandra Road (PRM004) and St Johns Wood (PRM015) Conservation Areas.

Summary of likely residual significant effects

6.4.16 There will be no significant effects on below-ground archaeological remains.

6.4.17 The Proposed Scheme will result in the demolition of a number of built heritage assets including 1 to 8 Langtry Walk/61 to 83 Loudoun Road (PRM042) and the partial demolition of a tunnelled section of the Up Empty Carriage Line (PRM056). A programme of built heritage works will be prepared to investigate, analyse, report and archive these assets.

6.4.18 Significant effects will occur as a result of temporary and permanent impacts on the setting of Alexandra Road Estate (PRM021) due to the construction of the Alexandra Road vent shaft headhouse. This new building will also have a permanent impact on the setting of the Alexandra Road Conservation Area (PRM004) which will be a significant effect.

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

6.5.3 As the Proposed Scheme is largely in tunnel, with limited surface features, there will be no additional noise or visual impacts from the operation of the railway. As such there will be no significant operational effects.

Cumulative effects

6.5.4 No significant cumulative effects have been identified in relation to cultural heritage.

Other mitigation measures

6.5.5 The Proposed Scheme includes a number of design measures to address potential impacts and significant effects. No additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified. Potential opportunities for further mitigation have not been identified, but will be considered as part of the detailed design process.

Summary of likely residual significant effects

6.5.6 No significant residual effects have been identified in this assessment.

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 the loss of: habitat at Chalk Farm Embankment and Adelaide Nature Reserve Site of Borough Importance Grade 1 (SBI.I); confirmed bat hibernation and summer roosts at the Up Empty Carriage Tunnel; and potential[47] bat tree roosts at the Adelaide Road vent shaft site.

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

- results of ecological surveys (Volume 5: Appendix 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, are reported in Volume 5: 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 The Proposed Scheme in the Primrose Hill to Kilburn (Camden) area is largely in tunnel, except for the above ground works at the two vent shaft sites, at Camden carriage sidings, and on existing tracks serving the WCML and NLL. In addition, works on the Up Empty Carriage Tunnel in connection with construction of the HS1-HS2 Link tunnel portal in the Camden Town and HS1 Link area (CFA2), will also involve works in the Primrose Hill to Kilburn (Camden) area (CFA3). It should be noted that the baseline

[47] A feature which is identified as being potentially suitable to support roosting bats. Potential roosts are graded as being of low, moderate or high potential to support bats depending on the likely suitability of the feature concerned.

information provided in this section does not include descriptions of designated sites, habitats and species above bored tunnel, where no impacts on ecological receptors are expected.

7.2.4 The scheme design, the urban location of the Proposed Scheme and the absence or limited extent of suitable habitats means that some species and species groups have been scoped out of the assessment. This is because the habitats that support them are not present (e.g. no natural rivers), or are considered inherently unsuitable for certain species of interest due to their man-made nature (e.g. concrete walled canals). Within this area species scoped out include badger, dormouse, otter, water vole, and white-clawed crayfish. In addition, as no impacts are expected on aquatic invertebrates and fish (including the London Canals Site of Metropolitan Importance (SMI) and the ponds at Adelaide LNR), they were excluded from the survey scope. Further information is presented in Volume 5: Appendices EC-001-001, EC-002-001, EC-003-001, and EC-004-001.

7.2.5 Access was not obtained to all the land area where general habitat survey (Phase 1 habitat survey) was proposed. Partial Phase 1 habitat survey was carried out from PRoW[48] for areas where access was not permitted. Locations with the potential to support key ecological receptors where access could not be gained for survey include Adelaide LNR, Chalk Farm Embankment and Adelaide Nature Reserve SBI.I (which partly overlaps the Adelaide LNR) and rail land to the south of B509 Adelaide Road. Access could not be gained for survey to a number of buildings and trees. Access was permitted in late February 2013 to the Up Empty Carriage Tunnel such that hibernation surveys were partial. Access for the hibernation survey was only permitted 10m into the tunnel; however it was inspected again as far as possible from the ground outside of the hibernation season. Access was gained to the Up Empty Carriage Tunnel and the Western Horse Tunnel in August 2013 and therefore summer emergence surveys were partial. No hibernation roost inspections were undertaken at the Western Horse Tunnel. Further details are provided in Volume 5: Appendices EC-001-001, EC-002-001, EC-003-001, and EC-004-001.

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

7.2.7 The precautionary approach to the assessment that has been adopted identifies 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 map series EC-01 to EC-12). Statutory and

[48] For ease of discussion, PRoW has been used throughout the document to describe pavements alongside public highways.

non-statutory designated sites are shown on Maps EC-03-003b and EC-03-004a (Volume 5, Ecology Map Book CFA3).

7.3.2 Land required for the construction of the Proposed Scheme and that adjacent to it consists of a predominantly built environment. Public green spaces[49] mostly occur in city squares, parks, public gardens, and amenity plantings around buildings. The most extensive area of such habitat is at Primrose Hill. Additional green spaces are present in private gardens.

Designated sites

7.3.3 There is one statutory designated site located within 500m of the land required for the construction of the Proposed Scheme[50]. This is the Adelaide LNR. The site comprises scrub, and part of a woodland which is dominated by the canopy species ash, sycamore and horse chestnut. The LNR is adjacent to the land required for the construction of the Adelaide Road vent shaft and is of district/borough value.

7.3.4 There are two Local Wildlife Site (LWS) relevant to the assessment in this area. These are:

- London Canals Site of Metropolitan Importance (SMI) – supports a number of scarce wetland plants and uncommon plants on banks, brickwork and towpaths. The wider canal supports bird, invertebrate, fish species. This site is within the land that may be required for utilities works[51] associated with the Proposed Scheme (though the works will not be intrusive into the water body itself) and is of county/metropolitan value; and
- Chalk Farm Embankment and Adelaide Nature Reserve SBI.I – includes Adelaide LNR and the wooded embankment to the east. The SBI.I has dense secondary woodland (to the east of the LNR) and the ground flora is dominated by ivy, bramble and common grasses. The SBI.I is within the land required for the construction of the Adelaide Road vent shaft and is of district/borough value.

Habitats

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

Woodland

7.3.6 A small area of secondary woodland, dominated by sycamore, is present on the railway embankment adjacent to the LNR and within the SBI.I. Woodland is a London Biodiversity Action Plan (BAP) habitat[52] and a Camden BAP habitat[53]. The woodland is of district/borough value.

[49] Green spaces are areas of natural or semi-natural land. For example parks, gardens and woodlands.
[50] Designated sites above the tunnel are not anticipated to be subject to impacts and as such are not included here.
[51] At this location, existing electricity cables in the Gloucester Avenue canal bridge structure will be examined and, potentially, replaced. Bats have been recorded in the area and it has been assumed that these could be present in the canal bridge, although this will need to be confirmed during future surveys.
[52] London Biodiversity Partnership (no date), *London's BAP Priority Habitats*; http://www.lbp.org.uk/londonhabspp.html#HAPlist ; accessed 11 November 2013
[53] Camden council, Camden Biodiversity Action Plan, http://camden.gov.uk/ccm/content/leisure/outdoor-camden/nature-in-camden/wildlife/introduction-to-the-camden-biodiversity-action-plan.en;jsessionid=E0266028 3A7728A22A21E404320EAC78, accessed 11 Nov '13

Grassland

7.3.7 Desk study information indicates that species-rich grassland is present in the SBI.I and the Adelaide LNR. Grassland and heath is a Camden BAP habitat. This grassland is considered likely to be of district/borough value.

7.3.8 Small areas of amenity grassland in other areas are left to grow tall as an urban wildlife enhancement. This amenity grassland is of local/parish value.

Ponds

7.3.9 Desk study has identified two small ponds in the Adelaide LNR. Standing water is a London BAP habitat. These areas have not been accessed for survey. They are likely to be of district/borough value.

Other habitats

7.3.10 All other habitats are of local/parish value or below. Full descriptions are provided in Volume 5: Appendix EC-001-001.

Protected and/or notable species

7.3.11 A summary of the species relevant to the assessment and the above ground elements of the land required for the Proposed Scheme is provided in Table 3.

Table 3: Protected and/or notable species

Species/ species group	Value	Receptors	Baseline and rationale for valuation
Birds	Up to national	Black redstart	Black redstart was not recorded during field surveys. However, further areas of habitat which are potentially suitable for black redstart, including the rail land and light industrial areas, could not be surveyed due to access restrictions. Black redstart could be present within these areas. The numbers of breeding birds in the UK are low (43 pairs)[54] and these areas are outside the known areas of higher concentrations of this species in London. However a conservative assumption that the species could be present has been made, and if present, they would represent more than 1% of the national population and therefore be of national importance.
	Local/parish	Breeding bird assemblage at Adelaide LNR and Chalk Farm Embankment and Adelaide Nature Reserve SBI.I	The Adelaide LNR Management Plan 2012-2017[55] reports a total of 19 bird species recorded during breeding bird surveys undertaken in 2011. Notable species include green woodpecker and dunnock. The restricted breeding bird community is typical of the habitats found in these urban areas. Dunnock are a species of principal importance[56].
	Up to local/parish	Wintering bird assemblage at Adelaide LNR and Chalk Farm Embankment and	No specific wintering bird surveys have been carried out. However, it is considered that the site is likely to support common species of over wintering birds, typical of the habitats found in these urban areas.

[54] Holling, M. and the Rare Breeding Birds Panel (2012), *British Birds*, *105*: p409.
[55] Lawrence, D.R. & Root, T.R. (2012) *Adelaide Local Nature Reserve Management Plan*; http://natureforthecommunity.co.uk/wp-content/uploads/2012/02/Management-Plan-Adelaide-LNR-2012-17.pdf
[56] *Natural Environment and Rural Communities Act 2006*. Section 41: Species of Principal Importance in England.

Species/ species group	Value	Receptors	Baseline and rationale for valuation
		Adelaide Nature Reserve SBI.I	
Bats	Up to regional	Bat assemblage associated with Up Empty Carriage Tunnel/Western Horse Tunnel	The Up Empty Carriage Tunnel, a large tunnel previously used for storing train carriages, runs from south-east to north-west from near Gloucester Avenue to B509 Adelaide Road. A single small vertical shaft, approximately two thirds of the way along, connects to a smaller tunnel, known as the Western Horse Tunnel, which has entrances leading to the Regent's Canal. Transect surveys along the Regent's Canal (part of the Grand Union Canal) are reported in Volume 2, CFA Report 2 and include low levels of activity from common pipistrelle with occasional passes of *Myotis* species. Access restrictions have limited the field surveys. The Up Empty Carriage Tunnel was subject to inspection and survey in February and March 2013, and July and August 2013.The Western Horse Tunnel was subject to limited inspection in July 2013 but contains features with moderate potential for summer roosts and high potential to support hibernating bats. Although the Up Empty Carriage Tunnel has fewer suitable summer and winter roost features than the Western Horse Tunnel, roosts were recorded. A single unidentified bat was found hibernating approximately 10m into the southern end of the Up Empty Carriage Tunnel, and a small number of pipistrelle bats were recorded emerging from the southern tunnel entrance indicating use as a summer roost. Static detectors were installed 30m into each end of the Up Empty Carriage Tunnel. Data recorded suggests that common pipistrelle, soprano pipistrelle and *Myotis* bats are using this tunnel for foraging and likely for commuting. High numbers of passes were recorded at both ends of the tunnel although this does not necessarily equate to large numbers of individual bats. Due to the lack of access to carry out detailed survey throughout the season it is not possible to confirm the exact nature of bat use in this tunnel complex, or the species present. The site may potentially support maternity roosts of common bats such as pipistrelles, or roosts of rarer bats and may be used for swarming. Therefore a precautionary value has been applied. Soprano pipistrelle is a species of principal importance. All bats are London BAP species.
	Up to county/ metropolitan	Pipistrelle population associated with a roost at Gloucester Avenue	Field survey has recorded the likely presence of a small summer roost of Pipistrelle sp. in the vicinity of Gloucester Avenue, either in the road bridge or an adjacent tree. Due to the lack of access to carry out detailed survey throughout the season it is not possible to confirm the exact nature of the bat use in this location. The site may potentially support a maternity roost. Therefore a precautionary value has been applied.
	Up to county/ metropolitan	Bat populations roosting in other buildings and trees in the area	Further trees, including trees within the Adelaide LNR and the SBI, and buildings and structures in this area are likely to support roosts. Due to the lack of access to carry out detailed survey it is not possible to rule out that a small number of trees and buildings potentially

Species/ species group	Value	Receptors	Baseline and rationale for valuation
			support maternity roosts of common bats such as pipistrelles, or roosts of rarer bats. Therefore a precautionary value has been applied.
	Up to local/ parish	Assemblages of bats foraging at land south of the B509 Adelaide Road	Woodland, grassland and ponds south of the B509 Adelaide Road within the SBI.I and adjacent railway land provides small areas of foraging habitat for bats. Whilst only common species have been recorded in the nearby Up Empty Carriage Tunnel to date, it is possible that larger numbers of common or rarer bats may forage in this area.
Terrestrial invertebrates	Up to county/ metropolitan	Terrestrial invertebrate assemblage at Adelaide LNR and Chalk Farm Embankment and Adelaide Nature Reserve SBI.I	Adelaide LNR and the adjacent Adelaide LNR and Chalk Farm Embankment and Adelaide Nature Reserve SBI.I have been reported to support a wide range of invertebrates in its multiple microhabitat features. This invertebrate community is considered to be of high nature conservation interest for invertebrates due to the range of species present including protected and / or notable species.
Amphibians	Up to local/ parish	Smooth newt population associated with ponds at Adelaide LNR	The desk study indicates that common amphibians including smooth newts are present in ponds at the Adelaide LNR but no records of great crested newt have been reported and the species is considered to be absent. Populations of common amphibians are uncommon in inner London. However desk study indicates small numbers are present.
Common reptiles	Up to local/ parish	Potential common reptile populations associated with Adelaide LNR and Chalk Farm Embankment and Adelaide Nature Reserve SBI.I and rail land to the south.	Field survey has shown habitats with the potential to support common reptiles are present in the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I, which encompasses the Adelaide LNR, and railway land, particularly south of Adelaide LNR. This area is relatively isolated in this urban setting with limited connectivity to other areas of railway land. It is considered that if present, reptiles would include common species in low numbers in this area. The desk study data did not include any records of reptiles in this section of the Proposed Scheme. There are no records of reptiles at the Adelaide LNR, despite the presence of suitable habitat, including tall grassland. Slow worm, adder, grass snake and common lizard are a species of principal importance and London BAP priority species.

Future baseline

Construction (2017)

7.3.12 A summary of the known developments, which are assumed to be mostly built and occupied prior to construction of the Proposed Scheme is provided in Volume 5: Appendix CT-004-000. None of these developments will affect the character and value of the baseline ecological resources.

Operation (2026)

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

7.4 Effects arising during construction

Avoidance and mitigation measures

7.4.1 The vent shaft location has been moved outside the LNR to reduce impacts on this designated site. Ecological connectivity with the woodland habitat to the east will be maintained by the creation of a green corridor to the south of the headhouse building.

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 Site preparation works for the construction of a vent shaft and headhouse building at Adelaide Road, will result in the loss of 0.33ha of Chalk Farm Embankment SBI.I, representing 37% of the site, but no habitat loss in Adelaide LNR. Construction will result in the loss of secondary woodland habitat suitable for foraging and roosting bats, breeding and wintering birds and invertebrates. In addition, the site falls within an area designated in the London Plan as an Area of Urban Ecological Deficiency[57] and there are few green spaces available for wildlife in the local area. The land required will result in a permanent adverse effect on the integrity of the site, which is significant at the district/borough level.

7.4.4 At the London Canals SMI, existing electricity cables in the Gloucester Avenue canal bridge structure will be examined and, potentially, replaced. In addition, the condition of existing electricity cables beneath the canal towpath will be monitored and potentially replaced. However, as a result of these activities, no significant effects on the integrity of the SMI are expected.

Habitats

7.4.5 Construction of the Adelaide Road vent shaft will result in the loss of approximately 0.33ha of the 0.7ha area of secondary woodland, representing 47% of this habitat. It will result in a permanent adverse effect on the conservation status of this woodland that will be significant at the district/borough level.

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

Species

7.4.7 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

[57] Greater London Authority, (no date) *Areas of deficiency in access to nature in London*; http://www.london.gov.uk/thelondonplan/maps-diagrams/map-3d-04.jsp . Accessed 11 November 2013.

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

7.4.8 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.

7.4.9 The Up Empty Carriage Tunnel works associated with the construction of the HS1-HS2 Link tunnel portal will involve the infilling of an approximate 100m section of the tunnel, which is located approximately 330m east of the Adelaide Road vent shaft site[58], and will include temporary disturbance to the foraging areas at the tunnel entrances. The associated preparation works will remove approximately 100m of the tunnel for the use of bats, which have been recorded hibernating and summer roosting. These works will also likely alter the humidity and air flow in the Up Empty Carriage Tunnel and potentially the Western Horse Tunnel which may also support hibernating and summer roosting bats. The loss of bat hibernation and summer roost habitat and use as a swarming site will result in a permanent adverse effect on the assemblage of bats utilising the tunnel, which following a precautionary assessment will be significant at up to a regional level.

7.4.10 Site preparation works for the construction of the Adelaide Road vent shaft and headhouse structure, works at the Camden carriage sidings, and potential utilities works in the Gloucester Avenue canal bridge area, will involve the demolition of buildings, disturbance of structures and the removal of trees, with the potential to support bats and therefore could result in the loss of roosts. This includes potential roosts in trees at the Adelaide Road vent shaft site and a likely roost identified in the Gloucester Avenue area[59]. Whilst there are alternative roost sites in the area, the loss of buildings and trees has the potential to have a permanent adverse effect on the local bat assemblage populations, which would be significant at up to the county/metropolitan level.

7.4.11 Construction of the Adelaide Road vent shaft will result in the loss of woodland habitat east of Adelaide LNR in the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I, which has the potential to support protected and/or notable terrestrial invertebrates. There are small areas of woodland habitat retained to the east and further scrub and grassland habitat to the south and west. Nevertheless, the loss of woodland habitat will result in a permanent adverse effect on the assemblage of terrestrial invertebrates, which will be significant at up to a district/borough level.

7.4.12 The rail upgrade works at Camden carriage sidings and works on the Up Empty Carriage Line may remove small areas of foraging and potential nesting habitat that are suitable for black redstart. However, there is extensive alternative nesting habitat in the area and the habitat loss is therefore not considered to affect the conservation

[58] See Volume 2, CFA Report 2 for more information on these works.
[59] This was identified in the vicinity of the Gloucester Avenue bridge over the canal, although the precise location of the roost was not determined and could be in the bridge structure, or other features, such as nearby trees or buildings.

status of any population that may be present. In addition, the draft CoCP includes controls to prevent the disturbance of breeding birds during construction. The loss of habitat will not result in a significant effect on the conservation status of black redstart.

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

Other mitigation measures

7.4.14 This section describes additional measures designed to reduce or compensate for significant ecological effects. These include habitat restoration and management and enhancement measures at Adelaide LNR and Chalk Farm Embankment and Adelaide Nature Reserve SBI.I.

7.4.15 Bats will be excluded from the Up Empty Carriage Tunnel prior to construction works in accordance with best practice to minimise impact. Works will be conducted under licence and seasonally timed to minimise impacts.

7.4.16 Much of the existing tunnel lining at both ends of the Up Empty Carriage Tunnel will not be removed during the works, which will retain existing bat roosts following construction. Measures to allow the continued safe passage of bats through the Up Empty Carriage Tunnel and reinstate the required conditions in accordance with best practice to minimise impact.

7.4.17 The provision of additional appropriate roost features will be implemented in the Up Empty Carriage Tunnel in accordance with the ecological principles of mitigation in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

7.4.18 Compensatory roosts for the loss of any building and tree roosts found to be present will be provided, either in trees within the land south of Adelaide Road or in the Gloucester Avenue road bridge, in accordance with the ecological principles of mitigation in the SMR Addendum (Volume 5: Appendix CT-001-000/2).

7.4.19 Following the implementation of these measures proposed, 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 populations concerned.

7.4.20 Mitigation and compensation for the loss of habitat at Chalk Farm Embankment and Adelaide Nature Reserve SBI.I will be provided. HS2 Ltd will continue to explore the potential for a funding agreement with LBC for the management and enhancement of Adelaide LNR and the retained area of Chalk Farm Embankment and Adelaide Nature Reserve SBI.I. Key management measures discussed in the management plan include the enhancement of existing ponds, grassland and hedgerow habitat and the provision of additional features for species including terrestrial invertebrates. This will mitigate the loss of the designated site reducing the effects to a level that is not significant.

7.4.21 Mitigation for the loss of 0.33ha of secondary woodland in Adelaide Nature Reserve and Chalk Farm Embankment SBI.I will include the reinstatement of approximately

0.2ha to native broad-leaved woodland, and management until it becomes established. The woodland will be enhanced with the creation of a native shrub understorey and wildflower grassland field layer. Additional features will be included to enhance the biodiversity of the reinstated woodland such as log piles, bat and bird boxes. In addition the enhancement measures at Adelaide LNR and the retained area of Chalk Farm Embankment and Adelaide Nature Reserve SBI.I will improve the integration of the woodland into the wider complex of habitats. This will reduce the significance of the effect on the area of woodland to insignificant.

7.4.22 Mitigation for the loss of habitat for terrestrial invertebrates will be through the restoration of native woodland following the temporary works in the SBI.I. This will restore high-quality habitat, which will also include enhancement features for invertebrates by way of compensation including log piles. HS2 Ltd will continue to explore the potential for a funding agreement with LBC for management and enhancement measures at Adelaide LNR. This is likely to include creation of additional features for terrestrial invertebrates. These measures will compensate for the loss of habitat at the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I and provide new habitat for terrestrial invertebrates thus reducing the effects to a level that is not significant.

7.4.23 Following incorporation of these measures, any effects on conservation status of the populations concerned are likely to reduce to a level that is not significant.

Summary of likely residual significant effects

7.4.24 The mitigation, compensation and enhancement measures described above will reduce the effects to a level that is not significant at the construction stage.

7.5 Effects arising from operation

Avoidance and mitigation measures

7.5.1 Measures that have been included as part of the design of the Proposed Scheme and avoid or reduce impacts on features of ecological value include noise attenuation in the vent shaft design, which means noise will only be emitted during testing, or an emergency, which would avoid significant disturbance to sensitive species including breeding birds.

Assessment of impacts and effects

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

Other mitigation measures

7.5.3 No additional mitigation measures for the operational stage are required.

Summary of likely residual significant effects

7.5.4 Taking into account mitigation, compensation and enhancement proposed, no significant residual ecological effects during operation are predicted.

8 Land quality

8.1 Introduction

8.1.1 This section of the report presents the baseline conditions that exist along the Proposed Scheme 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 environments and what needs to be done to prevent such contamination.

8.1.3 The main environmental features of this area include:

- residential areas of land; and
- the Grand Union Canal (also known locally as the Regent's Canal).

8.1.4 The main land quality issues in this area include:

- the presence of a motor vehicle repair garage and railway land adjacent to the proposed Adelaide Road vent shaft site; and
- the dry cleaning business and adjacent railway land at the proposed Alexandra Place vent shaft site.

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-001-003: 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 LBC, the Environment Agency and the Petroleum Officers (London Fire Brigade) in relation to information held on land contamination. Relevant information from the LBC planning portal was also reviewed. Information provided is described in Volume 5: Appendix LQ-001-003. Information sought has been incorporated where received.

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 (see Volume 5: Appendix CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2). This section follows the standard assessment methodology.

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

8.2.3 With respect to land quality issues, utility works within the highway are a low-risk construction activity, as most of the excavation works will be within the highway construction layers, and reinstatement will be made with highway construction materials.

8.2.4 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. However, the purpose of site visits is to verify desktop information and the lack of complete site walkovers is considered unlikely to have substantially affected the land quality assessment.

8.3 Environmental baseline

Existing baseline

8.3.1 Unless otherwise stated, all features described in this section are presented in Maps LQ-01-003b and LQ-01-004a (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-02-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

8.3.3 The presence of made ground is not indicated on BGS mapping[60], but a cover of made ground will potentially be present throughout the study area due to previous cycles of development, in particular on railway land where embankments or track bed materials have been placed.

8.3.4 Geological mapping indicates that there are no superficial deposits in this area.

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

8.3.5 The bedrock geology underlying the entirety of the Primrose Hill to Kilburn (Camden) area is the London Clay Formation of the Thames Group.

8.3.6 Typically, this is a stiff, grey (weathering to brown) clay with thin beds of sand and pebbles at the base. The deepest parts of the Proposed Scheme in this area will be constructed within the London Clay Formation.

8.3.7 The geological succession beneath the London Clay comprises, in turn, the:

- Harwich Formation (potentially only locally): a very thin sandy deposit;
- Lambeth Group (also termed the Woolwich and Reading Formations) which comprises a mixture of clay, sand and occasional pebble beds;
- Thanet Sand Formation a dense green sand; and
- Cretaceous Chalk Group, which is a succession of soft white limestones.

Groundwater

8.3.8 The London Clay Formation that is present beneath the study area has been designated by the Environment Agency as unproductive strata (i.e. it is not a usable groundwater resource).

8.3.9 In the London area, the lower part of the Lambeth Group, the Thanet Sand Formation, and the Chalk are collectively known as the 'lower aquifer'. Specifically the Chalk is designated as a Principal aquifer by the Environment Agency (and thus may be regarded as an important groundwater resource). The deepest excavations during construction of the Proposed Scheme will be within the London Clay and so will not affect abstractions in the lower aquifer.

8.3.10 A single licensed groundwater abstraction has been identified in the area. This is located in South Hampstead, west of Winchester Road and is potentially intersected by the route.

8.3.11 There is one groundwater abstraction from the Chalk aquifer for public water supply near Primrose Hill, north of Prince Albert Road. The route is located within the outer Source Protection Zone (SPZ) related to this abstraction.

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

Surface waters

8.3.13 The route will pass in tunnel beneath Regent's Canal near Fitzroy bridge (Gloucester Avenue). There are no other surface water bodies in the study area.

8.3.14 There are no surface water abstractions located on or within 250m of the route.

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

8.3.16 Surface water features are shown on Map WR-01-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

Current and historical land use

8.3.17 There are a number of current potentially contaminative land uses within the limits of the study area. These were identified by a review of current and historical mapping, inspection of regulatory data and a site reconnaissance of the study area from publicly accessible areas.

8.3.18 During site reconnaissance a number of warehouses, depots and light commercial units were observed in the Chalk Farm area as shown on Map LQ-01-003b, G4 (Volume 5, Land Quality Map Book). Additionally, a rail corridor is present adjacent to B509 Adelaide Road and parallel to Belsize Road, as shown on Map LQ-01-003b, E4 (Volume 5, Land Quality Map Book). A vehicle MOT testing garage was observed within 50m of the proposed Adelaide Road vent shaft site, as shown on Map LQ-01-003b, E4 (Volume 5, Land Quality Map Book) and a dry cleaning business noted within land required to operate the Proposed Scheme at Alexandra Place, as shown on Map LQ-01-003b, B6 (Volume 5, Land Quality Map Book).

8.3.19 Historical mapping indicates land use in the study area principally comprised housing and areas of farmland during the late 19th century with the development of residential areas having occurred more recently.

8.3.20 Railway land has existed since the 1850s and has not changed appreciably in use since that time.

8.3.21 A small number of industrial sites have been present in the study area in the past. Potential sources of contamination include former chemical works, metal plating works, printing works and electrical works. None of these were located within 50m of the land required to construct the Proposed Scheme.

8.3.22 There are no identified contamination sources within the proposed Adelaide Road vent shaft site. Nearby potential sources are limited to those identified during site reconnaissance.

8.3.23 In addition to the potentially contaminative land uses identified at the Alexandra Place vent shaft site during site reconnaissance, other sources in the vicinity relate to former fuel stations and former printing works shown on historical mapping (see Map LQ-01-003b, B6 and B7 (Volume 5, Land Quality Map Book)).

8.3.24 Contaminants commonly associated with the identified land uses could include various metals, semi-metals, organic and inorganic compounds.

8.3.25 Where present, contamination sources within the study area are all underlain by the low permeability London Clay. The London Clay is known to provide an effective barrier to contaminant migration and any contamination, if present, is likely to be localised.

8.3.26 No apparent significant sources of land gas (such as landfill sites) have been identified in this study area.

Other regulatory data

8.3.27 Regulatory data reviewed include pollution incidents, radioactive and hazardous substances consents and environmental permits (previously known as landfill,

Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) licences).

8.3.28 A single data entry was recorded within the land required to construct the Proposed Scheme and relates to the control of air pollution associated with the dry cleaning business at the proposed Alexandra Place vent shaft.

8.3.29 Several further entries are also located within the wider study area, predominantly relating to local authority pollution control licences associated with various operational dry cleaners and fuel stations.

Mining and mineral areas

8.3.30 There are no mining or mineral extraction sites within the study area. There are no minerals safeguarding areas or planned extraction sites indicated by the mineral planning authority to be present within the study area.

Geo-conservation areas

8.3.31 Supplementary planning guidance issued by the London Geodiversity Partnership indicates that there are no current or potential geological designations within the study area[61].

Receptors

8.3.32 The sensitive receptors that have been identified within this study area are summarised in Table 4.

Table 4: Summary of receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land contamination	People	Residents	High
		Workers	Medium
	Controlled waters	Regent's Canal	High
	Built environment	Buildings and property	Low to high
		Underground structures and services	Low

Future baseline

8.3.33 As part of the assessment of potential future baselines, a search was undertaken of planning permissions within the study area. There are currently no identified committed development sites within the study area that are likely to change the land quality baseline before or during construction or operation of the Proposed Scheme. Any committed development sites identified are all located outside of the land required to construct the Proposed Scheme and thus considered unlikely to be able to affect land quality within the Proposed Scheme.

[61] BGS/Natural England/Mayor of London (2012), *Green Infrastructure and Open Environments: London's Foundations: Protecting the Geodiversity of the Capital, Supplementary planning guidance.* London, Greater London Authority.

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, gases and vapours (draft CoCP, Sections 5, 7, 13 and 15);
- methods to control spillage and prevent contamination of adjacent areas (draft CoCP, Section 5);
- the management of human 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 prior to and during construction a programme of further investigations, which may include both desk-based and site-based work, will take place in order to confirm the full extent of areas of contamination and a risk assessment undertaken to determine what, if any, site specific remediation measures will be required to allow the Proposed Scheme to be constructed safely and to prevent harmful future migration of contaminants (draft CoCP, Section 11). The investigation and detailed assessment of potentially contaminated sites will be undertaken in accordance with:

- Environment Agency CLR11 'Model Procedures for the Management of Land Contamination' (2004)[62]; and

[62] Environment Agency (2004), *CLR11 Model Procedures for the Management of Land Contamination*.

- British Standard BS10175 'Investigation of Potentially Contaminated Sites' (2011)[63].

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)[64]. 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 reuse) or to an appropriately permitted landfill.

Assessment of impacts and effects

8.4.5 The Proposed Scheme in this area will largely comprise excavation of the Euston and HS1-HS2 Link tunnels within the underlying London Clay Formation. In addition to the large scale below ground works, a vent shaft will be constructed on a wooded slope, part of the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I, adjacent to the existing railway corridor[65] and the B509 Adelaide Road. A second vent shaft will be constructed at Alexandra Place (Langtry Walk/Loudoun Road).

8.4.6 Construction at both locations will involve excavation of underlying soils and the creation of the vent shafts, the foundations for headhouse buildings and tunnels connecting the base of the vent shafts with the Euston and HS1-HS2 Link tunnels. At the Adelaide Road vent shaft site, construction will involve disturbance of made ground as well as the deeper excavations within the London Clay Formation.

8.4.7 Construction at either vent shaft location will not disturb the ground beneath the London Clay.

8.4.8 Construction compounds within the study area are limited to the two vent shaft sites and the Camden carriage sidings near Gloucester Avenue (see Section 2.3).

Land contamination

8.4.9 In line with the assessment methodology, as set out in the SMR, the SMR Addendum and its appendices, an initial screening process was undertaken (identified in the methodology as Stages A and B) to identify areas of current or historical contaminative use within the study area and to consider which of these areas might

[63] British Standard Institute (2011), *British Standard BS10175 Investigation of Potentially Contaminated Sites*.
[64] Sustainable Remediation Forum UK (2010), *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation*.
[65] The railway corridor is in a cutting at this location and the Adelaide Road vent shaft site is on NR owned land, which slopes down from the B509 Adelaide Road to the existing operational rail corridor.

pose contaminative risks for the Proposed Scheme. In total, 72 areas were considered during this screening process; eight of these areas were taken forward to more detailed risk assessments (Stages C and D), in which the potential risks were assessed more fully. All areas assessed are shown on Maps LQ-01-003b and LQ-01-004a (Volume 5, Land Quality Map Book) and those considered as potentially posing a risk to the Proposed Scheme are labelled with a reference number.

8.4.10 Conceptual site models (CSM) have been produced for the eight areas taken to Stage C and D assessments. The detailed CSM are provided in Volume 5: Appendix LQ-001-003 and the results of the baseline risk assessments are summarised in this section. Potentially contaminated sites 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 route or associated offline works; e.g. roads;
- the vertical alignment, i.e. whether the route is in cutting, on embankment or in tunnel;
- the presence of underlying Principal or Secondary A aquifers or nearby watercourses; and
- the presence of adjacent residential properties or sensitive ecological receptors.

8.4.11 A summary of the baseline CSM is provided in Table 5. 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 5: Summary of baseline CSM for sites that may pose a contaminative risk for the Proposed Scheme

Area reference[1]	Area name[2]	Main potential impacts	Main baseline risk[3]
3-25, 3-02	Existing rail land overlying the London Clay Formation and adjacent to the proposed Adelaide Road and Alexandra Place vent shaft sites, at the Camden carriage sidings, and within the WCML/NLL railway corridors. (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property from contaminants in soil	Low
3-09, 3-21, 3-50, 3-58, 3-72	Historical or current off-site or adjacent contaminative land uses overlying London Clay (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property	Low

Area reference[1]	Area name[2]	Main potential impacts	Main baseline risk[3]
		from contaminants in soil.	
3-73	Existing on-site dry cleaning business at the Alexandra Place vent shaft (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property from contaminants in soil.	Low

(1) Each area is assigned a unique identification number (See Volume 5, Appendix LQ-001-003).
(2) CSMs have been prepared as part of the detailed land contamination methodology (refer to Volume 5) for baseline, construction and post-construction.
(3) The moderate or high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high or moderate existing baseline risk, in the absence of site investigation a precautionary, worst case risk is reported in the table.

Temporary effects

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

8.4.13 Table 6 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. The details of these comparisons are presented in Volume 5: Appendix LQ-001-003.

8.4.14 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 6: Summary of temporary (construction) effects

Area reference	Area name	Main baseline risk	Main construction risk [1]	Temporary effect and significance
3-25, 3-02	Existing rail land overlying the London Clay Formation and adjacent to the proposed Adelaide Road and Alexandra Place vent shaft sites, at the Camden carriage sidings, and within the WCML/NLL railway corridors. (Map LQ-01-003b, Volume 5, Land Quality	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 property from	Moderate/low Low	Negligible (not significant)

Area reference	Area name	Main baseline risk	Main construction risk [1]	Temporary effect and significance
	Map Book)	contaminants in soil = low		
3-09, 3-21, 3-50, 3-58, 3-72	Historical or current off-site or adjacent contaminative land uses overlying London Clay (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property from contaminants in soil = low	Moderate/low Low	Negligible (not significant)
3-73	Existing on-site dry cleaning business at the Alexandra Place vent shaft (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property from contaminants in soil = low	Low Low	Negligible (not significant)

(1) 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.

8.4.15 Table 6 indicates that based upon the assessment, no significant effects have been identified during the construction phase, in relation to potential land contamination. However, risks have been identified, which relate to on-site human health where historical and current potentially contaminating uses are intersected by the Proposed Scheme, principally the dry cleaning business at Alexandra Place. These risks will be addressed by the implementation of the measures detailed in the draft CoCP.

8.4.16 Construction 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 implementation measures outlined in the draft CoCP will manage risks from the storage of such materials.

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

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

Permanent effects

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

8.4.20 Table 7 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 001-003.

Table 7: Summary of permanent (post-construction) effects

Area reference	Area name/type	Main baseline risk	Main post-construction risk	Post-construction effect and significance
3-25, 3-02	Existing off-site rail land overlying the London Clay Formation and adjacent to the proposed Adelaide Road and Alexandra Place vent shaft sites. (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property from contaminants in soil and surface water/groundwater = low	Moderate/low Low	Negligible (not significant)
3-09, 3-21, 3-50, 3-58, 3-72	Historical or current off-site or adjacent contaminative land uses overlying London Clay (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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 property from contaminants in soil and surface water/groundwater = low	Moderate/low Low	Negligible (not significant)
3-73	Existing on-site dry cleaning business at the Alexandra Place vent shaft site (Map LQ-01-003b, Volume 5, Land Quality Map Book)	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	Very low	Negligible to minor beneficial (not significant)

Area reference	Area name/type	Main baseline risk	Main post-construction risk	Post-construction effect and significance
		waters = low Potential impact on property from contaminants in soil = low	Low	

8.4.21 The magnitude of the permanent effects and their significance have been determined by calculating the change in risk between the main baseline risk and the main post-construction risk. Therefore, where there is no change between the main baseline risk and the main post-construction risk, the permanent effect significance is deemed to be negligible even if the risk is assessed to remain as high. This 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.

8.4.22 Table 7 indicates 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. A minor beneficial effect will be related to the removal or isolation of any contaminants associated with the dry cleaning operation and proposed vent shaft construction at Alexandra Place.

8.4.23 There will be a negligible effect on all sites identified as posing a contaminative risk that are located outside of the area required to construct the Proposed Scheme as these will be unchanged throughout the construction phase and into operation.

Mining/mineral sites

8.4.24 There are no mining or mineral sites or minerals safeguarding areas located within this study area.

Geo-conservation sites

8.4.25 There are no geo-conservation sites located within this study area.

Other mitigation measures

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

Summary of likely significant residual effects

8.4.27 With the application of the mitigation measures detailed above, there are likely to be no significant residual effects.

8.5 Effects arising from operation

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

Avoidance and mitigation measures

8.5.2 Maintenance and operation of the Proposed Scheme will be in accordance with environmental legislation and good practice whereby appropriate spillage and pollution response procedures will be established.

Assessment of impacts and effects

8.5.3 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.

8.5.4 It is unlikely that there will be any cumulative effects on land quality receptors due to the environmental controls that will be placed on operational procedures.

Other mitigation measures

8.5.5 No other mitigation measures will be required.

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

Summary of likely significant residual effects

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

9 Landscape and visual assessment

9.1 Introduction

9.1.1 This section reports the assessment of the likely significant landscape and visual effects. It starts by describing 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 (LCA) 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 Principal landscape and visual issues in the area include:

- temporary effects on LCA and visual receptors during construction arising from the demolition of buildings, the removal of existing vegetation, the presence of construction plant, activity and traffic and the re-routeing of traffic and footways;
- permanent effects on LCA and visual receptors during operation arising from the presence of the HS1-HS2 Link tunnel portal headhouse (approximately 4.5m high) on the site of the former Primrose Hill station (in CFA2), the vent shaft headhouse (approximately 4.5m high), hardstanding, lighting and security fencing at the B509 Adelaide Road and the vent shaft headhouse (approximately 9.7m high) at Alexandra Place[66]; and
- effects will also arise from the loss of open space and vegetation at the B509 Adelaide Road and the loss of active frontage provided by shops and businesses on Regent's Park Road[67] and Langtry Walk, due to the demolition of the existing buildings on the sites.

9.1.4 A separate, but related, assessment of effects on the setting of heritage assets is included in Section 6. Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in Volume 5: Appendix LV-001-003, 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 effects that are not significant.

9.1.5 The extent of the landscape and visual study area, the distribution of visual receptor viewpoints and the location of verifiable photomontages has been discussed with the LBC, WCC and the GLA. Summer field surveys, including photographic studies of LCA

[66] Both headhouse heights are in relation to road level.
[67] This road forms the boundary between CFA3 and CFA2 (see Map CT-06-003, Volume 2 CFA3 Map Book).

and visual assessment of viewpoints, were undertaken from May to October 2012 and from May to June 2013. Winter surveys were undertaken from December 2012 to March 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-0001-000/1) and the SMR Addendum (Volume 5: Appendix CT-0001-000/2). 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-07-002c to LV-07-006a and LV-08-002c to LV-08-006a (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-0001-000/2), and is an indication of the theoretical visibility of the Proposed Scheme. In some locations, extensive vegetation cover will mean that the actual visibility is substantially less than that shown in the ZTV and professional judgement out on site has been used to refine the study area to focus on likely significant effects. Tall construction plant (e.g. cranes and piling rigs) is excluded from the ZTV for the construction phase and OLE is excluded from the ZTV for the operational phase, but these are described and taken into account in the assessment of effects on LCA and visual receptors.

9.2.3 LCA and visual receptors within approximately 500m of the Proposed Scheme have been assessed. In addition, at the request of stakeholders, long distance views of up to 2km have been considered from Primrose Hill as these are designated views identified in the London View Management Framework (LVMF) Supplementary Planning Guidance (SPG)[68].

Assumptions

9.2.4 Utility works have been assessed on the available information about the scale and duration of excavations. Utilities works will be temporary in nature and are a common-place occurrence in urban areas. Trees will be retained where possible, in line with the draft CoCP (Section 12), and disturbance minimised. Where vegetation is removed, there will be appropriate replanting.

Limitations

9.2.5 During the baseline survey there were some areas that 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.

[68] Greater London Authority (2012), *London Plan: London View Management Framework, Supplementary Planning Guidance, London.*

9.3 Environmental baseline

Existing baseline

Landscape baseline

9.3.1 Land use within this densely developed inner-city environment includes extensive areas of 19th and 20th century housing, industry and commercial development. The WCML and the London Overground run along a single railway corridor through the area, south of B509 Adelaide Road and B509 Belsize Road in cutting and tunnel. Main roads include the B509 Adelaide Road, B509 Belsize Road, A502 Chalk Farm Road and A41 Finchley Road. The land rises gradually towards the north-west but the topography is largely masked by the overlying urban development. The 25ha Grade II registered[69] Primrose Hill is the largest public open space in the area with panoramic views across central London from its highest point at 64m AOD. The Adelaide LNR and adjacent Chalk Farm and Adelaide Nature Reserve SBI are situated on a sloping railway embankment south of B509 Adelaide Road. The study area includes six conservation areas and the intact nature and high quality of the architecture of many of its residential streets contribute to its distinctive urban character and sense of place.

9.3.2 The LCA have been determined with reference to the London Landscape Framework[70].

9.3.3 Descriptions of all LCA are provided in Volume 5: Appendix LV-001-003, Part 2. For the purposes of this assessment the study area has been subdivided into eight discrete LCA, two of which are most likely to be significantly affected. A summary of these LCA is provided in the following paragraphs. The LCA are shown in Maps LV-02-002c to LV-02-006a (Volume 5, Landscape and Visual Assessment Map Book).

Eton and Primrose Hill residential LCA

9.3.4 This LCA includes parts of the Eton and Primrose Hill Conservation Areas. Development is largely residential and the street trees and vegetation growing in gardens give the area a verdant quality. Housing south of the B509 Adelaide Road and south of the WCML corridor ranges from large, 19th century three- and four-storey terraced houses to two storey artisan cottages. North of the B509 Adelaide Road, in the Eton Conservation Area, are Italianate villas and terraces, built after the opening of the railway line in 1837. The pattern of development changed in the 20th century with the construction of substantial blocks of flats on Haverstock Hill and Adelaide Road. These break the otherwise regular street pattern of the older villas and terraces. The high street shops at the northern end of Regent's Park Road and the businesses in the former Primrose Hill station building on Bridge Approach contribute to activity in the streets. The overall landscape condition is good. The Regent's Park Road bridge is closed to vehicles and as a result, the area to the south feels more secluded. A red brick wall runs along the top of the vegetated slope on the southern side of Adelaide Road (adjacent to the Adelaide LNR and Chalk Farm and Adelaide Nature Reserve

[69] English Heritage (no date), Register of Parks and Gardens of Special Historic Interest in England; http://www.english-heritage.org.uk/caring/listing/registered-parks-and-gardens/ ; Accessed 11 November 2013.
[70] Natural England (2011), *London's Natural Signatures: The London Landscape Framework*.

SBI.I). The WCML and London Overground rail corridor passes in cutting through the centre of the LCA along the southern base of the slope. Adelaide Road is a busy main road, with buses and through traffic, but other streets in the area are noticeably quieter. Overall tranquillity is medium. This LCA is of borough value due to the high quality of the architecture and its conservation area status. It has a high sensitivity to change.

South Hampstead Station LCA

9.3.5 The Alexandra Road Estate is Grade II* listed and forms part of the Alexandra Road Conservation Area. The estate, designed by LBC architects in the 1970s, is a largely intact example of Modernist, post-war housing design. It is laid out on a gentle curve with numerous changes of levels, steps, ramps, aerial walkways and light wells and was constructed in concrete and render. A concrete ramp and planter provides the pedestrian link between the Alexandra Road Estate and Loudoun Road. The red brick building on the corner of Loudoun Road and Alexandra Place (1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only) is in the Alexandra Road Conservation Area but it was built after the Alexandra Road Estate and in a different architectural style. Its façades are broken up by windows, doors and shop fronts; the building varies in height, rising from two storeys to four storeys. The shops and small businesses on the ground floor contribute to activity in the street. The building to the west (9 Langtry Walk) is currently used as a refugee centre and there are a small number of trees growing in the courtyard of the centre and along Langtry Walk. The 19th century Grade II listed Church of All Souls building is on the corner of Alexandra Road and Loudoun Road. The entrance to South Hampstead station is on the north side of the bridge over the WCML and London Overground, which pass through the area in cutting. Schools and residential tower blocks in the south of the LCA are set within well vegetated grounds, which contribute to the verdant quality of the area. The overall condition of the LCA is fair. At night, the area is generally well lit by street lighting and light spill from buildings. Residential areas are quieter than the busy main roads, which include the A41 Finchley Road, but overall, tranquillity is low. This LCA is of borough value due to the high architectural quality of the Alexandra Road Estate and its conservation area status. Outside the conservation area, the built environment lacks its uniformity of architectural style or quality. The area has a medium sensitivity to change.

Visual baseline

9.3.6 Descriptions of the identified representative viewpoints are provided in Volume 5: Appendix LV-001-003 Part 2. A summary description of the distribution and types of receptors most likely to be affected is provided in the following paragraphs. The viewpoints are shown in Map Series LV-03-002c to LV-03-006a and LV-04-002c to LV-04-006a (Volume 2, Map Book CFA3). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 1: Protected views, 2: Residential, 3: Recreational and tourist 4: Transport.

9.3.7 The view from Primrose Hill looking south-east towards St Paul's Cathedral is a protected view (LVMF 4A.1) in the LVMF SPG and a designated view on the Camden

LDF proposals map[71]. The view from Fitzroy Road looking north-east towards the Roundhouse is a protected view in the Primrose Hill Conservation Area Statement[72]. The view from Rowley Way looking north-east is a protected view in the Alexandra Road Conservation Area Statement[73]. The protected LVMF view is shown on Map LV-05-003 (Volume 5, Landscape and Visual Assessment Map Book).

9.3.8 Residential receptors have a high sensitivity to change and are located on Bridge Approach, Gloucester Avenue, Eton Road, Primrose Hill Road, Adelaide Road, King Henry's Road, Alexandra Place, Loudoun Road, Hilgrove Road and Belsize Road. Views are typically urban in character obtained over garden and railway embankment vegetation and along tree-lined streets.

9.3.9 Recreational receptors, also with a high sensitivity to change, are located on Primrose Hill. Foreground views are of trees and open space but longer views towards central London and the City are urban in character and typically include housing, office buildings and transport infrastructure.

9.3.10 Commuters travelling along the urban streets and people at work or attending educational institutions generally have a low sensitivity to change. People travelling through residential areas have a medium sensitivity to change. They are mostly located in Parkway, Alexandra Road, Loudoun Road and Fairfax Road. Views are typically urban in character and include housing, industrial or commercial premises, high street shops, street trees and transport infrastructure.

Future baseline

9.3.11 A summary of the committed developments that are assumed to be built and occupied prior to either the construction or operation of the Proposed Scheme is provided below, along with the consequential effect on the character of LCA and nature of views. These developments are shown on Maps CT-13-03b to CT-13-04a (Volume 5, Cross Topic Map Book).

Construction (2017)

9.3.12 There are a number of mixed-use, residential and educational developments within the study area, which are assumed to be built and occupied by 2017. They include the redevelopment of buildings at 2 to 12 Harmood Street and 34 Chalk Farm Road, a former petrol station at 29 to 33 Chalk Farm Road, buildings at 17 and 25 to 27 Ferdinand Street and a warehouse off Ferdinand Street. These developments would be similar in scale and use to the buildings in the area and hence largely characteristic of their setting. They would not change the overall sensitivity of the Roundhouse and Chalk Farm Road LCA (reported in Volume 5: Appendix LV-001-003, Part 2 since it is not significantly affected). The new schools planned for the corner of Adelaide Road and Avenue Road and between Finchley Road and Marlborough Hill would be built on sites formerly occupied by schools and would therefore be characteristic of their setting. They would not change the overall sensitivity of the Adelaide Road Residential LCA (reported in Volume 5: Appendix LV-001-003, Part 2 since it is not

[71] Camden Council (no date), LDF Proposals map: http://gis.camden.gov.uk/geoserver/LDF.html; Accessed 15 oJuly 2013.
[72] Camden Council (2001), *Conservation Area Statement 5 Primrose Hill.*
[73] Camden Council (2000), *Conservation Area Statement 31 Alexandra Road*.

significantly affected) or the South Hampstead Station LCA respectively. These developments would replace existing buildings or be located in an area where visual receptors have already been identified and included in this assessment. These developments would not introduce new visual receptors.

Operation (2026)

9.3.13 Extensive tree planting has not been proposed in any of the developments above and therefore the developments would not change the overall sensitivity of the LCA they are in or adjacent to. New visual receptors have not been identified.

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 and works at vent shafts. The effects associated with the peak construction phase in the Primrose Hill to Kilburn (Camden) area will generally be considered to be long term given the construction programme (see Section 2.3). Overall, civil engineering works associated with construction in this area will be undertaken between the start of 2017 and the end of 2024. The main compounds at the HS1-HS2 Link tunnel portal (in CFA2) and the Adelaide Road and Alexandra Place vent shaft sites will be in place for this period although there will be some breaks in construction activity during this time. 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 assessing the effects on landscape and visual receptors include:

- construction of the HS1-HS2 Link tunnel portal approach ramp and the tunnel portal headhouse on the site of the former Primrose Hill station in the neighbouring Camden Town and HS1 Link area (CFA2);
- demolition of the former Primrose Hill station, 200 Regent's Park Road and part of the brick boundary wall (approximately 140m) along B509 Adelaide Road (also in CFA2);
- loss of 0.36ha of woodland on the slope down to the railway south of B509 Adelaide Road;
- demolition of 1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only) and of the planted walkway linking the Alexandra Road Estate to Loudoun Road (Langtry Walk);

- removal of vegetation including street trees at Alexandra Place, trees in the courtyard adjacent to 1 to 8 Langtry Walk and plants growing in the Langtry Walk planter;
- construction of the vent shafts and headhouse buildings at Adelaide Road and Alexandra Place including, the presence of 10m high hoardings around the Alexandra Place construction site;
- presence of construction plant and traffic at all construction sites;
- temporary highway closures at Adelaide Road and Alexandra Place; and
- temporary alternative pedestrian routes at Adelaide Road, Alexandra Place, Langtry Walk and Loudoun 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):

- maximising the retention and protection of existing trees and vegetation (draft CoCP, Section 12);
- use of well-maintained hoardings and fencing (draft CoCP, Section 5);
- prevention of damage to the landscape features adjacent to the construction sites due to 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); and
- replacement of any trees intended to be retained, which may be affected as a consequence of construction works (draft CoCP, Section 12).

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

Assessment of impacts and effects

9.4.5 The most apparent changes to landscape character and views during construction will result from the presence of construction plant and worksites, the demolition of buildings and the construction of the HS1-HS2 Link tunnel portal east of Regent's Park Road bridge (in the Camden Town and HS1 Link area (CFA2)) and vent shaft structures (at Adelaide Road and Alexandra Place). Impacts on the physical landscape include the removal of vegetation, the red brick boundary wall along Adelaide Road and the planted walkway at Alexandra Place. The existing dense urban development, street trees and vegetation in gardens and on the WCML and London Overground railway embankment will screen much of the construction activity from the wider area. However, the height of the construction plant and hoardings (particularly at Alexandra Place), and the large scale of the works will result in significant effects on LCA and visual receptors in close proximity to construction.

9.4.6 Utility works will be temporary in nature and are a common occurrence in urban areas. Trees will be retained where possible, in line with the draft CoCP (Section 12), and disturbance minimised. Where vegetation is removed, there will be appropriate replanting and no significant effects are anticipated.

Landscape assessment

9.4.7 The following section describes the likely significant effects on LCA during construction. All LCA within the study area considered to experience a non-significant effect (minor adverse or negligible) are described in Volume 5: Appendix LV-001-003, Part 4.

Eton and Primrose Hill Residential LCA

9.4.8 The HS1-HS2 Link tunnel portal and headhouse will be built on the site of the former Primrose Hill station, requiring the demolition of a former railway tunnel (Up Empty Carriage Tunnel) and 200 Regent's Park Road (also part of the former station, which is currently occupied by two commercial premises and one residential premises)[74]. The land in the railway corridor between the former station and Juniper Crescent will be used as a main construction compound and worksite (HS1-HS2 Link portal main construction compound and the adjacent worksite).

9.4.9 The construction of the Adelaide Road vent shaft and headhouse will require the removal of trees and shrubs from a wooded slope and part of the red brick boundary wall along B509 Adelaide Road. The demolition works, the compound hoardings and the presence of cranes, construction traffic and activity will introduce large-scale and prominent new elements into the LCA, altering the setting of the character area. However, the works will be taking place in the context of an existing working railway corridor.

9.4.10 Construction vehicles will use B509 Adelaide Road and the A41 Finchley Road or A502 Haverstock Hill. Construction activity, construction plant, worksite lighting, lorry movements and temporary road closures will reduce tranquillity in the LCA.

9.4.11 The HS1-HS2 Link tunnel portal site is substantially lower than the land to the north and west and as a result, apart from the demolition of 200 Regent's Park Road, most of the construction activity taking place at this location, will not be apparent from the LCA and will not affect the landscape setting of the Primrose Hill Conservation Area. Construction impacts on the landscape setting of the Eton Conservation Area will be reduced by the screening effect of the intervening buildings on B509 Adelaide Road. Impacts generally will be most intense in close proximity to the works and along construction vehicle routes, but they will diminish across the wider LCA due to the density of the surrounding urban development. The overall magnitude of change is considered to be medium.

9.4.12 The Proposed Scheme would result in effects that are at variance with the existing character area. The medium magnitude of change, combined with the high sensitivity of the character area, will result in a moderate adverse effect.

[74] This work is in the Camden Town and HS1 Link area (CFA2) but can be seen from the Primrose Hill to Kilburn (Camden) area (CFA3), as discussed in this report.

South Hampstead Station LCA

9.4.13 The construction of the Alexandra Place vent shaft will require the removal of sycamore and acacia trees in Alexandra Place, the courtyard of the refugee centre at 9 Langtry Walk and the concrete ramp and planter, which form the pedestrian walkway between the Alexandra Estate and Loudoun Road. An alternative pedestrian route will be provided. The construction site will occupy the vent shaft site, Langtry Walk, the courtyard belonging to the refugee centre and part of Alexandra Place. The site will be surrounded by hoardings 10m high. The works will be carried out within the Alexandra Road Conservation Area and the landscape setting of the conservation area, the listed Alexandra Road Estate and the former Church of All Souls, which is listed (this has been converted for residential development) will be affected by the presence of hoardings, construction activity and tall construction plant. The loss of trees and the walkway will result in the partial loss of key characteristics of the character area. The demolition works, the high compound hoardings and the presence of cranes, construction traffic and activity will introduce large-scale and prominent new elements into the LCA, altering the setting of the character area. However, the works will be taking place in the context of an existing working railway corridor.

9.4.14 Construction vehicles will access the construction site via the A41 Finchley Road via Boundary Road or the B509 Hilgrove Road to Loudoun Road and onto Alexandra Place. Construction activity, construction plant, worksite lighting, lorry movements and temporary road closures will reduce tranquillity in the LCA.

9.4.15 Impacts will be most intense in close proximity to the works but they will diminish across the wider LCA due to the density of the surrounding urban development. The overall magnitude of change is considered to be medium.

9.4.16 The medium magnitude of change, combined with the medium sensitivity of the character area, will result in a moderate adverse effect.

Visual assessment

9.4.17 The following sections describe 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, will 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-001-003, Part 4.

9.4.18 The number identifies the viewpoint locations, which are shown on Maps LV-03-002c to LV-03-006a (Volume 2, CFA3 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.

9.4.19 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.

9.4.20 Unless specified, there are no significant night-time effects at any of the viewpoints assessed.

Viewpoint 005-2-004: View north-east from Regent's Park Road/Gloucester Avenue junction

9.4.21 The demolition of 200 Regent's Park Road and the cranes and construction activity on the Hs1-Hs2 Link tunnel portal worksite will be visible over the Regent's Park Road bridge parapet and the WCML railway corridor from upper floors. The majority of construction activity will be contained within the existing railway cutting, limiting views from ground level. The presence of hoardings, construction activity and cranes will result in the introduction of new features into the view a short distance from receptors but these will be viewed in the context of the wider infrastructure setting of the railway corridor. Overall, the magnitude of change is considered to be medium.

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

Viewpoint 005-2-005: View south-east from Bridge Approach

9.4.23 There will be close and clear views of the demolition of 200 Regent's Park Road in the foreground. Cranes and construction activity on the Hs1-Hs2 Link tunnel portal worksite will be visible over temporary hoardings from upper floors of houses on Bridge Approach. The presence of hoardings, construction activity and cranes will result in the introduction of new features into the view a short distance from receptors but these will take place largely below the level of the houses in Bridge Approach and will be viewed in the context of the wider infrastructure setting of the railway corridor. The magnitude of change is 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 005-2-006: View north from King Henry's Road

9.4.25 The removal of trees and shrubs on the railway embankment on the opposite embankment will open up views of cranes and construction activity on the Adelaide Road vent shaft site, across the existing railway corridor. However, existing garden vegetation of the residential properties along King Henry's Road will continue to provide some screening. The presence of hoardings, construction activity and cranes, although a short distance from receptors, will be viewed in the context of the wider infrastructure setting of the railway corridor. Therefore, the magnitude of change is considered to be medium.

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

9.4.27 At present, at night, the back gardens and the railway corridor in the foreground of the view and the planting on the railway embankment beyond are dark. The street lighting in Adelaide Road and the urban areas beyond is evident in the background of the view, partly filtered through the embankment vegetation. Continuous lighting of the vent shaft site will be visible in the middle ground of the view, set against the lit

urban area beyond. The magnitude of change is considered to be medium, resulting in a moderate adverse effect.

Viewpoint 005-2-007: View south from Adelaide Road

9.4.28 The removal of the red brick boundary wall along Adelaide Road and the existing vegetation on the adjacent slope will reveal open and uninterrupted views from residential properties of construction activity on the Adelaide Road vent shaft site, across Adelaide Road. The presence of hoardings, construction activity and cranes will result in the introduction of new features into the view that will be highly visible a short distance from receptors. Therefore, the magnitude of change is considered to be high.

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, additional lighting of the construction compound will be viewed in the context of the existing street lighting. Effects at night are therefore considered not significant and are reported in Volume 5: Appendix LV001-003, Part 4.

Viewpoint 005-2-008: View south from Eton Road

9.4.31 The removal of the red brick boundary wall along Adelaide Road and the existing vegetation on the adjacent slope will reveal narrow and oblique views from residential properties of construction activity on the Adelaide Road vent shaft site, across Adelaide Road. The presence of hoardings, construction activity and cranes will result in a change in the view but one that will be largely screened by surrounding buildings. Therefore, the magnitude of change is considered to be low.

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

9.4.33 At night, additional lighting of the construction compound will be viewed in the context of the existing street lighting. Effects at night are therefore considered not significant and are reported in Volume 5: Appendix LV001-003, Part 4.

Viewpoint 005-3-013: View east from Adelaide Local Nature Reserve

9.4.34 The trees and shrubs growing on the slope in the LNR will partially filter views of construction activity on the Adelaide Road vent shaft site from parts of the LNR, especially in the summer. However, the worksite will extend up to the eastern boundary of the LNR and as a result views will be close and direct. The presence of hoardings, construction activity and cranes will result in the introduction of new features into the view that will be highly visible a short distance from 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.

Viewpoint 009-4-001: View west from Alexandra Road

9.4.36 There will be views, framed by the listed Church of All Souls to the south and flats to the north, of the 10m high hoardings, cranes and construction activity at the Alexandra Place vent shaft site. The presence of hoardings, construction activity and

cranes will result in the introduction of new features into the view that will be highly visible a short distance from receptors. Therefore, the magnitude of change is considered to be high.

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

Viewpoint 009-2-002: View north and north-east from Alexandra Place

9.4.38 The direct view from the refugee centre looking north-east will be blocked by the 10m high hoarding adjacent to the eastern façade of the building. From other properties at Alexandra Place, there will be direct views of the 10m high hoardings, cranes and other construction activity at the Alexandra Place vent shaft site in the foreground. These will be highly visible and in close proximity to the receptors. The view from the flats on the west side of Alexandra Place will be filtered through London plane trees in summer, but clearer in winter. Views from the dwellings south of the vent shaft site are limited due to the small number of windows on the northern façades of the buildings. Overall, the magnitude of change is considered to be high.

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

9.4.40 At night, additional lighting of the construction compound will be screened from view by the 10m high hoardings surrounding the site. Effects at night are therefore considered not significant and are reported in Volume 5: Appendix LV001-003, Part 4.

Viewpoint 009-2-003: View west from Loudoun Road

9.4.41 There will be direct and oblique views, some filtered through street trees, of the 10m high hoardings, cranes and other construction activity at the Alexandra Place vent shaft site. The views from the Southbury flats on the east side of Loudoun Road will be screened at lower levels by the three storey flats on Loudoun Road. From the higher floors, the views over the shaft site will be oblique and part of a wider panorama. Overall, the magnitude of change is considered to be medium.

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

9.4.43 At night, additional lighting of the construction compound will be screened from view by the 10m high hoardings surrounding the site. Effects at night are therefore considered not significant and are reported in Volume 5: Appendix LV001-003, Part 4.

Viewpoint 009-4-004: View north-west along Loudoun Road

9.4.44 There will be close views from the street of the 10m high hoardings, cranes and other construction activity at the Alexandra Place vent shaft site. These will be highly visible for the duration of the works, but partly screened in summer by London plane trees on the west side of the street. Overall, the magnitude of change is considered to be medium.

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

Viewpoint 010-2-003: View south-west from Loudoun Road

9.4.46 There will open views from the flats at 154 Loudoun Road, directly opposite the Alexandra Place vent shaft site and oblique views from the Church of All Souls (converted for residential development) of the 10m high hoardings, cranes and other construction activity for the duration of construction. However, the works will be viewed in the context of the neighbouring railway station and corridor. Views for pedestrians walking over the bridge and station users will be partially screened by the existing brick parapet wall. Overall, the magnitude of change is considered to be medium.

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

9.4.48 At night, additional lighting of the construction compound will be screened from view by the 10m high hoardings surrounding the site. Effects at night are therefore considered not significant and are reported in Volume 5: Appendix LV001-003, Part 4.

Viewpoint 010-04-005: View south from Loudoun Road/Hilgrove Road roundabout

9.4.49 There will be views from the street of the 10m high hoardings, cranes and other construction activity at the Alexandra Place vent shaft site for the duration of the works. The view is framed by the flats at 59-65 Belsize Road and the newly constructed flats opposite the vent shaft site. The vent shaft site, the listed Church of All Souls and part of the Alexandra Road Conservation Area will be visible in the same view, but in the context of the neighbouring railway station and corridor. The magnitude of change is considered to be medium.

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

Viewpoint 010-2-006: View south from Belsize Road

9.4.51 There will be clear views of the 10m high hoardings, cranes and other construction activity on the Alexandra Place vent shaft site from the flats directly north of the site, over the existing railway lines. The construction site, including cranes, will be highly visible for the duration of the works. However, they will be viewed in the context of the existing railway corridor. Overall, the magnitude of change is considered to be medium.

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

9.4.53 At night, additional lighting of the construction compound will be screened from view by the 10m high hoardings surrounding the site. Effects at night are therefore considered not significant and are reported in Volume 5: Appendix LV001-003, Part 4.

Cumulative effects

9.4.54 No committed developments have been identified that would be under construction at the same time as the Proposed Scheme and no cumulative effects have therefore been considered.

Other mitigation measures

9.4.55 Other mitigation measures to further reduce the significant effects described above will be considered during the detailed design stage, including consideration of where planting can be established early in the construction programme. However, not all landscape and visual effects can be practicably mitigated due to the visibility of construction activity and the sensitivity of surrounding receptors. No other mitigation measures are considered practicable during construction.

Summary of likely residual significant effects

9.4.56 As no other mitigation measures are considered practicable, the temporary residual significant effects during construction remain as described previously. However, these effects will be temporary and reversible in nature lasting only for the duration of the construction works. Any residual effects will generally arise from the widespread presence of construction activity and construction plant within the landscape and viewed from surrounding residential receptors and main roads within the study area.

9.5 Permanent effects arising during operation

9.5.1 The specific elements of the Proposed Scheme that have been taken into account in determining the effects on landscape and visual receptors includes:

- the Hs1-Hs2 Link tunnel portal, the tunnel portal headhouse (approximately 4.5m high, 60m long and 20m wide), the 350m long tunnel approach ramp and the associated electricity substation. All of these features are in the adjacent Camden Town and HS1 Link area (CFA2), east of Regent's Park Road bridge;
- the Adelaide Road vent shaft headhouse (approximately 30m long by 20m wide and 4.5m high), and hardstanding, lighting and security fencing; and
- the Alexandra Place vent shaft headhouse (approximately 27m long by 25m wide and 9.7m high), hardstanding, lighting and security fencing and the restored public realm.

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 the following:

- the proposed height of the Hs1-Hs2 Link tunnel portal headhouse has been reduced from 10m high to 4.5m, making it less prominent in the landscape and views;
- the Adelaide Road vent shaft headhouse has been reduced in height from 8m high to 4.5m high making it less prominent in the landscape and views. The building will form part of the northern boundary to the vent shaft site, which will minimise the total length of security fencing required. This will reduce the extent to which the fence detracts from landscape character and views. The existing red brick wall will be rebuilt where appropriate; and

- the permanent footprint of the Adelaide Road vent shaft site has been reduced and no longer occupies part of the Adelaide LNR. This will enable a larger area of the embankment to be returned to woodland and will remove the requirement for visually intrusive retaining walls. In time, the woodland will partly restore the screen between the railway corridor and the viewpoints in Adelaide Road. The existing retaining walls at the foot of the embankment will also be retained. These are a characteristic component of the existing view from King Henry's Road.

9.5.3 These measures have been taken account of in the assessment of the operational effects discussed.

Assessment of impacts and effects

9.5.4 The likely significant effects on landscape character and visual receptors in operation will arise from the presence of the HS1-HS2 Link tunnel portal headhouse, Adelaide Road vent shaft headhouse and associated hardstanding, lighting and fencing and Alexandra Place vent shaft headhouse.

9.5.5 Effects arising from the Adelaide Road vent shaft headhouse and hardstanding will reduce over time as replacement planting matures.

Landscape assessment

9.5.6 This section describes the significant effects on LCA during year 1, year 15 and year 60 of operation. Non-significant effects on LCA are presented in Volume 5: Appendix LV-001-003, Part 4.

9.5.7 The assessment of effects in year 15 assumes proposed planting has grown by approximately 450mm a year (i.e. trees will be 7-7.5m high). The assessment of effects in year 60 assumes all planting has reached its fully mature height. However, these estimates may be altered by the impacts of extreme weather events and climate change.

Eton and Primrose Hill Residential LCA

9.5.8 The Hs1-Hs2 Link tunnel portal headhouse, a long and low building, will be situated in CFA2 (east of this LCA) in the existing rail corridor; the building will be largely screened from the LCA by the Regent's Park Road bridge and intervening buildings because the corridor is at a lower level than the land to the north and west (in this LCA). The Adelaide Road vent shaft headhouse will be built into the embankment and will be approximately 4.5m above street level. The façades will be blank, except for doors and ventilation louvres. Trees and shrubs removed from the embankment during construction will be replaced, apart from an area 10m wide and 21m long to the east of the vent shaft headhouse, which will be required for hardstanding. Approximately 90m of the red brick boundary wall along Adelaide Road will be rebuilt. The dense urban development surrounding the permanent vent shaft site and the Hs1-Hs2 Link tunnel portal headhouse will contain and limit the extent of impacts on the surrounding landscape including the setting of the Eton and Primrose Hill Conservation Areas.

9.5.9 Landscape impacts during year 1 of operation will arise from:

- the loss of activity in the street generated by the business and residential uses in 200 Regent's Park Road following its permanent removal;
- an alteration to the character of the LCA due to loss of trees from the Adelaide Road embankment; and
- the presence of the large scale new vent shaft headhouse building, which will be a prominent new element in the LCA.

9.5.10 The operation of the headhouse is unlikely to noticeably alter tranquillity as the site will only be used occasionally for maintenance and emergency escape or escape exercises.

9.5.11 Approximately half of the wooded slope that will be cleared for construction at the Adelaide Road vent shaft site will be replanted, but planting will not have established sufficiently to provide screening in year 1 of operation. Given the localised impacts on landscape character as a result of the addition of the prominent new buildings and structures within the setting of an existing railway corridor, the magnitude of change is considered to be medium in year 1 of operation.

9.5.12 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

9.5.13 Although planting will have established sufficiently to partly restore the vegetation structure of the railway corridor, operational effects will remain unchanged in year 15 of operation.

9.5.14 The medium magnitude of change, assessed alongside the high sensitivity of the character area, will result in a significant (moderate adverse) effect in year 15 of operation.

9.5.15 By year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming non-significant. This is reported in Volume 5: Appendix LV-001-003, Part 4.

South Hampstead Station LCA

9.5.16 The proposed vent shaft headhouse at Alexandra Place will contain ventilation fans and provide a means of emergency escape. The façades will be blank, except for doors and ventilation louvres. The headhouse will be a rectangular structure approximately 9.7m high. This is a similar height to the highest part of the two to four-storey building currently occupying the site, but the headhouse will appear more substantial in the landscape than the existing building. Security fencing will be erected along the western and northern sides of the building. The pedestrian access ramp and integral planting bed connecting Alexandra Place and the Alexandra Road Estate will be rebuilt. Landscape impacts during year 1 of operation will arise from:

- loss of activity in the street generated by the business and other uses due to the demolition of 1 to 8 Langtry Walk and 61 to 83 Loudoun Road (odd numbers only); and
- the presence of the new vent shaft headhouse and associated security fencing.

9.5.17 The operation of the headhouse is unlikely to noticeably alter tranquillity as the site will only be used occasionally for maintenance and emergency escape.

9.5.18 The new headhouse will be a prominent new feature in the landscape. It will replace a less substantial building which currently houses commercial and residential uses. Designed for transport infrastructure use, it will not be characteristic of the largely residential LCA. However, the dense urban development surrounding it will limit the extent of its impacts on landscape character to a small part of the LCA. Overall, the magnitude of change is considered to be medium in year 1 of operation.

9.5.19 The medium magnitude of change, assessed alongside the medium sensitivity of the character area, will result in a moderate adverse effect in year 1 of operation.

9.5.20 The limited scope for mitigation planting at the vent shaft site means that operational effects will remain unchanged in years 15 and 60 compared to year 1 of operation.

Visual assessment

9.5.21 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-001-003, Part 4.

9.5.22 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.

9.5.23 No significant effects at night-time arising from additional lighting have been identified.

9.5.24 The number identifies the viewpoint locations which are shown on Maps LV-08-002c to LV-08-006a (Volume 2, CFA3 Map Book). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 1. Protected view, 2: Residential, 3: Recreational and tourist 4: Transport.

9.5.25 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.

9.5.26 The view of the Proposed Scheme from viewpoint LVMF 4A.1 (illustrated in the photomontage shown in Figure LV-01-011 (Volume 2, CFA3 Map Book)) will not be significantly affected as the works at Euston station will not be discernible in the view due to the screening effect of intervening development and the distance of the works from the receptor.

9.5.27 The view of the Proposed Scheme from viewpoint 009-4-001 illustrated in the photomontage shown in Figure LV-01-017 and 010-4-005 illustrated in the photomontage shown in Figure LV-01-018 (Volume 2, CFA3 Map Book) will not be

significantly affected. The vent shaft headhouse will replace an existing building currently occupying the shaft site resulting in a minor alteration to the view.

Viewpoint 005-2-007: View south from Adelaide Road

9.5.28 Views of the vent shaft headhouse in the foreground will be direct and uninterrupted. Its northern façade will be adjacent to the footpath on Adelaide Road, reaching to approximately 4.5m above ground level. The vent shaft headhouse will be a prominent new feature in the view, in close proximity to receptors. The loss of the vegetation on the wooded slope will also open up views of the railway corridor and dwellings in King Henry's Road in the distance. However, the rebuilt red brick boundary wall will screen part of the site from the north. The 2.4m high security fence around the site will replace a similar existing fence and therefore will not be a new feature in the view. Overall, the magnitude of change is considered to be high.

9.5.29 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.

9.5.30 In the summer of 2026 when the operation of the Proposed Scheme commences (year 1), effects would be unchanged due to the lack of established intervening vegetation.

9.5.31 The view of the Proposed Scheme from this location in the winter of year 1 of operation is illustrated in the photomontage shown in Figure LV-01-012 (Volume 2, CFA 3 Map Book).

9.5.32 Approximately half of the area of vegetation cleared for construction at the vent shaft site will be replanted and by year 15, planting will have established sufficiently to partly filter views of the railway corridor and housing in King Henry's Road; however, the headhouse will continue to be clearly visible from the properties on the opposite side of Adelaide Road, where there will be no intervening vegetation. The overall magnitude of change is considered to be medium, giving rise to a moderate adverse effect in year 15.

9.5.33 The view of the Proposed Scheme from this location in the summer of year 15 of operation is illustrated in the photomontage shown in Figure LV-01-221 (Volume 2, CFA 3 Map Book).

9.5.34 By year 60 planting will have further established and the railway corridor and housing in King Henry's Road will still be visible, but less prominent in the view. There will be no change to the view of the headhouse. The overall magnitude of change is considered to be medium, giving rise to a moderate adverse effect in years 60 of operation.

Viewpoint 005-3-013: View east from Adelaide Local Nature Reserve

9.5.35 The Adelaide Road vent shaft headhouse will be approximately 4.5m above ground level on Adelaide Road with its western façade adjacent to the eastern boundary of the Adelaide LNR. A new security fence will separate the shaft site from the Adelaide LNR and a substantial area of embankment vegetation in the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I adjacent to the LNR will be lost, opening up longer views of the railway corridor and Adelaide Road and resulting in a loss of a key characteristic of the view. The headhouse and the fence in the

foreground will be prominent new features clearly visible from the Adelaide LNR. Overall, the magnitude of change is considered to be high.

9.5.36 The high magnitude of change, assessed alongside the high sensitivity of the receptor will result in a major adverse in the winter of year 1 of operation.

9.5.37 In the summer of year 1 of operation, the view of the headhouse and the fence will be partially filtered by trees and shrubs in leaf, but effects will remain unchanged.

9.5.38 Approximately half of the area of vegetation in the SBI cleared for construction will be replanted and by year 15 and beyond to year 60 of operation, planting will have established sufficiently to partially restore the appearance of the vegetated embankment in the background of the view. However, the headhouse and fence will remain highly visible in the foreground. The magnitude of change is considered to be medium, giving rise to a moderate adverse effect in years 15 and 60 of operation.

Viewpoint 005-2-006: View north from King Henry's Road

9.5.39 The view towards the Adelaide Road vent shaft headhouse over the existing railway corridor will be partly filtered by vegetation in the back gardens of the residential properties along King Henry's Road. The vent shaft headhouse hardstanding and the 2.4m high security fence will form new and prominent features in the view. A substantial area of embankment vegetation in the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I adjacent to the LNR will be lost resulting in a loss of a key characteristic of the view. Therefore, the magnitude of change is considered to be medium.

9.5.40 There will be noticeable deterioration in the existing view. 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.

9.5.41 In the summer of year 1 of operation, back garden vegetation will further screen views of the vent shaft headhouse, but the site will be clearly visible from upper floors and effects will remain unchanged.

9.5.42 By year 15 of operation planting on the slope adjacent to the vent shaft will have established sufficiently to partially restore its vegetated appearance, but the headhouse will remain clearly visible from upper floors. Effects will remain unchanged.

9.5.43 Approximately half of the area of vegetation in the SBI.I cleared for construction will be replanted and by year 15 and on to year 60 of operation will have established sufficiently to partially restore the vegetated appearance of the embankment; however, the headhouse will remain clearly visible from the properties, and due to the lack of intervening mitigation planting, the effects will remain unchanged. The magnitude of change is considered to be medium, giving rise to a moderate adverse effect in years 15 and 60 of operation.

Viewpoints 009-2-002: View north and north-east from Alexandra Place; and 010-2-003: View south-west from Loudoun Road

9.5.44 There will be close and open foreground views of the Alexandra Place vent shaft headhouse. Though the footprint of the new building will be similar to that of the

existing building on the site, its larger scale means it will occupy a greater proportion of the view. The headhouse will have largely blank façades, only broken by ventilation louvres and doors and will lack the active frontage and varied roofline of the existing building. The security fencing on the northern and western sides of the building will be visible from the Refugee Centre. The headhouse will be a highly visible new feature in the view. The magnitude of change is therefore considered to be medium.

9.5.45 There will be noticeable deterioration in the existing views. 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.

9.5.46 In the summer of 2026 when the operation of the Proposed Scheme commences (year 1), the view from dwellings in Alexandra Place will be filtered through London plane trees but overall, effects will remain unchanged.

9.5.47 The limited scope for mitigation planting at the shaft site means that operational effects in years 15 and beyond to year 60 will remain unchanged.

Cumulative effects

9.5.48 Volume 5: 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 consequential cumulative effect of these committed developments on LCA and viewpoints is described below. These developments are shown in Maps CT-13-003b and CT-13-004a (Volume 5, Cross Topic Map Book).

9.5.49 There are no known committed developments that will result in a cumulative effect on LCA or visual receptors.

9.5.50 None of the LCA or visual receptors will be significantly affected by the operation of the Proposed Scheme when considering the combined presence of operational activity from nearby developments.

Other mitigation measures

9.5.51 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

9.5.52 As no other mitigation measures are considered practicable, the permanent residual significant effects during operation remain as described previously. Where new or replacement planting is proposed, 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:

- the large-scale buildings at the HS1-HS2 Link portal, Adelaide Road and Alexandra Place will remain prominent new features in the landscape affecting the Primrose Hill Residential and South Hampstead Station LCA;
- the permanent loss of a key landscape feature resulting from the removal of vegetation from the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I affecting the Primrose Hill Residential LCA;
- the loss of vegetation from the Chalk Farm Embankment and Adelaide Nature Reserve SBI.I will result in the loss of a key feature of the view from viewpoints 005-2-007 (Adelaide Road), 005-3-013 (Adelaide LNR), and 005-2-006 (King Henry's Road); and
- the large-scale buildings at Adelaide Road and Alexandra Place will remain new features in the view from viewpoints: 005-2-007 (Adelaide Road), 005-3-013 (Adelaide LNR), 005-2-006 (King Henry's Road), 009-2-002 (Alexandra Place) and 010-2-003 (Loudoun Road).

10 Socio-economics

10.1 Introduction

10.1.1 This section reports the likely significant economic and employment effects during the construction and operation of the Proposed Scheme.

10.1.2 The need for a socio-economic assessment results from the potential for the Proposed Scheme to affect:

- existing businesses and community organisations and thus the amount of local employment;
- local economies, including employment; and
- planned growth and development.

10.1.3 The beneficial and adverse socio-economic effects of the Proposed Scheme are reported at two different levels: route-wide and CFA. Effects on levels of employment are reported at a route-wide level in Volume 3. Localised effects on businesses and observations on potential local economic effects are reported within each CFA report.

Construction

10.1.4 The proposed construction works will have the following relevance in terms of socio-economics:

- premises demolished with their occupants and employees needing to relocate to allow for construction of the Proposed Scheme; and
- potential employment opportunities arising from construction in the local area (including in adjacent CFA).

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 Engagement with stakeholders and community organisations, including the LBC, has been undertaken with regard to socio-economic resources that may be impacted by the Proposed Scheme.

10.3 Environmental baseline

Existing baseline

Study area description

10.3.1 Section 2 of this report provides a general overview of the Primrose Hill to Kilburn (Camden) 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 in the area[75].

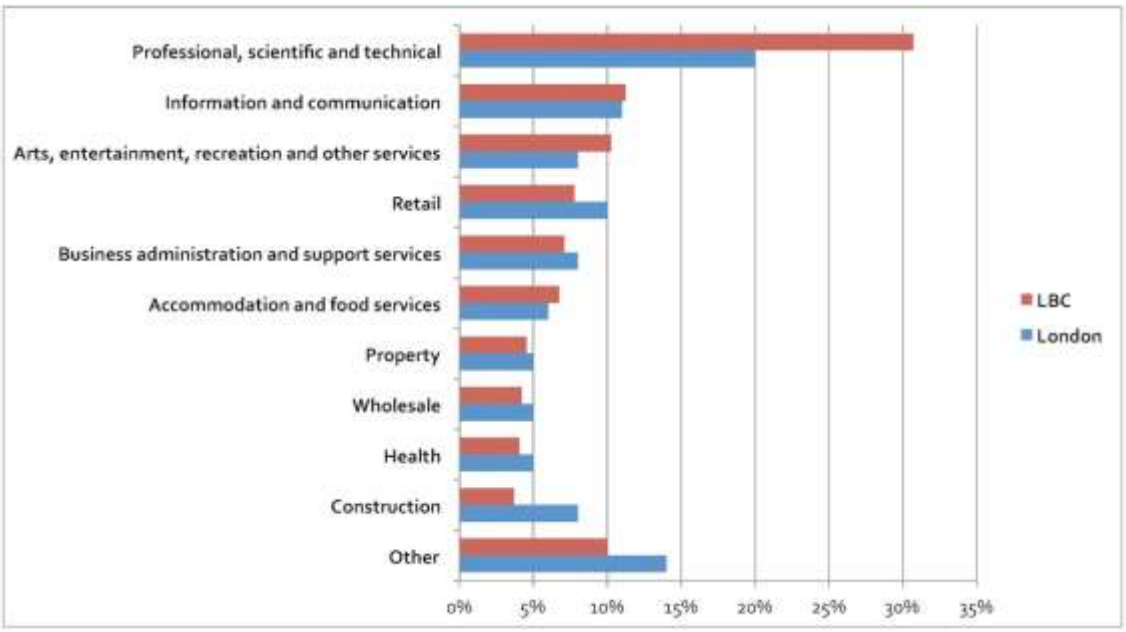
10.3.2 The Primrose Hill to Kilburn (Camden) area is entirely within the LBC. Where possible, baseline data has been gathered on demographic character areas (DCA)[76] to provide a profile of local communities. Map SE-02-003 (Volume 5, Socio-economics Map Book) shows the location of the DCA. The area contains the Kilburn and Swiss Cottage, Primrose Hill and Belsize and Chalk Farm DCA.

Business and labour market

10.3.3 Within the LBC, there is a wide spread of business types reflecting a diverse range of commercial services. As shown in Figure 6, the professional, scientific and technical services sector accounts for the largest proportion of businesses (31%), with the information and communication (11%), arts, entertainment, recreation and other services (10%), and retail (8%) sectors also accounting for relatively large numbers of businesses within the borough. For comparison, within London, 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 within the region[77].

[75] Further information on the socio-economics baseline, with regard to business and labour market profile, within the area is contained in the Volume 5: Appendix SE-001-000.
[76] 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 (LSOA).
[77] Office for National Statistics (ONS) (2012), *UK Business: Activity, Size and Location 2011*, ONS, London. Please note 2011 data has been presented to provide an appropriate comparison with 2011 Census data.

Figure 6: Business sector composition in LBC and London[78,79]

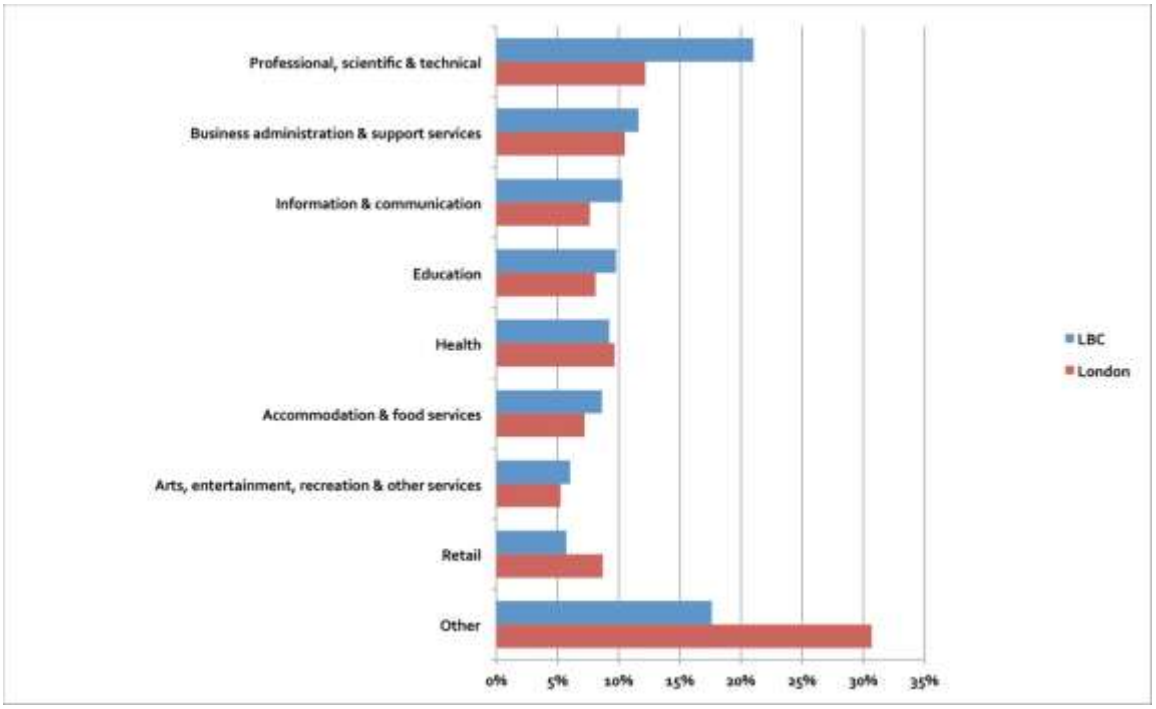


10.3.4 Approximately 291,000 people worked in LBC, 7,000 people worked within the Kilburn and Swiss Cottage DCA, 3,800 within the Primrose Hill DCA and 3,800 within the Belsize and Chalk Farm DCA[80].

10.3.5 As shown in Figure 7, the sector with the highest proportion of employment in the borough is professional, scientific and technical (22%), which accounts for a higher proportion of jobs than that recorded across London (13%) and England (8%). The business administration and support services sector is also important in LBC accounting for 11% of employment compared to 10% recorded across London and 8% across England. The information and communication sector in LBC accounts for 10% of employment, higher than that recorded for London (8%) and England (4%). Key sectors for the Kilburn and Swiss Cottage DCA are health (16%), retail (15%) and professional, scientific and technical (11%). For the Primrose Hill DCA, key sectors are information and communication (28%) and professional, scientific and technical (19%). Key sectors in the Belsize and Chalk Farm DCA are education (25%), arts, entertainment, recreation and other services (16%) and accommodation and food services (14%).

[78] 'Other' includes agriculture, forestry and fishing, production, motor trades, transport and storage (including postal), finance and insurance, public administration and defence and education sectors.
[79] ONS (2012), *UK Business: Activity, Size and Location 2011*, ONS, London
[80] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London

Figure 7: Proportion of employment by industrial sector in LBC and London[81,82]



10.3.6 According to the 2011 Census[83], the employment rate[84] within LBC was 63% (which represents 109,000 people), broadly in line with that recorded for both London and England (both 65%). The employment rate in the Kilburn and Swiss Cottage DCA was 66%, 71% in the Primrose Hill DCA and 72% in the Belsize and Chalk Farm DCA.

10.3.7 In 2011, the unemployment rate in LBC stood at 8%, slightly above the England average of 7%. The unemployment rate in the Kilburn and Swiss Cottage DCA was 8%, 4% in the Primrose Hill DCA and 6% in the Belsize and Chalk Farm DCA[85].

10.3.8 According to the 2011 Census, 51% of LBC residents aged 16 and over were qualified to National Vocational Qualification Level 4 (NVQ4), compared to 38% in London and 27% in England, and 13% had no qualifications, which was lower than that recorded both for London (18%) and England (23%). In 2011, 52% of Kilburn and Swiss Cottage DCA residents aged 16 and over were qualified to NVQ4 level, compared to 64% in the Primrose Hill DCA and 63% in the Belsize and Chalk Farm DCA. The proportion of residents with no qualifications was 13% in the Kilburn and Swiss Cottage DCA, 9% in the Primrose Hill DCA and 8% in the Belsize and Chalk Farm DCA.

10.3.9 The Kilburn and Swiss Cottage, Primrose Hill and Belsize and Chalk Farm DCA are predominantly prosperous inner London areas with above average rates of employment and high qualification attainment. Primrose Hill and Belsize and Chalk Farm DCA both have significantly higher qualification attainment rates compared to the average for both London and England.

[81] 'Other' includes agriculture, forestry and fishing, production, construction, motor trades, wholesale, transport and storage, financial and insurance, property and public administration; and defence sectors.
[82] ONS (2012), *Business Register and Employment Survey 2011*, ONS, London
[83] ONS (2012), *Census 2011*, ONS, London
[84] The proportion of working age (16-74 years) residents that is in employment. Employment comprises the proportion of the total resident population who are 'in employment' and includes full-time students who are employed.
[85] Unemployment figures have been rounded to the nearest whole number. DCA unemployment rates are presented for each DCA in this section while in Section 2 they are shown in aggregate.

Property

10.3.10 Data for quarter three of 2012, published by Jones Lang LaSalle, indicated there were 1.7 million square metres of industrial and warehousing floorspace available (i.e. vacant and marketed) in London[86].

10.3.11 Vacancy for industrial and warehousing property in July 2013 in LBC has been assessed as 1% based on marketed space against known stock[87]. Overall, this suggests low availability of alternative accommodation.

10.3.12 Vacancy for retail property in July 2013 in LBC has been assessed as 2% based on marketed space against known stock. Overall, this suggests low availability of alternative accommodation.

Future baseline

Construction (2017)

10.3.13 Volume 5: Appendix CT-004-000 provides details of the developments that are assumed to have been implemented by 2017. Implementation of all outstanding development consents and land allocations would result in an additional 50 jobs[88] in the area by 2017. The existing composition and numbers of employers, employees and economic sectors in the area are likely to change over time in ways that cannot be accurately forecast.

Operation (2026)

10.3.14 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 area that are expected to accommodate material additional employment between 2017 and 2026.

10.4 Effects arising during construction

Avoidance and mitigation measures

10.4.1 In order to avoid or reduce the environmental impacts during construction, the Proposed Scheme design includes provisions to maintain access to businesses during the construction phase.

10.4.2 The draft CoCP includes a range of provisions that will help mitigate the 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);

[86] Jones Lang LaSalle (2012), *UK Industrial Property Trends Today: Issue 3* (December 2012), Jones Lang LaSalle, London.
[87] 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).
[88] Potential employment has been estimated through employment floor space and the Homes and Communities Agency (HCA) Employment Densities Guide 2nd Edition (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas.

- applying best practicable means (BPM) during construction works to reduce 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 socioeconomic 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 businesses have been identified in the area that are expected to experience significant amenity effects as a result of the Proposed Scheme.

Isolation

10.4.4 No businesses have been identified in the area that are expected to experience significant isolation effects as a result of the Proposed Scheme.

Construction employment

10.4.5 A number of construction compounds for the Proposed Scheme will be located within the Primrose Hill to Kilburn (Camden) area, and will include main compounds at Adelaide Road vent shaft and Alexandra Place vent shaft. These locations are set out in Section 2.3 of this report.

10.4.6 The use of these sites could result in the creation of approximately 300 person years of construction employment[89] opportunities or approximately 30 full-time equivalent jobs[90] 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 the direct construction employment creation has been assessed as part of the route-wide assessment (see 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 (see Volume 3).

Cumulative effects

10.4.8 No committed developments have been identified that are considered to interact with the Proposed Scheme.

[89]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.
[90] Based on the convention that 10 employment years is equivalent to one full-time equivalent job.

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 (see Volume 3).

Permanent effects

Businesses

10.4.10 Businesses directly affected, i.e. those that lie within the land required for the construction of the Proposed Scheme, are reported in groups where possible to form defined resources, based on their location and operational characteristics. A group could contain either one or a number of businesses reflecting the fact that a building may have more than one occupier or that similar businesses/resources are clustered together.

10.4.11 In all, 18 business accommodation units in the area will be directly impacted upon by the Proposed Scheme. These together form three defined resources. Two of the resources that experience direct impacts are subject to potentially significant effects on business activities and employment. These are listed in Table 8.

Table 8: Resources with potentially significant direct effects

Resource	Description of business activity
61 to 83 Loudoun Road (odd numbers only)	12 commercial (light industrial) units
1 to 8 Langtry Walk	Six commercial (retail/services) units located on a precinct. There are two residential units above the commercial units at this location[91].

Impact magnitude

10.4.12 The magnitude of impact focuses on the number of jobs that are affected (either through displacement or possible loss) by the Proposed Scheme. It also considers the implications of this impact in relation to the scale of economic activity and opportunity in the area.

Sensitivity

10.4.13 The following was taken into account when considering the sensitivity of resources:

- availability of alternative, suitable premises;
- size of the local labour market;
- skill levels and qualifications of local people; and
- levels of unemployment.

Significance of effects

10.4.14 Taking account of the sensitivity of the resource and the magnitude of impact, the significance of the resultant effects is set out in Table 9.

[91] Impacts on residential premises are discussed in Section 5.

Table 9: Significance of effects on resources

Resource	Impact magnitude	Sensitivity	Significance of effect
61 to 83 Loudoun Road (odd numbers only)	Medium	Medium	Moderate adverse
1 to 8 Langtry Walk	Medium	Medium	Moderate adverse

10.4.15 Construction of the vent shaft and associated features will require the demolition of a building containing 12 commercial (light industrial) units (61 to 83 Loudoun Road (odd numbers only). The availability of premises of this type (i.e. low cost work units for start-ups) within LBC is constrained (vacancy rates at 1% of total stock). The effect on this resource and its employees is assessed to be moderate adverse and will therefore be significant.

10.4.16 Construction of the vent shaft and associated features will require the demolition of a building containing six commercial (retail/services) units at 1 to 8 Langtry Walk. Availability of premises of this type within LBC is constrained (vacancy rates at 2% of total stock) and therefore the effect on this resource and its employees is assessed to be moderate adverse and will therefore be significant.

10.4.17 It is estimated that the Proposed Scheme will result in the displacement or possible loss of around 50 jobs[92] in this area. Taking into account the availability of alternative premises, skill levels of local people and the relatively healthy local economy, the displacement or possible loss of jobs is considered to be relatively modest compared to the scale of economic activity and opportunity in the area.

Cumulative effects

10.4.18 No committed developments have been identified that are considered to interact with the Proposed Scheme.

10.4.19 Cumulative effects also arise in relation to the accumulation of individual resource based job displacement/losses on a local labour market. These effects are dealt with as part of the route wide assessment (see Volume 3).

Other mitigation measures

10.4.20 The assessment has concluded that there are significant adverse effects arising during construction in relation to businesses directly affected by the Proposed Scheme. 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.

10.4.21 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the line of route in terms of supplying goods and

[92] Employment within businesses has been estimated through a combination of sources, for example, surveys of businesses, the Experian employment dataset, employment floor space and the Homes and Communities Agency (HCA) *Employment Densities Guide 2nd Edition* (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas and may vary from actual employment at the sites.

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

10.4.22 Likely significant residual effects are shown on Map SE-01-005 to SE-01-006a (Volume 5, Socio-economics Map Book).

10.4.23 The Proposed Scheme will require the demolition of two socio-economic resources in the area, which will therefore be significant.

10.5 Effects arising during operation

Avoidance and mitigation measures

10.5.1 No mitigation measures are required during operation in this area.

Assessment of impacts and effects

Resources with direct effects

10.5.2 There are no resources considered likely to experience significant direct effects during the operational phase of the project in this area.

Change in business amenity

10.5.3 No 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 and train crew facilities, which could be accessed by residents of the area, particularly given its proximity to stations at Old Oak Common (in CFA4) and Euston (in CFA1).

10.5.5 Direct operational employment created by the Proposed Scheme could also lead to indirect employment opportunities for local businesses in terms of supplying the project or benefiting from expenditure of directly employed workers on goods and services.

10.5.6 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, residents living further afield.

10.5.7 The impact of operational employment creation has been assessed as part of the route-wide assessment (see 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 this section of the route will be either negligible or beneficial and therefore mitigation is not needed.

Summary of likely residual significant effects

10.5.10 No residual significant socio-economic effects are likely to arise during the operation of the Proposed Scheme.

11 Sound, noise and vibration

11.1 Introduction

11.1.1 This section reports the assessment of the likely noise and vibration significant effects arising from the construction and operation of the Proposed Scheme for the Primrose Hill to Kilburn (Camden) area on:

- people, primarily where they live ('residential receptors') in terms of a) individual dwellings and b) on a wider community basis, including any shared community open areas[93]; 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'[94].

11.1.2 The assessment of likely significant effects from noise and vibration on community, cultural heritage or ecological receptors and the assessment of tranquillity are presented in Sections 5, 6, 7 and 9 of this report respectively.

11.1.3 In this assessment 'sound' is used to describe the acoustic conditions which people experience as a part of their everyday lives. The assessment considers how those conditions may change through time and how sound levels and the acoustic character of community areas is likely to be modified through the introduction of the Proposed Scheme. Noise is taken as unwanted sound and hence adverse effects are noise effects and mitigation is, for example, by noise barriers.

11.1.4 Effects can either be temporary from construction or permanent from the operation of the Proposed Scheme. These effects may be direct, resulting from the construction or operation of the Proposed Scheme, and/or indirect e.g. resulting from changes in traffic patterns on existing roads or railways that result from the construction or operation of the Proposed Scheme.

11.1.5 This section sets out the means to avoid or reduce the adverse effects that may occur.

11.1.6 The approaches to assessing sound, noise and vibration and appropriate mitigation are outlined in Volume 1 and scope and methodology are defined in the following documents:

- SMR (Volume 5: Appendix CT-001-000/1); and
- SMR Addendum (Volume 5: Appendix CT-001-000/2).

11.1.7 More detailed information and mapping regarding the sound, noise and vibration assessment for the Primrose Hill to Kilburn (Camden) area is available in the relevant appendices in Volume 5:

[93] '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.

[94] Quiet areas are defined in the SMR 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).

- sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000);
- sound, noise and vibration baseline (Appendix SV-002-003);
- sound, noise and vibration construction assessment (Appendix SV-003-003);
- sound, noise and vibration operation assessment (Appendix SV-004-003); 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 The existing baseline sound environment for the Primrose Hill to Kilburn (Camden) area is generally urban in character – typically being dominated by transportation sources, particularly road and rail traffic.

11.2.2 In the area around the Adelaide Road vent shaft the baseline sound environment is dominated by road traffic on the B509 Adelaide Road and other surrounding roads. Typical daytime sound levels of around 70dB[95] along the B509 Adelaide Road reducing to around 55dB in locations screened from the major roads. Other sound sources include traffic on the surrounding roads, trains and localised commercial and domestic activities.

11.2.3 In the area surrounding the Alexandra Place vent shaft the dominant sound source is traffic on the surrounding roads and daytime sound levels are typically 55dB. Sound from trains on the nearby rail lines is also intermittently audible in this area.

11.2.4 Generally, night-time sound levels[96] may be 10dB lower at night in locations near major roads, due to the reduced traffic flows, with a smaller reduction of around 5dB in locations screened from these roads.

11.2.5 Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for this area in Volume 5: Appendix SV-002-003.

11.2.6 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[97], save for those receptors closest to existing railways. On a reasonable worst-case basis, vibration from the Proposed Scheme has therefore been assessed at all receptors using specific thresholds, below which receptors will not be affected by vibration, as described in Volume 1, Section 8. No vibration baseline measurements have therefore been undertaken.

Future baseline

11.2.7 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 and also growth in rail

[95] Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,16hr}$.
[96] Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr}$.
[97] Further information is available in the Volume 5: Appendix SV-001-000, the SMR and SMR Addendum.

traffic on the WCML. Changes in car technology may offset some of the expected sound level increases due to road traffic growth on low speed roads. On higher speed roads[98], tyre sound dominates and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

Construction (2017)

11.2.8 The assessment of noise from construction activities assumes a baseline year of 2017 which represents the period immediately prior to the start of the construction period. As a reasonable worst case, it has been assumed that no change in baseline sound levels will occur between the existing baseline (2012/13) and the future baseline year of 2017. The assessment of noise from construction traffic assumes a baseline year of 2021, representative of the middle of the construction period when the construction traffic flows are expected to be at their peak. Further information can be found in Section 12.

Operation (2026)

11.2.9 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 Tunnel boring machines (TBM) will be used to excavate the tunnels. It is likely that materials (including tunnel lining segments), people and equipment will be transported from the surface to the TBM using small construction trains, which will travel at relatively low speeds along a temporary construction railway laid behind each TBM as it drives forward. Excavated material from each TBM will be transported to the surface by conveyor. Significant noise and vibration effects arising from use of the temporary construction railway will be avoided through appropriate design and the maintenance specification.

11.3.3 Although the majority of works will be undertaken during normal working hours, surface works to support concrete supply for sprayed concrete lined cross passage tunnels will need to be undertaken during the evening and night time for reasons of safety and engineering practicability.

[98] Tyre noise typically becomes the dominant sound source for steady road traffic at speeds above approximately 30mph.

11.3.4 The assessment takes account of people's perception of noise throughout the day. More stringent criteria are applied during evening and night-time periods, when people are more sensitive to noise, compared to the busier and more active daytime period.

Local limitations

11.3.5 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-002-003.

Avoidance and mitigation measures

11.3.6 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[99];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 rehousing will be offered in accordance with the draft CoCP's noise insulation and temporary rehousing policy;
- lead contractors will seek to obtain prior consent from the relevant local authority under Section 61 of CoPA for the proposed construction works. The consent application will set out BPM measures to minimise construction noise, including control of working hours, and provide a further assessment of construction noise and vibration including confirmation of noise insulation/ temporary rehousing provision;
- contractors will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to and be reviewed by the Nominated Undertaker and will be made available to the local authorities; and
- contractors will be required to comply with the terms of the CoCP and

[99] Warning signals that consist of bursts of noise.

appropriate action will be taken by the Nominated Undertaker as required to ensure compliance.

11.3.7 In addition to this mitigation, taller screening as described in the draft CoCP[100] has been assumed along edge of the construction site boundary around the Adelaide Road vent shaft site. Site hoarding at the Alexandra Place vent shaft site may need to be up to 10m high.

11.3.8 Noise insulation will be offered for qualifying buildings as defined in the draft CoCP's noise insulation and temporary rehousing policy. Noise insulation or ultimately temporary rehousing will avoid residents being significantly affected[101] 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.

11.3.9 Qualification for noise insulation and temporary rehousing 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 rehousing provided, before the start of the works predicted to exceed noise insulation or temporary rehousing 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

11.3.10 Taking account of the avoidance and mitigation measures set out in the previous paragraphs, approximately 10 residential buildings on the B509 Adelaide Road and Loudoun Road (containing in total approximately 30 dwellings) are forecast to experience noise levels higher than the noise insulation trigger levels as defined in the draft CoCP. For daytime construction the trigger level is 75dB[102] measured outdoors, or the existing ambient if this is already above this level. The equivalent night-time trigger level is 55dB[103].

11.3.11 The mitigation measures, including noise insulation, will reduce noise inside all dwellings, including the aforementioned buildings on the B509 Adelaide Road and Loudoun Road, such that it does not reach a level where it would significantly affect[101] residents.

Residential receptors: direct effects – communities

Airborne noise

11.3.12 The avoidance and mitigation measures in this area will avoid airborne construction noise adverse effects[101] on the majority of receptors and communities. Residual temporary noise or vibration effects are identified in rest of this section.

[100] 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.
[101] Information is provided in the emerging National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk. e.g. the table summarising the noise exposure hierarchy.
[102] $L_{pAeq,0800\text{-}1800}$ measured at the façade.
[103] $L_{pAeq,2200\text{-}0700}$ measured at the façade, outdoors, or the existing ambient if this is already above this level.

11.3.13 With regard to noise outside dwellings, the assessment of temporary effects takes account of construction noise relative to existing sound levels.

11.3.14 In locations with lower existing sound levels[104], construction noise effects[101] are likely to be caused by changes to noise levels outside dwellings. These may be considered by the local community as an effect on the acoustic character of the area and hence be perceived as a change in the quality of life. These effects are considered to be significant when assessed on a community basis taking account of the local context[105] as identified in Table 10.

Table 10: 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-003-003)	**Type of significant effect**	**Time of day**	**Location**	**Cause (construction activities)**	**Assumed approximate duration of impact**
CSV03-01	Noise (temporary increased annoyance)	Daytime	Approximately 20 dwellings on Adelaide Road	HS2-HS1 Link tunnel portal: – diaphragm wall construction works with typical and highest monthly noise levels of around 50dB and 65dB[106]	5 months
CSV03-02	Noise (temporary increased annoyance)	Daytime	Approximately 25 dwellings on Adelaide Road and Beaumont Walk	Construction activities at the Adelaide Road vent shaft with typical and highest monthly noise levels of around 75dB and 80dB106	15 months
CSV03-03	Noise (temporary increased annoyance)	Daytime	Approximately 120 properties on King Henry's Road	Construction activities at the Adelaide Road vent shaft with typical and highest monthly noise levels of around 60dB and 75B106	Up to 15 months
CSv03-04	Noise (temporary increased annoyance)	Daytime	Approximately 20 dwellings on Loudoun Road	Demolition and construction activities at Alexandra Place shaft compound with typical and highest monthly noise levels of 70dB	8 months

[104] Further information is provided in Volume 5: Appendix SV-001-000.
[105] Further information is provided in SV-001-000 and SV-003-003.
[106] Daytime: equivalent continuous sound level at the facade, $L_{pAeq,\ 0700\text{-}1900}$.

				and 80dB[106]	
		Night-time	Approximately 10 dwellings on Loudoun Road	Surface activities associated with the shotcrete shell tunnel works at the Alexandra Place shaft compound with typical and highest monthly noise levels of around 55dB and 60dB[107].	12 months

Ground-borne noise and vibration

11.3.15 Tunnel boring machines 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.

11.3.16 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

11.3.17 Construction traffic is likely to cause adverse noise effects on residential receptors along the following local roads:

- the A502 Haverstock Hill between England's Lane and the B509 Adelaide Road (CSV03-C05) – dwellings located immediately adjacent to the road are forecast to experience an increase in outdoor noise levels of around 4dB during the peak months (further information on traffic flows is provided in Section 12); and
- England's Lane between the B509 Adelaide Road and the A502 Haverstock Hill (CSV03-C06) – dwellings located immediately adjacent to the road are forecast to experience an increase in outdoor noise levels of around 6dB during the peak months (further information on traffic flows is provided in Section 12).

11.3.18 These adverse effects[101] would be a change in the acoustic character of the area such that there is a perceived change in the quality of life and are considered significant when assessed on a community basis taking account of the local context[105].

[107] Night: equivalent continuous sound level at the facade, $L_{pAeq, 23:00-07:00}$.

Non-residential receptors: direct effects

11.3.19 Significant construction noise or vibration effects have been identified on a worst-case basis on the following non-residential receptors:

- Applied Sustainable Health located in Dumpton Place, London (CSV03-N01). Significant noise effects[108] have been identified during the daytime with noise levels rising at times to around 65dB[109] during the construction of the HS1-HS2 Link tunnel portal; and
- James Town Mental Health Centre and Adelaide Road Medical Centre on Adelaide Road, London (CSV03-N02 and N03). A significant noise effect has been identified during the daytime with noise levels rising at times to around 80dB[109] during the demolition and site preparation works at the Adelaide Road vent shaft.

Non-residential receptors: indirect effects

11.3.20 On a worst-case basis, construction traffic is likely to cause significant indirect noise effects at non-residential receptors along the following local roads:

- the A502 Haverstock Hill between England's Lane and the B509 Adelaide Road (CSV03-N06) – affecting a number a number of non-residential receptors located immediately adjacent to the road including the Haverstock School and the Seventh Day Adventist Church. This is associated with a forecast increase in way side noise levels of approximately 4dB in the peak months (further information on traffic flows is provided in Section 12); and
- England's Lane between the B509 Adelaide Road and the A502 Haverstock Hill (CSV03-N07) – affecting a number a number of non-residential receptors located immediately adjacent to the road including The Britannia Hotel. This is associated with a forecast increase in way-side noise levels of approximately 6dB in the peak months (further information on traffic flows is provided in Section 12).

Cumulative effects from the Proposed Scheme and other committed development.

11.3.21 This assessment has considered the potential cumulative construction noise effects of the proposed scheme and other committed developments[110]. In this area, there are small-scale developments proposed along Gloucester Avenue that could be built at the same time as the Proposed Scheme. These developments will not involve significant levels of construction activities and will not impact upon the same aspect of sensitive receptors affected by the Proposed Scheme. Therefore, construction noise or vibration from the Proposed Scheme is unlikely to result in any significant cumulative noise effects.

[108] Activity disturbance, especially for activities that require good conditions for verbal communication .
[109] Equivalent continuous sound level at the facade, $L_{pAeq,\ 0700\text{-}1900}$.
[110] Refer to Volume 5: Appendix CT-004-000.

Summary of likely residual significant effects

11.3.22 The avoidance and mitigation measures reduce noise inside all dwellings from the construction activities such that it is does not reach a level where it would significantly affect[101] residents.

11.3.23 The measures also reduce any adverse effects from construction noise outdoors on the majority of residential communities such that they are not considered significant except at the residential communities along the following roads that are closest to the works:

- Adelaide Road at two separate locations, in close proximity to the HS1-HS2 Link tunnel portal site and the Adelaide Road vent shaft site;
- King Henry's Road in close proximity to the Adelaide Road vent shaft site; and
- Loudoun Road, in close proximity to the Alexandra Place vent shaft site.

11.3.24 On a worst-case basis, noise from specific construction activities has been identified as resulting in significant residual temporary effects on commercial properties including Applied Sustainable Health located on Dumpton Place, James Town Mental Health Centre and Adelaide Road Medical Centre located on Adelaide Road and the Ready Steady Go Nursery and Loudoun Road Community Centre located on Loudoun Road.

11.3.25 Construction traffic on the A502 Haverstock Hill and England's Lane is likely to cause significant noise effects on adjacent residential and non-residential receptors located along these roads.

11.3.26 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[111]. As a reasonable worst case, this assessment is based upon the service pattern for Monday to Saturday including Phase Two services. Passenger services will start at or after 05:00 from the terminal stations and in this area will progressively increase to the number of trains per hour in each

[111] The change in noise and vibration effects between the different passenger services is assessed in Volume 1.

direction on the main lines set out in Table 11. 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 11.

Table 11: 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	07:00-21:00 hours	18 (14)	230 kph, reducing towards Euston
HS1-HS2 Link tunnel	07:00-21:00	3 (3)	230 kph, reducing towards HS1-HS2 Link portal

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[112], 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 under existing transport corridors and therefore away from main residential community areas. These avoidance measures have protected many residential community areas from likely significant noise or vibration effects.

Airborne noise

11.4.5 Significant noise effects from the operational static sources such as mechanical ventilation at tunnel portals and vent shafts as well as 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

11.4.6 Significant ground-borne noise or vibration effects will be avoided or reduced through the design of the track and track-bed.

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.4.7 The mitigation measures will reduce airborne noise, ground-borne noise and ground-borne vibration inside all dwellings such that it will not reach a level where it would significantly affect residents.

[112] For example, HS1 vent shaft fans are tested monthly.

Residential receptors: direct effects – communities

11.4.8 The avoidance and mitigation measures in this area will avoid ground-borne noise and vibration effects on all residential communities in this area.

Residential receptors: indirect effects

11.4.9 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

11.4.10 The assessment of operational noise and vibration indicates that significant direct effects on non-residential receptors are unlikely to occur in this area.

Non-residential receptors: indirect effects

11.4.11 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

11.4.12 The mitigation measures reduce noise and vibration generated inside all dwellings by the operation of the Proposed Scheme such that it will not reach a level where it would significantly affect[101] residents.

11.4.13 The mitigation measures in this area will also avoid ground-borne noise and vibration impacts and adverse effects[101] on all residential communities and sensitive receptors.

12 Traffic and transport

12.1 Introduction

12.1.1 This traffic and transport section describes the likely impacts on all forms of transport and the consequential effects on transport users arising from the construction and operation of the Proposed Scheme through the Primrose Hill to Kilburn (Camden) area.

12.1.2 With regard to traffic and transport, the main issues are increased traffic as a result of implementation of the Proposed Scheme, temporary road diversions, temporary road closures, temporary closures of PRoW and the impact of traffic diverted due to construction works in other CFA areas.

12.1.3 The effects on traffic and transport have been assessed quantitatively, based on baseline traffic conditions and future projection scenarios.

12.1.4 A detailed report on traffic and transport and surveys undertaken within the area is contained in Volume 5 Appendix: TR-001-000, Transport Assessment.

12.1.5 Figure 2 shows the location of the key transport infrastructure in this area.

12.1.6 Engagement has been undertaken with the key transport authorities including Transport for London (TfL) and LBC.

12.2 Scope, assumptions and limitations

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

12.2.2 The study area includes the A502 Haverstock Hill towards the eastern end and the A5 Kilburn High Road at the western end. The A41 Finchley Road is located approximately half way between these two roads.

12.2.3 A number of transport modelling tools have been used to inform the assessment including Transport for London's CLoHAM (Central London Highway Assignment Model). The assessment covers the morning (08:00-09:00) and evening (17:00-18:00) peak periods for an average weekday.

12.2.4 The assessment particularly focuses on construction of the Proposed Scheme in the Adelaide Road and Alexandra Place areas. In addition, traffic and transport impacts and effects within the Primrose Hill to Kilburn (Camden) area include those arising from the Euston – Station and Approach area (CFA1) and Camden Town and HS1 Link area (CFA2) scheme elements, for both construction and operation.

12.3 Environmental baseline

Existing baseline

12.3.1 Existing traffic and transport conditions in the Primrose Hill to Kilburn (Camden) area have been determined through site visits, specially commissioned transport surveys,

and liaison with LBC and TfL to source transport models, information on public transport, PRoW and accident data.

12.3.2 Traffic surveys of all roads crossing the route or potentially affected were undertaken in June/July 2012 comprising junction turning counts, automatic traffic counts, pedestrian counts, parking accumulation surveys and journey time information. All transport modes have been surveyed including private vehicles, public transport, walking, cycling and taxis. This was supplemented by traffic and transport data obtained from other sources, including regional and local transport models from TfL. The highway peak hours in the study area that were used in the assessment were 08:00-09:00 and 17:00-18:00.

12.3.3 Surveys of PRoW were undertaken in September 2012 to establish the nature of the PRoW and their usage by pedestrians and cyclists (non-motorised users). The surveys included all PRoW and roads that will cross the route of the Proposed Scheme and those that will be affected by the Proposed Scheme. The proposed scheme impacts on one PRoW in the Alexandra Place area.

12.3.4 The A41 Finchley Road, part of the Transport for London Road Network (TLRN) is the main strategic route in the area, and connects to the A40. Survey and model data indicates that the A41 is particularly prone to congestion in peak weekday periods.

12.3.5 The main local roads in the study area that are affected by the Proposed Scheme are B509 Adelaide Road, Alexandra Place, St John's Wood Park, Prince of Wales Road, Ferdinand Street, Gloucester Avenue, A502 Haverstock Hill, B507 Abbey Road, Albert Terrace, A41 Finchley Road, Primrose Hill Road, England's Lane, Regent's Park Road, A502 Chalk Farm Road, Avenue Road, Regent's Park Road, A4201 Parkway and A502 Rosslyn Hill.

12.3.6 The B509 Adelaide Road is a single carriageway bi-directional 'B' class road. A traffic-calmed 20mph zone is located in the streets to the north of the proposed Adelaide Road vent shaft main compound.

12.3.7 Alexandra Place is a minor residential access road which connects with Loudoun Road in broadly a crescent shape. Pedestrian access from Rowley Way to and from Alexandra Place/Loudoun Road is obtained via the Langtry Walk PRoW.

12.3.8 Safety and accident data has been obtained from TfL for the period from March 2009 to March 2012. This has been assessed and no identified clusters have been identified in the areas close to the Proposed Scheme works, specifically around the B509 Adelaide Road and Alexandra Place.

12.3.9 There are numerous bus routes across the area, but the B509 Adelaide Road is served by one daytime route (route 31 with up to 12 buses per hour per direction) providing connections between Camden and White City, and two night routes (routes N31 and N28 at four buses per hour per direction) providing connections to Camden, Wandsworth and Clapham Junction.

12.3.10 There are no bus routes in the vicinity of Alexandra Place. The closest routes are to the north along B509 Belsize Road and B509 Hilgrove Road and to the east along A41 Finchley Road.

12.3.11 Chalk Farm underground station is located at the eastern end of Adelaide Road. Rail services are accessible via South Hampstead station (London Overground) located immediately north of Alexandra Place.

12.3.12 Parking in the vicinity of the Proposed Scheme is generally confined to designated permit holder, disabled spaces, pay and display, motorcycle and car club bays within controlled parking zones (CPZ). Surveys indicated that demands in the vicinity of Adelaide Road and Alexandra Place were generally within capacity.

12.3.13 Parking demand was found to be much higher to the east and south of the area with demands substantially outstripping supply on routes leading to and from Finchley Road.

12.3.14 High levels of pedestrian activity were observed on the northern footway of B509 Adelaide Road near Chalk Farm underground station but there was low use of the southern footway. Pedestrian movements along the northern arm of Alexandra Place were relatively low.

12.3.15 The B509 Adelaide Road is not part of a recognised cycle route but there are several signed routes to the north. Alexandra Place is located directly off a signed TfL cycle route on Loudoun Road.

12.3.16 The closest navigable waterway is the Regent's Canal located in the south-eastern part of the study area where it passes under Fitzroy bridge at Gloucester Avenue. This is not affected by the Proposed Scheme and consequently is not considered further in this assessment.

Future baseline

12.3.17 The forecast future baseline traffic volumes have been incorporated within the TfL CLoHAM 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 the Primrose Hill to Kilburn (Camden) area.

Construction

12.3.18 Construction activities have been assessed against 2021 baseline traffic flows, irrespective of when they occur during the construction period. Future baseline traffic volumes in the peak hours are forecast to grow by around 5% by 2021 compared to 2012.

Operation (2026)

12.3.19 Future baseline traffic volumes in the peak hours are forecast to grow by around 7.5% by 2026 compared to 2012.

Operation (2041)

12.3.20 Future baseline traffic volumes in the peak hours are forecast to grow by around 12% by 2041 compared to 2012.

12.4 Effects arising during construction

Avoidance and mitigation measures

12.4.1 The following measures (as described in Section 2) have been included as part of the engineering design of the Proposed Scheme and will avoid or reduce effects on transport users:

- although there will be a four-month temporary closure of the B509 Adelaide Road affecting general traffic, buses and cyclists, the remaining temporary closures will be limited to partial closures, wherever reasonably practicable, including maintaining a limited traffic flow (e.g. through one-way or shuttle working);
- HGV routeing as far as reasonably practicable along the strategic road network and using designated routes for access, as shown in Maps TR-03-003B and TR-03-004A (Volume 5, Traffic and Transport Map Book); and
- traffic diversions and the provision of alternative pedestrian and cycle routes and temporary traffic management.

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 construction sites (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[113] that will require travel plans to be used, 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 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

[113] 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. 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 practical 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

Temporary 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 the Primrose Hill to Kilburn (Camden) area are expected to be:

- construction vehicle movements;
- partial and full road closures and associated diversions;
- removal of parking and loading; and
- the provision of alternative PRoW routes.

12.4.8 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. The duration of when there will be substantial transport activity at each site is shown in Table 12. This represents the periods when the construction traffic flows is 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 12: Typical vehicle trip generation for site 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 (Months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
Main site	Adelaide Road vent shaft	B509 Adelaide Road	2018	5	4-6 months	10-20	90-100

Compound type	Location	Access to/from compound	Indicative start / set up date	Estimated duration of use (Years)	Estimated duration with busy vehicle movements (Months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/LGV	HGV
Main site	Alexandra Place vent shaft	Alexandra Place	2018	5	4-6 months	10-20	90-100
Satellite site	Camden carriage sidings	Gloucester Avenue	Late 2015	1	Under 1 month	Less than 10	Less than 10

12.4.10 The average construction traffic levels for the peak month have been assessed. Activity will be lower than that shown in Table 12 for much of the time.

12.4.11 Details of the indicative construction programme are provided in Section 2.3. Construction phasing of works will mean that not all the movements will occur at the same time and the timing of peak construction works at each site will in practice not be simultaneous.

12.4.12 The A40 Western Avenue and M25 motorway will provide the primary HGV access and egress routes.

12.4.13 With the exception of the four-month road closure in Adelaide Road it is expected that two-way traffic or alternate shuttle working as a minimum can be maintained for the duration of the construction period.

12.4.14 Within this area, most of the Proposed Scheme is in tunnel and direct impacts are mainly limited to the operation of the main compounds during construction at the Adelaide Road and Alexandra Place vent shafts sites.

12.4.15 In the busiest month these movements are not expected to exceed 100 combined in/out vehicle movements per day per construction site across the study area which is small in comparison to the wider area traffic flows. These are almost all HGVs.

12.4.16 Construction traffic movements related to the work at the Camden carriage sidings are expected to be negligible and will be mostly confined to night time, weekends and bank holidays. The effect is therefore not expected to be significant.

12.4.17 However, the traffic impacts of construction in adjacent CFAs, particularly the Euston – Station and Approach area (CFA1), associated with construction of the station and approaches, will have more substantial effects in this area.

12.4.18 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 will have only localised impacts and are expected to be short-term in duration. Utilities works are not expected to result in significant additional adverse effects.

12.4.19 In order to assess the different combinations of enabling works within the Primrose Hill to Kilburn (Camden) area (CFA3), potential impacts arising from utility diversions and construction lorry movements throughout the construction period across the CFA3 area for three distinct temporal phases have been considered:

- Scenario 1, Quarter 2 (Q2) 2017. This phase corresponds with early enabling work and utilities on the highway network around Euston together with around 70% of the maximum construction traffic arising from construction in the Euston – Station and Approach area (CFA1);
- Scenario 2, Quarter 3 (Q3) 2019. This phase corresponds with the main construction period in CFA1 together with the peak month (i.e. the maximum total) of construction traffic, along with works and temporary highway closures at the Chalk Farm Road bridge (in the Camden Town and HS1 Link area (CFA2)), and the works involving closures at the B509 Adelaide Road; and
- Scenario 3, Quarter 4 (Q4) 2021. During this phase, the majority of enabling works on the highway around Euston will be complete, and there will be only short-term highway interventions in CFA2.

12.4.20 The Alexandra Place works are scheduled to commence towards the latter part of Scenario 1 and will be in operation for approximately five years.

12.4.21 For each scenario, there will be different levels of construction traffic, together with different patterns of road closures and traffic management. The assessment below focuses particularly on scenario 2 as this includes most impacts, but additional impacts during other scenarios are identified as appropriate.

12.4.22 Construction of the Proposed Scheme will result in changes in traffic flows and delays to vehicle users in the area due to increased traffic flows from construction activity in neighbouring CFA1 and CFA2 areas in addition to diversionary effects of the closure of B509 Adelaide Road.

12.4.23 The changes in traffic flows are expected to lead to increases in congestion[114] and delays at the junctions, predominantly during scenario 2, at the following locations in the area:

- A502 Haverstock Hill/Parkhill Road – (major adverse effect); and
- Gloucester Avenue/Oval Road – (major adverse effect).

12.4.24 The combined impact of closure of the B509 Adelaide Road and construction traffic relating to the Proposed Scheme in CFA1, will result in increases in daily traffic flow

[114] 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 close to capacity and the increases in traffic due to the Proposed Scheme will be such as to substantially increase queues and delays on a routine basis. 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 cause occasional queues and delays or small increases in existing delays.

(i.e. more than 30% for HGV or all vehicles), during scenario 2 that are expected to cause a significant increase in traffic-related severance[115] in the following locations:

- Avenue Road – moderate adverse effect (all vehicles);
- Chalk Farm Road – moderate adverse effect (HGV and all vehicles);
- St John's Wood Park - moderate adverse effect (all vehicles);
- A502 Rosslyn Hill – moderate adverse effect (HGV);
- Regent's Park Road – moderate adverse effect (HGV) and minor adverse effect (all vehicles);
- Parkway – moderate adverse effect (HGV);
- Prince of Wales Road – moderate adverse effect (all vehicles and HGV);
- Primrose Hill Road – moderate adverse effect (HGV);
- Primrose Hill Road/England's Lane north of A509 Adelaide Road – major adverse effect (HGV) and minor adverse effect (all vehicles);
- Ferdinand Street – minor adverse effect (all vehicles);
- A41 Finchley Road – moderate adverse effect (HGV);
- Gloucester Avenue – major adverse effect (all vehicles and HGV); and
- A502 Haverstock Hill – major adverse effect (all vehicles and HGV).

12.4.25 There are expected to be fewer traffic-related severance effects in other phases of the construction. The effects in the other phases are:

- Albert Terrace – scenario 1 (moderate adverse effect - all vehicles);
- Regent's Park Road – scenario 1 (minor adverse effect - all vehicles);
- A41 Finchley Road – scenario 3 (moderate adverse effect - HGV); and
- Prince Albert Road – scenario 3 (minor adverse effect - HGV).

12.4.26 Some of the effects listed previously will extend across CFA boundaries, and where this is the case they are also identified and reported within those areas.

12.4.27 It is expected that construction will require the extension of the Alexandra Place vent shaft compound boundary into part of the Alexandra Place public highway, resulting in the loss of vehicular through movements to and from Loudoun Road for up to two and a half years. The diversions are not expected to have a significant effect on road users.

[115] In the context of this 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 full closure of the B509 Adelaide Road to traffic will require the introduction of a diversion route of up to a 500m for bus routes 31, N31 and N28 via Primrose Hill Road, England's Lane and Haverstock Hill. This is expected to have a moderate adverse effect on public transport delays. Under the temporary partial closure condition, shuttle-working (i.e. alternating one-way working) will remove the need for any bus diversions.

12.4.29 No significant effects on bus operations are expected in the vicinity of the Alexandra Place vent shaft main compound.

12.4.30 Construction of the Proposed Scheme will have a number of impacts on parking. These will be:

- during partial closure of the B509 Adelaide Road some parking bays on the south side will be suspended to accommodate a relocated bus stop. This is not a significant effect;
- during full closure of the B509 Adelaide Road, suspension of parking bays on the south side of England's Lane and a motorcycle bay will be required to minimise traffic congestion from diverted traffic. Both will cause minor adverse effects;
- the Alexandra Place vent shaft main compound is expected to result in suspension of parking spaces during construction, which will be a minor adverse effect; and
- partial demolition of the Dinerman Court car park wall and temporary suspension of approximately six private off-street car parking spaces to provide temporary facilities for servicing vehicles. Due to the small number involved this will not be a significant effect.

12.4.31 As a result of potential traffic diversions increasing traffic on diversionary routes, the following links are expected to have an increased risk of accidents:

- A41 Finchley Road – scenario 2 and 3, (minor adverse effect); and
- St John's Wood Park – scenario 2, (minor adverse effect).

12.4.32 The interchange at Chalk Farm underground station is expected to be affected by the diversion of bus Route 31 during the closure of Adelaide Road with bus stops serving Chalk Farm underground station being suspended. Potential alternative temporary bus stops on Haverstock Hill mean the effect will not be significant.

12.4.33 During full closure of the B509 Adelaide Road the suspension of other bus stops serving bus routes 31, N31 and N28 with alternative bus stops approximately 290m away will be a major adverse effect. During partial closure, convenient relocation will be possible and will not therefore result in a significant effect. The diversions and footway restrictions at B509 Adelaide Road will also affect pedestrians and cyclists but this is not expected to be significant.

12.4.34 Extension of the Alexandra Place vent shaft compound into the highway will require alternative pedestrian routes to be provided and the removal of a pedestrian crossing,

but this is not expected to be a significant adverse effect due to the alternative routes being short.

12.4.35 The Alexandra Place compound will also result in the closure of part of the Langtry Walk PRoW between Rowley Way and Loudoun Road and the length of alternative routes (110m) will result in a minor significant adverse effect on severance for PRoW users.

12.4.36 Rail possessions to accommodate the interface of the Proposed Scheme with Network Rail will be required as part of works to the WCML and NLL. These will be short-term, generally involving overnight weekday or weekend works and will not have significant effects for rail users.

Cumulative effects

12.4.37 The assessment includes the cumulative effects of planned development during construction by taking this into account within the background traffic growth.

12.4.38 The assessment also includes in-combination effects by taking into account traffic and transport impacts of works being undertaken in neighbouring areas of the Proposed Scheme. Specifically, the assessment includes the general traffic diversion effects of road closures and construction traffic associated with the Euston – Station and Approach area (CFA1), Camden Town and HS1 Link area (CFA2) and Kilburn (Brent) to Old Oak Common area (CFA4).

Permanent Effects

12.4.39 Any permanent construction effects 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 wide impacts and effects of the operation phase need to be considered together.

Other mitigation measures.

12.4.40 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.

12.4.41 Many signalised junctions in this area have adaptive control which will optimise the signals to accommodate changes in traffic and minimise delays due to changes in traffic flows. Consequently, many of those junctions with an identified minor adverse effect will be mitigated through adaptive control, which will mean that the adverse effects may be over-stated. This is, however, less effective where there is an overall increase in traffic.

12.4.42 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

12.4.43 The main construction impacts and effects are expected during the period of peak construction traffic together with a road closure at Chalk Farm Road bridge (CFA2) and closures of the B509 Adelaide Road (scenario 2).

12.4.44 Changes in traffic flows will lead to congestion, increasing delays at: Haverstock Hill/ Parkhill Road; Gloucester Avenue/Oval Road; and Albert Terrace.

12.4.45 Changes in traffic flows will affect non-motorised users, making it more difficult to cross the road at: Regent's Park Road; Avenue Road; Chalk Farm Road; St John's Wood Park; A502 Rosslyn Hill; Prince of Wales Road; Primrose Hill Road; Primrose Hill Road/England's Lane north of Adelaide Road; Ferdinand Street; A41 Finchley Road; Gloucester Avenue; A502 Haverstock Hill; Parkway; and Prince Albert Road.

12.4.46 There are expected to be beneficial effects in terms of reduced traffic flows on Harmood Street and westbound on Prince of Wales Road between Grafton Road and Talacre Road.

12.4.47 Diversions and delays to bus routes 31, C2, N31 and N28 are expected when Adelaide Road is subject to a full closure.

12.4.48 There will be temporary bus stop relocations during a full closure of Adelaide Road to diversion routes.

12.4.49 A temporary loss of parking will be required on B509 Adelaide Road, England's Lane, Alexandra Place and at Dinerman Court private off-street car park.

12.4.50 An increase in accident risk due to increased traffic flows is expected at A41 Finchley Road and St John's Wood Park. Temporary rerouteing of a small section of Langtry Walk PRoW in the vicinity of Alexandra Place will be required.

12.4.51 The significant effects that result from construction of the Proposed Scheme are shown in Maps TR-03-003B and TR-03-004A (Volume 5, Traffic and Transport Map Book).

12.5 Effects arising from operation

Avoidance and mitigation measures

12.5.1 The following measures have been included as part of the design of the Proposed Scheme and will avoid or reduce impacts on transport users:

- the Proposed Scheme in this area is predominantly in tunnel, meaning there are minimal highway impacts; and
- above-ground features (i.e. the two vent shafts) will be located away from the public highway, allowing on-street parking controls to be generally reinstated.

12.5.2 The station travel plan for Euston station (CFA1) will help reduce any traffic impacts in this area, although this has not been taken into account specifically in this assessment.

Assessment of impacts and effects

12.5.3 The following section considers the impacts on traffic and transport and the consequential effects resulting from the operational phase of the Proposed Scheme (as described in Section 2.4 of this report).

12.5.4 The transport related impacts during operation of the Proposed Scheme are limited due to:

- there will be no stations or depots within the area that generate any additional traffic and with the exception of the two vent shaft sites, the Proposed Scheme is entirely within tunnel; and
- there are no changes to the highway networks and roads that will be affected temporarily during construction will be reinstated to their pre-construction condition.

12.5.5 Occasional traffic may access the two vent shaft sites and Camden carriage sidings for maintenance purposes. This will involve small numbers of vehicles on an infrequent basis and will not in itself be a significant effect. However, the assessment also includes the general traffic effects of operation associated with the Euston – Station and Approach area (CFA1).

12.5.6 The reconfiguration of roads around Euston station is forecast to result in a redistribution of traffic. Depending on location, this could lead to either an increase or decrease in daily traffic flow.

12.5.7 Decreases in traffic flow are expected to cause a reduction in pedestrian severance on Prince Albert Road in 2026 and 2041. This will result in a moderate beneficial effect.

12.5.8 In 2041, increases in traffic flow are expected (more than 10%) as a result of the operation of Euston station, causing an increase in traffic-related severance for non-motorised users on the B507 Abbey Road. This will result in a moderate adverse effect, but in total represents just over one additional vehicle per minute in the peak hour. There will be a localised loss of parking on the B509 Adelaide Road but this will not be a significant effect.

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 includes in-combination effects by taking into account operational traffic and transport impacts of neighbouring areas of the Proposed Scheme. For this area, this includes the Euston – Station and Approach area (CFA1).

Other mitigation measures

12.5.11 No additional mitigation is required for the operation of the Proposed Scheme.

Summary of likely significant residual effects

12.5.12 As a result of the reconfiguration of the highway network in the Euston area, there will be some decreases in traffic flow, making it easier to cross the road on Prince Albert Road.

12.5.13 Increased traffic flows will make it more difficult to cross the road on the B507 Abbey Road.

12.5.14 The significant effects that result in this area from the Proposed Scheme in 2041 are shown in MapsTR-04-003B to TR-04-004A (Volume 5, Traffic and Transport Map Book).

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 flood risk. It then reports on the likely impacts and significant effects on these aspects as a result of the construction and operation of the Proposed Scheme.

13.1.2 The main environmental features of relevance to water resources and flood risk include:

- the Grand Union Canal (Regent's Canal);
- a private licensed groundwater abstraction in South Hampstead (abstraction reference: 28/39/39/0219 on Map WR-02-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book)); and
- one groundwater abstraction for public water supply and its associated Source Protection Zone (SPZ) near Primrose Hill.

13.1.3 Key environmental issues relating to water resources and flood risk include:

- the potential for loss or damage to the private licensed abstraction in South Hampstead; and
- potential risk of surface water flooding at the two vent shafts at Alexandra Place and Adelaide Road.

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 (WFD) [116] 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-002-003: Water Resources Assessment report; and
- Appendix WR-003-003: Flood Risk Assessment.

[116] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, European Parliament and European Council, Strasbourg.

13.1.6 Map Series WR-01 to WR-03 showing details 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 Discussions have been held with the Environment Agency, TWUL, the Canal and River Trust (formerly British Waterways) and LBC.

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 (see Volume 5: Appendix CT-001-000/1) and its Addendum (see Volume 5 Appendix CT-001-000/2). This report follows the standard assessment methodology.

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 Proposed Scheme, except where there is clearly no hydraulic connectivity and in urban areas where the extent was 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 works on utilities, 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 have been carried out at the two vent shaft sites (Adelaide Road and Alexandra Place). With the exception of track modification work on existing railway land[117], the remainder of the Proposed Scheme in this area will be entirely in tunnel and no further site visits to view the existing above ground environment were considered necessary.

13.2.4 Water Framework Directive (WFD) classification data has been made available by the Environment Agency. For surface water bodies that do not have a WFD status class shown in the relevant River Basin Management Plan (RBMP), the status class has been taken as the status class for the first downstream water body for which a status class is reported. Where groundwater does not have a WFD status class shown in the relevant River Basin Management Plan (RBMP), these are referred to as 'not assessed by the Environment Agency' in the summary of geology and hydrogeology tables (see Table 14 and Volume 5: Appendix WR-002-003).

13.2.5 Limited data from the Environment Agency in relation to groundwater levels and groundwater quality from existing boreholes has been used for this assessment. No additional monitoring was undertaken as part of this assessment.

13.2.6 The Flood Zone Maps 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-003-003.

[117] At Camden carriage sidings, WCML north of A4201 Parkway and NLL west of Regent's Park Road bridge.

13.3 Environmental baseline

Existing baseline – surface water resources

Surface water features

13.3.1 The current surface water baseline is shown on Map WR-01-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book) and all surface water features within the study area are assessed within Volume 5: Appendix WR-002-003. Table 13 includes features potentially affected by the Proposed Scheme.

13.3.2 The area is heavily urbanised with one WFD classified surface water body, the Grand Union Canal. The route will pass in tunnel under the Grand Union Canal (Regent's Canal) near Fitzroy Bridge (on Gloucester Avenue). All water bodies[118] in the area fall within the Thames River Basin District (RBD) as set out in the Thames RBD River Basin Management Plan (RBMP)[119].

13.3.3 The Grand Union Canal is currently used for navigation by both commercial and leisure users.

13.3.4 Surface water runoff currently drains into the TWUL combined sewer network. The quality of surface water runoff is likely to reflect the urban nature of the area and therefore may be contaminated with sediment, oil and other contaminants associated with urban catchments.

Table 13: Surface water features potentially affected by the Proposed Scheme

Water feature	Location description (and map reference)	Watercourse classification[120]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[121]
Grand Union Canal (Regent's Canal)	The route will pass in tunnel under the Grand Union Canal (Regent's Canal) near Fitzroy Bridge on Gloucester Avenue, Primrose Hill. (SWC-CFA03-01)	Artificial	Grand Union Canal (Uxbridge to Hanwell Locks, Slough Arm, Paddington Arm) (GB70610078) Moderate	Good potential	High
Three small ornamental landscaped ponds	Located close to Fitzroy Road and Regent's Park	Not applicable	Not applicable	Not applicable	Low

[118] The Environment Agency's Detailed Rivers Network (DRN) indicates a culverted watercourse (the River Fleet which is also known locally as the Middle Level No.2 Sewer) crossing the Grand Union Canal (the Regent's Canal, lower section) 30m west of Royal College Street. The watercourse has been included in the DRN to ensure connectivity between Highgate Ponds and the Thames within the DRN. It is considered that the watercourse is a part of the sewer network and is not a surface water feature. It has therefore not been included in this assessment.
[119] Environment Agency (2009) River Basin Management Plan, Thames River Basin District.
[120] 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.
[121] For examples of receptor value see Table 43 in the SMR Addendum (Volume 5: Appendix CT-0001-000/2).

Water feature	Location description (and map reference)	Watercourse classification[120]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[121]
– Primrose Hill	Road near Primrose Hill, south of the route (CFA03-P01)				
One Hampstead Theatre pond	Located close to Hampstead Theatre, South Hampstead, 20m north of the route near Winchester Road (CFA03-P02)	Not applicable	Not applicable	Not applicable	Low

Water Framework Directive status

13.3.5 The only water body in the area that is given a WFD classification by the Environment Agency is the Grand Union Canal (Regent's Canal) - the WFD name being 'Grand Union Canal (Uxbridge to Hanwell Locks, Slough Arm, Paddington Arm)'. It is designated as an artificial waterbody and is currently assessed by the Environment Agency as having 'Moderate' status. The objective for 2027 is 'Good Potential/Status' for this waterbody.

Abstractions and permitted discharges

13.3.6 There are no licensed surface water abstractions within the study area[122]. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20 cubic metres per day.

13.3.7 The Environment Agency reports that there is one current consented surface water discharge within 500m of the route, discharging cooling water into the Grand Union Canal (Regent's Canal) approximately 15m from the route near Fitzroy Bridge (details in Volume 5, Appendix WR-002-003).

Existing baseline – groundwater resources

Geology and hydrogeology

13.3.8 The location of abstractions, geological formations and indicative groundwater elevations are shown on Map WR-02-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.9 The geological formations within this study area are described further in Section 8 of this report, with a schematic geological cross-section in Volume 5: Appendix WR-002-003.

[122] Surface water abstractions for public supply are not included.

13.3.10 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 14. Unless otherwise stated, the geological groups listed are all crossed by the route.

Table 14: Summary of geology and hydrogeology in the Primrose Hill to Kilburn (Camden) 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						
No superficial deposits are present in the study area.						
Bedrock						
Thames Group (London Clay Formation and Harwich Formation)	Across entire study area. (penetrated by Proposed Scheme).	Sandy, silty, clay.	Unproductive Strata	Not assessed by the Environment Agency.	Not assessed by the Environment Agency.	Low
Lambeth Group (Reading and Woolwich Formations)	Assumed to underlie London Clay Formation throughout the study area (not penetrated by Proposed Scheme).	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
Thanet Sand Formation	Assumed to underlie Lambeth Group (not penetrated by Proposed Scheme).	Green, brown silty sand.	Secondary A	Not assessed by the Environment Agency.	Not assessed by the Environment Agency.	Moderate
Cretaceous Chalk Group (White Chalk Subgroup)	Underlies the Thanet Sand Formation throughout the area (not penetrated by Proposed Scheme).	Firm white chalk with marl seams and flint bands.	Principal	Mid Chilterns Chalk (GB40601G601200) Poor	Good	High

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Superficial deposits

13.3.11 No superficial deposits are present in the study area. However, there may be a cover of made ground 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.

Bedrock aquifers

13.3.12 The London Clay Formation underlies the whole of the study area: this is a blue-grey clay that weathers to a brown colour in its upper part. The London Clay Formation is designated as unproductive strata.

13.3.13 The geological succession beneath the London Clay Formation comprises, in turn the:

- Harwich Formation, a thin sandy deposit (at least locally);
- Lambeth Group (also termed the Woolwich and Reading Formations), which comprises mixed sands and clays and pebble deposits locally;
- Thanet Sand Formation, a dense green sand; and
- Cretaceous Chalk Group, which is a succession of soft white limestones.

Water Framework Directive status

13.3.14 No superficial deposits are present in the study area. Therefore, no WFD classification has been given by the Environment Agency to superficial deposits.

13.3.15 The London Clay Formation is classed as unproductive strata and as such has not been classified under the WFD.

Abstractions and permitted discharges

13.3.16 According to Environment Agency and LBC records, there are two licensed groundwater abstractions in the study area as follows (further details are provided in Volume 5: Appendix WR-002-003 and shown on Map WR-02-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book)):

- a private licensed groundwater abstraction which is used for irrigation purposes. This is located in South Hampstead, west of Winchester Road and is intersected by the route; and
- a groundwater abstraction for public water supply near Primrose Hill, north of Prince Albert Road, with a SPZ that will be crossed by the route.

13.3.17 There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20 cubic metres per day. Details are presented in Volume 5: Appendix WR-002-003. The abstractions are classified as high value receptors.

13.3.18 The Environment Agency reports that there are no current consented discharges to ground/groundwater in the study area.

Surface water/groundwater interaction

13.3.19 There are no surface water/groundwater interactions in the study area.

Water dependent habitats

13.3.20 The route will not cross any areas with statutory ecological designations in relation to surface water or groundwater.

Existing baseline – flood risk

River flooding

13.3.21 The agreed data set for river flooding is the Environment Agency Flood Zone Mapping[123].

13.3.22 As the Proposed Scheme is in largely in tunnel, the route will not cross over any Environment Agency designated main rivers or ordinary watercourses shown on the Digital River Network, as shown on Map WR-01-003 (Volume 5, Water Resources and Flood Risk Assessment Map Book). The entire study area is within Flood Zone 1.

Surface water flooding

13.3.23 The locally agreed surface water flooding dataset is from the modelling activities undertaken as part of the Drain London project for the production of the LBC Preliminary Flood Risk Assessment (PFRA)[124] and the LBC Surface Water Management Plan[125]. The Environment Agency Flood Map for Surface Water (FMfSW)[126] has also been reviewed to inform the assessment of surface water flood risk, and is shown on Map WR-01-03 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.24 A large area in the north of Camden was affected by surface water flooding in August 2002. A retaining wall collapsed onto the track in the approach to Euston station during this flooding event and caused a closure of the station[127].

13.3.25 There are parts of the study area that are shown to 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 route is in tunnel through the whole of the study area, surface water flood risk has only been considered where the above ground structures associated with the vent shafts will be constructed.

13.3.26 Close to the Adelaide Road vent shaft, to the south of B509 Adelaide Road, there is an area at risk of surface water flooding in the existing railway cutting on the WCML and NLL. The railway cutting at South Hampstead station, to the north of the Alexandra Place vent shaft, is also at risk of surface water flooding. At both of these locations, the ground level at the vent shafts is significantly higher than that in the adjacent railway cuttings where there is a risk of surface water flooding. There are no surface water flooding overland flow routes identified at the vent shaft sites.

Sewer flooding

13.3.27 The agreed datasets for sewer flooding are the TWUL records in the LBC PFRA and the North London Strategic Flood Risk Assessment (SFRA)[128].

13.3.28 TWUL historic sewer flooding records show that there have been a number of sewer flooding incidents in the study area. The LBC PFRA states that sewer flooding

[123] Environment Agency web site http://www.environment-agency.gov.uk/homeandleisure/37837.aspx; Accessed September 2013
[124] Halcrow (2011), *London Borough of Camden Preliminary Flood Risk Assessment*.
[125] Camden Council (2013), *Managing flood risk in Camden: The Camden flood risk management strategy*.
[126] Environment Agency (2013), *Flood Map for Surface Water.*
[127] Camden Council (2003), *Floods in Camden: Report of the Floods Scrutiny Panel*.
[128] Mouchel (2008), North London Strategic Flood Risk Assessment. North London Waste Authority

occurred within LBC in August 2004, September 2005 and July 2007. Specific locations of these flood incidents are not given.

Artificial water bodies

13.3.29 Flooding from artificial water bodies, such as canals and reservoirs, may occur as a result of failure of a retaining structure that impounds water. The agreed dataset for flooding due to reservoir failure is the Environment Agency Reservoir Inundation Map[129].

13.3.30 The nearest canal to the route of the Proposed Scheme in this study area is the Grand Union Canal (Regent's Canal). The route will pass in tunnel approximately 18m beneath the canal at Fitzroy Bridge on Gloucester Avenue near Primrose Hill.

13.3.31 Within the study area there are no areas that are shown to have a residual risk of flooding from failure of impounded reservoirs.

Groundwater flooding

13.3.32 The agreed dataset for groundwater flooding is the LBC PFRA.

13.3.33 There are no historic incidents of groundwater flooding within the study area, and geological mapping indicates that there are no superficial deposits present. The LBC PFRA does not report a potential for 'elevated groundwater' (i.e. groundwater flooding) within the study area.

Future baseline

13.3.34 Volume 5: 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 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.

13.3.35 There are no committed developments that are likely to cause significant changes to the water resources and flood risk baseline prior to construction of the Proposed Scheme in this study area. All developments are required to comply with the National Planning Policy Framework (NPPF[130]), development plans and other legislation and guidance. As such, committed developments should have a neutral effect on the water resources and flood risk baseline.

13.3.36 Water Framework Directive future status objectives are set out in Table 13 and Table 14. These are not considered to result in significant changes to the reported effects from the Proposed Scheme.

[129] Environment Agency (2013) 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: 11 November 2013.
[130] Department for Communities and Local Government, (2012), National Planning Policy Framework Technical Guidance

Climate change

13.3.37 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.

13.3.38 Current projections indicate that there will be more frequent, higher intensity rainfall events in the future. The probability and severity of surface water flooding could therefore increase as surface water drainage systems fail to cope with more frequent, higher intensity storms. Peak river flows during flood events are expected to increase, potentially causing greater depths and extents of flooding.

13.3.39 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.

13.3.40 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 in 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, Section 9.15.

13.4.2 The following avoidance and mitigation measures will serve to reduce potentially significant adverse effects on water resources and flood risk. Further details are given in Volume 5: Appendices WR-002-003 and WR-003-003.

13.4.3 The deepest excavation and foundation works for the bored tunnels will be within the London Clay Formation (unproductive strata) and will not penetrate the underlying Chalk aquifer, thereby avoiding effects on groundwater.

13.4.4 Construction sites for the Adelaide Road and Alexandra Place vent shafts will be located outside of areas at risk of surface water flooding, where practicable (Section 16 of the draft CoCP). Where these cannot be located outside flood risk areas, site specific flood risk management plans will be prepared prior to the construction to manage the potential risks.

13.4.5 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.

13.4.6 Due to the urban nature of the area, the alignment of the Proposed Scheme in tunnel, the nature of the geology and presence of potentially contaminated made ground, there is limited potential for the incorporation of sustainable drainage systems (SuDS) features within the surface water drainage. Attenuation will therefore be provided through use of lined tanks or other forms of storage as necessary. The SuDS features will be designed where practicable to discharge at existing run-off rates and will accommodate for events up to and including the 1 in 100 annual probability (1%) including an allowance for climate change. Approval to discharge to storm drains or combined sewers will be obtained prior to construction from Thames Water Utilities Limited to ensure that there is sufficient capacity in the receiving infrastructure. This will avoid an increase in the risk of surface water or sewer flooding and any risks to surface or groundwater quality.

13.4.7 With regard to flood risk, implementation of the measures defined in the draft CoCP (Section 16), to control and manage the rate and volume of runoff, will reduce the risk of flooding. These measures will also reduce the risk of accidental discharge where utility or other construction work is being carried out in the vicinity of the Grand Union Canal (the Regent's Canal, lower section) and on the Middle Level No. 2 Sewer (culverted River Fleet[131]).

13.4.8 The draft CoCP requires contractors to obtain the necessary approvals from TWUL to enable discharge of surface water run-off to the public sewer network from construction compounds, such as at the Adelaide Road and Alexandra Place main compounds, avoiding an increase in the risk of sewer flooding.

Assessment of impacts and effects

13.4.9 This section describes the significant effects following the implementation of avoidance and mitigation measures.

13.4.10 Further details of the potential impacts that will have no significant effects are provided in the Water Resources Assessment report in Volume 5: Appendix WR-002-003 and Flood Risk Assessment in Volume 5: Appendix WR-003-003.

13.4.11 An assessment of the impact on the WFD status is detailed within the WFD Compliance Assessment (see Volume 5: Appendix WR-001-000).

13.4.12 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

13.4.13 The assessment shows that there will be no significant temporary adverse effects on surface water resources during the construction period.

[131] Part of the TWUL combined sewer network.

Groundwater

13.4.14 The assessment shows that there will be no significant temporary adverse effects on groundwater or water dependent habitats during the construction period.

Flood risk

13.4.15 The construction sites at the Adelaide Road and Alexandra Place vent shafts will not obstruct any surface water flooding overland flow routes.

13.4.16 The assessment has identified no significant temporary increase in flood risks during the construction period.

Cumulative effects

13.4.17 There are no committed developments that have been identified that will result in significant cumulative temporary effects.

Permanent effects

Surface water

13.4.18 The assessment did not identify any significant permanent adverse effects on surface water resources or on the single surface water discharge consent.

Groundwater

13.4.19 The licensed private groundwater abstraction (28/39/39/0219) located in South Hampstead, west of Winchester Road is located between the three tunnel bores (Euston tunnel (twin-bore) and HS1-HS2 Link tunnel (single-bore)) and the abstraction borehole infrastructure could be physically impacted during construction. The abstraction is used for irrigation purposes and, as such, is of moderate value. In the event that the borehole needs to be decommissioned, this would constitute a major impact on the licensed user's rights of abstraction, giving rise to a large effect, which is considered significant.

13.4.20 No other significant permanent adverse effects on groundwater abstractions or discharge consents are expected as a result of construction.

Flood risk

13.4.21 The permanent headhouses at the Adelaide Road and Alexandra Place vent shafts will not obstruct any surface water flooding overland flow routes and, through the implementation of the run-off attenuation measures described previously, there will be no significant permanent adverse effects on flood risk.

Cumulative effects

13.4.22 There are no committed developments that have been identified that will result in significant cumulative permanent effects.

Other mitigation measures

13.4.23 There will be no significant temporary or permanent adverse effects to surface water or flood risk as a result of construction and therefore no other mitigation is proposed.

13.4.24 The condition of the private abstraction borehole (28/39/39/0219) will be monitored. The monitoring schedule will include monitoring groundwater quality and rates of

abstraction in agreement with the owners of the borehole (LBC) and the Environment Agency. The monitoring data will be assessed and used to define appropriate mitigation.

13.4.25 If the private abstraction borehole (28/39/39/0219) is decommissioned[132], an alternative water supply will be provided and as a result there will be no significant permanent adverse effects.

Summary of likely significant residual effects

13.4.26 Following mitigation, no significant temporary or permanent residual effects have been identified within the assessment.

13.5 Effects arising from operation

Avoidance and mitigation measures

13.5.1 The route-wide drainage strategy for tunnels comprises measures to accommodate water originating from two sources: seepage and fire water. Water will be collected by channel drains and conveyed by gravity in a piped system to sumps located at low points within the tunnels and at the vent shafts. Within the study area pump stations and sumps will be located at the Adelaide Road vent shaft and Alexandra Place vent shaft. Discharge will be to sewer at a controlled rate, subject to consultation with TWUL.

13.5.2 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 watercourses and groundwater bodies are described in Volume 1 and the draft operation and maintenance plan for water resources and flood risk included in Volume 5: Appendix WR-001-000.

13.5.3 Operation and management of the Proposed Scheme is not likely to have a significant adverse effect on flood risk anywhere in the catchments through which it passes. Generic examples of management measures that may mitigate flood risk are described in Volume 1.

Assessment of impacts and effects

13.5.4 There are considered to be no significant adverse effects to surface water, groundwater or flood risk arising from operation of the Proposed Scheme.

Other mitigation measures

13.5.5 There are considered to be no further mitigation measures required to mitigate adverse effects on surface water resources, groundwater resources or flood risk.

[132] Decommissioning should be undertaken in accordance with the Environment Agency (2012), *Good practice for decommissioning redundant boreholes and wells*; http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/LIT_6478_8cbe6f.pdf; Accessed July 2013.

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