

DRAFT ENVIRONMENTAL STATEMENT

Community Forum Area Report
7 | Colne Valley

HS2 London-West Midlands

May 2013



ENGINE FOR GROWTH

DRAFT ENVIRONMENTAL STATEMENT

Community Forum Area Report
7 | Colne Valley

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Draft Volume 2: Community Forum Area Report Colne Valley/No 7

Structure of the HS2 draft Environmental Statement

The draft ES documentation for the purpose of this consultation comprises:

- A non-technical summary (NTS) – providing a summary of the Proposed Scheme, the likely significant effects of the Proposed Scheme, both beneficial and adverse, and the means to avoid or reduce the adverse effects;
- A main report – consisting of two volumes:
 - Volume 1: Introduction to the Environmental Statement and Proposed Scheme which provides an introduction to HS2, an overview of the hybrid Bill process and the environmental impact assessment (EIA) methodology, an introduction to consultation and engagement, the main strategic and route-wide alternatives considered; and
 - Volume 2: Includes 26 Community Forum Area (CFA) reports, each with a separate corresponding set of drawings, which together provide the assessment of local environmental effects. An assessment of the effects of the Proposed Scheme on a route-wide basis is presented in Report 27.

HS2 Ltd set up 26 community forums along the line of route of the Proposed Scheme, as a regular way of engaging with local communities¹. Volume 2 of this draft ES supports this engagement strategy by providing a draft ES report for each CFA. This is a report for the Colne Valley area, CFA7.

The draft ES has been written in a clear and accessible manner however, on occasion it has been necessary to use technical terms. Given this, a glossary of terms and list of abbreviations for all draft ES documentation is provided.

¹ Details of these community forums are provided on the HS2 Ltd website at www.hs2.org.uk/have-your-say/forums/community-forums. Accessed 11 April 2013.

Part A: Introduction

1 Introduction

1.1 Introduction to HS2

- 1.1.1 HS2 is planned to be a Y-shaped rail network with stations in London, Birmingham, Leeds, Manchester, South Yorkshire and the East Midlands, linked by high speed trains running at speeds of up to 360 kilometres per hour (kph) (225 miles per hour (mph)).
- 1.1.2 HS2 is proposed to be built in two phases. Phase One (the Proposed Scheme), the subject of this draft ES, would involve the construction of a new railway line of approximately 230km (143 miles) between London and Birmingham that would become operational by 2026; with a connection to the West Coast Main Line (WCML) near Lichfield and to the existing HS1 line in London. The Phase One route and the 26 CFAs are shown in Figure 1.
- 1.1.3 On opening, Phase One would run up to 14 trains per hour (tph). HS2 trains would be up to 400 metres (m) long with 1,100 seats during peak hours. Beyond the dedicated high speed track, these high speed trains would connect with and run on the existing WCML to serve passengers beyond the HS2 network. A connection to HS1 would also allow some services to run to mainland Europe via the Channel Tunnel.
- 1.1.4 Phase Two would involve the construction of lines from Birmingham to Leeds and Manchester; with construction commencing around 2027, and planned to be operational by 2033. After Phase Two opens, it is expected that the frequency of train services on some parts of the Phase One route could increase up to 18tph.
- 1.1.5 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.

1.2 Purpose of this report

- 1.2.1 This report presents the likely significant environmental effects as a result of the construction and operation of Phase One of HS2 (the Proposed Scheme) that have been identified to date within the area of the Colne Valley (CFA7). It provides a summary of the likely environmental issues and proposed mitigation measures that are being addressed during the design development process within the Colne Valley area.
- 1.2.2 The final details of the Proposed Scheme and assessment of its environmental impacts and effects will be presented in the formal ES submitted in accordance with the requirements of Parliamentary Standing Order 27A (SO27A)².

² *Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment)*, House of Commons.

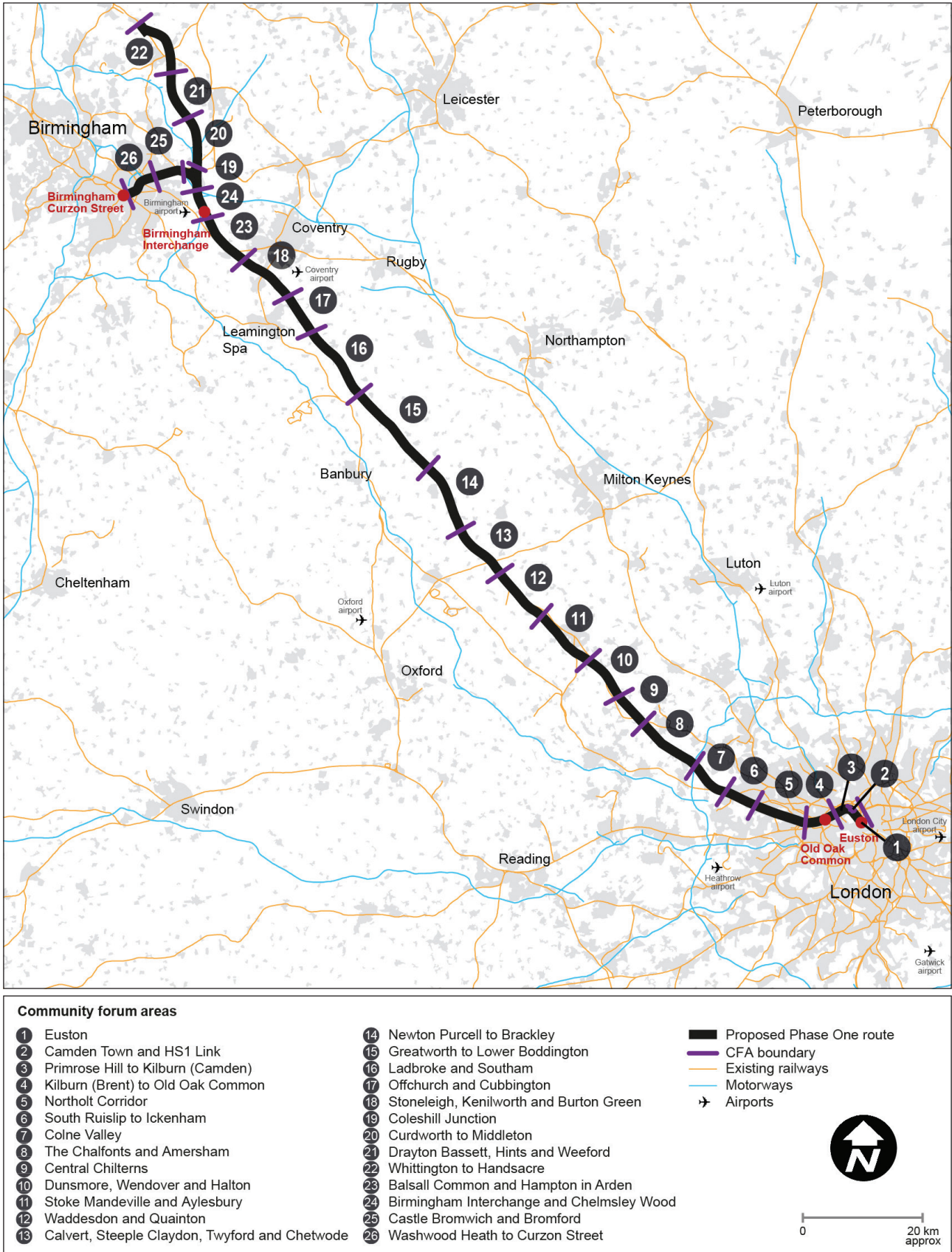


Figure 1: HS2 Phase One route and community forum areas

1.3 Structure of this report

1.3.1 This report is divided into three parts:

- **Part A** – an introduction to HS2 and the purpose of this report;
- **Part B** – overview of the area, description of the Proposed Scheme within the Colne Valley area and its construction, community forum engagement, and a description of the main local alternatives; and
- **Part C** – environmental topic assessments, overview of the policy framework, the environmental baseline within the area, an assessment of construction and operational effects, the proposed mitigation measures, and significant residual effects for the following environmental topics:
 - Agriculture, forestry and soils;
 - Air quality;
 - Community;
 - Cultural heritage;
 - Ecology;
 - Land quality;
 - Landscape and visual assessment;
 - Socio-economics;
 - Sound, noise and vibration;
 - Traffic and transport; and
 - Water resources and flood risk.

1.3.2 The maps relevant to the Colne Valley are provided in a separate corresponding document entitled Volume 2: CFA 7 Colne Valley map book, which should be read in conjunction with this report.

1.3.3 In addition to the environmental topics covered in Part C of this report, Report 27 also addresses climate, electromagnetic interference and waste and material resources on a route-wide basis.

Part B: Colne Valley – overview of the area and description of the Proposed Scheme

2 Colne Valley

2.1 Overview of the area

- 2.1.1 This Colne Valley CFA covers approximately 6km of the Proposed Scheme in the London Borough of Hillingdon and the South Buckinghamshire, Chilterns and Three Rivers District Councils. The area extends from Harvil Road in the south, over the Colne Valley lakes to the M25. The Proposed Scheme would pass through the parishes of Denham and Chalfont St Peter. The area also includes land within the Greater London Authority and Hertfordshire County that is not defined by parish boundaries.
- 2.1.2 As shown in Figure 2, South Ruislip to Ickenham (CFA6) lies to the south east of the Colne Valley area and the Chalfonts and Amersham (CFA 8) lies to the north-west.

Settlement, land use and topography

- 2.1.3 The Colne Valley area sits between the suburban fringe of London and the Chilterns. Agricultural land is interspersed with urban development linked to commuter towns and villages. Urban areas include Ickenham, Denham and Denham Green between 250m to 1.4km to the south of the Proposed Scheme; West Hyde, Harefield and South Harefield between 350m to 1.4km to the east; and Maple Cross 650m to the north of Chalfont Lane. Chalfont St Peter, in the Chalfonts and Amersham area, is 1.2km to the west of the M25.
- 2.1.4 The Colne Valley Regional Park, which covers an area of approximately 110km² and includes the Mid Colne Valley Site of Special Scientific Interest (SSSI), is focused around the Colne Valley lakes, the Grand Union Canal and the River Colne, which defines the central character of this area (see maps CT-01-10 and CT-01-11). This mosaic of water features runs in a north-south direction and is the remnants of gravel abstraction in the valley bottom. The lakes are divided by spurs of land that have become heavily wooded and which screen direct views around the area. The majority of these water features are now used for a range of leisure activities including sailing, fishing, water skiing, walking and bird watching.
- 2.1.5 Either side of the central wetland area the land use is predominantly arable but interspersed with urban fringe development and other recreational facilities, notably golf courses and Denham Aerodrome.

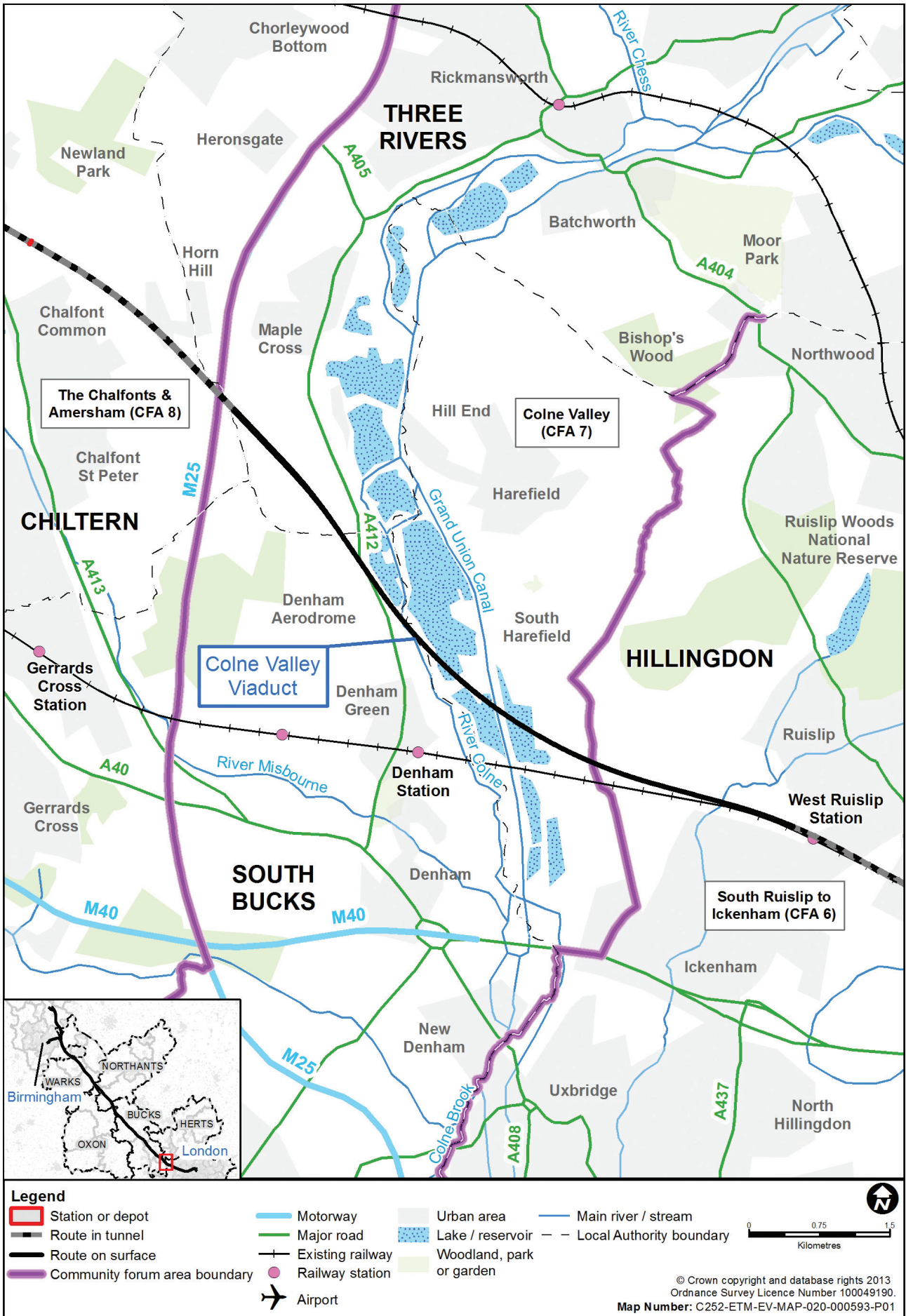


Figure 2: Area context map

Key transport infrastructure

- 2.1.6 The A412 Denham Way (North Orbital Road) runs centrally through the area in a north-south direction and is parallel to the M25 motorway, which forms the western boundary of the area (see Figure 2). A number of smaller local roads cross the Colne Valley including Moorhall Road and Cooper Mill Lane (see maps CT-03-10 and CT-03-11), both of which link the A412 with Harefield and South Harefield. The eastern boundary of the Colne Valley area is Harvil Road which runs broadly north-south, linking Ickenham with Harefield.
- 2.1.7 The existing Marylebone to Aylesbury Line from London Marylebone to Birmingham is located to the south of the Proposed Scheme and runs in an east-west direction.
- 2.1.8 The Grand Union Canal, which is navigable, runs north-south through the centre of the area and forms part of the mosaic of water features in this area. The majority of users of the canal are recreational users.
- 2.1.9 The Colne Valley area is crossed by a number of significant public rights of way (PRoW). These include the Colne Valley Trail, Grand Union Canal Walk and the Hillingdon Trail, all of which follow the course of the canal (see map CT-03-10). In the west, the Old Shire Lane Circular Walk and the South Bucks Way cross the arable farmland on the western side of the Colne Valley and link Horn Hill and Chalfont St Peter in the Chalfonts and Amersham area with the wetlands of the Colne Valley.
- 2.1.10 A number of footpaths also cross the spurs of land that separate the Colne Valley lakes, linking recreational facilities with local populations.

Demographic profile

- 2.1.11 The population within 1km of the route is estimated to be 4,600 based on 2011 national census data for Neighbourhood Statistics³. At present 50% of the population are under the age of 45 and there is a low proportion of under 15-year olds (15%). There is low ethnic diversity, with 89% of the population formed of white ethnic groups (81% white British). The next largest group is Asian. Approximately 65% of the population state their religion as Christian. The proportion of people of working age in employment is 67%, which is similar to that of South Buckinghamshire (69%), Three Rivers (71%) and Hillingdon (65%). There are relatively low levels of deprivation in both Hillingdon and Three Rivers and very low levels in South Buckinghamshire. The proportion of owner-occupied property in the area (62%) is slightly lower than the regional and national averages (68% and 63% respectively).

Notable community facilities

- 2.1.12 The main shops and services are located in the village of Denham Green, Denham, Harefield, South Harefield and Maple Cross (see maps CT-03-10 to CT-03-12). Denham Green is the closest to the Proposed Scheme and its high street comprises a small range of convenience shops, a post office, pharmacy, estate agents, and a few restaurants and cafes. There is one primary school, Tilehouse Combined School, which has approximately 180 pupils aged 4 to 11. The village has one doctor's surgery, a dentist, an independent physiotherapy practice that specialises in treating children and a nursing home. There are a range of community facilities including Denham Village Memorial Hall and St Mark's Church and Hall.
- 2.1.13 Harefield is the largest settlement along this section of the Proposed Scheme. Its High Street comprises a good range of shops and services, St Marys Church and Hall, and The King's Arms and The Harefield public houses. Close to the High Street are a public library and Harefield Infant and Junior School. There is one secondary school, The Harefield Academy, which caters

³ Office for National Statistics; Census 2011; <http://www.ons.gov.uk/ons/guide-method/census/2011/index.html>. Accessed: 1 February 2013.

for 11-18 year olds. There is a dentist and doctor's surgery in Harefield (Frays Dental Centre and Harefield Health Centre).

- 2.1.14 South Harefield and Denham village are much smaller settlements and have few services. There is a small range of convenience shops, Harefield Community Centre and two churches in Denham village.
- 2.1.15 Maple Cross is in the northern part of the area and has a small range of services, including a few convenience stores, a post office, Maple Cross Junior Mixed and Nursery School and the Maple Cross and West Hyde Community Centre.

Recreation, leisure and open space

- 2.1.16 Informal and formal recreation spaces are provided by the Mid Colne Valley SSSI (including Broadwater Lake), Savay Lake, the Grand Union Canal, Northmoor Hill Wood Nature Reserve, Frays Nature Reserve and Denham Country Park (see maps CT-01-10 to CT-01-12). These all form part of the wider Colne Valley Regional Park, which stretches from Staines in the south to Rickmansworth in the north and from Ickenham and Harefield in the east to Chalfont St Peter in the west. The regional park is made up of a mosaic of lakes, reservoirs, rivers, canals, woodland and arable farm land, interspersed with urban areas and linked by a network of PRow.
- 2.1.17 Other main recreational facilities include, Hillingdon Outdoor Activity Centre, a water sports and activity centre for all ages, Denham aerodrome and the Buckinghamshire, Denham and Uxbridge golf clubs. There are several playgrounds and informal open spaces in the area.

Planning context and key designations

- 2.1.18 Volume 1 sets out the national policies under which HS2 has been developed. Given that the Proposed Scheme has been developed on a national basis and 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 is the overall strategic plan for London and relates to the London Borough of Hillingdon section of the Colne Valley area.⁴ 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 London Mayor.
- 2.1.20 The Colne Valley area falls within the administration of the London Borough of Hillingdon and the South Buckinghamshire, Chilterns and Three Rivers District Councils, with the local planning policies from these areas applying. These include the adopted Hillingdon Local Plan Part 1, the Saved Unitary Development Plan (UDP) policies (also referred to as the Hillingdon Local Plan: Part 2), the South Buckinghamshire Core Strategy and the saved policies of the South Buckinghamshire Local Plan (Consolidated 2011)^{5,6,7,8}.
- 2.1.21 The policies referred to in this section are those that relate to the area of land that would be directly affected by the Proposed Scheme.

⁴ Greater London Authority (2011) *The London Plan: Spatial Development Strategy for Greater London*.

⁵ London Borough of Hillingdon (2012) *Hillingdon Local Plan Part 1: Strategic Policies*.

⁶ London Borough of Hillingdon (2007) *Unitary Development Plan, Saved Policies*.

⁷ South Buckinghamshire District Council (2011) *Core Strategy*.

⁸ South Buckinghamshire District Council (2007) *South Buckinghamshire Local Plan, Saved Policies*.

- 2.1.22 Relevant policies from these documents have been taken into account in relation to the technical assessments reported in Sections 3 to 13.
- 2.1.23 Emerging policies are not considered in this report. However it should be noted that during 2013 the London Borough of Hillingdon intends to prepare and consult on various components of Part 2 of the Hillingdon Local Plan, which will consist of the Development Management Policies, Site Specific Allocations and an associated Policies Map. South Buckinghamshire District Council has also noted its intention to produce Development Management and Townscape Character Development Plan Documents (DPDs) over the coming year. Any policy changes arising will be reported in the formal ES.
- 2.1.24 With regards to planning designations there are a number of Air Quality Management Areas (AQMA) in place in South Buckinghamshire and Three Rivers Districts and the London Borough of Hillingdon. Planning policies in these areas also seek to protect and enhance existing historic, natural and landscape features.

2.2 Description of the Proposed Scheme

- 2.2.1 The general design of the Proposed Scheme is described in Volume 1. The following section describes the main features of the Proposed Scheme in the Colne Valley area, including the main environmental mitigation measures.
- 2.2.2 Since the January 2012 scheme was announced by the Secretary of State, route development work has continued and the Proposed Scheme now differs in some respects as follows:
- The introduction of an auto-transformer feeder station off Harvil Road and a National Grid feeder substation north of Hillingdon Outdoor Activity Centre to provide traction power supply from National Grid power lines;
 - Utility diversions to accommodate the auto-transformer station, including a high pressure gas main and a high voltage pylon diversion;
 - A horizontal realignment of the Colne Valley viaduct to cross the River Colne on a straighter alignment. This viaduct would be approximately 60m further north than the January 2012 announced scheme at its maximum deviation and as a consequence now only has one viaduct supporting pier in the River Colne;
 - Provision of earthworks and turnouts to allow for the future provision of a Heathrow Spur. This would be the minimum required area to construct the spur without impacting on the operational capacity of Phase One of HS2; and
 - Slip roads onto the M25 from the Chiltern tunnel main construction compound, using a new temporary junction on the M25 north of Chalfont Lane between existing Junctions 16 and 17, for use by construction traffic during the period of construction of HS2.
- 2.2.3 These changes are discussed in more detail in Section 2.6.

Overview

- 2.2.4 The Proposed Scheme through this area would enter from the south by crossing under the realigned Harvil Road. The Proposed Scheme would then pass onto an approximately 3.4km long viaduct through the Colne Valley over the Grand Union Canal, the Mid Colne Valley SSSI, the River Colne, a number of other lakes including Harefield No 2 Lake used by the Hillingdon Outdoor Activity Centre, and the A412 Denham Way (North Orbital Road). On leaving the viaduct, the route would be on embankments and then cutting, before passing into the southern portal of a tunnel through the Chilterns.

Proposed Scheme – Section by section

- 2.2.5 The route would enter the Colne Valley section of the Proposed Scheme from the area's eastern boundary at Harvil Road and continue to the A412 (see maps CT-06-019 to CT-06-021). Key features of this section would include:
- The southern embankment approach to a viaduct through the Colne Valley (approximately 90m long and up to 10m high);
 - An approximately 3.3km long Colne Valley viaduct with an associated diversion to the River Colne due to a viaduct pier being located within the river. The viaduct would be between 10-15m above ground level, have piers located at approximately 45m spacing, and include noise barriers to attenuate noise impacts and overhead catenary structures to provide power to the Proposed Scheme;
 - A realigned Harvil Road;
 - Auto-transformer feeder station at Harvil Road; and
 - A National Grid feeder substation and diverted overhead power lines. The power lines would be realigned to the east of the current route, passing east over the Grand Union Canal, Uxbridge Golf Club and Harvil Road before turning north over Newyears Green Covert and then returning back westward to link up with the existing power lines and new substation north of the Hillingdon Outdoor Activity Centre with associated National Grid construction site. This diversion would be partly in the Colne Valley area but also within the South Ruislip to Ickenham area (CFA6) and will be subject to further design development in conjunction with National Grid (see Section 2.6.30 for alternatives).
- 2.2.6 From the A412, the route would enter the approach to the southern portal of the tunnel through the Chilterns (see maps CT-06-021 and CT-06-022) prior to passing under the M25. Key features of this section would include:
- A cutting approximately 700m long which would include an overbridge at Tilehouse Lane;
 - Passive provision for the Heathrow Spur (following the recent announcement on Heathrow by the government this provision has been included to ensure that Phase One of the railway could continue to operate if the Heathrow connection is progressed in the future);
 - An approximately 700m long embankment between the newly realigned Tilehouse Lane and the Chiltern tunnel southern approach cutting;
 - An approximately 300m long approach cutting to the southern portal of the Chiltern tunnel with associated retaining structures, portal buildings, auto-transformer station, porous portal and access road located approximately 100m east of the M25⁹; and
 - Extensive permanent landscape earthworks to mitigate the impact of the scheme from a noise and visual perspective.
- 2.2.7 Once the engineered elements described above are completed, the rail infrastructure of the Proposed Scheme would be constructed and commissioned, prior to the scheme becoming operational.
- 2.2.8 In addition, as shown on map CT-05-022, footpath 'Rickmansworth 004' would be temporarily closed during construction and then diverted via the new Tilehouse Lane overbridge. Bridleway CSP/44/1 would be permanently diverted westwards around the southern portal of the Chiltern tunnel. Chalfont Lane to the north of the main construction sites would be stopped up to local traffic for the duration of the construction period. Local traffic would be

⁹ Porous portals are perforated box-like structures at tunnel portals, usually formed of concrete, designed to allow passage of air, in order to reduce air pressure and noise generated when a high speed train enters the tunnel.

diverted from the west of the M25 via a new access road to Horn Hill, through Maple Cross and back onto the A412. The local road diversion and M25 slip road would be removed on completion of the scheme (although if the construction of the Proposed Scheme coincides with the programme for the Heathrow Spur these may be retained for use in the latter's construction).

- 2.2.9 The route would leave the area in the north-west in the Chiltern tunnel as it passes under the M25.

Land required for the Proposed Scheme

- 2.2.10 The Proposed Scheme would require land on both a temporary and permanent basis. The land required for construction is shown on the construction maps (map series CT-05) and will be subject to review as the engineering design and formal ES is prepared. The final permanent and temporary land requirements will be set out in the formal ES.

2.3 Construction of the Proposed Scheme

- 2.3.1 This section sets out the key construction activities that are envisaged to build the Proposed Scheme in the Colne Valley area and the control measures that are proposed to manage the works. General descriptions of construction works that are relevant to the whole of the Proposed Scheme are provided in Volume 1.

Environmental management and Code of Construction Practice

- 2.3.2 All contractors would be required to comply with the environmental management regime for the Proposed Scheme, which would include:
- Code of Construction Practice (CoCP)¹⁰; and
 - Local environmental management plans (LEMPs), which would apply within each CFA.
- 2.3.3 The CoCP, in conjunction with associated LEMPs, would be the means of controlling the construction works associated with the Proposed Scheme, with the objective of ensuring that the effects of the works upon people and the natural environment are kept to a practicable minimum. The CoCP will contain generic control measures and standards to be implemented throughout the construction process.
- 2.3.4 A draft CoCP has been prepared and is published alongside this document. It will be kept under review as the design of the Proposed Scheme develops and further engagement with stakeholders is undertaken.

Construction site operation

Working hours

- 2.3.5 Core working hours would be from 08:00 to 18:00 on weekdays (excluding bank holidays) and from 08:00 to 13:00 on Saturdays. While there would not normally be any construction activity on Sundays, some activities (e.g. weekend possessions, tunnelling and ventilation and intervention shaft (vent shaft) construction) would be undertaken. Site specific variations to core hours and/or additional hours likely to be required would be included within LEMPs, following consultation with the relevant LPA. To maximise productivity within the core hours, HS2 Ltd's contractors would require a period of up to one hour before and up to one hour after the core working hours for start-up and close down of activities. These activities would be subject to controls set out in the CoCP.

¹⁰ Arup/URS (2013) *Phase One: Draft Code of Construction Practice*. HS2 Ltd, London.

- 2.3.6 Track laying activities, transportation of over-sized equipment (such as the auto-transformer feeder station) and work requiring possession of major transport infrastructure (e.g. highways) may be undertaken during night time, Saturday afternoon, Sunday and/or bank holidays for reasons of safety or operational necessity and would often involve work on consecutive nights, including over weekend possessions.
- 2.3.7 Bored tunnelling and directly associated activities (such as removal of excavated material, supply of materials and maintenance of tunnel boring machines (TBM) and other equipment) will be carried out on a 24-hour day, 7-day week basis. Where reasonably practicable, material will be stockpiled within the site boundary for removal during normal working hours.

Construction site compounds

- 2.3.8 Main site compounds would be used for core project management (engineering, planning and construction delivery), commercial, and administrative staff.
- 2.3.9 Satellite site compounds would generally be smaller in size, providing office accommodation for limited numbers of staff. The satellite site compound would provide local storage for plant and materials and limited car parking would be provided for staff and site operatives. Limited welfare facilities would be provided at each site.
- 2.3.10 The location of all site compounds along with their duration of use and a broad current estimate of the number of workers likely to work at the construction sites is set out in Table 1 and shown in maps CT-05-019 to CT-05-022. Construction site details and arrangements are continuing to be refined and will be confirmed in the formal ES. All construction staff would be required to comply with codes of behaviour set out in the CoCP.

Compound type	Location	Typical use	Estimated duration of use ¹¹	Estimated number of workers	
				Average work day ¹²	Peak period work day ¹³
Main site	Colne Valley viaduct main construction compound, map CT-05-022	Main area administration and support. Staff and vehicle parking, materials storage and handling, fuel storage, electricity generation, concrete batching and pre-cast yard, slurry treatment, laboratory and staff accommodation/facilities.	4.5 years	Up to 15	Up to 40
Main site	Chiltern tunnel main construction compound, map CT-05-022	Main area administration and support. Staff and vehicle parking, materials storage and handling, fuel storage, electricity generation, concrete batching and pre-cast yard, slurry treatment and laboratory.	5.5 years	Up to 220	Up to 275
Satellite site	Colne Valley viaduct southern approach embankment compound, map CT-05-019	Construction of the southern third of the Colne Valley viaduct and its approach embankment, as well as the Harvil Road AT station.	4 years	Up to 40	Up to 60

¹¹ The duration for each site compound is currently based on a draft programme, which will be refined for the formal ES.

¹² Average numbers of workers per day for the duration of construction.

¹³ Average numbers of workers per day in the peak month of construction.

Compound type	Location	Typical use	Estimated duration of use ¹¹	Estimated number of workers	
				Average work day ¹²	Peak period work day ¹³
Satellite site	Colne Valley viaduct satellite compound, map CT-05-20	Support site for the construction of the southern third of the Colne Valley viaduct and construction jetty access at Hillingdon Outdoor Activity Centre.	3 years	Up to 15	Up to 15
Satellite site	Colne Valley viaduct jetty storage satellite compound, map CT-05-20	Laydown site for the construction jetty from Moorhall Road northwards (and viaduct construction).	2.5 years	Up to 15	Up to 15
Satellite site	Colne Valley viaduct storage satellite compound, map CT-05-20		3.5 years	Up to 40	Up to 40
Satellite site	Colne Valley viaduct laydown satellite compound, map CT-05-021	Laydown site for the construction of the northern third of the Colne Valley viaduct.	3 years	Up to 15	Up to 15
Satellite site	Colne Valley north launch satellite compound, map CT-05-021	Construction site for the northern third of the Colne Valley viaduct.	3 years	Up to 40	Up to 40
Satellite site	Colne Valley northern approach embankment satellite compound, map CT-05-021	Construction site for the embankment leading to the northern third of the Colne Valley viaduct.	3.5 years	Up to 85	Up to 210

Table 1: Location of construction site compounds

- 2.3.11 All main site compounds would contain space for the storage of bulk materials (aggregates, structural steel, and steel reinforcement), an area for the fabrication of temporary works equipment and finished goods, fuel storage, plant and equipment storage and necessary operational parking. Buildings would be generally temporary modular units and layout would maximise construction space and limit land required. In urban areas it may be necessary to stack these units due to space restrictions. Hard standing areas would be installed at all site compounds.
- 2.3.12 The adjacent areas would be used for the temporary storage of any topsoil stripped as part of the works. A concrete batching and precast concrete production facility would be located within the two main construction compounds, which would provide concrete supply to the construction works.

Fencing and lighting

- 2.3.13 Security fencing would be provided on the perimeter of each site compound. Individual site compounds for offices, welfare and storage would generally be demarcated and secured with fences and gates. Fence type and construction would be appropriate to the level of security required, likelihood of intruders, level of danger and visual impact to the environment.

- 2.3.14 Lighting of site compounds during hours of darkness would seek to reduce, as far as reasonably practicable, light pollution to the surrounding area, in accordance with the requirements of the CoCP.

Temporary worker accommodation sites

- 2.3.15 Two temporary worker accommodation sites would be located within this section of the Proposed Scheme as detailed in Table 2. Temporary worker accommodation sites will adhere to the measures set out within the CoCP.

Location	Site description	Facilities provided	Estimated duration of use	Estimated number of workers
Colne Valley viaduct main construction compound adjacent to the A413 and Chalfont Lane	Modular temporary living accommodation	Living accommodation, welfare facilities and car parking	4.5 years	Up to 130

Table 2: Location of temporary worker accommodation sites

Construction traffic and access

- 2.3.16 The following lorry routes are currently proposed to access each of the compounds:
- The route to the Colne Valley viaduct main construction compound would be via Chalfont Lane, continuing onto the A412 and then north to the M25 or alternatively via Chalfont Lane and the new M25 slip roads;
 - The route to the Chiltern tunnel main construction site would be via Chalfont Lane, continuing onto the A412 and then north to the M25 or alternatively via Chalfont Lane and the new M25 slip roads;
 - The route to the Colne Valley viaduct and southern approach embankment compound would be via Harvil Road and southwards onto the A40 or via Harvil Road, Moorhall Road, the A412 and onto the A40;
 - The route to the Colne Valley viaduct compound would be via Dew's Lane, Harvil Road and southwards onto the A40 or via Harvil Road, Moorhall Road, the A412 and onto the A40;
 - The route to the Colne Valley viaduct storage and jetty compound would be via Moorhall Road, the A412 and onto the A40;
 - The route to the Colne Valley viaduct laydown compound would be via the A412 northwards to the M25 or via the A412, Chalfont Lane and the new M25 slip roads;
 - The route to the Colne Valley north launch satellite compound would be via the A412 northwards to the M25 or via the A412, Chalfont Lane and the new M25 slip roads; and
 - The route to the Colne Valley northern approach embankment satellite site compound would be via the A412 northwards to the M25 or via the A412, Chalfont Lane and the new M25 slip roads.
- 2.3.17 Construction site details and arrangements are continuing to be refined and will be confirmed in the formal ES.

Preparatory and enabling works

Demolition works

2.3.18 It is anticipated that the Proposed Scheme would require the demolition of several buildings in the area. These works are outlined in Table 3.

Description of structure	Location
One outbuilding associated with No. 2 Dew's Farm Cottages	Dew's Lane
One outbuilding opposite Dew's Farm Cottages	Dew's Lane
Dews Farm and three associated outbuildings	Dew's Lane
Three outbuildings associated with Hillingdon Outdoor Activity Centre	Dew's Lane
Three outbuildings associated with Weybeards Cottages	A412

Table 3: Demolition works

Drainage and culverts

2.3.19 It is anticipated that drainage ponds would be required for both railway track and highway drainage. Indicative locations are shown on maps CT-06-019 to CT-06-022.

Watercourse diversions

2.3.20 The route of the Proposed Scheme and associated highway works require two diversions of watercourses, these being:

- Newyears Green Bourne; and
- The River Colne.

2.3.21 The details of these diversions will be reported in the formal ES.

Utility diversions

2.3.22 There are a number of major items of utility infrastructure in proximity to the Proposed Scheme, including: high pressure gas mains; large diameter water mains; large diameter sewers; fibre optic/signal cabling; and high and low voltage electricity lines. In summary, the main proposed utility diversions required in the area would be:

- A National Grid gas main running south-west to north-east through the existing alignment of Harvil Road;
- An Affinity Water main on the north side of the Harvil Road bridge;
- A pressured Thames Water sewerage main connecting to Harefield pumping station next to Hillingdon Outdoor Activity Centre;
- The National Grid power line crossing the Colne Valley viaduct alignment west of Hillingdon Outdoor Activity Centre;
- Two Affinity Water mains on the north side of Moorhall Road;
- A Thames Water sewerage main on the west side of the A412;
- An Affinity Water main on the west side of the A412;
- A National Grid gas main on the A412;
- A Thames Water sewerage main crossing the fields alongside footpath CSP/43/2;
- An Affinity Water main crossing the fields close to the southern portal of the Chiltern tunnel;

- The Scottish and Southern Energy power lines to the east of the M25; and
 - Existing utilities within highways which would be diverted within new highway diversion proposals.
- 2.3.23 Discussions with utility providers are under way to confirm whether plant and/or apparatus would need to be realigned away from the area of work, protected from the works by means of a concrete slab or similar, or have sufficient clearance from the work that they would not be affected.
- 2.3.24 Wherever practicable, temporary connections for construction site compounds would be made to local existing utility services (i.e. electricity, water, data, sewerage and surface water drainage) to reduce the need for generators, storage tanks and associated traffic movements for fuel tankers.
- 2.3.25 Safeguarding borehole abstraction points in the Colne Valley would also be required during construction. HS2 Ltd is engaging in discussions with Affinity Water on this subject, which may require the curtailment of abstraction in certain locations where construction activities are in close proximity to pumping station sites. Further details on design, construction and phasing requirements will be reported in the formal ES.

Highway and road diversions

- 2.3.26 Proposed highway and road diversions are shown on maps CT-05-019 to CT-05-022 and include:
- Harvil Road, permanently diverted for 800m to the east of the existing alignment (CFA6);
 - Tilehouse Lane Overbridge, temporary road diversion via A412 Denham Way and Denham Green Lane;
 - Chalfont Lane, temporary road diversion via A412 Denham Way, Woodland Road, Hornhill Road and new temporary link road; and
 - Chalfont Lane, temporary road diversion via A412 Denham Way, Woodlands Road, Hornhill Road, Shire Lane, Rickmansworth Lane, Denham Lane and West Hyde Lane.
- 2.3.27 In addition, a new set of slip roads would be provided on the north side of Chalfont Lane leading from the M25 to the main construction compounds on the south side of Chalfont Lane. The slip road leading off the M25 would be located in the Colne Valley area, with the slip road leading onto the M25 and a local diversion road being located in the Chalfonts and Amersham area (CFA8).
- 2.3.28 The total duration of works does not necessarily indicate periods of actual closure. The closure of routes will be kept to as short a duration as possible. Diversions show indicative alternative routes available to maintain general access which will be subject to change as part of the development of the design and will be detailed in the formal ES.

Footpath, cycleway and bridleway diversions

- 2.3.29 Proposed footpath, cycleway and bridleway diversions are shown on maps CT-06-019 to CT-06-022 and shown in Table 4. Temporary impacts on these paths would be managed in accordance with measures set out within the CoCP to reduce the impacts in terms of duration of temporary closures or diversions and length of additional journeys. Further detail about proposed temporary diversions and closures, if required, will be reported in the formal ES.

Name	Location	Permanent reinstatement or diversion	
		Route	Approximate additional journey length ²⁴
Public footpath	Footpath running broadly north-south from Harvil Road through the Hillingdon Outdoor Activity Centre site	Permanent diversion via west and south side of Proposed Harvil Road auto-transformer site.	500m
Public footpath, bridleway, cycleway	Western side of the Grand Union Canal	Temporary offline diversion of all PRoW to tow-path on eastern side of the Grand Union Canal between Moorhall Road and next crossing point in Denham Country Park.	Negligible
DEN/3/1 Shire Lane Public Bridleway	Bridleway running east-west from Tilehouse Lane to A412	Temporary offline diversion along A412 under the viaduct then joining the permanent diversion around the passive provision for the Heathrow spur.	200m
CSP/44/1, DEN/2/1 Shire Lane Public Bridleway	Bridleway running south-east to north-west across Chalfont Lane and the M25	Temporary closure for part of the route due to restrictions at Chalfont Lane bridge. Temporary diversion alongside compound boundary.	Negligible
Public Bridleway	Bridleway running between Shire Lane and the A412	Temporary closure due to Chilterns compound, permanent diversion via Tilehouse Lane bridge on scheme completion.	400m

Table 4: Footpath, cycleway and bridleway diversions

Restricted accesses

2.3.30 There would be no restricted accesses in the local area.

Main construction works – Earthworks

Earthworks

2.3.31 Major earthworks in the area would include:

- The southern embankment approach to the Colne Valley viaduct (approximately 90m long and up to 10m high);
- The northern embankment approach to the Colne Valley viaduct (approximately 300m long and up to 13m high);
- A cutting at Tilehouse Lane (approximately 700m long and down to 10m deep);
- An embankment in the approach to the southern portal of the Chiltern tunnel (approximately 700m long and up to 10m high); and
- A cutting in the approach to the southern portal of the Chiltern tunnel (approximately 300m long and down to 20m deep).

2.3.32 Works would be carried out in a sequence, taking due consideration of the impacts of road and footpath closures, flows within watercourses and vehicle movements by road.

2.3.33 During design development consideration has been given to the movement of materials. Wherever possible excavated material would be moved directly from the area of excavation to areas of the works where fill material is required. Some processing and temporary stockpiling of fill material may be necessary if direct placement into the permanent works is not possible.

²⁴ Diversions of less than 50m are reported as negligible in this table.

Some material may require crushing and/or screening to render it acceptable for use elsewhere.

Main construction works – Structures

Colne Valley viaduct

- 2.3.34 The general construction sequence for the Colne Valley viaduct would be:
- Phase 1: Install jetty for construction access over the Colne Valley including piled foundations, lift, place and weld cross girders and ties and fix deck with rails for crawler cranes;
 - Phase 2: Viaduct pier foundations constructed from jetty using coffer-dams (where over water), constructing the pile caps and viaduct piers;
 - Phase 3: Construct superstructure using either the launched or in-situ construction methods between the viaduct piers;
 - Phase 4: Fit out and commissioning of rail infrastructure; and
 - Phase 5: Removal of construction jetty and restoration of the landscape.
- 2.3.35 Construction activities on the Colne Valley viaduct would be undertaken from three locations, namely the northern and southern launch sites and from Moorhall Road. Work would run concurrently from these locations.
- 2.3.36 The upgrading of roads and utility diversion activity within the programme is in order to set up and service the main construction and satellite site compounds as part of the preparatory and enabling works, such as road, footpath and utility diversions. These works would be undertaken in advance of the site clearance, fencing and enabling works.
- 2.3.37 Site clearance would be programmed so that areas are clear as they are required, respecting environmental constraints, rather than as a 'once through' activity. As a result, the areas concerned would not be left bare for longer than necessary.

Chiltern tunnel

- 2.3.38 The construction of the Chiltern tunnel would be conducted in five phases as follows:
- Phase 1: The main construction compound and specialised tunnelling plant assembly and commissioning would include ground profiling, erection of workforce temporary buildings and the assembly of specialised tunnelling plant;
 - Phase 2: The Chiltern tunnel would be driven from within the Colne Valley area. The construction of the temporary works would include the assembly and commissioning of tunnel boring machines and the construction of the launch base;
 - Phase 3: Processing of excavated tunnel material from the bored Chiltern tunnel and subsequent use of material to create required mitigation earthworks;
 - Phase 4: After the completion of the Chiltern tunnel, the demobilisation of the tunnel boring plant and the associated main construction compound; and
 - Phase 5: This would involve the installation and commissioning of new tracks to serve the Proposed Scheme.

Rail infrastructure fit out

- 2.3.39 The principal elements of rail infrastructure to be constructed are track, overhead line equipment, communications equipment and power supply. The installation of track in open

areas would be of standard ballasted track configuration, comprising principally of ballast, rail and sleepers. Further details are set out in Volume 1.

Power supply

- 2.3.40 HS2 trains would draw power from overhead line equipment, requiring feeder stations and connections to the 400kV National Grid network. There would be one feeder station within the local area. In addition to the feeder station, smaller auto-transformer stations would be required at more frequent intervals. The anticipated locations of the proposed feeder station and auto-transformer stations are:
- An auto-transformer feeder station and access track adjacent to Harvil Road;
 - A National Grid feeder substation located to the north of the Hillingdon Outdoor Activity Centre and accessed from Dew's Lane; and
 - An auto-transformer station adjacent to the southern portal of the Chiltern tunnel, with an access track from Chalfont Lane.
- 2.3.41 The locations are shown on maps CT-06-019 to CT-06-022.

Landscaping and permanent fencing

- 2.3.42 Landscaping (i.e. earthworks and seeding and planting) would be provided to address visual and noise impacts, as well as to provide screening for intrinsically important ecological habitats and heritage features. Where appropriate, the engineering embankments and/or cuttings would be reshaped to integrate the alignment sympathetically into the character of the surrounding landscape. The planting would reflect tree and shrub species native to the Colne Valley landscape. Opportunities for ecological habitat creation would be considered.
- 2.3.43 Permanent fencing would be erected and will be shown on plans to accompany the formal ES.

Construction programme

- 2.3.44 A construction programme that illustrates indicative periods for each core construction activity in this area is provided in Figure 3.

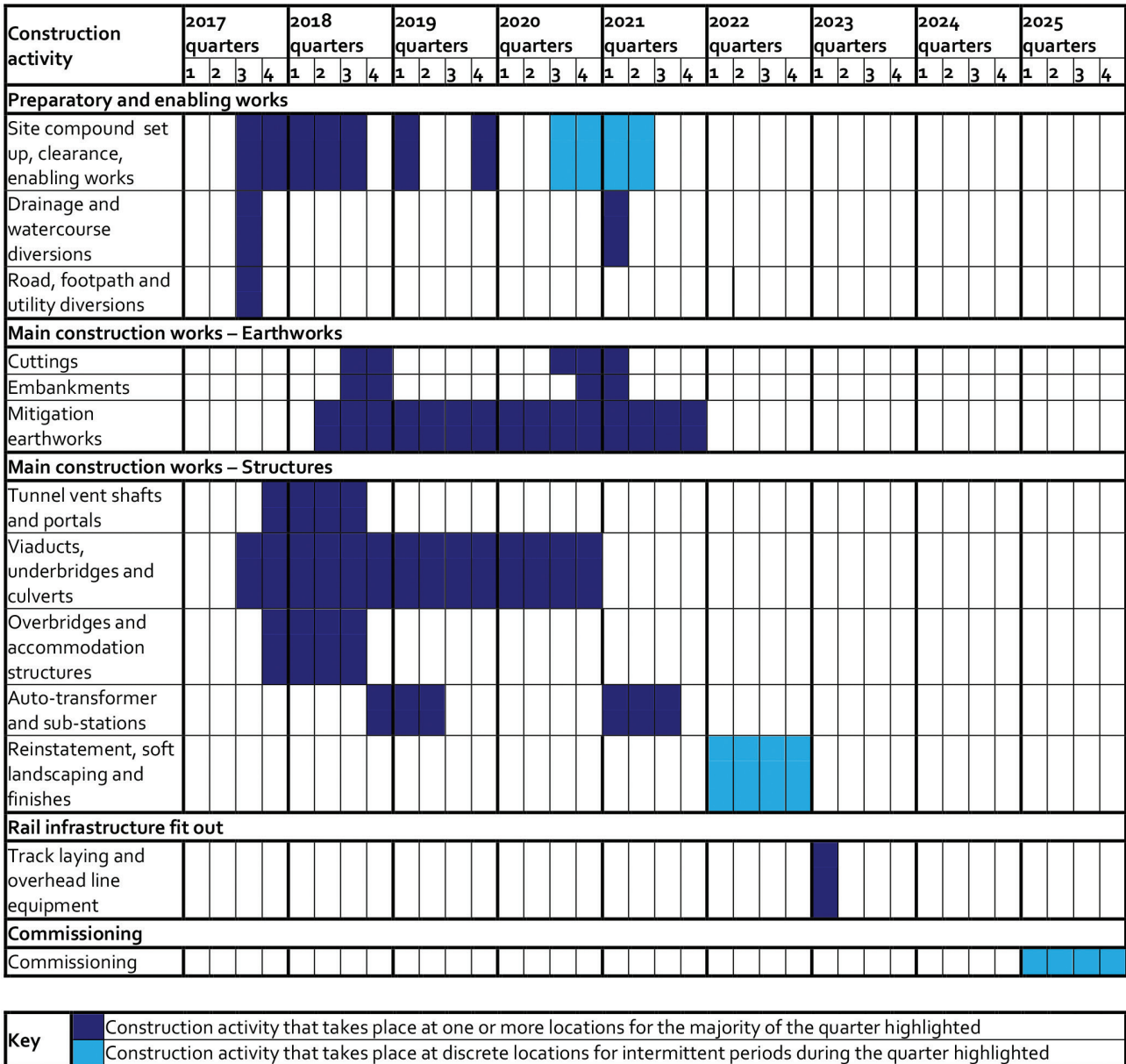


Figure 3: Indicative construction programme for the area

Commissioning

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

2.4 Operation of the Proposed Scheme

2.4.1 In this area, HS2 trains would run at speeds up to 360kph, and would be accelerating or decelerating. During Phase One of HS2, up to 14 trains per hour (tph) would pass in each direction. This would increase to a potential maximum of 18tph in each direction should Phase Two also become fully operational.

2.4.2 The trains would be either 200m (one-unit train) or 400m (two-unit trains) long. They would run between the hours of 05:00 and 24:00 (Monday to Saturday) and between 08:00 and 24:00 (Sunday). When required, maintenance would be conducted outside those operating hours.

2.4.3 The operation of the Proposed Scheme is described in more detail in Volume 1.

2.5 Community forum engagement

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

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

- 21 March 2012 at the De Vere Hotel, Denham Grove¹⁵;
- 14 June 2012 at the De Vere Hotel, Denham Grove;
- 13 September 2012 at Colne Valley Park Visitor Centre;
- 8 November 2012 at Colne Valley Park Visitor Centre; and
- 21 February 2013 at Colne Valley Park Visitor Centre.

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

2.5.4 The main themes to emerge from these meetings were:

- The impact upon the A412 which is used as a diversion route when the M25 is closed and that HS2 Ltd should allow for this in its construction plans. The impact on Moorhall Road which is the link between Harefield and Denham station;
- The interaction between HS2 and small aircraft using Denham Aerodrome;
- The ability of Hillingdon Outdoor Activity Centre to continue to provide the outdoor community activities during the construction of the viaduct and when the service was operational;
- The option for tunnelling under the lakes;
- The approach to the noise survey and assessment;
- The additional impact of the Feeder Station on this; and
- The mineral extraction proposed in the vicinity of Denham Park Farm and the effect of traffic movements during construction.

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 were reviewed. The purpose of these reviews has been to ensure that the Proposed Scheme draws the right balance between engineering requirements, cost and actual and potential environmental impacts.

Position of the Colne Valley viaduct

2.6.3 The Proposed Scheme would pass on a viaduct over the Colne Valley Regional Park, including parts of the Mid Colne Valley SSSI, the A412 and adjacent to local properties including listed buildings, notably Savay Farm and the locally listed Dews Farm.

¹⁵ Denham Grove was formerly known as Durdent Court.

- 2.6.4 The viaduct would curve away from the Marylebone to Aylesbury Line, passing over the Hillingdon Outdoor Activity Centre, the Grand Union Canal, Moorhall Road, the southern part of the Mid Colne Valley SSSI, the River Colne and between the settlements of South Harefield and Denham Village.
- 2.6.5 The viaduct was part of the scheme announced in January 2012; however, the alignment has been moved approximately 60m at its centre point to the north-east in the Proposed Scheme compared with the January 2012 announced route.
- 2.6.6 The scheme would have potential impacts on the River Colne and alternative options were considered in order to try and reduce these impacts. Three horizontal alignments have been considered for the position of the viaduct. These include:
- Option A: The January 2012 announced route;
 - Option B: A moderate straightening of the viaduct, moving it approximately 60m north-east at its centre point, the Proposed Scheme; and
 - Option C: A minor straightening of the viaduct, moving it approximately 25m north-east at its centre point.
- 2.6.7 All three options would result in construction and operational impacts on ecology including impacts to parts of the SSSI and the River Colne. There would also be visual impacts from all the options. However, Option B provided environmental benefits compared with Option A and C because it reduced the number of piers in the channel of the River Colne to one, rather than six and three respectively for Options A and C. Therefore, Option B would have reduced impacts for both ecology and water. The different options would affect the piers placed within the SSSI however there was not considered to be a significant difference in terms of the impact from each of the options because all the alternative alignments have a similar construction and operational footprint within the SSSI.
- 2.6.8 The various alignment options would also affect the property impacts at the southern end of the viaduct. Option B would have a reduced direct impact on the buildings affected at the Hillingdon Outdoor Activity Centre compared with Options A and C. However, it would also cause an additional demolition at Dews Farm which would not have been required under Option A or C. This property would still have been affected under Option A and C because it would have been close to the viaduct under these options.
- 2.6.9 Option B was included in the Proposed Scheme because it would have less impact on the River Colne and overall was considered a better environmental outcome.
- 2.6.10 HS2 Ltd is in discussions with the Environment Agency regarding the impact on the River Colne from the Proposed Scheme and further work is being undertaken to investigate whether the single pier in the river channel could be avoided. Further details are provided in section 2.7 below.

Height of the Colne Valley viaduct

- 2.6.11 The Proposed Scheme includes a viaduct over the Colne Valley, as described in Section 2.2, above. The viaduct height would vary from approximately 10m to 15m above ground level through this section of the route¹⁶.
- 2.6.12 The viaduct was part of the scheme announced in January 2012; however, the alignment has been moved slightly to the north-east in the Proposed Scheme compared with the January 2012 announced route, as described above.

¹⁶ The height above surface water level would be less than this.

- 2.6.13 The operators of Denham Aerodrome raised concerns about the possibility of aircraft from the aerodrome colliding with the viaduct structure and proposed that the height of the viaduct be lowered.
- 2.6.14 HS2 Ltd has undertaken a safety assessment of the proposed alignment in response to the concerns raised by the Aerodrome and do not consider that there is a risk. Therefore, lowering the height of the viaduct would not be necessary to allow the safe operation of the Aerodrome and altering the vertical alignment has not been investigated further. Environmental considerations were not a material factor in determining this decision and it was based on health and safety requirements¹⁷.

Tunnel under the Colne Valley

- 2.6.15 The Proposed Scheme includes a viaduct over the Colne Valley, as described above in Section 2.2. The viaduct was part of the scheme announced in January 2012; however, the alignment has been moved to the north-east in the Proposed Scheme compared with the route announced in January 2012, as explained above.
- 2.6.16 The Colne Valley Community Forum requested that a tunnel be constructed to pass beneath the lakes between Ruislip and the M25. This would be considered preferable by the community because it would avoid above ground disturbance from construction and would remove visual and noise impacts during construction and operation.
- 2.6.17 HS2 Ltd acknowledges that there would be environmental benefits if a tunnel was proposed; however, the use of the viaduct to cross the Colne Valley was based on a combination of practical, financial and safety considerations. The lakes are large former gravel pits and the ground beneath falls well below the water level. This means that tunnelling would likely be more difficult and expensive than elsewhere on the route.
- 2.6.18 Consequently it was determined early in the project that tunnelling was not appropriate and an option for tunnelling has not been re-visited in detail as part of the work since the announcement of the scheme in January 2012.
- 2.6.19 HS2 maintain that in order to pass beneath the lakes at sufficient depth it would not be feasible for the Proposed Scheme to meet the surface again before reaching the southern portal of the Chiltern tunnel. The consequence of this is that a tunnel under the Colne Valley would need to be an extension of the Chiltern tunnel. This longer tunnel would require a more extensive requirement for fire safety and emergency public evacuation in the event of a train failure or fire, such as a third tunnel bore and/or an emergency intervention station in the middle of the extended tunnel length. This would in itself introduce additional potentially significant adverse effects and additional cost.
- 2.6.20 A long tunnel option from the edge of London and heading north under the Colne Valley and into the Chilterns would also mean that all excavated tunnelling material would have to be taken north, along the Chiltern tunnel to be extracted and transported within the AONB. Alternatively, it would require all of the excavated material from the Chiltern tunnel to be taken further south and extracted and handled in central London.
- 2.6.21 For these reasons, tunnelling beneath the Colne Valley has not been considered in detail since January 2012 and has not been incorporated into the Proposed Scheme.

¹⁷ Environmental factors were considered in the decision for a viaduct at 10-15 metres high over the Colne Valley as part of the work to develop the scheme consulted upon in 2011 and contained within the route announced in January 2012.

Location of the Chiltern tunnel portal

- 2.6.22 The Proposed Scheme includes a tunnel portal south of the M25 for the Chilterns bored tunnel.
- 2.6.23 In the scheme announced in January 2012 the location of the southern portal of the Chiltern tunnel would have impacted on the piled bridge foundations of the Chalfont Lane overbridge to the M25. Four alternatives were assessed as a result of identifying this impact:
- Option A: January 2012 announced route;
 - Option B: Increase the separation between the two bores within the tunnel, i.e. move one bore to the south of the underground structure and the other north of it;
 - Option C: Move both bores to the west, the Proposed Scheme; and
 - Option D: Move both bores to the east.
- 2.6.24 Option A was not considered feasible because of the impact on the bridge foundations and the additional work this would involve. All three of the other options (B, C and D) would be similar in terms of environmental impacts. Option C was chosen as it would avoid the need for a highways diversion to Chalfont Lane and avoid potential impacts to the overhead power lines on the eastern side of the M25.
- 2.6.25 For these reasons Option C was included in the Proposed Scheme.

Porous tunnel portal

- 2.6.26 The Proposed Scheme includes a porous tunnel section at the southern end of the bored Chiltern tunnel, located within the section of cutting adjacent to the M25. The scheme in January 2012 did not identify the need for a porous portal and this has been identified as part of the development of the scheme design.
- 2.6.27 The purpose of the porous portal is to reduce air pressure within the bored tunnel, to maintain passenger comfort and to reduce the pressure transient created by a train when it enters/exits the tunnel and the associated impact on local receptors. Two options were considered:
- Option A: that the porous portal at the southern end of the tunnel be external to the tunnel, the Proposed Scheme; and
 - Option B: that the porous portal is contained within the tunnel length.
- 2.6.28 To achieve the reduction in air pressure the porous portal needs to allow air to pass through it. It therefore needs to be exposed to the surface in some way. Placing the portal within the tunnel structure in this location would make it impossible to achieve this, as it would be located directly under the M25. Consequently Option B was not considered feasible in this situation and was not assessed in detail.
- 2.6.29 However, locating the porous portal at the base of the cutting for the Proposed Scheme, as with the January 2012 announced route, results in a reduced visual impact, thereby addressing the primary concern of the Community Forum.
- 2.6.30 For these reasons Option A was adopted for the Proposed Scheme.

2.7 Proposals for further consideration

2.7.1 A number of further engineering developments to the Proposed Scheme are being investigated, including:

- The Colne Valley power line diversion and feeder station – at Colne Valley there is an existing high voltage power line crossing the lakes. The existing overhead power line crosses the Grand Union Canal and the Harefield No2 Lake to the north-west of the Hillingdon Outdoor Activity Centre. This power line would need to be diverted to allow for the construction of the Colne Valley viaduct. At this stage the proposals are at an early stage of development and are still evolving. Map CT-06-019 shows the current proposal developed in conjunction with National Grid. Realigning the OLE would have potential impacts on ecology and landscape in this area. Therefore, HS2 Ltd is continuing to work with National Grid to identify options for the diversion of the power line and a National Grid feeder substation to assess whether the potential impacts could be avoided or reduced;
- Crossing of the River Colne – HS2 Ltd has changed the alignment of the viaduct across the River Colne, as explained above, to reduce the number of piers that would directly affect the river channel. The Proposed Scheme would still have one pier in the river and this would likely require a diversion of the river. HS2 Ltd is investigating whether it is possible to avoid this impact with for example, a longer span over the entire river channel. However, this would lead to additional visual impacts and construction costs that need further evaluation; and
- M25 slip roads – HS2 Ltd is in dialogue with the Highways Agency regarding the provision of a new temporary junction on the M25 north of Chalfont Lane between the existing junctions 16 and 17, for use by construction traffic during the period of construction of HS2. An alternative option for site access to the main construction worksites for the Colne Valley viaduct and Chiltern tunnel if the temporary slip roads were not provided would be off the A412 Denham Way. In this case it is anticipated that delivery vehicles would either exit the M25 motorway at Junction 17 and travel south on the A412 through Maple Cross, or vehicles would travel north on the A412 through Denham. This would have an impact on traffic volumes through these communities and initial calculations indicate that the volume of HGV traffic on the A412 would be approximately double the current volumes. For these reasons HS2 Ltd are pursuing the option of a new temporary junction on the M25.

Part C: Environmental topic assessments

3 Agriculture, forestry and soils

3.1 Introduction

3.1.1 This section of the report provides a summary of the impacts and the likely significant effects to agriculture, forestry and soils arising from the construction and operation of the Proposed Scheme. The section covers soils, agricultural land quality, farm enterprises, forestry and agri-environment schemes.

3.2 Policy framework

3.2.1 The planning policy documents (and their status) applicable to the Colne Valley area are described in Section 2.1. Policies of relevance to agriculture, forestry and soils are set out in the following paragraphs.

3.2.2 Policy 7.22 of the London Plan: Spatial Development Strategy for Greater London (2011) seeks to encourage and support thriving farming and land-based sectors, particularly in the Green Belt.

3.2.3 A number of policies afford protection to agricultural land at the local level. They seek to:

- Prevent the irreversible loss of the best and most versatile (BMV) agricultural land by reference to criteria for the acceptability of development on agricultural land – Saved Policy OL12 of the London Borough Hillingdon Unitary Development Plan; and
- Encourage farm diversification – Saved Policy GB9 (Agricultural Diversification) of the South Buckinghamshire Local Plan (Saved Policies, 2007).

3.3 Assessment scope and key assumptions

3.3.1 The assessment scope and key assumptions for the farm impacts and agricultural land quality assessments are set out in Volume 1.

3.3.2 There are no additional topic specific assumptions or limitations in this area.

3.4 Environmental baseline

3.4.1 The main geographical features of the area are the water bodies of the River Colne, the Grand Union Canal and the lakes formed in the valley floor on former gravel extraction sites. These water bodies mark the lowest altitudes of the section at around 40m Above Ordnance Datum (AOD). Above these water bodies, the valley sides slope upwards to higher ground, reaching around 75m AOD at the tunnel portal just east of the M25. The Chiltern Hills rise to the west.

3.4.2 The principal underlying geology varies from chalk formations in the south-east, through London clay in the central section from Gerrards Cross to Chalfont St Peter, to mixed bedrock of the Lambeth Group in the northern part, with significant sand and gravel deposits between the River Colne and the Chilterns.

3.4.3 The soils throughout this area are described as highly variable¹⁸. The National Soil Map shows, from south-east to north-west, the Wickham 4, Park Gate, Essendon and Marlow associations along the Proposed Route¹⁹.

¹⁸ Jarvis, M.G. et al. (1984) *Soils and their Use in South East England*. Harpenden: Soil Survey of England and Wales, Bulletin no.15.

¹⁹ Cranfield University (2001) *The National Soil Map of England and Wales 1:250,000 scale*. National Soil Resources Institute, Cranfield University, UK.

- 3.4.4 Wickham 4 and Park Gate soils are closely associated with the lower ground around the Grand Union Canal and Broadwater Lake nature reserve. Both are characterised by fine silty or loamy topsoils overlaying clay subsoils and are imperfectly to poorly drained.
- 3.4.5 As the land rises to the west, Essendon and Marlow soils become prominent. Both are developed in ancient river terrace drift, which gives rise to their fine loamy or silty over clayey properties. The soils vary from well drained Marlow soils, due to the presence of flints, to poorly drained Essendon soils.
- 3.4.6 National Provisional ALC mapping shows the area to be mostly of Grade 3 (good to moderate) quality agricultural land²⁰. In the north-west of the area, detailed ALC survey data shows the land to comprise mostly Subgrades 3a and 3b, with a small proportion of Grade 2 agricultural land. Based on published and field survey data the study area has been assessed as approximately 20% Grade 2, 30% Subgrade 3a and 50% Subgrade 3b.
- 3.4.7 The probable agricultural land quality in the wider 4km study area is shown on the map entitled 'Likelihood of best and most versatile agricultural land' published by the Department for Environment, Food and Rural Affairs (Defra)²¹. In the study area the highest proportion of land is found in the category "20-60% likelihood of best and most versatile agricultural land" (see map CT-02-06), and this coincides with the data available for the study area.
- 3.4.8 Agricultural land uses in the study area are divided into two distinct types, with mainly arable cropping to the west of the Colne Valley and pasture to the east. The arable land is used for combinable crops with the grassland providing grazing for horses and beef and dairy cattle.
- 3.4.9 To date the surveys have identified three farms in the study area as set out in Table 5. These range from approximately 70 hectares (ha) to approximately 1,200ha. Two are run as arable farms and one is a dairy farm.

Holding	Primary farming activities
Park Lodge Farm	Dairy
Home Farm	Arable and beef
Denham Park Farm	Currently unknown

Table 5: Holdings that would be affected by the Proposed Scheme

- 3.4.10 Most of the land in the study area is entered in the Entry Level Stewardship Scheme which encourages environmental management practices such as hedgerow management, buffer strips and low-input grassland. The whole of the area is classified as a Nitrate Vulnerable Zone, within which measures have been introduced to reduce the potential for nitrogen losses from agricultural sources into watercourses.
- 3.4.11 There are a number of blocks of woodland around the flooded gravel pits, including one classified as ancient woodland.
- 3.4.12 In assessing the impact on farms it is important to recognise that the ability to adapt to change depends, in part, upon the size of the holding, its layout and fragmentation (both before and after construction), and the enterprises operated. In this local area there is one dairy farm that could have a high sensitivity to change, especially if buildings are affected or significant areas of land are severed and two arable holdings of medium sensitivity.

²⁰ Natural England (2002) *Provisional Agricultural Land Classification mapping at 1:250,000* (version date 10/01/2002) [online]. Available at: http://www.gis.naturalengland.org.uk/pubs/gis/gis_register.asp. Accessed 18 February 2013.

²¹ Defra (2009) *Likelihood of Best and Most Versatile Agricultural Land*.

3.5 Construction

Assessment of impacts and mitigation

- 3.5.1 HS2 Ltd would require all of its contractors to comply with the CoCP, which would include the following measures:
- Measures to maintain farm access and avoid traffic over land which is used temporarily during construction;
 - Ensuring that each affected farm holding would receive specific and relevant liaison regarding the construction activities that would affect the holding;
 - Ensuring that agricultural land and corresponding soil quality can be reinstated post construction where this is the agreed end use;
 - Ensuring that the impacts on infrastructure and livestock for individual farm holdings would be reduced as far as reasonably practicable;
 - Ensuring that there is appropriate access provided to areas of severed land during and post-construction; and
 - Ensuring the appropriate handling and conservation of soil stockpiles to allow them to be reused without any substantive reduction in long term productive capability.
- 3.5.2 Soil resources would be stripped at the outset of the construction phase and stored. Where land is required temporarily for construction of the Proposed Scheme, stored soils would be used to reinstate those sites to a pre-construction agricultural condition. Soils removed from the area of permanent works would be utilised, where reasonably practicable, in the construction of the Proposed Scheme.
- 3.5.3 The soils most affected in this area are those of the Wickham 4 and Marlow associations. Marlow soils are well-drained but overlie clay sub-soils and care is needed to ensure soil handling does not result in a downgrading of quality. The Wickham 4 soils are imperfectly to poorly drained and also sensitive to the timing of soil handling. This would affect the timing of construction and restoration activities, limiting activity to drier periods to prevent damage to soil structure.
- 3.5.4 Aspects of the Proposed Scheme that would assist to reduce effects on agricultural resources include an agricultural overbridge at Home Farm, to enable continued agricultural access to severed land.
- 3.5.5 Loss of forestry land would be mitigated by replanting in nearby locations. Such locations would include areas of agricultural land that are no longer agriculturally viable as a result of severance caused by the Proposed Scheme. The extent of the forest cover in the study area is considerably greater than the national average. The loss of forestry land would remain a significant effect during the construction phase, but would reduce to insignificant as planting matures.
- 3.5.6 The agricultural land required temporarily to construct the Proposed Scheme would include land of BMV quality. Since there is a limited amount of BMV agricultural land in the wider (i.e. 4km) study area, the temporary loss of BMV land to the Proposed Scheme is considered to be significant. Although it is intended that most of the soils and farmland required for temporary construction purposes would be returned to agricultural use or used within the design of the Proposed Scheme, the residual permanent effect on BMV land remains significant.
- 3.5.7 The Proposed Scheme includes a number of construction compounds, in addition to the creation of embankments and cuttings. These extend beyond the 200m study area, and would affect a significant area of Grade 2, Subgrade 3a and Subgrade 3b agricultural land. It is

intended that most of the agricultural land affected by temporary construction works would be returned to agriculture after the works. Subject to appropriate handling (set out in the CoCP), the restored land would be of comparable agricultural quality to that existing before the construction. Overall, however, the temporary effect on agricultural land would be significant, as a consequence of the area and quality of land affected, and the likely dominance of BMV agricultural land in this area.

- 3.5.8 The permanent loss of significant areas of best and most versatile agricultural land would also remain a significant adverse effect.
- 3.5.9 Loss of commercially managed woodland and forestry land would be mitigated, where practicable, by replanting in nearby locations. In this area some 13.0ha has been identified, south of the main construction site, for woodland planting and it is proposed that soils displaced from Wyatts Covert would be used in this woodland creation. Although the loss of forestry land would be a significant effect during the construction phase, the effect would become insignificant as planting matures.
- 3.5.10 Three holdings would be affected in this area. Based on the information currently available, it is likely that three holdings – Park Lodge Farm, Home Farm and Denham Park Farm – would experience significant effects due to the proportion of land loss during construction.
- 3.5.11 Following the construction phase, much of the land would be returned to agricultural use. As a result, the permanent land take for two of the holdings would involve only modest proportions of the holdings and would not be likely to have a significant effect. For Denham Park Farm, however, the permanent loss of land is still considered likely to represent a significant proportion of the farm (though accurate farm details are still awaited).
- 3.5.12 No farm or diversified enterprises, such as housed livestock units, horticulture, farm shops or visitor accommodation, which would be particularly sensitive to dust, noise or vibration during construction, have been identified. The emission of dust, noise and vibration during the construction phase would be controlled through the CoCP, which would adopt best practice measures in this regard.
- 3.5.13 The construction process could lead to transportation of weed seeds and plants along the route. Since the land affected is largely in agricultural use there is the potential for the spread of existing weeds; particularly invasive and damaging weeds as listed in the Weeds Act 1959 and the Wildlife and Countryside Act 1981^{22,23}. Defra has powers to require occupiers of land on which such weeds are growing to take action to prevent their spreading. Application of control measures within the CoCP would regulate this potential effect.

Likely residual significant effects

- 3.5.14 The permanent residual effect within the local area is likely to be a significant permanent loss of agricultural land of BMV quality.
- 3.5.15 Following the construction phase much of the land would be returned to agricultural use. However, for Denham Park Farm some 15ha would be removed for ecological mitigation and planted with trees. This loss represents over 20% of the area farmed and remains a significant adverse effect for this holding. The permanent land take for Park Lodge Farm and Home Farm would involve only a modest proportion of the area farmed would not be a significant effect.

Further mitigation

- 3.5.16 No further mitigation is currently proposed.

²² *Weeds Act 1959* (7 & 8 Eliz II c. 54). London, Her Majesty's Stationery Office.

²³ *Wildlife and Countryside Act 1981* (c.69). London, Her Majesty's Stationery Office.

3.6 Operation

Assessment of impacts and mitigation

- 3.6.1 All run-off from the operational area would be captured in designated drainage arrangements capable of control prior to discharge to watercourses.
- 3.6.2 Comparison with other railway and highway land indicates that all corridors of transport infrastructure have the potential to support weed growth which may prejudice agricultural interests where weeds can spread to adjoining land.
- 3.6.3 The potential for the establishment and spread of weeds from the operational area would be addressed through the adoption of an appropriate land management regime by the network operator which identifies and remedies areas of weed growth which might threaten adjoining agricultural interests.

Likely residual significant effects

- 3.6.4 There are not considered to be any significant residual effects associated with the operation of the Proposed Scheme.

4 Air quality

4.1 Introduction

4.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality arising from the construction and operation of the Proposed Scheme, covering nitrogen dioxide (NO₂), fine particulate matter (PM₁₀, PM_{2.5}) and dust. Emissions of these pollutants are typically associated with construction activities and equipment and road traffic.

4.2 Policy framework

4.2.1 The planning policy documents (and their status) applicable to the Colne Valley area are described in Section 2.1. Policies of relevance to air quality are set out in the following paragraphs.

4.2.2 The London Plan forms the regional spatial strategy for Greater London and integrates economic, environmental, transport and social frameworks. Specifically for air quality, it seeks to achieve reductions in pollutant emissions and minimise public exposure to pollution. Policy 7.14 sets out a number of objectives, such as minimising increased exposure to existing poor air quality, the need to reduce emissions from demolition and construction activities using best practice and the provision of on-site mitigation measures during development.

4.2.3 The Mayor's Air Quality Strategy and Supplementary Planning Guidance on Sustainable Design and Construction set out actions for improving London's air quality and include measures aimed at reducing emissions from transport and new developments^{24,25}. A key objective of the Strategy is to make better use of the planning process so that new developments do not contribute to air pollution. Policy 3 also gives support to the expansion of competitive rail-based alternatives to aviation, including the development of a national high speed rail network.

4.2.4 A number of policies from the London Borough of Hillingdon Local Plan: Part 1 (2012), the London Borough of Hillingdon UDP (Saved Policies, 2007) (now the Hillingdon Local Plan: Part 2), South Buckinghamshire Core Strategy (2011) and the South Buckinghamshire Local Plan (Saved Policies, 2007) seek to protect and enhance air quality within the borough/district. These include: strategic objectives SO10 and SO11, and Policies EM1 and EM8 of the Hillingdon Local Plan: Part 1; Policy OE1 of the Hillingdon Local Plan: Part 2; and Core Policy 13 of the South Buckinghamshire Core Strategy (2011).

4.2.5 In addition, there are a number of local and regional guidance documents relevant to this assessment including: London Borough of Hillingdon's Air Quality Action Plan (2004); and South Buckinghamshire's Air Quality Action Plan (2006)^{26,27}.

4.3 Assessment scope and key assumptions

4.3.1 The assessment scope and key assumptions for the air quality assessment are set out in Volume 1.

4.3.2 There are no additional topic specific assumptions or limitations in this area.

²⁴ Greater London Authority (2010) *Clearing the Air: The Mayor's Air Quality Strategy*.

²⁵ Greater London Authority (2006) *Sustainable Design and Construction: The London Plan Supplementary Planning Guidance*.

²⁶ London Borough of Hillingdon (2004) *Air Quality Action Plan*.

²⁷ South Buckinghamshire District Council (2006) *Consultation Draft Air Quality Action Plan*.

4.4 Environmental baseline

- 4.4.1 The environmental baseline reported in this section represents the environmental conditions identified within the study area. The air quality in the study area reflects a transition from the urban areas of outer London to more rural areas in Buckinghamshire, with road traffic the main source of emissions in all areas. The urban areas have a higher density road network with associated traffic flows generating airborne pollutants. Consequently, airborne pollutant concentrations are mostly lower in this study area than those closer to central London. The exception to this occurs at locations adjacent to the M25.
- 4.4.2 Estimates of background air quality have been obtained from Defra for 2011 and future years (2017 and 2026). These data are estimated for 1km grid squares for nitrogen oxides (NO_x), NO₂, PM₁₀ and PM_{2.5}.
- 4.4.3 There are automatic monitoring stations in the London Borough of Hillingdon (the majority of which are in the south of the borough near Heathrow Airport) and 39 diffusion tube sites (measuring concentrations of NO₂). South Buckinghamshire District Council focuses its monitoring on the effects of road traffic, with one automatic monitoring site where the A40 crosses the M25 and with a district wide network of 16 diffusion tubes measuring NO₂ concentrations at the roadside. Three Rivers District Council adopts a similar approach, concentrating its resources on major roads, although it does not undertake monitoring in the vicinity of the study area.
- 4.4.4 The data collected by the local authorities, along with national mapping data provided by Defra, indicate that for most parts of the study area concentrations of NO₂, PM_{2.5} and PM₁₀ comply with air quality standards and meet objectives. Notable exceptions to this occur at locations near to major roads (particularly the M25). AQMAs have been declared for places near the major roads which are thought not to be meeting the air quality objective for NO₂ (see map CT-02-06). South Buckinghamshire has an AQMA that includes the M4, M25 and the M40. At its nearest point, this AQMA is just over 1 km from the Proposed Scheme. Chorleywood has an AQMA (around junction 18 of the M25) approximately 5km to the north of the Proposed Scheme and recent monitoring indicates that the NO₂ objective is not met there. The London Borough of Hillingdon has an AQMA to the south of the study area, with the Marylebone to Aylesbury Line as its border and which covers the motorway network and Heathrow Airport.
- 4.4.5 Receptors are primarily those residential properties within 350m of construction activity and those within 200m of roads where traffic flows would change as a consequence of construction activity or operation of the Proposed Scheme. The Mid Colne Valley SSSI would be crossed by the Proposed Scheme (see map CT-02-06), which is of importance mainly for the bird populations on the standing water, but also contains a small area of calcareous grassland near Mount Pleasant. These receptors are potentially sensitive to nitrogen and dust deposition.

4.5 Construction

Assessment of impacts and mitigation

- 4.5.1 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 NO₂ and PM₁₀, as well as ecological receptors sensitive to dust and nitrogen deposition.

- 4.5.2 Air quality would be controlled and managed during construction through the route-wide implementation the draft CoCP, where appropriate. Specific measures would include:
- Contractors being required to control dust, air pollution, odour and exhaust emissions during construction works;
 - Inspecting and monitoring undertaken after consultation with London Borough of Hillingdon, and the South Buckinghamshire, Chilterns and Three Rivers District Councils 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 (including historical features), watercourses and surface drains 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.
- 4.5.3 In the Colne Valley area, dust generating activities would comprise the removal of excavated material from the Chiltern tunnel, Colne Valley viaduct southern and northern approach embankments, the Tilehouse Lane cutting and the Chiltern tunnel southern approach embankment. Dust emissions from these sites would arise from: the demolition of buildings; the construction of the proposed tunnel portal; the portal approach cutting extending for approximately 100m; earthworks associated with the preparation of the ground; the use of construction compounds; the construction of the permanent replacement road infrastructure and bridges; and dust from vehicles leaving the site onto local roads. There are some properties within 20m of the earthworks along the route and others less than 20m from the viaduct, including The Alders' and Dews Farm, the latter of which would be demolished as part of the Proposed Scheme. These receptors would be most likely to experience adverse effects because of their proximity.
- 4.5.4 The Chiltern tunnel main construction site and the construction of the Chiltern tunnel south portal would be located adjacent to the M25. The tunnel portal itself would be approximately 100m south of the M25. Slip roads would also be installed on the M25 at this point to allow access to the construction site. There would be properties less than 20m from this construction compound, including at Sunnyhill Road, off Chalfont Lane.
- 4.5.5 Given implementation of the measures outlined above, the assessment of effects arising from dust emissions confirms that impacts would be negligible for residential receptors and for the Mid Colne Valley SSSI. None of these effects would be significant.
- 4.5.6 Construction activity could also affect local air quality through the additional traffic generated on local roads as a result of construction traffic routes and changes to traffic patterns arising from temporary road diversions. Examination of the predicted changes in traffic flows for 2017 along the affected roads has shown that they would be too small to meet the criteria required for further assessment, with the exception of those on the A412 Denham Way. An assessment of the air quality impacts for receptors at this location found that they would be negligible and therefore not significant.
- Likely residual significant effects**
- 4.5.7 The methods outlined within the CoCP to control and manage potential air quality effects are considered effective in this location. Hence, no residual effects are considered likely.

4.6 Operation

Assessment of impacts and mitigation

- 4.6.1 Impacts from the operation of the Proposed Scheme relate mainly to changes in the nature of traffic. There are no direct atmospheric emissions from the operation of trains that would cause an impact on air quality.
- 4.6.2 Traffic data in the Colne Valley area have been screened to identify roads that required further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2026. There are no changes that meet the criteria for significance and consequently it has been concluded that there would be no significant effects.

Likely residual significant effects

- 4.6.3 No residual effects would be anticipated for air quality in this area during operation of the Proposed Scheme.

5 Community

5.1 Introduction

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

5.2 Policy framework

5.2.1 A key objective of the London Plan: Spatial Development Strategy for Greater London (2011) is that London should be a place where people and businesses want to locate, with facilities to meet their needs. The London Plan (2011) seeks to achieve this by:

- Ensuring that development proposals protect and enhance facilities and services that meet the needs of particular groups and communities (Policy 3.1);
- Providing people, in their neighbourhoods, with a good quality environment in an active and supportive local community with the best possible access to services, infrastructure and public transport (Policy 7.1); and
- The Plan contains a range of policies that seek to avoid the loss of community facilities and affordable housing, including Policies 3.6, 3.14, 3.16, 3.18 and 3.19. Additionally, Policy 7.18 seeks to protect local open space.

5.2.2 The Hillingdon Local Plan: Part 1 (2012) contains strategic objectives SO3 that seek to prevent the loss of open space and promote social inclusion. Policies EM4, Cl1 and Cl3 seek to prevent the loss of public local open space, urban green space, community services and facilities, and education facilities. Policy Cl2 seeks to safeguard existing viable leisure and recreational facilities and supports proposals for new and improved facilities. The Saved UDP Policies (2007) in Hillingdon Local Plan: Part 2 set out further specific guidance in relation to community facilities in Policies H3, R5, R8, R11 and BE34. Additionally, Saved Policies Com1 and Com2 from the South Buckinghamshire Local Plan (2011) seek to resist the loss and encourage the enhancement of community facilities in the district.

5.2.3 There are no allocations for development sites of more than 0.5 hectare located within 2km of the route centre line.

5.3 Assessment scope and key assumptions

5.3.1 The assessment scope and key assumptions for the community assessment are set out in Volume 1.

5.3.2 Consultation has not been undertaken in relation to all community facilities impacted by the Proposed Scheme. As a result detailed information on the usage, services provided and future plans of some facilities is not available.

5.4 Environmental baseline

5.4.1 The study area includes the area of land within the construction boundary (comprising the temporary and permanent land take), as well as a suitable additional area as relevant to inform the respective environmental topics upon which the assessment is based.

5.4.2 The baseline study area and baseline data will be further refined in light of ongoing assessment work as part of the formal ES process.

5.4.3 The Colne Valley area covers a mainly rural area, including crossing the Grand Union Canal and River Colne. The villages of Denham Green and South Harefield are located outside of the

temporary and permanent land take but are within 1km of the route (see maps CT-03-10 and CT-03-11).

- 5.4.4 The route would be above ground, in a mixture of cutting and viaduct for most of this area and would enter a tunnel at the boundary between the Colne Valley and the Chalfonts and Amersham area. This baseline focuses on the community resources and receptors located in close proximity to design features applicable to this CFA, such as the construction compounds associated with the Colne Valley viaduct and storage areas as described below.
- 5.4.5 The Maple Cross Junior Mixed Infant and Nursery School, which caters for 3-to-11 year olds and is outside the temporary and permanent land take, is located on the boundary of the study area to the south of Maple Cross and would be within 500m of the Colne Valley viaduct main site compound. The West Hyde and Maple Cross Youth Centre, the church of St Thomas of Canterbury and the Royal Oak Public House would also lie within 250m of the temporary land take.
- 5.4.6 The Hillingdon Outdoor Activity Centre, which is situated on land along the eastern side of the Colne Valley lakes, and accessed off Harvil Road, is owned by the London Borough of Hillingdon, but operates as a charitable organisation (see map CT-03-10). It is an important centre for a range of water and land-based activities in the area and acts as an educational outdoor charity. While the charity caters for the whole community, it prioritises young people, disadvantaged people and those with disabilities, who make up the majority of the users. Both annual membership and day passes are available along with activities for groups, including schools, scouts, guides and colleges. The site would be directly affected by demolition of some buildings and land take.
- 5.4.7 The Colne Valley Trail is a country-walking route starting to the south of Rickmansworth. It follows the River Colne, adjacent to the Mid Colne Valley lakes. It is well used by walkers and dog walkers. The trail falls within the permanent land take and temporary land take where the route of the Proposed Scheme crosses over the trail on viaduct.
- 5.4.8 The London LOOP (London Outer Orbital Path) is a 240km signed walk along public footpaths and through parks, woods and fields around the edge of Outer London. At the point where the Proposed Scheme would cross it, the London LOOP is on a canal towpath next to the Grand Union Canal and it shares the footpath with the Grand Union Canal Walk. The PRoW, which is used primarily by walkers, would pass through the permanent and temporary land take, but under the route, which would be on viaduct at this point.
- 5.4.9 The Old Shire Lane Circular Walk and PRoW would be intersected twice by the route, at the end of a section of viaduct and at the entrance to the Chiltern tunnel portal, falling within the permanent land take. The PRoW would run adjacent to the temporary land take for approximately 4.5km.
- 5.4.10 The South Bucks Way is a walk promoted by Buckinghamshire County Council from the Grand Union Canal at Denham to Coombe Hill near Wendover. The route would cross the PRoW where it is in tunnel. It would fall within the permanent and temporary land take.
- 5.4.11 The Buckinghamshire Golf Course would fall outside of the temporary and permanent land take on the very edge of the study area to the east of Denham.

5.5 Construction

Assessment of impacts and mitigation

Residential property

- 5.5.1 The route of the Colne Valley viaduct would require the demolition of a residential dwelling at Dews Farm and several of its outbuildings and those associated with Dews Farm Cottages, off Harvil Road and outbuildings at Weybeards Cottages. It is considered that the permanent loss of this dwelling and outbuildings is a minor adverse effect and, therefore, not considered significant.

Community infrastructure

- 5.5.2 The Colne Valley viaduct would cross the Hillingdon Outdoor Activity Centre site. The construction of the viaduct would require placement of piers at the site, including in the adjoining 18ha lake, where water based activities take place. The erection of viaduct piers at 45m intervals, and the scale and duration of the construction works would mean that the lake used by the Hillingdon Outdoor Activity Centre would be closed during the construction period. Three outbuildings used by Hillingdon Outdoor Activity Centre would also be demolished as part of the construction works. The longest anticipated duration for construction would be between two and three years. Alternative access to the activities centre would be provided, as the existing route from Harvil Road would be used for construction traffic and a small section of the Colne Valley viaduct site compound.
- 5.5.3 Hillingdon Outdoor Activity Centre provides both water-based and land-based activities. Although land take of the instruction centre would not be required and some land-based activities would be able to continue, it is likely that the ability of the activities centre to function would be severely compromised and it may not be viable for it to remain open during the construction period.
- 5.5.4 There are no other centres providing similar services to those provided by the Hillingdon Outdoor Activity Centre within the region. Users include local people, education groups, community groups and specific facilities are in place to enable those with disabilities to participate. The activities centre also has a role beyond recreation, providing training for new and existing instructors. The Hillingdon Outdoor Activity Centre is a valuable community resource and the proposed construction works would therefore result in a major adverse significant effect on the community if the resource were not able to remain open.

Public rights of way and open space

- 5.5.5 The study area includes the Colne Valley Regional Park (see Section 2), which would be crossed by a new viaduct. The effects on ecology (see Section 8) and landscape (see Section 11) are considered elsewhere in this report. The construction of the viaduct would result in direct temporary land take for the Colne Valley viaduct laydown compound (off Moorhall Road) and storage area (off North Orbital Road, north of West Hyde House) for approximately three years. The construction works for piling and erection of the viaduct piers and decking would also take up to three years of works in the regional park. The footprint of the piers represents permanent land take.
- 5.5.6 Providing opportunities for countryside recreation and encouraging community participation are key objectives for Colne Valley Regional Park (through its Community Interest Company). The Park is accessible to communities in west London as well as providing a recreational resource for nearby communities. Although there would be temporary land take for three years and some permanent land take from the park, it is considered that the park is sufficiently large that the construction works would not be likely to affect the ability of the

park to retain its function. Therefore it is considered that there would not be a significant effect on the Colne Valley Regional Park.

- 5.5.7 The study area, including Colne Valley Regional Park, has a number of public rights of way through it (see maps CT-03-10 and CT-03-11). These include the Colne Valley Trail and Hillingdon Trail (along the banks of the Grand Union Canal), the Old Shire Lane Circular Walk and the South Bucks Way, as well as other informal routes. Those routes that would be intersected by the Proposed Scheme would be provided with temporary or permanent diversions. Impacts on the Grand Union Canal have been avoided by increasing the span between piers as the viaduct crosses overhead. The users of these routes such as pedestrians, dog walkers, cyclists and horse riders may experience amenity impacts. However these are unlikely to be significant.

Amenity

- 5.5.8 In the formal ES we will assess the incidence of significant effects, including in-combination effects, on community amenity.

Likely residual significant effects

- 5.5.9 The impacts on Hillingdon Outdoor Activity Centre during the construction period would remain a major adverse significant effect on the community if the resource were not able to remain open.
- 5.5.10 Multiple (in combination) community effects will be considered, and where significant reported in the formal ES.

Further mitigation

- 5.5.11 Further work is being undertaken to understand the effects on Hillingdon Outdoor Activity Centre and to identify possible mitigation options.
- 5.5.12 The development of specific mitigation measures where required, which could include improvement or provision of community resources as appropriate, will be reported in the formal ES.

5.6 Operation

Assessment of impacts and mitigation

- 5.6.1 Potential effects on the community resulting from the operation of the Proposed Scheme could potentially arise from changes to amenity. This assessment draws upon the findings of other technical disciplines (e.g. air quality, noise and vibration, visual, transport and traffic) to inform the assessment of amenity. The presence of in combination impacts from these other disciplines could result in significant amenity effects on community resources or residential properties within the Colne Valley area. This will be addressed in the formal ES.

Likely residual significant effects

- 5.6.2 Multiple (in combination) community effects will be considered, and where significant reported in the formal ES.

Further mitigation

- 5.6.3 The development of specific mitigation measures where required, which could include improvement or provision of community resources as appropriate, will be reported in the formal ES.

6 Cultural heritage

6.1 Introduction

6.1.1 This section of the report presents a summary of the impacts and likely significant effects on heritage assets and the historic environment as a result of the construction and operation of the Proposed Scheme. Heritage assets comprise:

- Archaeological and palaeo-environmental remains;
- Historic landscapes; and
- Historic buildings and the built environment.

6.2 Policy framework

6.2.1 Policy 7.8 of the London Plan: Spatial Development Strategy for Greater London (2011) seeks to conserve the significance of London's heritage assets and their settings through good planning and design, noting that archaeological assets should, where possible, be made available to the public in their original location, in-situ. Policy 7.9 requires an assessment of the significance of heritage assets when a development is proposed, and schemes should be designed so that the heritage significance is recognised and is used as a catalyst for regeneration.

6.2.2 A number of policies from the London Borough of Hillingdon Local Plan (2012), the London Borough of Hillingdon UDP (Saved Policies, 2007) (now the Hillingdon Local Plan: Part 2), South Buckinghamshire Core Strategy (2011) and the South Buckinghamshire Local Plan (Saved Policies, 2007) seek to conserve and enhance the borough's/district's cultural heritage. These policies aim to:

- Preserve archaeological priority areas, scheduled monuments and conservation areas (Saved UDP Policies Be1, BE2, Be3 & BE4 of the Hillingdon Local Plan: Part 2);
- Conserve and enhance heritage assets (Policy HE1 of the London Borough Hillingdon Local Plan: Part 1 (2012));
- Protect the built and historic environment (Core Policy 8 of the South Buckinghamshire Core Strategy (2011)); and
- Preserve listed buildings and conservation area settings (Policies C1 & C6 of the South Buckinghamshire Local Plan (Saved Policies, 2007)).

6.2.3 In addition, a number of local and regional guidance documents have been considered including:

- Colne Valley Park Historic Landscape Characterisation²⁸; and
- London World Heritage Sites – Guidance on Settings Special Planning Guidance²⁹.

6.3 Assessment scope and key assumptions

6.3.1 The assessment scope and key assumptions for the cultural heritage assessment are set out in Volume 1.

6.3.2 No further assumptions have been made for the assessment specifically for this area.

²⁸ Beckley, R. (2007) *Colne Valley Park: Historic Landscape Characterisation*.

²⁹ The Greater London Authority (2012) *London World Heritage Sites – Guidance on Settings SPG*.

6.4 Environmental baseline

- 6.4.1 The Thames Terrace Gravels within the Colne Valley area and its vicinity have produced numerous Palaeolithic finds, many of which have contributed to the understanding of Late Glacial Europe. Lower Palaeolithic finds have typically been recovered during industrial gravel extraction, usually from the geological horizons of the Lynch Hill Gravels and Langley Silt Member. These gravel deposits are overlain by deposits of alluvium and peat, which can 'seal in' evidence of palaeo-environmental interest.
- 6.4.2 Access to the resources associated with the river made the Colne Valley an attractive location for the nomadic groups of the early prehistoric period. The floodplains and adjacent higher ground also provided a suitable location for agriculture and settlement respectively during the subsequent Neolithic and Bronze Age periods, as evidenced by the artefacts and features reflecting settlement recorded during the construction of the M25 at Denham.
- 6.4.3 Local high points overlooking the river remained attractive locations for settlement throughout the Iron Age, with exploitation of the floodplains as farmland. This landscape would have primarily comprised small agricultural settlements, isolated farmsteads, and the associated field systems and paddocks. This settlement pattern remained into the Roman period, with further artefacts and features being recorded on the higher ground overlooking the Colne near Nock Hill Wood and Juniper Wood. The major landscape change within the study area during this period was the establishment of the Roman road network. At least one road ran through the study area, connecting the Roman settlements at Langley Park and Chorleywood. The line of this road is preserved in the modern landscape as Shire Lane.
- 6.4.4 The wider landscape in the Anglo-Saxon and medieval periods would have been characterised by open strip fields, with nucleated villages and scattered farmsteads replacing the earlier, more dispersed, settlements. It is likely that the extant pattern of settlement across the landscape (including centres at Denham, Maple Cross, Ickenham and South Harefield) dates from this period. The continuing use of these settlement centres makes identification of Anglo-Saxon remains difficult, as they can be screened by the later activity. Anglo-Saxon pottery has been found on the west facing slope of the Colne Valley, and settlement of similar date is well established elsewhere on the Thames Gravels.
- 6.4.5 As well as the larger settlements, the more isolated farmsteads in the area may also have medieval origins, some of which were potentially manorial centres. Moated sites are recorded in the vicinity including at Brackenbury Farm (in CFA 6 – South Ruislip Ickenham). These were high status residences outside of the villages.
- 6.4.6 The landscape of the study area was enclosed in the post-medieval period, and subsequently large scale gravel extraction has taken place, dramatically reshaping the landscape and resulting in the large lakes situated along the course of the Colne. The Proposed Scheme would cross the line of the Grand Union Canal on a viaduct to the south of South Harefield.
- 6.4.7 Within the area of study only the following designated and non-designated assets are recorded.

Designated assets

- 6.4.8 Designated assets are represented on maps CT-01-09 to CT-01-12.
- 6.4.9 No designated assets lie within either the permanent land take or temporary landtake.

- 6.4.10 The following designated assets are located within the draft ZTV (see section 9.3 of this report):
- One Scheduled Monument comprising a mound with a ditch and outer bank to the south of Savay Farm;
 - Four Grade I Listed Buildings (St Mary’s Church, South Harefield; Breakspear House, South Harefield; St Mary’s Church, Denham, and The Savay at Savay Farm);
 - Four Grade II* Listed Buildings and 43 Grade II Listed Buildings – the majority of these are located at Denham, Harefield, Savay, on the western outskirts of Ickenham, and West Hyde;
 - One Grade II Registered Park, Denham Place; and
 - Three Conservation Areas comprising Denham; Denham Lock; and Harefield Village.

Non-designated assets

- 6.4.11 Large areas of the proposed temporary land take have been previously quarried for gravel extraction. In those areas that have not been disturbed there is considered to be a high potential for surviving buried archaeological remains from a range of periods. These may comprise Palaeolithic finds of stone tools and animal bones, as well as evidence for later prehistoric, Roman and early medieval period settlement and field systems.
- 6.4.12 The only confirmed non-designated heritage asset within the proposed temporary land take is Dews Farm, a locally listed two-storey farmhouse.

6.5 Construction

Assessment of impacts and mitigation

- 6.5.1 The construction works have the potential to affect heritage assets. Impacts would occur to assets within the area of temporary and permanent land take, as well as the setting of heritage assets within the ZTV.
- 6.5.2 The draft CoCP sets out the provisions that would be adopted to control effects on cultural heritage assets. The provisions include:
- Management measures to control damage to assets that are to be retained within the area of temporary land take and the preparation of project wide principles, standards and techniques for works affecting heritage assets;
 - A programme of archaeological investigation and recording to be undertaken prior to construction works affecting the assets; and
 - A programme of historic building investigation and recording to be undertaken prior to modification or demolition of the assets.
- 6.5.3 In addition the following measures have been included as part of the design of the Proposed Scheme and with the aim of avoiding or reducing impacts on heritage assets:
- Provision of earthworks and planting to screen the construction sites on either side of the Colne Valley.
- 6.5.4 Assets that would or might experience a significant physical effect in this area are:
- Dews Farm, a locally listed (non-designated) asset of moderate heritage value, would be demolished; and
 - Potential buried archaeological remains of prehistoric to post-medieval date, surviving in areas not disturbed by quarrying, assets of moderate heritage value, may be removed.

6.5.5 The settings of the following specific heritage assets would experience significant effects:

6.5.6 Grade I listed Savay Farm and the associated Grade II listed gatehouse, bridge and barns.

Likely residual significant effects

6.5.7 The impacts of the construction phase on the heritage assets through setting changes are temporary and therefore not considered to result in residual significant effects.

6.5.8 Although a programme of archaeological and historic building investigation contributes to knowledge gain, such works would not fully mitigate the effect or reduce the impact on heritage assets. The following effects would therefore remain:

- Demolition of Dews Farm; a locally listed building; and
- Potential archaeological remains within the footprint of the Proposed Scheme that would be removed as a result of it.

Further mitigation

6.5.9 No further mitigation measures have been identified at this time.

6.6 Operation

Assessment of impacts and mitigation

6.6.1 There would be no effects on buried archaeological remains arising from operation.

6.6.2 The introduction of the Proposed Scheme into an area of existing open landscape has the potential to introduce impacts on the setting of heritage assets. The Proposed Scheme would include elevated sections on the embankment and viaduct, together with realignment of the existing highway infrastructure. The Proposed Scheme would be designed to reduce effects on the settings of listed buildings such as Savay Farm located in proximity to the proposed viaduct as far as practicable.

6.6.3 Although the viaduct would be a large and highly visible structure from listed buildings at Denham Green, Harefield, West Hyde and Mount Pleasant, the historic landscape of the area has already been compromised by gravel extraction, the M25 and numerous overhead power lines, and as such would not cause a significant impact to the setting of any heritage assets in the vicinity.

6.6.4 The provision of earthworks and planting close to the viaduct would provide an effective means of mitigation to reduce the effects of the Proposed Scheme on the historic landscape and specific heritage assets within it. The viaduct could also be screened by earthworks and planting close to the assets. However, mitigation would not be fully effective until planting has matured.

Likely residual significant effects

6.6.5 There would be no residual effects on cultural heritage assets during operation.

7 Ecology

7.1 Introduction

7.1.1 This section of the report provides a summary of the predicted impacts and significant effects upon species and habitats as a consequence of the construction and operation of the Proposed Scheme. This includes effects upon sites recognised or designated on the basis of their importance for nature conservation.

7.2 Policy framework

7.2.1 Policy 7.19 of the London Plan: Spatial Development Strategy for Greater London (2011) seeks to ensure a proactive approach to the protection, enhancement and management of biodiversity. Policy 7.21 seeks to retain existing trees of value and where there is any loss from development, these should be replaced following 'right place, right tree' principle.

7.2.2 A number of local policies seek to conserve and enhance the boroughs' and districts' ecology, including strategic objective SO8 and Policy EM7 of the Hillingdon Local Plan: Part 1 (2002), Saved UDP Policies BE32 and BE34 of the Hillingdon Local Plan: Part 2 (2007), Core Policy 9 of South Buckinghamshire Core Strategy (2011), and Policy C15 of the South Buckinghamshire Local Plan (Saved Policies, 2007).

7.2.3 The emerging policy baseline will be available as part of the formal ES.

7.2.4 In addition, the following local and regional guidance is relevant to this assessment:

- The Mayor's Biodiversity Strategy 2002³⁰; and
- The Buckinghamshire and Milton Keynes Biodiversity Action Plan 2000-2010³¹.

7.3 Assessment scope and key assumptions

7.3.1 The assessment scope and key assumptions for the ecological assessment are set out in Volume 1.

7.3.2 The current assessment draws on existing information gathered from national organisations and from regional and local sources including Natural England (London Region), the EA (North Thames Region), the Hertfordshire and Middlesex Wildlife Trust, Buckinghamshire County Council and Greenspace Information for Greater London.

7.3.3 Biological records from the Hertfordshire Bat Group have now been received but are yet to be incorporated. Data from the Buckinghamshire Badger Group and additional data from the South Buckinghamshire and Bedfordshire Bat Group have been requested.

7.3.4 Field surveys undertaken to date have been limited to locations where landowner permission has been obtained and to areas accessible to the public, largely in the Mid Colne Valley SSSI. They include (but are not limited to) habitat and hedgerow and National Vegetation Classification surveys; bat surveys including tree assessments, emergence surveys, and transect surveys to establish movement corridors and foraging areas; wintering and breeding bird surveys including vantage point surveys; terrestrial and aquatic invertebrates surveys; and otter and water vole surveys.

³⁰ Greater London Authority (2002) *Connecting with London's Nature The Mayor's Biodiversity Strategy*.

³¹ Buckinghamshire and Milton Keynes Biodiversity Partnership (2008) *Buckinghamshire and Milton Keynes Biodiversity Action Plan 2000-2010. Revised 2008*.

7.3.5 Surveys will continue during 2013 and will include (but are not limited to) the following:

- Further bat surveys along the River Colne to establish species diversity, as well as automated surveys at above 10 metres to establish levels of noctule activity; and
- Botanical and breeding bird surveys to supplement those carried out in 2012.

7.4 Environmental baseline

7.4.1 This section presents the environmental baseline that is relevant to the consideration of impacts and effects reported in Sections 7.5 and 7.6. Details of the environmental baseline for the full search areas investigated in support of the ecological assessment will be provided in the formal ES.

7.4.2 In the Colne Valley area the Proposed Scheme crosses the valley of the River Colne, where past mineral extraction has created large lakes that have since returned to nature. Aquatic, and water-margin habitats, together with waterfowl they support are therefore of importance. Extensive areas of agricultural land are present to the west of the A412.

7.4.3 Statutory and non-statutory designated sites are shown on maps CT-01-10, CT-01-11 and CT-02-06.

7.4.4 There are no internationally designated sites within 500m, but the Proposed Scheme would be approximately 12km north of South West London Waterbodies Special Protection Area (SPA), which is designated for wintering gadwall and shoveler.

7.4.5 Two Sites of Special Scientific Interest (SSSI) are present within 500m of the Proposed Scheme. They are each of national value based on the features for which they are designated:

- The Mid Colne Valley SSSI is partially within the Proposed Scheme, which crosses the site on viaduct. It is designated for its assemblage of wintering birds including nationally significant numbers of great crested grebe, cormorant, tufted duck, shoveler and gadwall³². However, only cormorant numbers have exceeded national significance in recent years. The SSSI is also designated for broad-leaved woodland, some of which is ancient woodland and an assemblage of woodland birds that includes lesser whitethroat, nuthatch, tawny owl and three species of woodpecker. Other designated features include water margin vegetation, wet woodland and part of the River Colne³³; and
- The Fray's Farm Meadows SSSI is located about 300m south of the proposed realignment of National Grid power lines, to the north of the A40 and east of the Grand Union Canal (but 1km south of the main construction works). This SSSI is designated for species-rich grassland and wetland plants and invertebrates.

7.4.6 Two Local Nature Reserves (LNR), Denham Country Park LNR and Frays Valley LNR are partially within the Proposed Scheme to the south of Moorhall Road. Both are designated for woodland, scrub and wetland habitats. Both are within the larger non-statutory Colne Valley Site of Metropolitan Importance for Nature Conservation (SMI), which is of greater value, as described below. A further LNR, Northmoor Hill Wood, is located approximately 45m from the Proposed Scheme on the western side of the A412 and is designated for ancient woodland. LNRs are designated to provide access to nature for local communities and are of district/ borough value (see maps CT-01-10, CT-01-11 and CT-02-06).

³² White, G.J. and Harris, A.J. (2008) *The Wetland Resource of the Colne Valley: An assessment of its importance to nature conservation, with special reference to waterbirds*. Natural England, Herts. Middx. Wildlife Trust, Environment Agency.

³³ Surveys in 2012 have recorded large stands of Japanese knotweed in woodland and mats of floating pennywort in the River Colne in the SSSI. Two waterweed species of the genus *Elodea* have also been recorded in the lakes in the Mid Colne Valley SSSI. All of these species are listed on Schedule 9 of the Wildlife and Countryside Act, 1981 and it is illegal to cause them to spread into the wild.

7.4.7 Non-statutory sites designated for nature conservation which are located within the extent of the Proposed Scheme or are considered potentially subject to significant effects are relevant to the assessment. The Colne Valley area is situated in both Greater London and Buckinghamshire and thus encompasses three types of non-statutory sites of nature conservation importance: Local Wildlife Sites (LWS) and Biological Notification Sites (BNS) in Buckinghamshire; and SMI and Sites of Borough Importance (SBI) in Greater London. In addition, a Hertfordshire and Middlesex Wildlife Trust Nature Reserve (Broadwater Lake which is within the Mid Colne Valley SSSI) is crossed by the Proposed Scheme. These sites are all of county/metropolitan value, except the SBIs, which are of district/borough value.

7.4.8 The ten sites located in or close to the extent of the Proposed Scheme are as follows:

- The Northmoor Hill Wood and Wyatts Covert LWS is designated for ancient woodland (also an LNR – see Section 7.4.6 above);
- Great Halings Wood LWS is adjacent to an area of the Proposed Scheme that would be used for ecological mitigation only. It too is designated for ancient woodland;
- The Tilehouse Gravel Pits BNS is in the Mid Colne Valley SSSI west of the River Colne and is designated for standing water, water-margin vegetation and water birds. The Proposed Scheme is partially within the south west corner of the site, which is woodland;
- The Juniper Wood BNS is south of the Proposed Scheme between Tilehouse Lane and the M25 motorway. It is also designated for ancient woodland;
- Nightingale Wood BNS is approximately 30m from the Proposed Scheme on the western side of the A412 and is designated for its stream and woodland, parts of which are ancient woodland and would be adjacent to an area for ecological mitigation;
- Broadwater Lake, a Hertfordshire and Middlesex Wildlife Trust Nature Reserve, is situated within the Mid Colne Valley SSSI. It is designated for the same reasons as the SSSI but also for large numbers of Daubenton's bat that feed along the River Colne;
- The Mid Colne Valley SMI is a large site which includes the Mid Colne Valley SSSI, but also extends south of Moorhall Road where Savay Lake would be partially within the Proposed Scheme. It is designated for similar reasons to the SSSI i.e. wetland and woodland habitats and bird assemblages and the River Colne; as well as for invertebrates such as Desmoulin's whorl snail and glow worm, and locally uncommon plants;
- The London's Canals SMI is a very large site that extends across London. It is designated for wetland plants and water birds. The Proposed Scheme would cross the SMI at the Grand Union Canal on viaduct between Denham Quarry Lake and Savay Lake;
- Dew's Dell SBI is designated for broad-leaved woodland and is partially within the Proposed Scheme; and
- Harefield Hall and The Lodge SBI is designated for broad-leaved woodland and is partially within the Proposed Scheme.

7.4.9 Other habitats located outside of the designated sites identified above and which are relevant to the assessment include the following:

- Ponds – are present to the south of Savay Lake and in the Uxbridge and Buckinghamshire Golf Clubs east and west of the Colne Valley, respectively. Some may qualify as habitats of principal importance under Section 41 of the NERC Act (2006) but are unlikely to exceed district/borough value³⁴;
- Hedgerows – species-poor hedges are mainly present between the M25 motorway and the A412 but some are located in farmland to the east. As most hedgerows are dominated by

³⁴ *Natural Environment and Rural Communities Act 2006* (2006 Chapter 16). Natural England.

native species they qualify as habitats of principal importance but, due to low species diversity, limited extent and poor connectivity, are unlikely to be of more than local/parish value;

- Watercourses – 300m of a small, unnamed stream is within the temporary land take area, west of Harvil Road and near Dew's Farm. It is less than 2m wide and overgrown with scrub and trees; and
- Woodland – Newyears Green Covert which is partly a habitat of principal importance is unlikely to be of more than local/parish value.

7.4.10 A summary of the likely value of species located outside of the designated sites identified above and covered by the assessment is provided in Table 6.

Resource/ Receptor	Value	Rationale
Bats	Up to county/ metropolitan value	All species are listed in the Wildlife and Countryside Act (WCA) 1981 (as amended) and Annex II of the Habitats Directive ³⁵ . Habitats along the River Colne and the Grand Union Canal support at least seven species of bat. Daubenton's bats are abundant with roost(s) present in the SSSI woodland and noctule bats (a species of principal importance) are also present.
Otter	Up to county/ metropolitan value	Otter is listed under both the WCA and the Habitats Directive. Field signs indicating regular presence of otter have been recorded in two locations in close proximity to the Proposed Scheme.
Fish	Up to county/ metropolitan value	Eel and bullhead, the former critically endangered and of principal importance and the latter listed on Annex II (as a non-priority species) of the Habitats Directive and of least concern, are present in the River Colne. They have been recorded during several years but in low numbers only.
Water vole	Likely to be no more than county/ metropolitan value	Water vole is listed under the WCA. No water vole has been recorded in the Mid Colne Valley SSSI. However, there is suitable habitat and there are existing records along the River Colne.
Hazel dormouse	Likely to be no more than county/ metropolitan value	Dormice are listed under the WCA and the Habitats Directive. Suitable habitat is present. However, they were not recorded in woodland west of the River Colne and there are no existing records within 500m of the Proposed Scheme. This species is therefore unlikely to be present.
Terrestrial invertebrates (outside of Mid Colne Valley SMI)	Up to district/borough value	Rare or notable invertebrates have not been recorded during surveys in the SSSI. However, Northmoor Hill Wood LWS supports three Red Data Book and one nationally notable species. It is possible that a similar assemblage is present in woodland in the extent of the Proposed Scheme.
Plants	Up to district/borough value	Outside the designated sites there are few records of notable plant species. Those present include green-flowered helleborine, which is a nationally scarce species and declining in southern England ³⁶ .
Great crested newt	Up to district/borough value	Great crested newt is listed under the WCA and the Habitats Directive. No great crested newts have been recorded in lakes close to the River Colne and there are no existing records. Further suitable habitat for great crested newt is present south of Savay Lake and this species is widespread in Hillingdon and much of Buckinghamshire.

³⁵ The Conservation of Habitats and Species Regulations 2010 transposed the Habitats Directive into national law – all references to the directive also therefore refer to the Regulations.

³⁶ Recorded in between 16 and 100 10km x 10km Ordnance Survey grid squares since 1987.

Resource/ Receptor	Value	Rationale
Birds (outside of SSSI and non-statutory designated sites)	Local/parish value	There are several records of widespread BOCC Red Listed bird species and species of principal importance within the extent of the Proposed Scheme, including bullfinch, skylark and song thrush ³⁷ .
Badger	Local/parish value	Several setts have been recorded in the vicinity of the Proposed Scheme. Badgers are, however, relatively common along much of the Proposed Scheme, as they are in the wider landscape.
Reptile	Local/parish value	No reptiles were recorded in surveys to date. There are a small number of historical records of grass snake in close proximity to the Proposed Scheme.

Table 6: Preliminary evaluation of likely value of protected and/or notable species occurring within this section of the route

- 7.4.11 If the otter numbers and distribution continue to expand, it is possible that breeding holts may be present in the vicinity of the Proposed Scheme at the time of construction.
- 7.4.12 The Hertfordshire and Middlesex Wildlife Trust has carried out habitat management, such as the creation of new reedbeds and shingle banks, intended to increase the numbers and diversity of wetland birds in the Colne Valley. It is considered unlikely that the ecological value of birds would change significantly from that stated in Table 6 and in preceding text regarding statutory and non-statutory sites of importance for nature conservation.
- 7.4.13 Signal crayfish are abundant and large colonies of Japanese knotweed and floating pennywort are present in the Mid Colne Valley SSSI. Further spread of these species could adversely affect the conservation value of the habitats in which they occur; conversely their effective control could increase conservation value.

7.5 Construction

Assessment of impacts and mitigation

- 7.5.1 The following section considers the impacts and effects on ecological receptors as a consequence of construction of the Proposed Scheme. All assessments made are provisional, based on the preliminary assessment of baseline value as presented in Section 7.4 of this report.
- 7.5.2 The following measures have been included as part of the design of the Proposed Scheme and avoid or reduce impacts on features of ecological value. In this area the value of ecological features has led to the development of an integrated wildlife mitigation strategy including the following:
- Any diversion of the River Colne would involve the creation of a natural channel of similar or greater ecological value to that currently present;
 - The area of floodplain compensation allocated within the SSSI was reduced to minimise impacts on ancient woodland; and
 - In order to mitigate for the loss of broad-leaved woodland from the Mid Colne Valley SSSI; new woodland is proposed to be created in advance of construction to the west of the A412, as close as possible to the SSSI.
- 7.5.3 The assessment assumes implementation of the measures set out within the draft CoCP, which includes: translocation of protected species where appropriate; protection of retained habitat; control of dust; water pollutants, light spillage and noise, and control of invasive and

³⁷ BOCC = Birds of Conservation Concern after: Eaton M.A et al. (2009) *Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds* 102, pp296-341.

non-native species. Of particular relevance in this CFA would be CoCP measures to mitigate the effects of construction disturbance on birds which would include:

- Hoarding erected around all construction sites to reduce noise and visual disturbance;
- During piling, a soft start procedure would be adopted to avoid sudden onset of loud noise and vibration; and
- As far as reasonably practicable, access routes and laydown areas would be sited away from important bird habitat to reduce disturbance.

- 7.5.4 The Proposed Scheme crosses habitat that is utilised by gadwall and shoveler. Overwintering populations of these species are the qualifying features of the South West London Waterbodies SPA, which is located approximately 12km to the south of the Proposed Scheme. In 2011/12 HS2 Ltd. carried out surveys of waterbodies close to the Proposed Scheme in order to establish whether the integrity of the South West London Waterbodies SPA was likely to be affected. By far the most important lake in the SSSI for gadwall and shoveler is Broadwater. This is a large lake, most of which would not be affected by the Proposed Scheme. There are also numerous other lakes in the wider Colne Valley which would be unaffected and which would be available for wintering birds during construction. It was concluded that there would be no likely significant effects on the SPA. This conclusion was agreed with Natural England.
- 7.5.5 Vegetation clearance required for the construction of the viaduct in the western part of the Mid Colne Valley SSSI would lead to the loss of approximately 0.2ha of ancient semi-natural woodland from Ranston Covert and Battlesford Wood (7.5% of that within the SSSI). Ancient woodland is irreplaceable in the timeframe of the Proposed Scheme.
- 7.5.6 HS2 Ltd would mitigate for the effects on woodland by providing approximately 15ha of new woodland and woodland edge habitat approximately 550m west of the SSSI. The planting would improve connectivity between Juniper Wood, Little Halings Wood and Great Halings Wood which are all ancient. It would include the translocation of soils, coppice stools and woodland herbs (including coralroot, a nationally scarce plant), from the SSSI in order to reduce the time for development of woodland of the greatest possible ecological value. While not fully replicating the (ancient) woodland lost, on maturation (at least 20 years) the large increase in woodland, including the translocation and appropriate management of the new habitat, would help to improve the ecological value of the local woodland resulting in a beneficial effect that would be significant at the district/borough level.
- 7.5.7 Construction within the SSSI would also involve loss or damage to the following habitats; which, due to the limited extent of habitat loss, are considered unlikely to be significant at more than the county/metropolitan level:
- The current design includes a pier in the existing channel, of the River Colne and so the river would be permanently diverted. This would be a temporary effect as it is assumed that the diversion would be designed as a natural channel, as noted above;
 - Approximately 0.4ha of open water (0.4% of that within the SSSI) would be permanently occupied by the viaduct's concrete piers; and
 - About 0.8ha of water margin vegetation including reed, sedge, willow scrub and wet alder woodland (approximately 10% of that within the SSSI) would be temporarily removed by the construction of the viaduct, of which the majority could be reinstated once the works are complete.
- 7.5.8 Further areas of open water and water margin vegetation would be shaded by the viaduct. This will be fully assessed in the formal ES.

- 7.5.9 Habitat loss in the SSSI would affect the woodland and wetland breeding bird assemblage for which the SSSI is designated. The number of breeding territories of these species will be confirmed by further surveys in 2013. Approximately 80% of woodland and a greater proportion of most wetland habitats would remain during the four year construction period. Mitigation for woodland loss described above would provide a greater area of breeding habitat than that lost.
- 7.5.10 During the construction of the viaduct wintering birds would be disturbed by noise, vibration, light and increased human disturbance. The main areas affected would be Korda Lake and Harefield Moor Lake that would be within the footprint of the Proposed Scheme; and the south west corner of Broadwater Lake, that would be adjacent to the Proposed Scheme. Large areas of undisturbed open water at Broadwater Lake would remain for wintering water birds to use and there are numerous lakes in the wider Colne Valley which would be unaffected and would be available for wintering birds during construction.
- 7.5.11 There is also potential for disturbance of breeding woodland birds, particularly as a significant proportion of woodland habitat in the western part of the SSSI would be disturbed by construction activities. However, effects would be temporary for approximately 3 years.
- 7.5.12 Common tern nests on artificial islands in the south-western part of Broadwater Lake within 300m of the Proposed Scheme, but there is intervening open water and they are unlikely to be frequently disturbed during construction.
- 7.5.13 Therefore, disturbance would be unlikely to affect the viability of breeding and wintering bird populations in the SSSI.
- 7.5.14 Piling for the construction of the viaduct piers could potentially have adverse effects on water quality and quantity, and hence the work would need to be done sensitively. Mitigation would be provided at source by careful selection of piling techniques. Thus, significant adverse effects on water quality and availability are not predicted (see Section 13).
- 7.5.15 Construction activities would therefore have the greatest effect on the Mid Colne Valley SSSI in respect of woodland habitats and breeding birds. Overall, as a consequence of the habitat loss and the disturbance anticipated there would be a temporary adverse effect on site integrity that would be significant at the county/metropolitan level until habitats provided for mitigation have established (anticipated to be at least 20 years).
- 7.5.16 In addition to the vegetation clearance described for the SSSI, a further 12.1ha of vegetation would be removed from the Mid Colne Valley SMI. This would represent approximately 4% of this SMI's area (including Denham Country Park LNR and the Frays Valley LNR, which are both within the SMI) as follows:
- Approximately 0.5 ha of open water (excluding that described above) would be permanently occupied by the viaduct's concrete piers;
 - Approximately 1.8ha of water margin vegetation would be permanently occupied or shaded by the viaduct; and
 - Approximately 4.2ha of broad-leaved and wet woodland (of which none is ancient) would be lost, largely from within the LNRs, for the current proposed realignment of National Grid power lines. Woodland loss would be permanent as ground beneath power supply cables would be kept clear of woody vegetation. However, it would be quickly colonised (in approximately three years) by rough grassland and ruderal vegetation that would reduce habitat fragmentation and provide foraging opportunities for bats and birds.
- 7.5.17 Habitat clearance would reduce habitat available for woodland breeding birds, but for many species this would be a largely temporary effect of between 5 and 10 years, as vegetation

beneath the power cable corridors and the development of scrub along their margins would provide alternative nesting habitat.

- 7.5.18 The construction of the viaduct over Savay Lake would disturb wintering wetland birds. The effects would be temporary for approximately three years and affect a more limited assemblage and smaller populations of birds than is present in the SSSI. Measures to reduce disturbance described in Section 7.5.4 above would further limit adverse effects on wintering birds.
- 7.5.19 The main effect on the Mid Colne Valley SMI (excluding effects on the Mid Colne Valley SSSI described above) would arise from woodland clearance for proposed realignment of National Grid power lines. Due to the limited extent of clearance and because ancient woodland, which is present elsewhere in the SMI, would not be affected, adverse effects on the integrity of the SMI would be significant at a district/borough level³⁸.
- 7.5.20 In the western part of the Mid Colne Valley SSSI, the Proposed Scheme would fragment woodland that is a movement corridor for Daubenton's bats. Loss of habitat connections would be a temporary effect as vegetation of sufficient height to provide a flight line for bats would re-establish in less than 10 years. However, construction work would last for approximately three years, which is a sufficient period to affect the viability of bat roosts and would have a temporary effect on conservation status that would be significant at up to the county/metropolitan level.
- 7.5.21 At least four Daubenton's bat roosts would be removed. HS2 Ltd. would provide alternative roost structures in sufficient numbers and in suitable locations to replace roost loss. Given that the existing roosts are in bat boxes, rather than tree cavities, there would be no long term adverse effects, and effects on conservation status of bats would be neutral.
- 7.5.22 Undisturbed areas would be provided close to the River Colne and the western edge of Broadwater Lake to enable otter to continue to move along the river corridor during the construction period. There would be no adverse effects on their conservation status.
- 7.5.23 Although they form part of the baseline due to their proximity to the Proposed Scheme, there would not be any adverse effects on the following sites of importance for nature conservation: Frays Farm Meadows SSSI, Northmoor Hill Wood and Wyatts Covert LWS/LNR, Great Halings Wood LWS, Juniper Wood BNS, Nightingale Wood BNS and London's Canals SMI.
- 7.5.24 A summary is provided in Table 7. Local/parish effects which in combination may be significant will be described in the formal ES.

Likely residual significant effects

- 7.5.25 Taking into account mitigation included in the design of the Proposed Scheme, anticipated significant residual ecological effects during construction are detailed in Table 7.

³⁸ Denham Country Park LNR and the Frays Valley LNR (of district/borough value) are within and subject to similar effects to the Mid Colne Valley SMI (of county/metropolitan value) and therefore are not assessed separately.

Resource/Receptor	Residual effect	Level at which the effect would be significant
Mid Colne Valley SSSI	Permanent adverse effect due loss of 0.2ha of ancient woodland. Temporary adverse effects, as a consequence of: <ul style="list-style-type: none"> • Temporary loss of habitat while replacement habitat matures; • Potential shading of open water and marginal habitats during construction; and • Temporary disturbance of breeding and wintering birds by noise, vibration, light and increased human disturbance. 	County/ metropolitan
	Permanent beneficial effect as a consequence of planting 15ha of broad leaved woodland to mitigate losses (shared with the mitigation for Mid Colne Valley SMI).	Up to district/ borough
Bats	Temporary adverse effect on conservation status due to fragmentation of movement corridors affecting large numbers of Daubenton's bats.	County/ metropolitan
Mid Colne Valley SMI (including Denham Country Park and Frays Valley LNRs)	Temporary adverse effect due to habitat loss (about 12.1ha of woodland, scrub and water margin vegetation) until mitigation planting matures and temporary disturbance of birds.	District/borough

Table 7: Significant residual construction effects on ecological receptors within this section of the route

Further mitigation

- 7.5.26 Further measures currently being considered but which are not yet part of the design include:
- In addition to the habitat creation described above, further options to mitigate the loss of broad-leaved woodland and wetland habitats in the Mid Colne Valley SSSI and SMI;
 - Mitigation for loss and disturbance of breeding bird habitat in the SSSI and SMI could include provision of birds nest boxes in woodland and nest rafts for common terns in the south east corner of Broadwater Lake;
 - HS2 Ltd will consider additional measures to further reduce disturbance of birds during the construction period; and
 - Mitigation to reduce the effects of habitat fragmentation on bats includes phasing of vegetation clearance and providing temporary movement corridors during construction.

7.6 Operation

Assessment of impacts and mitigation

- 7.6.1 The following section considers the potential effects on ecological receptors during operation of the Proposed Scheme. Assessments made are provisional, based on the preliminary assessments of baseline value presented in Section 7.4 of this report.
- 7.6.2 The following measure has been included as part of the design of the Proposed Scheme and avoid or reduce impacts on features of ecological value:
- Barriers along the Proposed Scheme where it passes close to retained woodland in the Mid Colne Valley SSSI, reducing noise and visual disturbance to sensitive woodland species.
- 7.6.3 The operational phase would not have adverse effects on birds as they would become habituated to the presence of trains. Vantage point surveys to date have not recorded uncommon species or significant numbers of geese and swans that would be at greatest risk of collision with the overhead line equipment. Ducks more readily avoid obstacles and are less likely to be at risk of collision.

- 7.6.4 Noctule bats commonly fly at a height of 10-40m and would therefore be potentially susceptible to collision with trains on the viaduct and may also be affected by the turbulence produced by passing trains. Loss of individuals is considered unlikely to result in a permanent adverse effect that is significant at more than the local/parish level. Further survey data will be collected during 2013 to inform the formal ES.

Likely residual significant effects

- 7.6.5 No residual effects at more than local/parish level would be anticipated.

8 Land quality

8.1 Introduction

- 8.1.1 This section provides a summary of the likely impacts and significant effects to land quality and geology as a result of the construction and operation of the Proposed Scheme.
- 8.1.2 Areas of land have been identified, both within and adjacent to construction areas, that could affect or be affected by the construction of the route because they are contaminated (for example contaminated soils may need to be removed or the construction may alter existing contamination pathways). Each of these areas has been studied in order to determine the scale of any potential impacts caused by existing contamination 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 would lead to contamination of its surroundings and what needs to be done to prevent such contamination. This process is known as a contamination risk assessment.

8.2 Policy framework

- 8.2.1 Policy 7.20 of the London Plan: Spatial Development Strategy for Greater London (2011) seeks to ensure that development proposals should, wherever possible, make a positive contribution to the protection and enhancement of geodiversity. Policy 5.21 supports the remediation of contaminated sites.
- 8.2.2 A number of local policies seek to preserve and enhance the boroughs' and districts' land quality including strategic objective SO5 of the Hillingdon Local Plan: Part 1 (2012) and Saved Policy C15 of the Buckinghamshire Local Plan (2007) seek to safeguard areas of geological importance. Policies EM7, EM8 and EM9 of the Hillingdon Local Plan: Part 1 (2012) and Saved UDP Policies OL21 and 22 of Hillingdon Local Plan: Part 2 (2007) include further specific provisions.

8.3 Assessment scope and key assumptions

- 8.3.1 The assessment scope and key assumptions for the land quality assessment are set out in Volume 1.
- 8.3.2 Engagement has been undertaken with LBH and Three Rivers, South Buckinghamshire and Chiltern District Councils regarding land contamination; and Greater London Authority, Hertfordshire and Buckinghamshire County Councils with regards to mineral policy.
- 8.3.3 There are no topic specific assumptions within this study area.

8.4 Environmental baseline

Geology

- 8.4.1 Geological mapping does not show any areas of significant made ground in this route section³⁹. However, historical mapping shows infilled ground located at former gravel pits south of Moorhall Road, 200m north of the Proposed Scheme and to the east of Tilehouse Lane, 55m east of the Proposed Scheme in this area. A cover of made ground may also be present in built up areas of this route section as a result of previous cycles of development in the study area.

³⁹ Made ground is a term given to any man-made or artificial deposits. It may be derived from a variety of materials including entirely natural products such as quarried stone, sand, gravel or clay or from the residues of industrial processes (such as ash or clinker) or a mixture of materials. It is frequently used interchangeably with the term 'fill'.

- 8.4.2 Superficial deposits, where present, consist of River Alluvium; mainly clay, peat, silt, sand and gravel associated with the River Colne and Shepperton Gravel exposed by workings to the north and south of the Proposed Scheme in the central section of the study area, around Broadwater Lake⁴⁰.
- 8.4.3 The first 150m at the southern end of this route section is underlain by the clay, silt and sand deposits of the Lambeth Group. To the south of the Proposed Scheme in this area, the study area is underlain by London Clay from the Thames Group. The remainder of the Proposed Scheme and study area is underlain by chalk.

Groundwater and surface water

- 8.4.4 The Chalk bedrock has been designated as a Principal Aquifer, and the Lambeth Group has been designated as a Secondary A Aquifer by the Environment Agency (EA). The Thames Group, including the London Clay, has been designated as unproductive strata. Where drift deposits are present at the surface these are designated as Secondary A Aquifers.
- 8.4.5 The entire route section would be within a Source Protection Zone (SPZ). The majority of the Proposed Scheme would cross a Zone 1 Inner Protection Zone (SPZ₁), although there are three smaller sections that would cross through a Zone 2 Outer Protection Zone (SPZ₂), as shown in map CT-04-06.
- 8.4.6 A search for groundwater and surface water abstractions in the study area confirmed that there are:
- 11 licensed groundwater abstractions, both up and down gradient of the Proposed Scheme;
 - Four major Public Water Supply (PWS) groundwater abstractions and associated SPZs up gradient and within 1km of the Proposed Scheme;
 - One private groundwater abstraction to the north of the De Vere Hotel, Denham Grove, where the Proposed Scheme would pass through the 50 day travel time zone; and
 - One surface water abstraction point within 1km of the Proposed Scheme, from the River Colne.
- 8.4.7 An area of groundwater contamination from a closed landfill has been reported north of the Proposed Scheme, beyond the junction of Harvil Road and New Years Green Lane.
- 8.4.8 The route would cross the River Colne and the Grand Union Canal. There are also a number of lakes that have been formed in some of the disused gravel pits in this area and make up the Broadwater Lake Nature Reserve, part of the Mid Colne Valley SSSI.
- 8.4.9 Groundwater and surface water resources are discussed in more detail in Section 13, Water resources and flood risk assessment.

Current and historic land use

- 8.4.10 The higher risk sites (both historic and current land uses) identified by the assessment are shown on maps CT-03-09 to CT-03-12⁴¹.
- 8.4.11 The main areas of potential contamination include activities related to historic gravel and chalk extraction and infilling along the length of this route section. There are small historical landfills, mainly based around areas of previous extraction, to the north of Denham Green,

⁴⁰ Superficial deposit is a term given to a geological deposit or formation that was laid down during the Quaternary period (within the previous 2,600,000 years). Such deposits were largely formed by fluvial (river) and glacial or periglacial processes including wind-blown deposits known as loess.

⁴¹ The definition of 'higher risk' sites in this instance relates to the contamination potential of the source, the type of construction works that are proposed at that location (e.g. tunnel, cutting or embankment) and the proximity of receptors (e.g. people, groundwater bodies etc.).

and three at the southern end (land off Harvil Road (see map CT-03-10), Harefield Marina (see map CT-03-10) and Dews Farm (see map CT-03-10)). Of these, the three immediately to the north of Tilehouse Lane and one at the northern end of this route section are recorded as 'Pynesfield Farm' landfill. The most northern of these is thought to have received industrial, commercial and special waste in 1968 and two are recorded as receiving inert, industrial and special waste in 1975 and 1978⁴². Harefield Marina is recorded as receiving inert, industrial, commercial and household waste in 1947. No further information is available about the landfills.

- 8.4.12 A historic quarry was located at Northmoor Hill (see map CT-03-10) but there are no available details about whether it was infilled. Former landfill sites may emit landfill gasses such as carbon dioxide or methane. Other relevant industrial activities include a former sewage works at Denham Green (see map CT-03-10), an oil depot and the existing Marylebone to Aylesbury Line all at the southern end of this route section. Contaminants commonly associated with these various industrial activities could include metals, semi -metals, organic and inorganic chemicals and asbestos.
- 8.4.13 Geological characteristics that could offer a pathway for the movement of any contaminants mobilised by the construction of the route include the high permeability of the alluvium, Shepperton Gravel and Chalk. Where present towards the south, London Clay is likely to provide an effective barrier to vertical contaminant migration.
- 8.4.14 In rural areas, where land use is primarily agricultural and has not changed significantly over the years, historical activities which might give rise to potential land contamination are likely to be localised and are largely unrecorded.

Mining/mineral resources

- 8.4.15 In LBH, a current permitted mineral working is located at Boyer Pit (see map CT-03-10) to the east of Denham Green on Moorhall Road. However, in 2006 the site was known to be inoperative and current mapping shows the area to be water filled and therefore not currently operating⁴³. This will be checked when access is available.
- 8.4.16 A historical quarry was located at Northmoor Hill that has exposures of the Chalk and Reading Beds.
- 8.4.17 Denham Park Farm, located between the M25 and the Buckinghamshire/Hertfordshire County Boundary currently has planning permission for the excavation of sand and gravel, and eventual backfilling, and has been designated as a Preferred Mineral Site by Buckinghamshire County Council. The permission includes the construction of an access road from the A412.
- 8.4.18 The section of the route that passes through Hertfordshire is located within a sand and gravel belt and is therefore within a Mineral Consultation Area for sand and gravel as designated by Hertfordshire County Council.
- 8.4.19 The route section within the boundary of Buckinghamshire County Council is within a Mineral Consultation Area and Minerals Safeguarding Area (MSA) designated by Buckinghamshire County Council for sand and gravel resources. The full extent of MSAs is not shown on the drawings but specific mineral sites which are permitted or have applications in process are shown.

Geo-conservation resources

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

⁴² Special waste is any waste with hazardous properties which may render it harmful to human health or the environment.

⁴³ Jacobs (2008) *London Borough of Hillingdon Local Development Framework, Background Technical Report: Minerals*.

Receptors

8.4.21 Contaminated land has the potential to affect a range of receptors if exposure to the contaminants occurs. The following potential receptors within the study area have been identified:

- People living or working on or adjacent to the route;
- Mineral resources of sand and gravel;
- Principal and secondary bedrock aquifers of the Chalk or Lambeth Group, secondary aquifers of the superficial deposits;
- The Grand Union Canal and the River Colne;
- Ecological resources; and
- The built environment.

8.5 Construction

Land contamination

Assessment of impacts and mitigation

8.5.1 This section of the route would start on embankment and run rapidly on to the approximately 3.3km viaduct across the Colne Valley. The route would then pass into cutting going below Tilehouse Lane, and then run on to an embankment approaching the Chiltern tunnel portal. There would be an auto-transformer station located at Harvil Road and at West Hyde. There would be two main construction site compounds at the Chiltern tunnel southern portal and the main viaduct construction site, south of the A412 at West Hyde, which would be used for activities including materials storage, precast works, concrete batching plant and a slurry plant. In addition, there would be seven satellite construction site compounds.

8.5.2 The draft CoCP sets out the measures and standards of work that would be applied to the construction of the Proposed Scheme. Its requirements would involve detailed ground investigations in order to confirm the full extent of areas of contaminated land. Measures would include:

- Methods to control waste, dust and vapours;
- Methods to control spillage and prevent contamination of adjacent areas; and
- Methods for the management of unexpected contamination.

8.5.3 The CoCP requires that a programme of ground investigation would take place prior to construction in order to confirm areas of contamination; and a risk assessment would be undertaken to determine what, if any, site specific remediation measures would be required to allow the Proposed Scheme to be constructed safely and to prevent harmful future migration of contaminants. Any remediation scheme would be agreed with the regulatory authorities.

8.5.4 Where sites are located beneath the viaduct there would be relatively limited potential for disturbance of soils. However, there would be substantial piling associated with the viaduct supports, which has the potential to disturb contaminated soils and create new pathways, particularly at the former sewage works at Denham Green located directly beneath the viaduct where historical sewage sludge deposits and associated organic and inorganic contamination may exist. Piling methods would need to take account of the potential to encounter contaminated land and be designed accordingly. Sites located outside the footprint of the viaduct, such as the oil depot and infilled quarries, but in landscape mitigation areas are unlikely to be disturbed and impacts would be limited.

- 8.5.5 The southern portal to the Chiltern tunnel would lie at the western end of this section of the Proposed Scheme where the route would run below ground level, as it passes into the Chalfonts and Amersham area. Consequently, it is unlikely there would be any impact in the Colne Valley study area from the landfill lying at Warren Farm in the Chalfonts and Amersham area (see map CT-03-012).
- 8.5.6 Contaminated soils excavated from the site, wherever feasible, would be treated as necessary to remove or render any contamination inactive, and would be reused within the Proposed Scheme where needed and suitable for use. Techniques would be likely to include stabilisation methods, soil washing and bioremediation to remove oil contaminants. Contaminated soil disposed off-site would be taken to a soil treatment facility, another construction site (for treatment, as necessary, and reuse) or an appropriately permitted landfill site.
- 8.5.7 For the majority of receptors, the construction phase would be expected to have no significant effect. However, for the former sewage works at Denham Green, beneath the viaduct, a minor short term adverse effect would be anticipated during the construction phase due to the potential mobilisation of contaminants that could occur. A disused gravel and chalk pit, immediately north of Tilehouse Lane is located partly within an area of ground treatment and construction works in this area would have the potential to cause mobilisation of contaminants resulting in a minor short term adverse effect. The short term effects are not considered to be significant.
- 8.5.8 Whilst the construction compounds would store and use potentially contaminative materials such as fuels, oils and solvents, these would be managed in accordance with the CoCP, thus minimising the impacts of contamination from these sources.
- 8.5.9 It is considered unlikely that additional remediation works would be required over and above the mitigation measures contained as standard within the CoCP.

Likely residual significant effects

- 8.5.10 It is not anticipated that construction effects would be significant or that any remediation would need to be carried out. However, in the event that unexpected contamination is encountered during the construction of the route in this area, this would be remediated as described in the draft CoCP and would result in an overall beneficial effect.

Mining/mineral resources

Assessment of impacts and mitigation

- 8.5.11 Parts of this area are located within a Mineral Consultation Area/Mineral Safeguarding Area for sand and gravel extraction, although these resources are not currently being worked in this area (see maps CT-03-10 and CT-03-11).
- 8.5.12 There are two outstanding planning permissions associated with this sand and gravel band located at Denham Park Farm and Moorhall Road. Denham Park Farm extraction has not yet commenced but must begin before August 2014, while extraction at Moorhall Road (Boyer Pit) appears to have been completed as the quarry is presently waterlogged. However, it has not been possible to confirm this status with the London Borough of Hillingdon. It is considered that the Proposed Scheme would have a minor impact on these mineral resources resulting in a minor adverse effect unless the resources are excavated prior to, or as part of the construction process.
- 8.5.13 The Proposed Scheme would be located in an area of proposed landscape mitigation that would cover parts of the area, particularly on the eastern side of the proposed quarry area at Denham Park Farm. Depending on the timescales this could result in a sterilisation of the

resource, which would be a negative impact and a significant effect in the context of this assessment. In addition, the placement of landscaping materials over the resource would increase future costs of extraction, thus reducing its value. However the excavation of the resource, followed by landscape mitigation, would remove the significance of this effect.

Likely residual significant effects

- 8.5.14 If the resource is not exploited before construction and hence sterilised, a significant negative residual effect would occur. The excavation of the resource, followed by landscape mitigation, would remove the significance of this effect.

Further mitigation

- 8.5.15 If the resource were to be excavated before construction begins, no significant residual effects would be identified and no further mitigation required. If the resource is sterilised, then no further mitigation is practicable.

- 8.5.16 Geo-conservation resources

Assessment of impacts and mitigation

- 8.5.17 There is potential for important geology to be exposed through construction and an opportunity for academic study could be of interest to academic groups, geological institutions and local enthusiasts.

Likely residual significant effects

- 8.5.18 No residual effects have been identified at this time.

8.6 Operation

Assessment of impacts and mitigation

- 8.6.1 Maintenance and operation of the railway would be in accordance with environmental legislation and best practice. Spillage and pollution response procedures similar to those outlined in the draft CoCP would be established for all high risk activities and employees would be trained in responding to such incidents.
- 8.6.2 An auto-transformer station would be located at West Hyde and an auto-transformer feeder station at Harvil Road and a National Grid feeder station on Harefield Moor. Such installations can, in principle, be a source of contamination through accidental discharge or leaks of coolants. However, the proposed substations, in common with other modern substations, would use secondary containment appropriate to the level of risk.
- 8.6.3 There exists the potential of minor leakage of hydraulic or lubricating oils from the trains. However, such leakage or spillage is expected to be very small and would not lead to any significant contamination.
- 8.6.4 Where contamination remediation works have been carried out during the construction period, there may need to be a requirement to undertake post-remediation monitoring of, for example, groundwater.

Likely residual significant effects

- 8.6.5 Residual pollution associated with the operation of the Proposed Scheme is not considered to be significant.

9 Landscape and visual assessment

9.1 Introduction

9.1.1 This section of the report presents the assessment of the likely significant landscape and visual effects. It starts by describing the current conditions found within and around the route of the Proposed Scheme, the nature and pattern of buildings, streets, open space and vegetation and their interrelationships within the rural and urban environment. A summary of the significant effects that would arise from the construction and operation on landscape character areas and visual receptors is provided.

9.2 Policy framework

9.2.1 The London Plan: Spatial Development Strategy for Greater London (2011) Policy 7.2 states that all new development should achieve the highest standards of accessible and inclusive design. Policy 7.4 states that development should respect local character and provide a high quality design response (and sets out various factors that contribute to this). Policy 7.6 highlights a variety of aspects that should be taken into account in the design of new buildings and structures.

9.2.2 A number of local policies also seek to conserve and enhance the borough's/district's landscape quality including to:

- Maintain the strategic functions of the green belt and the condition and use of open land (Policy EM2 of the Hillingdon Local Plan: Part 1 (2012) and Saved UDP Policy OL9 in the Hillingdon Local Plan: Part 2 (2007));
- Ensure that development is appropriate to the context of townscapes, landscapes and views and protects the built historic environment (Policy BE1 of the Hillingdon Local Plan (2012) and Core Policies 8 and 9 of the South Buckinghamshire Core Strategy (2011)); and
- Retain topographical and landscape features (Saved Policies BE38 and OL26 of the Hillingdon Local Plan: Part 2; and Policy L4 of the South Buckinghamshire Local Plan (Saved Policies, 2007)).

9.2.3 The emerging policy baseline will be available as part of the formal ES.

9.2.4 In addition, the following local and regional guidance documents are relevant and have informed the assessment:

- London View Management Framework (2012)⁴⁴;
- Green Infrastructure and Open Environments: All London Green Grid (2012)⁴⁵;
- National Character Areas (2005)⁴⁶;
- The London Regional Landscape Framework (2011)⁴⁷; and
- Tranquillity Mapping (2000)⁴⁸.

⁴⁴ Mayor of London (2012) *London View Management framework*. Greater London Authority.

⁴⁵ Mayor of London (2012) *Green infrastructure and open environments: The all London green grid*. Greater London Authority.

⁴⁶ Countryside Commission (1998) *Countryside character, South East and London national character areas*. Countryside Agency.

⁴⁷ Natural England (2011) *London's Natural Signature, The London Landscape Framework*.

⁴⁸ Jackson, S., et al. (2008) *Tranquillity Mapping: developing a robust methodology for planning support*. Report to the Campaign to Protect Rural England, Centre for Environmental & Spatial Analysis, Northumbria University, Bluespace environments and the University of Newcastle upon Tyne.

9.3 Assessment scope and key assumptions

- 9.3.1 The assessment scope and key assumptions for the landscape and visual assessment are set out in Volume 1.
- 9.3.2 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 Three Rivers District Council, South Buckinghamshire District Council, Chiltern District Council, Chilterns Conservation Board, Natural England and the London Borough of Hillingdon. Field surveys were undertaken from June to August 2012 and from December 2012 to March 2013, including photographic studies of LCAs and visual assessment of viewpoints. Further surveys will be undertaken during 2013 and reported in the formal ES.
- 9.3.3 The study area has been informed by early drafts of the zone of theoretical visibility (ZTV), which is being prepared for inclusion in the formal ES. LCAs and visual receptors within approximately 1km of the Proposed Scheme have been assessed. Long distance views of up to 1.5km have been considered at locations such as Mount Pleasant west of Harefield and the nearby PRoW. The study area extends beyond all land required for the Proposed Scheme.
- 9.3.4 HS2 Ltd is continuing to work with National Grid on proposals to divert the overhead power lines in the Colne Valley area. At this stage there is relatively limited detail on the realignment of the overhead power lines. Map CT-05-019 shows the current understanding and this would have potential impacts on landscape and visual receptors.

9.4 Environmental baseline

- 9.4.1 The following section sets out the baseline conditions for the landscape and visual assessment in the study area. Maps LV-11-09 to LV-11-12 show the location of landscape character areas and visual receptor viewpoints.
- 9.4.2 The settlement pattern in the Colne Valley is relatively sparse, although the valley is more densely developed to the south. The corridors of open space that follow the River Colne, Grand Union Canal and the lakes that these waterways support are dominant landscape features. There is concentrated residential and industrial development around Uxbridge. The Marylebone to Aylesbury Line spans the Colne Valley and has a distinctive influence upon settlements along its route. The M25 corridor is a major urban feature within the landscape. A number of conservation areas, registered parks and gardens and listed buildings are located within the area. The vegetation patterns within the area comprise woodland, scrub and meadow within green spaces, trees and shrubs within river corridors and small woodlands. Farmland is also present within the Colne Valley area.

Landscape character assessment

- 9.4.3 Landscape character areas (LCAs) are defined as areas with broadly homogenous characteristics and are influenced by national and district published character assessments. The Proposed Scheme in this area is located within national character areas (NCA) 115: Thames Valley as defined by the Character of England mapping and Natural England⁴⁹.
- 9.4.4 For the purposes of this assessment the study area has been sub-divided into seven discrete LCAs, six of which would be significantly affected. Harefield Farmland LCA which is largely pasture with areas of woodland; River Colne Valley LCA, consisting of a series of lakes; the Colne Valley LCA, an area of small arable fields and woodland blocks with a high sensitivity to change; Colne Valley Gravel Pits LCA, dominated by water bodies created from restored

⁴⁹ Natural England (1996); *The Character of England 1996*; <http://www.naturalengland.org.uk/publications/nca/default.aspx>. Accessed 8 January 2013.

mineral workings; Maple Cross Slopes LCA, a series of dry valleys and large arable fields; and Chalfont St Peter LCA, a largely wooded area at the edge of the Colne Valley. All have a medium sensitivity to change.

Visual baseline

9.4.5 The visual baseline has been considered in terms of representative viewpoints to capture the range of residential, recreational, transport and employment receptors within the study area. There are a number of key receptors with a high sensitivity to change. This is particularly the case for receptors in close proximity to the line of the proposed Colne Valley viaduct. Receptors in this area include recreational users of the Grand Union Canal PRoW and other local public rights of way, as well as users of the Canal and Hillingdon Outdoor Activities Centre. Additional receptors include residential properties and PRoW located along the perimeter of the settlements of South Harefield and Harefield which afford views across the Colne Valley. Residential properties and PRoW around Maple Cross also have a high sensitivity to change, despite the presence of the M25. Receptors with a lower sensitivity to change focus upon those in the area of Harvil Road and Moorhall Road, where other development or transport infrastructure reduces the sensitivity to change.

9.5 Construction

Assessment of impacts and mitigation

9.5.1 Due to the scale of the construction activities, works would be highly visible in many locations and would have the potential to give rise to significant effects which cannot be mitigated. This is commonplace with construction of major infrastructure projects, but it should be noted that these effects are temporary in nature and relate to the peak construction phase. Effects during other phases of works are likely to be less due to less construction equipment being required at the time and a reduced intensity of construction activity.

9.5.2 Measures that have been incorporated into the draft CoCP to avoid or reduce landscape and visual effects during construction include:

- Maximising the retention and protection of existing trees and vegetation where reasonably practicable;
- Use of well-maintained hoardings and fencing;
- Replacement of any trees intended to be retained which may be accidentally felled or die as a consequence of construction works;
- Early implementation of planting and other landscape measures where there is no conflict with construction activities or other requirements of the Proposed Scheme; and
- Appropriate maintenance of planting and seeding works and implementation of management measures, to continue through the construction period as landscape works are completed.

9.5.3 These measures have been included as part of the design of the Proposed Scheme in the assessment of the construction effects in this section.

Landscape assessment

9.5.4 The key changes to character as a result of the construction activities, relate to the presence of construction plant (for example, 30m high cranes), and the demolition of prominent buildings and structures. Areas of vegetation along waterways and transport corridors would be removed to accommodate the Proposed Scheme, namely along the Grand Union Canal where the route traverses the water body on viaduct. The removal of the existing pylons and

construction of the proposed power line diversion would require large areas of vegetation to be removed in this area and the adjacent South Ruislip to Ickenham area. A 50m-wide easement strip either side of the line and a substantial construction site would be required. To the south of South Harefield, a substantial area would be used as a construction site for the overhead power line diversion. The introduction of large construction plant and substantial earthworks on the southern side of the M25 road corridor would discernibly alter the tranquillity of the local landscape.

9.5.5 Table 8 summarises the LCAs that would be significantly affected during construction of the Proposed Scheme.

LCA	Sensitivity of LCA	Magnitude of change	Level of effect to LCA
Harefield Farmland LCA Construction resulting in loss of woodland, severance of agricultural land and construction activity associated with the viaduct, auto-transformer and overhead power lines and pylons.	High	High	Major Adverse
River Colne Valley LCA Construction resulting in loss of lakeside vegetation and activity associated with the proposed Colne Valley viaduct.	High	High	Major adverse
Colne Valley LCA Construction activity resulting in loss of woodland vegetation, viaduct construction including the north embankment and diversion of the River Colne.	High	Medium	Moderate adverse
Colne Valley Gravel Pits LCA Construction activity taking place in the adjacent LCAs including the large scale M25 construction site utilised for the Chiltern tunnel.	Medium	Medium	Moderate adverse
Maple Cross Slopes LCA Construction resulting in severance of agricultural land and large scale construction activity of the Chiltern tunnel construction site.	Medium	High	Major adverse
Chalfont St Peter LCA Construction activity taking place in the adjacent LCAs including the large scale M25 construction site used for construction of the Chiltern tunnel.	Medium	High	Major adverse

Table 8: Significant landscape effects during construction

Visual assessment

- 9.5.6 There would be no perceptible views from receptors to the north side of Harefield because of the undulating topography and intervening buildings. There would also be no perceivable views from the south west side of Ickenham within the Colne Valley, due to intervening water body vegetation which would screen views of the proposed viaduct construction activity.
- 9.5.7 Visual receptors including residential properties, recreational users and transport corridors would have views towards construction activities associated with the Proposed Scheme. Cranes would be perceptible at long distances of up to 1km, with other machinery and plant visible from short to middle distances, where not screened by intervening landform or mature vegetation.
- 9.5.8 The construction of the viaduct across the Colne Valley would be a particularly dominant activity within the view, as would the earthworks east of the M25 close to Maple Cross. In

order to accommodate the viaduct, works to the existing overhead power lines pylons would be required.

- 9.5.9 The removal of the existing pylons and construction of the new pylons would result in the removal of substantial areas of vegetation and a new visual feature. To the east of Harvil Road up to Breakspear Road within Ickenham and South Ruislip (CFA 6), a large proportion of the land would be used as construction site compounds including segment casting and storage for excavated material. To the south of South Harefield there is a substantial area to be used as the overhead power line diversion construction site.
- 9.5.10 An assessment of effects arising from lighting during construction (where required) will be prepared and included as part of the formal ES.
- 9.5.11 The views that would be significantly affected by the construction of the Proposed Scheme are summarised in Table 9. The numbers in brackets identify the viewpoint locations which are shown on maps LV-11-09 to LV-11-12. The assessed level of effect is considered to be the maximum level at the height of construction activity in the view at each location. The duration of this effect would in most instances be less than the entire construction period and will be considered in the formal ES. An indicative construction programme is set out in section 2.3.

Viewpoint	Sensitivity of visual receptors	Magnitude of change	Level of effect to visual receptors
Residential receptors			
Views north from residences on Harvil Road, Ickenham (049.2.002). Middle-ground views of construction activity within the Ruislip construction site.	High	Medium	Moderate adverse
Views south-west from residences on Harvil Road (052.2.004). Middle-ground views of large construction site and associated plant.	Medium	High	Major adverse
Views north from residences on Savay Lane, Denham Green (053.2.001). Background views of viaduct construction including cranes.	High	Medium	Moderate adverse
Views south from the south perimeter of Harefield (054.02.004). Middle-ground views of construction activity associated with the Colne Valley viaduct including loss of lakeside vegetation.	High	High	Major adverse
Views from dwellings looking south from residences on St Mary's Road (056.2.002). Background views of loss of vegetation and construction activity associated with the Colne Valley viaduct.	High	Medium	Moderate adverse
Views from residences on Merle Avenue, South Harefield (056.2.003). Background filtered views of the loss of vegetation and construction activity associated with the Colne Valley viaduct.	High	Medium	Moderate adverse
Views north-east from residential properties and Denham Grove De Vere Hotel off Tilehouse Lane (057.2.003). Middle-ground filtered views through the hotel grounds vegetation to viaduct construction and vegetation clearance to accommodate the Heathrow spur site.	High	Medium	Moderate adverse
Views south from Broadwater Sailing Club and nearby residential properties (058.2.001). Filtered background views towards removed lakeside vegetation and the viaduct construction activity including cranes.	High	Medium	Moderate adverse

Viewpoint	Sensitivity of visual receptors	Magnitude of change	Level of effect to visual receptors
Views south from residential properties on Park Lane and the Orchard Public House (058.2.003 and 058.2.005). Middle-ground views of removed lakeside vegetation and construction activity associated with the Colne Valley viaduct and background views of the Chiltern tunnel construction site.	High	High	Major adverse
Views south-west from residential properties along Denham Way (058.2.006). Middle-ground filtered views towards the Chiltern tunnel construction site and the construction of Tilehouse Lane overbridge.	High	Medium	Moderate adverse
Views south from residences on Chalfont Lane (060.2.001). Foreground views of the Chiltern tunnel site compound and associated construction traffic. Views of the northern approach embankment of the viaduct.	High	High	Major adverse
Views south- west from residences on Old Uxbridge Road (060.2.003). Background views of Tilehouse Lane overbridge construction and the storage of excavated material.	High	High	Major adverse
Views south- west from residences on Hornhill Road (FP005) at the western edge of Maple Cross (062.2.001). Middle-ground views of the temporary M25 exit slip construction and background views of the Chiltern tunnel construction site including excavated material storage and associated plant.	High	High	Major adverse
Recreational receptors			
View west from footpath adjacent to Harvil Road (049.3.005). Middle-ground views of loss of vegetation associated with overhead power line diversion.	High	High	Major Adverse
View north along the Grand Union Canal Walk (051.3.002). Middle-ground views of cleared vegetation along the canal and construction activity associated with the Colne Valley viaduct.	High	High	Major adverse
View south from footpath at the northern edge of Hillingdon Outdoor Activities Centre (052.3.002). Middle-ground views across the lake to the Colne Valley viaduct construction including, positioning of jetties and plant and loss of vegetation.	High	High	Major adverse
Views north from the footpath within Uxbridge Golf Course (053.3.003). Middle-ground views of overhead power line diversion, plant and associated vegetation clearance.	High	Medium	Moderate adverse
View south from Colne Valley Trail (054.3.003). Middle-ground views of loss of canal side vegetation and associated viaduct construction activity including cranes.	High	High	Major adverse
View looking north from the footpath along Tilehouse Lane (055.3.002). Background views of viaduct construction activity including removal of vegetation and views of cranes.	High	Medium	Moderate adverse
View south-west from the London Loop Walk along the Grand Union Canal (056.3.001). Background views of the Colne Valley viaduct construction activity including views of cranes.	High	Medium	Moderate adverse
View east from Old Shire Lane, footpath DEN/2/1 (057.3.002). Middle-ground views of the Chiltern tunnel construction site, Tilehouse Lane over bridge and the Proposed Scheme in cutting construction.	High	High	Major adverse

Viewpoint	Sensitivity of visual receptors	Magnitude of change	Level of effect to visual receptors
View south-west from public open space near Mount Pleasant (058.3.004). Middle-ground views of cuttings and construction of the southern tunnel portal. Views of the viaduct construction and associated vegetation removal.	Medium	Medium	Moderate adverse
Views east and north from the Old Shire Lane footpath DEN/2/1 (059.3.002 and 059.3.003). Middle-ground views of construction activity associated with the Proposed Scheme in cutting and the tunnel portal.	High	High	Major adverse
View west from footpath BR004 close to Denham Way, North Orbital Road (060.3.002). Middle-ground views of the Tilehouse lane over bridge construction and cutting construction including earthworks.	Medium	High	Major adverse
Transport receptors			
View north from the Marylebone to Aylesbury Line (051.4.003). Middle-ground views of viaduct construction and associated vegetation clearance.	Medium	High	Moderate adverse
View south from Harvil Road (052.4.001). Middle-ground views of south viaduct embankment construction activity and associated woodland clearance.	Medium	Medium	Moderate adverse
View north from Moorhall Road (053.4.002). Middle-ground views of roadside vegetation clearance and viaduct construction across Moorhall Road.	Medium	High	Moderate adverse
View south west from Moorhall Road (054.4.001). Middle-ground views of roadside vegetation clearance and viaduct construction across Moorhall Road.	Medium	High	Moderate adverse
View looking east from Tilehouse Lane (057.4.001). Foreground views of northern approach embankment, the Proposed Scheme in cutting and Tilehouse Lane over bridge construction activity.	Medium	High	Major adverse

Table 9: Significant visual effects during construction

Likely residual significant effects

- 9.5.12 Due to the highly visible nature of the construction activities along the Proposed Scheme there would be significant residual effects as set out in Tables 9 and 10 above, although they would be temporary and reversible in nature, lasting only for the duration of the construction works. Residual effects would generally arise from the widespread visibility of construction activity and construction sites associated with the Colne Valley viaduct and the nearby M25 roadworks. Residual effects would be experienced by residential receptors, users of PRoW and travellers on roads throughout the study area.

9.6 Operation

Assessment of impacts and mitigation

- 9.6.1 The operational assessment of impacts and mitigation measures is based on the first year of opening of the Proposed Scheme (2026). 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:

- Reinstatement of severed lengths of hedge/enclosure of fields evident to the south side of the Proposed Scheme adjacent to the M25;
- Replacement of lost vegetation and woodland within the Colne Valley, around the perimeter of the affected water bodies;
- Introduction of screening through new planting where this fits into the existing landscape pattern required in particular adjacent to Denham Way and Chalfont Lane; and
- Integration of embankment landforms into the natural topography where Tilehouse Lane bridge spans the Proposed Route.

9.6.2 These measures have been included as part of the design of the Proposed Scheme and have been taken account of in the assessment of the operation effects.

Landscape assessment

9.6.3 Operation of Phase One would result in significant effects on five landscape character areas. Harefield Farmland LCA would be affected by the Proposed Scheme on embankment, in cutting and a short section of viaduct. The overhead power line diversion would be a prominent element within this LCA and the adjacent River Colne Valley LCA. The 50m-easement area cleared of vegetation either side of the overhead power line diversion would not have had the opportunity to re-establish itself in the first year of operation and would leave large gaps within the existing vegetation. A small section of the diversion would pass into the adjacent South Ruislip to Ickenham area.

9.6.4 Within the River Colne Valley LCA the overhead power line diversion and National Grid auto-transformer feeder station would be a significant new element within the landscape. The proposed 3.3km long viaduct would pass through the LCA spanning the various water bodies within the floor of the valley. Replacement planting would not have had opportunity to re-establish itself in the first year of operation. During operation the Colne Valley LCA would be directly affected in the northern part of the Character Area through the introduction of new elements such as the Colne Valley northern embankment approach and the Phase Two Heathrow Spur passive provision, together with the removal of substantial areas of woodland.

9.6.5 Within Maple Cross Slopes LCA, Tilehouse Lane overbridge and the 700m long cutting would be prominent within the landscape as the proposed planting would not have established by the first year of operation. The route would not directly pass through the Chalfont St Peter LCA. However, the route would be perceptible from the adjacent Maple Cross Slopes LCA as it runs across the landscape in cutting before travelling under the M25 in tunnel. Evidence of the Proposed Scheme would still be noticeable in the first year of operation, with areas of vegetation removal and replacement planting yet to re-establish. Changes in the local character to the south of the M25 would still be evident given the significant extent of earthworks and re-profiling in this area.

9.6.6 Table 10 summarises the LCAs that would be significantly affected by the Proposed Scheme in year one of operation (2026).

LCA	Sensitivity of LCA	Magnitude of change	Level of effect to LCA ⁵⁰
Harefield Farmland LCA – presence of the Proposed Scheme on viaduct and ATFS feeder station, severing areas of agricultural land.	High	Low	Moderate adverse
River Colne Valley LCA – presence of the Colne Valley viaduct spanning the Colne Valley water bodies.	High	High	Major adverse
Colne Valley LCA – presence of the Proposed Scheme on viaduct.	High	Medium	Moderate adverse
Maple Cross Slopes LCA – presence of the proposed Tilehouse Lane over bridge and the southern tunnel portal and associated buildings.	Medium	Medium	Moderate adverse
Chalfont St Peter LCA – the Proposed Scheme would be perceptible from the adjacent Maple Cross Slopes LCA including the Proposed Scheme in cutting, Tilehouse Lane over bridge and the southern tunnel portal. The Proposed Scheme viaduct, located in the adjacent Colne Valley LCA, would also be apparent.	Medium	Medium	Moderate adverse

Table 10: Significant landscape effects during operation year 1 (2026)

Visual assessment

- 9.6.7 Views of the Proposed Scheme would be limited by existing vegetation. The western edge of Ickenham, a suburban area centred on an old village, would not have views of the Proposed Scheme because of the dense intervening vegetation within Uxbridge Golf Course and along the Marylebone to Aylesbury Line embankment.
- 9.6.8 The residential receptors located at the north eastern edge of Denham village would have limited views due to a large amount of intervening woodland, particularly along the Marylebone to Aylesbury Line.
- 9.6.9 The residential properties at the southern edge of Rickmansworth, the northern edge of Higher Denham village and along Hill End Road to the northeast of Harefield village would have limited views due to screening by vegetation.
- 9.6.10 Within the Colne Valley north of Maple Cross village and the sewage works, receptors would not have views of the Proposed Scheme because of the intervening dense vegetation and built form.
- 9.6.11 Significant visual impacts are anticipated to arise at a number of viewpoint locations. Residential receptors along Harvil Road, the western edge of South Harefield, Harefield and at Maple Cross would be likely to receive the greatest change in view, resulting in significant adverse effects in the first year of operation during both summer and winter. The view would be slightly more open in winter months as intervening garden vegetation would be without leaf cover.
- 9.6.12 Many recreational users would experience a medium magnitude of change in views during the first winter and summer of the scheme's operation, resulting in moderate adverse effects. Users of transport corridors throughout the Colne Valley area would also experience a medium magnitude of change, resulting in moderate adverse effects, where views of the Proposed Scheme on viaduct or embankment would be available from local roads.
- 9.6.13 The main visible elements would be the viaduct and the introduction of the overhead power line diversion spanning the Proposed Scheme in a more visible location than its current location. There would be little difference in visual impact between winter and summer in the

⁵⁰ In year one of operation, any new planting along the Proposed Scheme would be immature and therefore not help to integrate the Proposed Scheme into the landscape. As the plants mature, screening of the Proposed Scheme would improve.

first year of operation as any mitigation planting would not yet have been able to establish an effective visual screen.

- 9.6.14 Photomontages have been produced illustrating the view of the Proposed Scheme during operation year 1 from viewpoint 051-3-002 on the Grand Union Canal Walk (figure LV-12-19), viewpoint 052-3-002 at the Hillingdon Outdoor Activities Centre (figure LV-12-20) and viewpoint 058-2-005 on Park Lane (figure LV-12-21).
- 9.6.15 The views from Park Lane (058-02-005) would not be significantly affected due to the integration of the Proposed Scheme into the landscape.
- 9.6.16 Table 11 summarises the visual receptors that would be significantly affected by the Proposed Scheme in year one of operation (2026). The numbers in brackets identify the viewpoint locations which are shown on maps LV-11-09 to LV-11-12.

Viewpoint	Sensitivity of visual receptor	Magnitude of change	Level of effect to visual receptors ⁵²
Residential receptors			
Views south-west from residences on Merle Avenue (056.2.003). Middle-ground visibility of the Proposed Scheme on viaduct.	High	Medium	Moderate adverse
Views west from residences on Old Uxbridge Road (060.2.001). Middle-ground visibility of the Proposed Scheme in cutting and Tilehouse Lane over bridge.	High	Medium	Moderate adverse
Views south-west from residences on Hornhill Road (FP005) at the western edge of Maple Cross (062.2.001). Middle-ground filtered views across agricultural fields to the Proposed Scheme in cutting and the Chiltern tunnel portal.	High	Medium	Moderate adverse
Recreational receptors			
Views west from footpath adjacent to Harvil Road (049.3.005). Middle-ground visibility of the overhead power line diversion.	High	High	Moderate Adverse
Views north along the Grand Union Canal Walk (051.3.002). Middle-ground visibility of the Colne Valley viaduct spanning the Grand Union Canal.	High	Medium	Moderate adverse
Views south from the northern edge of Hillingdon Outdoor Activities Centre from footpath (052.3.002). Middle-ground visibility across the lake to the Colne Valley viaduct.	High	High	Major adverse
Views south from the Colne Valley Trail (054.3.003). Middle-ground visibility of the Colne Valley viaduct spanning the Grand Union Canal.	High	Medium	Moderate adverse
View south-west from the London Loop Walk along the Grand Union Canal footpath (056.3.001). Background filtered visibility of the proposed Colne Valley viaduct.	High	Medium	Moderate adverse
Views east from Old Shire Lane footpath DEN/2/1 (057.3.002). Middle-ground views of the proposed scheme in cutting and the Tilehouse Lane over bridge.	High	Medium	Moderate adverse
Views east and north from the Old Shire Lane footpath DEN/2/1 (059.3.002 and 059.3.003). Middle-ground visibility of the Proposed Scheme in cutting, the Chiltern tunnel portal and Tilehouse Lane over bridge.	High	Medium	Moderate adverse

Viewpoint	Sensitivity of visual receptor	Magnitude of change	Level of effect to visual receptors ⁵¹
Transport receptors			
Views north from the Marylebone to Aylesbury Line (051.4.003). Middle-ground visibility of the proposed viaduct crossing the Colne Valley waterbodies, filtered in places by the lakeside vegetation.	Medium	Medium	Moderate adverse
Views south from Harvil Road (052.4.001). Middle-ground visibility of the viaduct and associated southern embankment.	Medium	Medium	Moderate adverse
Views looking north from Moorhall Road (053.4.002). Middle-ground visibility of the viaduct spanning Moorhall Road.	Medium	Medium	Moderate adverse
Views south-west from Moorhall Road (054.4.001). Middle-ground visibility of the viaduct spanning Moorhall Road.	Medium	Medium	Moderate adverse
Views east from Tilehouse Lane (057.4.001). Middle visibility of the Proposed Scheme in cutting and the Tilehouse Lane over bridge.	Medium	Medium	Moderate adverse

Table 11: Significant visual effects during operation year 1 (2026)

9.6.17 Where planting has been proposed, visual impacts in year 15 (2041) and 60 (2086) of operation would be significantly reduced compared to year one (2026), due to the increased height and maturity of vegetation. An assessment of effects for these assessment years will be prepared and presented within the formal ES.

Likely residual significant effects

9.6.18 Due to the highly sensitive nature of the landscape and visible nature of the Proposed Scheme, significant residual effects would remain, as set out in Tables 11 and 12 above. Residual effects would arise as a result of the introduction of a large new viaduct structure into the landscape.

Further mitigation

9.6.19 Further measures currently being considered but which are not yet part of the design include:

- Integrating the southern approach to the Colne Valley viaduct into the surrounding topography. Planting would mature to screen views and integrate the proposed southern embankment into the existing vegetation;
- Proposed mitigation planting to integrate earthworks, Tilehouse Lane diversion and overbridge;
- Proposed mitigation planting to integrate the isolated pocket of land between the M25 and the temporary M25 exit slip road;
- Integration of all new earthwork features of the Proposed Scheme, including road and public footpath overbridges, bridges and auto-transformer stations into the landscape; and
- Incorporation of balancing pond features within the landscape earthworks and planting design strategy.

⁵¹ In year one of operation, any new planting along the Proposed Scheme would be immature and therefore not help to integrate the Proposed Scheme into the landscape. As the plants mature, screening of the Proposed Scheme would improve.

10 Socio-economics

10.1 Introduction

10.1.1 This section provides a summary of the assessment methodology and scope, environmental baseline and likely significant economic and employment effects during construction and operation of the Proposed Scheme.

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

- Existing businesses and community organisations and thus the amount of local employment;
- Local economies, including employment; and
- Planned growth and development.

10.1.3 The beneficial and adverse socio-economic effects of the Proposed Scheme are reported at two different levels: route-wide and CFA. Effects on levels of employment are reported at a route-wide level within Report 27 (route-wide effects). Localised effects on businesses and observations on potential local economic effects are described within each CFA report.

10.2 Policy framework

10.2.1 The planning policy documents (and their status) applicable to the area are described in Section 2.1.

10.3 Assessment scope and key assumptions

10.3.1 At a Colne Valley area level the socio-economic assessment identifies the beneficial and adverse effects of the Proposed Scheme with regard to the following:

- Businesses displaced during construction because of the construction footprint;
- Effects on the amenity of an area (e.g. air quality, noise and visual impacts) which could affect a business' operations. Any resulting effects on employment numbers are reported at a route-wide and sub-regional level;
- Potential employment opportunities arising from construction in the local area (including in adjacent areas); and
- Potential employment opportunities created by new business opportunities.

10.3.2 The assessment draws upon the assessments undertaken of other technical disciplines including: agriculture, forestry and soils air quality; landscape and visual; sound, noise and vibration; and traffic and transport⁵².

10.3.3 The socio-economic assessment specifically focuses on the implications of the Proposed Scheme for people as workers, with the consequent community implications of these effects being considered as part of the Community Assessment (Chapter 6).

10.3.4 Further details of the assessment scope and key assumptions are set out in Volume 1.

⁵² The amenity assessment requires analysis of results from these other topic assessments and will be undertaken later in 2013 for the formal ES when the findings are fully available.

10.4 Environmental baseline

- 10.4.1 Section 2.1 provides a general overview of the Colne Valley area which includes data of specific relevance to socio-economics notably demographic and employment data. The following provides a brief overview in terms of employment, economic structure, labour market and business premises available within the area.
- 10.4.2 The Colne Valley area primarily crosses the boundaries of the London Borough of Hillingdon (LBH), South Buckinghamshire District and Three Rivers District, with a small portion lying in Chiltern District.
- 10.4.3 In 2011 367,000 people worked in LBH, 62,000 in South Buckinghamshire and 65,000 in Three Rivers.⁵³ The employment rate⁵⁴ within LBH in 2011 was 65% (which represents 130,000 people), for South Buckinghamshire 69% (33,000 people) and Three Rivers District 71% (44,000 people). This compares with a rate of 65% for England.⁵⁵ As of September 2012 the unemployment rates for LBH and Three Rivers District stood at 10% and 12% respectively compared to the England average of 8%^{56,57}.
- 10.4.4 In 2011 28% of LBH residents aged 16 and over were qualified to National Vocational Qualification Level 4 (NVQ4) compared with 38% in London and 27% in England; Whilst 13% of LBH residents had no qualifications, which was lower than that recorded both for London (18%) and England (23%). In South Buckinghamshire, 37% were qualified to NVQ4 level, compared to 30% in the South East region, and 17% had no qualifications, compared to 19% regionally. In Three Rivers, 34% were qualified to NVQ4 level, compared to 36% in the East of England region, and 18% had no qualifications compared to 23% regionally⁵⁸.
- 10.4.5 Within LBH, where most socio-economic impacts would arise, there is a wide spread of business types reflecting a diverse range of commercial services. The professional, scientific and technical services sector accounts for the largest proportion of businesses (13%), with the construction (12%), and retail (11%) sectors also accounting for relatively large numbers of businesses within the borough. This is shown below in Figure 4⁵⁹. For comparison within the London region the professional, scientific and technical services sector accounts for the largest number of businesses (20%), with the information and communication (11%), retail (10%) and arts, entertainment, recreation and other services (8%) sectors also accounting for relatively large numbers of businesses within the region⁶⁰.

⁵³ Office for National Statistics (ONS) (2012), *Business Register and Employment Survey 2011*.

⁵⁴ The proportion of working age residents (16-74 years old) living in the borough that are employed.

⁵⁵ ONS (2012), *Census 2011*.

⁵⁶ ONS (2012), *Annual Population Survey*.

⁵⁷ Unemployment rate for South Buckinghamshire District is unavailable as survey sample size is too small.

⁵⁸ ONS (2012), *Census 2011*.

⁵⁹ Figure 4 presents the proportion of businesses within each business sector in the borough but not the proportion of employment by sector.

⁶⁰ ONS (2011), *UK Business: Activity, Size and Location*.

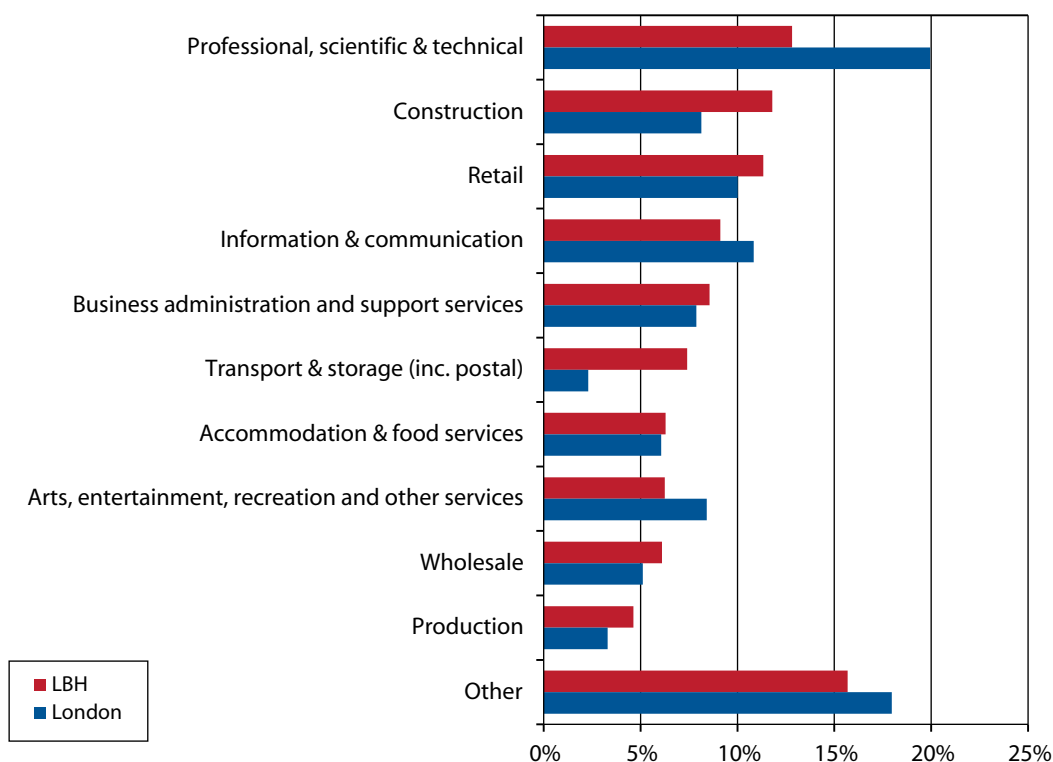


Figure 4: Business Sector Composition in LBH Council Area and London

Source – Office for National Statistics (2011), *UK Business: Activity, Size and Location*⁶¹

- 10.4.6 Data for quarter 4 of 2012, published by Knight Frank, indicated that in the northwest sector of the M25 office market, including LBH, floor space vacancy was estimated at around 9% of total stock⁶². In LBH total commercial office stock is estimated to be 683,000 sq. m (7.1 million sq. ft.)⁶³. Although there is no known recent floor space vacancy rate available for the borough, vacancy (for office and industrial units) in 2008 was estimated to be moderately high, at around 14%, within designated employment sites⁶⁴.
- 10.4.7 Data for quarter 3 of 2012, published by Jones Lang LaSalle, indicated that 10% of the 7.6 million sq. m (around 82 million sq. ft.) of industrial and warehousing floor space in West London was vacant⁶⁵. In LBH itself total industrial/warehousing stock is estimated to be 1.3 million sq. m (14 million sq. ft.). As is the case for offices, there is no known recent floor space vacancy rate available for industrial/warehousing in the borough although vacancy (for office and industrial units) in 2008 was estimated to be moderately high, at around 14%, within designated employment sites⁶⁶.
- 10.4.8 As of September 2011 in South Buckinghamshire there was 30,000 sq. m of vacant employment (office, industrial and warehousing) floor space⁶⁷. Based on a total stock figure for the district of around 337,000 sq. m of office and industrial/warehousing floor space, as estimated by the Valuation Office Agency (VOA) in 2012, this would equate to an employment space vacancy rate of around 9%⁶⁸.

⁶¹ 'Other' includes Agriculture, Forestry & Fishing; Production; Motor Trades; Finance and Insurance; Property; Public Administration and Defence; and Education and Health sectors.

⁶² Knight Frank (2013), *M25 Offices: Quarter 4 2012*.

⁶³ Valuation Office Agency (2012), *Business Floorspace (Experimental Statistics)*.

Available at: http://www.voa.gov.uk/corporate/statisticalReleases/120517_CRLFloorspace.html. Accessed 27 February 2012.

⁶⁴ Hillingdon Council (2009), *London Borough of Hillingdon Employment Land Study*.

⁶⁵ Jones Lang LaSalle (2012), *The Western Corridor Industrial and Warehouse Market Report* (September 2012).

⁶⁶ Hillingdon Council (2009), *London Borough of Hillingdon Employment Land Study*.

⁶⁷ South Buckinghamshire Council (2011), *Annual Monitoring Report 2010/2011*.

⁶⁸ Valuation Office Agency (2012), *Business Floorspace (Experimental Statistics)*.

Available at: http://www.voa.gov.uk/corporate/statisticalReleases/120517_CRLFloorspace.html. Accessed 27 February 2012.

10.5 Construction

Assessment of impacts and effects

- 10.5.1 No significant direct effects on non-agricultural employment have been identified within the CFA.
- 10.5.2 Land take associated with construction of the Proposed Scheme would impact the Hillingdon Outdoor Activities Centre. This is a community resource (see Chapter 6 for further details) whose ability to operate would be compromised and it may not be viable for it to remain open during the construction period. However the employment losses are not in themselves of a sufficient scale to be significant in socio-economic terms.
- 10.5.3 It is estimated that the Proposed Scheme would result in the displacement or possible loss of a total of up to 5 jobs⁶⁹ within the Colne Valley area. Taking into account the availability of alternative premises, and the relatively healthy local economy, the displacement or possible loss of jobs is considered to be relatively modest compared with the scale of economic activity and opportunity in the area.
- 10.5.4 There are plans to locate construction compounds for the Proposed Scheme at the following locations within the Colne Valley area:
- Colne Valley viaduct main construction site;
 - Chiltern Tunnel main construction site;
 - Colne Valley viaduct and southern approach embankment satellite site;
 - Colne Valley viaduct satellite site;
 - Colne Valley viaduct storage satellite site;
 - Colne Valley viaduct jetty storage satellite site;
 - Colne Valley viaduct laydown satellite site;
 - Colne Valley northern approach embankment satellite site; and
 - Colne Valley north launch satellite site.
- 10.5.5 The use of these sites could result in the creation of up to 1,650 person years of construction employment⁷⁰ 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. It could also lead to opportunities for local businesses to supply the project or to benefit from expenditure of construction workers. Quantification of direct and indirect construction employment effects are captured at a route-wide level (see Report 27, route-wide effects).
- 10.5.6 It is intended that discretionary enhancement measures, such as business support, supply chain engagement and local construction skills development initiatives to enhance local business performance will be included as appropriate in the formal ES.

Likely residual significant effects

- 10.5.7 The likely residual significant socio-economic effects are currently being assessed and will be reported in the formal ES.

⁶⁹ 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 (2010). The estimate is calculated using standard employment density ratios and estimates of floor areas and may vary significantly from actual employment at the sites.

⁷⁰ 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.

10.6 Operation

Assessment of impacts and mitigation

- 10.6.1 The Proposed Scheme will create direct and wider operational employment opportunities at locations along the route including stations, train crew facilities and infrastructure/maintenance depots. Although no plans exist to locate these facilities within this area it is considered possible that direct (given the location of a portion of the Colne Valley area within the London travel to work area (TTWA) in which Old Oak Common and Euston Stations would be located⁷¹) and wider operational employment opportunities could be accessed by residents of the Colne Valley area. Operational effects are captured and assessed at a route-wide level (see Report 27, route-wide effects).

Likely residual significant effects

- 10.6.2 The likely residual significant socio-economic effects are currently being assessed and will be reported in the formal ES.

⁷¹ ONS (2007), *Travel to Work Area Analysis*.

11 Sound, noise and vibration

11.1 Introduction

11.1.1 This chapter provides a summary of the likely noise and vibration significant effects associated with the construction and operation of the Proposed Scheme for the Colne Valley CFA. This chapter should be read in conjunction with Volume 1.

11.2 Policy framework

11.2.1 The policy framework for sound, noise and vibration is set out in Volume 1.

11.3 Assessment scope and key assumptions

11.3.1 The approach to the assessment of sound, noise and vibration and related key assumptions are set out in Volume, with local variations as described below. A summary of the operating assumptions is given in section 2.4 of this report.

Assumptions

11.3.2 In addition to the assumptions given in Volume 1, the following apply to this area:

- Passenger services have been assumed to operate at up to 360kph in this area with speed reducing towards the Chiltern tunnel.

11.4 Environmental baseline

11.4.1 The baseline sound environment for this CFA varies across the different communities, although all receptors are affected to a greater or lesser degree by the M25 motorway. In South Harefield, and the areas of Denham Green away from the A412 road, the baseline is typical for a suburban residential area. The baseline sound levels at dwellings in Denham Green and Wyatts Covert that are close to the A412 road are influenced by this road, to a varying degree. With the sound from the M25 motorway as well, the baseline sound levels are considered to be reasonably high for a suburban location.

11.4.2 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration. For the draft ES, vibration at all receptors has been assessed using the absolute vibration criteria as described in Volume 1.

11.5 Construction

Assessment of effects and mitigation

11.5.1 This initial assessment has considered the potential effects on community receptors within the study area, their occupants and their use (including annoyance, activity disturbance and sleep disturbance) arising from construction noise and/or vibration.

11.5.2 The mitigation measures specified within the draft CoCP have been included within the assessment of construction noise and vibration.

11.5.3 Tunnel boring machines (TBMs) would be used to excavate the Chiltern tunnels. The tunnel drives are proposed to be launched and supported on a 24/7 basis from the proposed portal just to the east of the M25, although the tunnels themselves are mostly located within CFA8 – The Chalfonts and Amersham.

- 11.5.4 Potential construction noise or vibration effects could occur on the receptors closest to the construction areas in the following communities:
- Newyears Green, in the general area of Harvil Road and New Years Green Lane, arising from construction activities such as construction of the south eastern section of the Colne Valley viaduct (refer to Section 2.2/2.3 and to map series CT-05 Construction Features);
 - Denham Grove (the De Vere Hotel) and Wyatt’s Covert, during construction of the north western section of the Colne Valley viaduct (refer to Section 2.2/2.3 and to map series CT-05 Construction Features); and
 - Old Uxbridge Road , Chalfont Lane (Sunnyhill Road) and the caravan site at Three Oaks Farm during the tunnelling support activities which are required to operate continuously (24/7) through the construction of the tunnels (refer to Section 2.2/2.3 and to map series CT-05 Construction Features).
- 11.5.5 Track laying, power system and signalling installation works along the line of route are unlikely to result in significant construction noise effects, given the short duration close to any communities and the presence of the permanent noise barriers.

Likely residual significant effects

- 11.5.6 Further work is being undertaken to confirm significant construction noise and vibration effects, including any temporary effects from construction traffic. Non-residential receptors identified at this stage as potentially subject to construction noise or vibration effects will be further considered, where necessary, on a receptor-by-receptor basis. Any further assessment will be reported in the formal ES.

Further mitigation

- 11.5.7 Further work is being undertaken to confirm the likely significant effects and identify any site specific mitigation considered necessary in addition to the general measures set out in the draft CoCP. Any site specific mitigation will be presented in the formal ES and will include an estimate of the number of properties that may qualify for noise insulation or temporary re-housing under provisions set out in the draft CoCP.

11.6 Operation

Assessment of effects and mitigation

- 11.6.1 This initial assessment has considered the potential effects on community receptors within the study area, their occupants and their use (including annoyance, activity and sleep disturbance) arising from operational noise and/or vibration. Further assessment will be undertaken for the formal ES.
- 11.6.2 The on-going development of the scheme includes noise barriers in the form of landscape earthworks, noise (fence) barriers and/or low level barriers on viaducts. The envisaged noise barrier locations are shown on the Operational Sound Contour and Potential Significant Effect Maps SV-01.
- 11.6.3 The Operational Sound Contour and Potential Significant Effect Maps SV-01 indicate the likely long-term daytime sound level (defined as the equivalent continuous sound level from 07:00 to 23:00 or $L_{pAeq,day}$) from HS2 operations alone. The contours are shown in 5dB steps from 50dB to 70dB. With the train flows described in Volume 1, the night-time sound level (defined as the equivalent continuous sound level from 23:00 to 07:00 or $L_{pAeq,night}$) from the Proposed Scheme would be approximately 10dB lower than the daytime sound level. The 50dB contour therefore indicates the distance from the Proposed Scheme at which the night-time sound

level would be 40dB. This contour represents where the lowest observed community noise effects would be expected to occur during the day (with respect to annoyance) and night (with respect to sleep disturbance). It is generally unlikely that there will be any adverse noise effects outside of this contour. With regard to sleep disturbance, the assessment has also taken account of the maximum sound levels generated by each train pass by.

- 11.6.4 Residential receptors within the daytime 65dB contour, and therefore the night-time 55dB contour, have been identified as being likely to experience a significant adverse effect from HS2 noise alone. This is in line with the daytime threshold for in the Noise Insulation Regulations and the Interim Target defined in the World Health Organization’s Night Noise Guidelines.
- 11.6.5 The potential for significant noise effects on communities in areas between the 50dB and 65dB daytime sound contours, or 40dB and 55dB night-time contours, will be dependent on the baseline in that area and the change in sound level brought about by the Proposed Scheme.
- 11.6.6 For the draft ES, the criteria used in assessing whether an effect is potentially significant includes factors such as the number and magnitude of impacts in a community, as well as the existing sound environment. The further significance criteria set out in the SMR, including the character of the existing sound environment, any unique features of the Proposed Scheme’s sound or impacts, and the potential combined impacts of sound and vibration will be taken into account in the formal ES.
- 11.6.7 This initial assessment has identified potential airborne noise effects on the following non-residential receptors and land uses (e.g. schools, hospitals, hotels):
- Denham Grove De Vere Hotel (identified by SV07-No1 on Maps SV-01).
- 11.6.8 Rights of way are by their nature transitory routes, with users not staying in any one location for long periods. Train sound from the Proposed Scheme is intermittent and its level at the right of way will vary as the right of way moves closer to and further from the Proposed Scheme. Noise effects would generally be reduced by the landscape earthworks envisaged to reduce visual impact of the scheme and envisaged noise mitigation to protect other receptors. No significant noise effects have therefore been identified on public rights of way within this CFA.
- 11.6.9 No potentially significant noise or vibration effects arising from changes to existing roads are anticipated at this stage. This will be confirmed in the formal ES.

Likely residual significant effects

- 11.6.10 The envisaged mitigation (especially landscape earthworks and noise barriers) described in this chapter substantially reduces the potential airborne sound impacts and noise effects that would otherwise arise from the Proposed Scheme. Nonetheless, potential significant adverse airborne noise effects have been identified for residential receptors in the following communities:
- Denham Green in the general vicinity of Savay Lane (identified by SV07-Co1 on maps SV-01); and
 - Denham Grove (the De Vere Hotel) and Wyatt’s Covert in the general vicinity of Tilehouse Lane (identified by SV07-Co2 on maps SV-01).

- 11.6.11 Further assessment work is being undertaken to confirm operational sound and vibration significant effects, including those at non-residential receptors and quiet areas (as necessary on a receptor-by-receptor basis). This will be reported in the formal ES which will present baseline levels, forecasts for the Proposed Scheme and the change in sound levels brought about by the Proposed Scheme both as impact plans and tables.

Further mitigation

- 11.6.12 Improvements in the performance of mitigation that may further reduce or avoid the potential significant airborne noise effects are being considered for the formal ES. Potential options are included in Table 12:

Potential significant effect	Further mitigation option
Denham Green (SV07-Co1)	Locally increase the mitigation to 4m parapet noise (fence) barrier or equivalent
Denham Grove (the De Vere Hotel) and Wyatt's Covert (SV07-Co2)	Locally increase the mitigation to 4m parapet noise (fence) barrier or equivalent

Table 12: Options for further mitigation

12 Traffic and transport

12.1 Introduction

12.1.1 This traffic and transport section describes the likely impacts and effects arising from the construction and operation of the Proposed Scheme through the Colne Valley area on all forms of transport.

12.2 Policy framework

12.2.1 Transport related local government policy is contained in the local transport plan (LTP3) for Buckinghamshire County Council and Hertfordshire County Council. Relevant regional and local policy documents comprise The London Plan 2011, the Mayor's Transport Strategy⁷² and London Borough of Hillingdon's Local Development Framework⁷³.

12.2.2 Buckinghamshire County Council's LTP3 covers the period 2011-2016 and is aligned with their Sustainable Community Strategy which sets the overarching long-term plan for the county up to 2026^{74,75}. The LTP3 implementation plan refers to the Proposed Scheme passing through Buckinghamshire.

12.2.3 A key transport objective for Buckinghamshire County Council is to maintain and improve the reliability of journey times on the key routes for freight, commuting and business travel, to benefit the local and national economy. The objective is to improve connectivity and access between centres and in particular to reduce public transport journey times through developing new services. The aim is to encourage more sustainable transport behaviour and reduce the need to travel, in preference to increasing road capacity, with the emphasis on reducing the negative impacts on the environment from transport. The objective for new developments is to deliver transport improvements to support regeneration and sustainable housing and employment growth.

12.2.4 Hertfordshire County Council's LTP3 covering the period 2011-2031, highlights the promotion and support of passenger transport to reduce dependency on the car and increase the use of sustainable modes⁷⁶. The Proposed Scheme would remove many intercity services from the existing WCML, thereby releasing capacity. Operational policies within the Bus Strategy (contained within Hertfordshire County Council's LTP3) include support, promotion and improvement of the bus network. Hertfordshire County Council's aspirations for rail include enhancement of interchange at stations. The LTP3 provides strong support for new development to be located and designed so that maximum use can be made of sustainable modes of transport. It states that development that would require significant HGV use of local roads would be resisted; they would be encouraged to use the primary routes.

12.2.5 The London Plan 2011 sets out the strategic planning guidance for London planning authorities over the next 20-25 years and notes that public transport capacity should be increased by exploring the scope for high speed rail services.

12.2.6 The Vision for Hillingdon 2026 was developed through discussion with Hillingdon's Local Strategic Partnership (Hillingdon Partners) and reflects the key priorities of the Sustainable Community Strategy. The key strategic objectives include promoting social inclusion through equality of access, improving the environment and infrastructure, focusing economic growth around the transport hubs and improving public transport links within the borough. Their

⁷² Mayor of London (2010) *Mayor's Transport Strategy*. London, Greater London Authority.

⁷³ London Borough of Hillingdon (2012) *A Vision for 2026*.

⁷⁴ Buckinghamshire County Council (2011) *Local Transport Plan 3 (2011-2016)*.

⁷⁵ Bucks Strategic Partnership (2009) *Sustainable Community Strategy for Buckinghamshire 2009-2026*. Aylesbury, Buckinghamshire County Council.

⁷⁶ Hertfordshire County Council (2011) *Hertfordshire County Council Local Transport Plan 3 (2011-2031)*.

policy on public transport is to improve north-south public transport links in the borough and link residential areas directly with employment areas and transport interchanges. In principle, the Council is supportive of a high speed rail network subject to review of possible route options and conditional upon climate change objectives and local community aspirations being met.

12.3 Assessment scope and key assumptions

- 12.3.1 The scope and methodology of the traffic and transport assessment is set out in Volume 1.
- 12.3.2 The scope of the assessment was discussed with the relevant local highway authorities including Buckinghamshire County Council on 30 November 2012, Hertfordshire County Council on 20 February 2013 and the Highways Agency with regards to the M25 on 22 October 2012.
- 12.3.3 The effects presented are those resulting from the changes arising from the introduction of the Proposed Scheme compared with the future transport baseline scenario without the Proposed Scheme in the respective years.
- 12.3.4 The baseline forecast traffic flows for the future years of assessment have been derived using Department for Transport's traffic forecasting tool, Trip End Model Presentation Program (TEMPRO).
- 12.3.5 The following key limitations exist in the reporting of significant effects:
- The capacity of junctions that would be affected by the Proposed Scheme has not yet been assessed in detail. A more detailed assessment will be carried out for the formal ES where necessary;
 - Forecast future year traffic flows with and without the Proposed Scheme are based on an approach that does not take account of wider effects, e.g. redistribution and reassignment of traffic, modal shift and peak spreading. As a consequence, local transport effects may be over-estimated;
 - The forecast construction traffic flows, temporary diversions, traffic management arrangements and phasing of construction interventions are based on initial scheme designs. Subsequent design development will have resulted in some changes to the quantities of construction materials, the size of the workforce at each construction compound and the phasing of construction activities. Consequently, forecast construction traffic flows used for this assessment do not precisely reflect the currently Proposed Scheme. These will be updated and the assessment revised accordingly for the formal ES;
 - The assessment is not fully capturing vehicles associated with the construction of the adjacent section of the route within London. This will, however, be fully assessed in the formal ES; and
 - The assessment assumes that construction lorry traffic would use the following routes between compounds and primary road and/or motorway network, as shown in maps CT-05-018 to CT-05-022:
 - Harvil Road via either B467 Swakeleys Road & A40 Western Avenue or Moorhall Road, A412 & A405 Denham Way/North Orbital Road & M25, providing access to the Colne Valley viaduct & southern approach embankment satellite site compound;
 - Haul Road from Harvil Road via either B467 Swakeleys Road & A40 Western Avenue or Moorhall Road, A412 & A405 Denham Way/North Orbital Road & M25, providing access to the Colne Valley viaduct satellite site compound;

- Moorhall Road via A412 & A405 Denham Way/North Orbital Road, M25 & A40 Oxford Road, providing access to the Colne Valley Viaduct Storage Satellite Compound and Colne Valley viaduct jetty storage satellite site compound;
- A412 & A405 Denham Way/North Orbital Road via M25 & A40 Oxford Road, providing access to Colne Valley Viaduct Laydown Satellite Compound, Colne Valley Viaduct North Launch Satellite Compound and Colne Valley viaduct northern approach embankment satellite site compound; and
- Chalfont Lane via temporary M25 slip road, providing access to Colne Valley Viaduct Main Construction Compound and Chiltern Tunnel main construction site.

12.4 Environmental baseline

- 12.4.1 Traffic surveys were carried out during June and September 2012 and February 2013 to establish current traffic flows on the road network subject to assessment. This was supplemented by traffic data obtained from other sources where available, including from the Highways Agency for the M25.
- 12.4.2 The highway network subject to assessment within this area includes the M25, M40, A40, A413, A405, A412 Denham Way/North Orbital Road, B467 Swakeleys Road, Harvil Road, Tilehouse Lane, Denham Green Lane, Chalfont Lane, Hornhill Road, Woodland Road, Moorhall Road/Moorfield Road, Chalfont Road, Downings Wood and Longcroft Road.
- 12.4.3 Bus services currently operate along the following roads within close vicinity of the Proposed Scheme:
- A412 Denham Way/North Orbital;
 - A40 Oxford Road;
 - Swakeleys Road;
 - Tilehouse Lane;
 - Moorhall Road/Moorfield Road;
 - Woodland Road;
 - Hornhill Road;
 - Downings Wood;
 - Longcroft Road; and
 - Harvil Road.
- 12.4.4 There are rail stations at Denham and Denham Golf Club on the Marylebone to Aylesbury Line. A frequent service is provided, with two or four passenger trains during peak hours and two per hour at other times during the day. Services run seven days a week. The Marylebone to Aylesbury Line is also regularly used by freight services carrying waste from London to Calvert.
- 12.4.5 There are several public footpaths, bridleways and cycleways that would cross the route of the Proposed Scheme including trails through the Colne Valley. All PRow which would be intersected by the Proposed Scheme have been surveyed, taking account of the nature of the PRow and their usage. As appropriate, these covered weekday and weekend use. These indicated that none of the roads, footpaths, bridleways and cycleways that would cross the route are used by more than 60 people per day walking, cycling or riding.

- 12.4.6 Relevant traffic accident data has been obtained from Buckinghamshire County Council and Hertfordshire County Council for the three year period of 2009 to 2011, for the road network subject to assessment.
- 12.4.7 The Grand Union Canal from London to Birmingham, entering the valley of the River Colne at Cowley follows a north-westerly course to Uxbridge. There are no other navigable canals or waterways that cross the Proposed Scheme in this area.
- 12.4.8 The future baseline traffic volumes have been calculated by applying growth factors derived from TEMPRO for the future years of 2021, 2026 and extrapolation to 2041. The factors have been derived for the individual road types and relevant wards. No other changes to the traffic and transport baseline are anticipated in Colne Valley.

12.5 Construction

Assessment of impacts and mitigation

- 12.5.1 The following section considers the impacts on traffic and transport and the consequential environmental effects resulting from construction of the Proposed Scheme. The information set out in this section is subject to review in the formal ES.
- 12.5.2 The following measures have been included as part of the engineering design of the Proposed Scheme and would avoid or reduce impacts on travellers:
- Defined lorry routes for construction equipment and materials to ensure only the most suitable roads are used;
 - Surplus spoil material would be reused wherever reasonably practicable along the alignment of the Proposed Scheme which will minimise lorry movements on the public highway; and
 - Temporary alternative routes provided for PRoW closed during construction to reduce loss of amenity.
- 12.5.3 Transport related effects of the Proposed Scheme during construction would arise from traffic generated by construction activities as well as temporary diversions of roads and PRoW.
- 12.5.4 Construction activities would result in the following temporary road closures and associated diversions lasting for a month or more as shown on maps CT-05-019 to CT-05-022:
- Temporary closure of Harvil Road requiring a temporary diversion via B467 Swakeleys Road, Breakspear Road South and New Years Green Lane;
 - Temporary closure of Tilehouse Lane requiring a temporary diversion via A412 Denham Way/North Orbital Road and Denham Green Lane; and
 - Temporary closure of Chalfont Lane requiring a temporary diversion via A412 Denham Way/North Orbital Road, Woodland Road, Hornhill Road and a new temporary link road to Shire Lane.
- 12.5.5 The temporary closure of Harvil Road would result in the temporary diversion of the U9 bus service.
- 12.5.6 Nine construction compounds would be required with separate vehicular access points. The construction vehicle movements would therefore be spread over a number of roads. Access points to construction compounds are shown on maps CT-05-018 to CT-05-022.
- 12.5.7 Construction vehicle movements related to the building of the Proposed Scheme have been calculated based on the quantity of materials required to construct the Proposed Scheme with a further 10% added to allow for ancillary delivery vehicles.

12.5.8 The typical numbers of vehicles estimated to be generated by the site compounds in this area are shown in Table 13.

Compound location	Access	Estimated duration of use	Typical daily number of two-way trips	
			LGVs ⁷⁷	HGVs
Colne Valley viaduct main construction compound, map CT-05-019	M25 temporary slip roads (HGVs) A412 Denham Way/North Orbital Road (workers)	4.5 years	120-190	110-150
Chiltern tunnel main construction compound, map CT-05-022		5.5 years		
Colne Valley viaduct and southern approach satellite embankment compound, map CT-05-019	Harvil Road	4 years	40-50	40-50
Colne Valley viaduct satellite compound, map CT-05-020	Haul Road from Harvil Road	3 years		
Colne Valley viaduct storage satellite compound, map CT-05-020	Moorhall Road	3.5 years	30-40	40-50
Colne Valley viaduct jetty laydown satellite compound, map CT-05-020		2.5 years		
Colne Valley viaduct laydown satellite compound, map CT-05-021	A412 Denham Way/North Orbital Road	3 years	Up to 10	Up to 10
Colne Valley north launch satellite compound, map CT-05-021	A412 Denham Way/North Orbital Road	3 years	40-50	30-40
Colne Valley northern approach embankment satellite compound, map CT-05-021		3.5 years		

Table 13: Typical vehicle trip generation for site compounds in this area⁷⁷

12.5.9 Construction of the Proposed Scheme is anticipated to result in significant increases in traffic flows (i.e. more than 30% for HGV or all vehicles) on the following roads as a result of construction traffic and/or temporary closures/diversions:

- A412 Denham Way/North Orbital Road;
- A40 Western Avenue;
- B467 Swankley Road, between A40 and Hornhill Road;
- Denham Green Lane;
- Hornhill Road;
- Woodland Road; and
- Harvil Road.

12.5.10 The CoCP would seek to reduce, as far as reasonably practicable, deliveries of construction materials and equipment, thus minimising construction lorry trip generation, especially during peak traffic periods. The CoCP would include HGV management and control measures.

12.5.11 A construction workforce travel plan would be put into operation with the aim of reducing workforce commuting by private car, especially sole occupancy car travel. Where practical in the rural context, this would encourage the use of sustainable modes of transport.

12.5.12 The combined effect of the CoCP and the construction workforce travel plan is anticipated to reduce construction traffic generation below that currently forecast. However, the beneficial

⁷⁷ Workers commuting trips.

effects arising from the implementation of the CoCP as a result of the associated demand management measures has not been taken into account for the purpose of this assessment, thereby giving a worst-case assessment.

- 12.5.13 Several PRoW crossing the Proposed Scheme would be temporarily diverted during construction, potentially resulting in impacts on user delay and/or severance.
- 12.5.14 Construction of the Proposed Scheme is not anticipated to result in any other significant impacts at this stage.

Likely residual significant effects

- 12.5.15 Likely residual significant effects in terms of delays to vehicle occupants due to increased congestion may occur to users of the following roads subject to more detailed assessment:
- B467 Swakeleys Road (level of effect to be determined);
 - Harvil Road (level of effect to be determined);
 - Chalfont Lane (level of effect to be determined);
 - Denham Green Lane (level of effect to be determined);
 - Hornhill Road (level of effect to be determined); and
 - Woodland Road (level of effect to be determined).
- 12.5.16 Users of the U9 bus service are likely to experience a minor significant effect in delay as a consequence of the temporary service diversion.
- 12.5.17 Significant effects are identified in relation to some of the temporary PRoW diversions. A full assessment of significant effects during construction will be presented as part of the formal ES.
- 12.5.18 Construction of the Proposed Scheme at this stage is not anticipated to result in any other significant effects.

Further mitigation

- 12.5.19 Further mitigation measures will be considered based on the outcomes of the ongoing assessment and will be reported in the formal ES.

12.6 Operation

Assessment of impacts and mitigation

- 12.6.1 The following section considers the impacts on traffic and transport and the consequential environmental effects resulting from operation of the Proposed Scheme (as described in Section 2.2 and 2.4 of this report). The information set out in this section is subject to review in the formal ES.
- 12.6.2 The following design and demand management measures have been included for the Proposed Scheme and would avoid or reduce impacts on travellers:
- The majority of roads crossing the Proposed Scheme retained in their current location or very close to their current location resulting in no significant diversions of traffic onto alternative routes; and
 - PRoW crossing the Proposed Scheme retained where reasonably practicable with localised diversions kept to a minimum.

- 12.6.3 Several PRow crossing the Proposed Scheme would be permanently diverted during operation, potentially resulting in impacts on user delay and/or severance.

Likely residual significant effects

- 12.6.4 Significant effects are identified in relation to some of the PRow diversions. A full assessment of significant operational effects will be presented as part of the formal ES.
- 12.6.5 The assessments undertaken at this stage have indicated that for this area there are no other significant transport related effects during the operation of the Proposed Scheme. This is because:
- There would be no stations or depots that would generate any additional traffic; and
 - All roads that would cross the route would be retained in or very close to their current location.

Further mitigation

- 12.6.6 Further mitigation measures will be considered based on the outcomes of the ongoing assessment and will be reported in the formal ES.

13 Water resources and flood risk assessment

13.1 Introduction

13.1.1 This section provides a summary of the likely impacts and significant effects on water resources and flood risk as a result of the construction and operation of the Proposed Scheme. The assessment considers effects on surface water resources, groundwater resources and flooding risk.

13.2 Policy framework

13.2.1 Policy 5.12 of the London Plan: Spatial Development Strategy for Greater London (2011) states that development proposals must comply with flood risk assessment and management requirements set out in Planning Policy Statement 25 (PPS25) (now replaced by the National Planning Policy Framework). A number of other relevant policies are included: Policy 5.3 (requires that sustainable design standards are integral to construction and operation); Policy 5.13 (development should utilise sustainable drainage systems (SuDS)), aiming to achieve greenfield run-off rates unless there are good reasons not to); Policy 5.14 (ensures that adequate wastewater infrastructure capacity is available in tandem with development and seeks to protect and improve water quality having regard to the Thames River Basin Management Plan) and Policy 5.15 (development should minimise the use of mains water, incorporating water saving measures).

13.2.2 A number of local policies seek to protect and enhance water resources, avoid development in areas of flood risk (unless appropriate mitigation is included) and enhance flooding protection. These policies include: Policies EM6 and EM8 of the Hillingdon Local Plan: Part 1 (2012), Core Policies 9 and 13 of the South Buckinghamshire Core Strategy (2011), and Saved Policies OE7, OE8 and OEG of the South Buckinghamshire Local Plan (Saved Policies, 2007).

13.2.3 In addition, various local and regional guidance documents are relevant to this assessment including:

13.2.4 The Mayor's Water Strategy⁷⁸;

- The London Regional Flood Risk Appraisal (RFRA)⁷⁹;
- Buckinghamshire Preliminary Flood Risk Assessment (PFRA)⁸⁰;
- Hertfordshire PFRA⁸¹;
- Dacorum, St. Albans, Three Rivers and Watford Strategic Flood Risk Assessment (SFRA)⁸²;
- The London Borough of Hillingdon SFRA, PFRA and Surface Water Management Plan (SWMP)^{83,84,85}; and
- The South Buckinghamshire SFRA⁸⁶.

⁷⁸ Greater London Authority (2011) *Securing London's Water Future, The Mayor's Water Strategy*.

⁷⁹ Greater London Authority (2009) *London Regional Flood Risk Appraisal*.

⁸⁰ Buckinghamshire County Council (2011) *Preliminary Flood Risk Assessment Report, Final, May 2011*.

⁸¹ Hertfordshire County Council (2011) *Hertfordshire PFRA*.

⁸² Halcrow (2007) *Dacorum, St. Albans, Three Rivers and Watford SFRA*.

⁸³ London Borough of Hillingdon (2008) *Strategic Flood Risk Assessment*.

⁸⁴ Capita Symonds (2011) *London Borough of Hillingdon PFRA*.

⁸⁵ Capita Symonds (2013) *London Borough of Hillingdon Surface Water Management Plan*.

⁸⁶ South Buckinghamshire District Council (2008) *Strategic Flood Risk Assessment*.

13.3 Assessment scope and key assumptions

- 13.3.1 The assessment scope and key assumptions for the water resources and flood risk assessment are set out in Volume 1.
- 13.3.2 The assessment of surface water resources and flood risk focuses on the River Colne, its tributaries and their associated catchment areas and floodplains.
- 13.3.3 The main limitations experienced in undertaking this assessment were:
- There is limited published information available on the groundwater dependency or hydraulic functioning of wetland areas. In the Colne Valley groundwater levels are close to the surface in the floodplain gravels and hence there is potential for some of the surface watercourses in parts of the area to be in hydraulic connection to underlying groundwater;
 - Borehole records along the route of the Proposed Scheme are limited. The assessment of local geological and hydrogeological conditions likely to be encountered during underground construction works are therefore considered in outline only; and
 - Based on the available borehole information, it is assumed that the effective thickness of the main flow zones in the Chalk aquifer extends at least 30m below the water table.

13.4 Environmental baseline

- 13.4.1 The route would cross the wide valley of the River Colne close to the confluence of the Newyears Green Bourne tributary and the River Colne. The River Colne, adjacent flooded gravel pits including the Savay Lake, which is an important fishery, and the Grand Union Canal each occupies parts of the valley floor.
- 13.4.2 The route would cross the 132ha Mid Colne Valley SSSI (see map CT-02-006). This SSSI consists of several lakes between the River Colne and Grand Union Canal. It is a 'very high' value receptor due to its national SSSI status, the water related aspects of which includes the River Colne, local wetlands and associated bird life.
- 13.4.3 The EA predicts ecological water quality of many of the water bodies to be the same as current conditions (i.e. 'good') by 2015. The overall status of the River Colne and Grand Union Canal is classified as moderate by the EA (from the confluence with the River Chess to the River Ash). Ecological potential is predicted by the EA to remain unchanged up to 2015 and with good potential by 2027. The EA holds no data regarding Water Framework Directive status for the Newyears Green Bourne.
- 13.4.4 The EA has listed two 'significant' pollution incidents – one near Pynesfield Lake and the other within the SSSI. This section of the route is within a designated surface water Nitrate Vulnerable Zone (NVZ)⁸⁷.
- 13.4.5 The Proposed Scheme would pass over Chalk, a Principal Aquifer (see map CT-04-006). Within 1 km of the Proposed Scheme there are 11 licensed groundwater abstractions, in addition to the four major public water supply (PWS) abstractions with associated Source Protection Zones (SPZs) up-gradient of groundwater flow of the route⁸⁸. The route would cross a number of SPZ Zone 1 (SPZ1) and Zone2 (SPZ2). In addition to this the route would pass through the 50-day travel time zone around a private abstraction to the north of Denham Grove. An area of groundwater contamination from a closed landfill has been reported north of the route, beyond the junction of Harvil Road and New Years Green Lane.

⁸⁷ The European Commission (EC) nitrates directive requires areas of land that drain into waters polluted by nitrates to be designated as Nitrate Vulnerable Zones (NVZs).

⁸⁸ <http://www.environment-agency.gov.uk/homeandleisure/37833.aspx>. Accessed 16 April 2013.

- 13.4.6 Gravel deposits form a shallow aquifer across the valley floor and the lakes occur where these gravels have been excavated. Groundwater levels in the gravels mirror those in the lakes and a degree of hydraulic continuity with the Chalk is expected. Any potential changes to the groundwater levels and quality in the gravels may therefore impact the surface water quality and levels and subsequently effect local ecology within the SSSI. Although vertical groundwater flow is somewhat restricted by a layer of weathered Chalk and some thin layers of finer material in the superficial deposits, the Chalk aquifer is vulnerable to contamination from the gravels and lakes.
- 13.4.7 Recorded groundwater levels are indicative of groundwater in the Chalk and suggest peak levels are below the proposed route elevation within the study area; however, they are nearer the ground surface under the valley floor. Groundwater flow in the Chalk is generally to the south-east and predominantly along fractures. Flow can be rapid, making the Chalk aquifer vulnerable to contamination.
- 13.4.8 The route of the Proposed Scheme would pass through the Radlett Tertiaries and Mid Chilterns Chalk groundwater bodies. The Radlett Tertiaries are classified as currently having poor quantitative quality (i.e. the capacity for the groundwater body to be sustainable with regard to usage and ecology) and poor current chemical quality. The EA predicts that the water body would have a good chemical quality and a poor quantitative quality by 2015. The Mid Chilterns Chalk is classified as having a poor current quantitative quality and a poor (deteriorating) chemical quality. The EA predicts that the water body would have a poor quantitative and chemical quality by 2015. There are a total of two discharge consents within the study area.
- 13.4.9 The proposed Colne Valley viaduct would pass over the Grand Union Canal, Newyears Green Bourne (5km² catchment) and the River Colne (720km² catchment). For the Newyears Green Bourne and River Colne respectively, the route would cross approximately 180m and 1,770m of Flood Zone 3 and 200m and 1,790m of Flood Zone 2 (see map CT-04-006). Approximately 150m of the River Colne and 530m of the Newyears Green Bourne centre lines lie within 50m of the route.
- 13.4.10 The National Grid Feeder Station is part of the Proposed Scheme and would be partly located within Flood Zone 2 and Flood Zone 3 of the Newyears Green Bourne catchment. At this location flood flow velocities are expected to be low or stagnant since this is an area of ponding.
- 13.4.11 The EA Flood Map for Surface Water (FMfSW) predicts that areas within the Colne Valley study area are at risk of flooding from surface water outside of the floodplain of the River Colne. The most notable area is where the route would cross the confluence of three dry valleys at Shire Lane, which is predicted to flood to depths of over 0.3m during the 1 in 30-year annual probability (3.3%) and 1 in 200-year annual probability (0.5%) events.
- 13.4.12 The South Buckinghamshire Strategic Flood Risk Assessment (SFRA) states that sewer flooding in the region appears to be sporadic and rare. The route would not cross any urban areas.
- 13.4.13 The British Geological Society (BGS) mapping dataset shows that there are areas that have a 'high' to 'very high' susceptibility to groundwater flooding within the study area. The most notable areas are within the superficial deposits of the River Colne, and also within the dry valleys at Shire Lane where the chalk aquifer is unconfined.
- 13.4.14 The SFRA identifies a potential flood risk from overtopping of the Grand Union Canal during flood conditions within the River Colne and a residual risk of flooding from the Harefield Service Reservoir.

- 13.4.15 Floodplain mapping suggests that the Grand Union Canal does not become inundated until the 1 in 1,000 year annual probability (0.1%) flood event and it is not included in the EA hydraulic model of the River Colne.

13.5 Construction

Assessment of impacts and mitigation

- 13.5.1 The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme. It would provide effective management and control of the impacts during the construction period including those required for utility diversions and strengthening, grouting, watercourse diversions, installing culverts and tunnelling.
- 13.5.2 The draft CoCP includes the following provisions:
- Implementing, in consultation with the Environment Agency, a surface water and/or groundwater monitoring plan as required, particularly in relation to works which may affect groundwater sensitive areas;
 - Undertaking further site-specific risk assessments associated with excavation work and impacts on surface water; groundwater; abstractions; aquifers and private water supplies;
 - Preparing site specific flood risk management plans for those areas at risk of flooding;
 - Avoiding the use of contaminating materials through appropriate design, construction and equipment specification and wherever possible, using biodegradable substances;
 - Following the measures outlined for the provision of suitable site drainage, for the storage and control of oils and chemicals and to mitigate against accidental spillages in the CoCP; and
 - Undertaking, as required, further site-specific pre-construction monitoring to establish baseline water quality conditions for watercourses; groundwater and during construction works. This would enable the effectiveness of those mitigation measures introduced to limit pollution risk to be monitored and any pollution incidents to be identified.
- 13.5.3 The following examples illustrate how the CoCP would reduce potential effects to levels that would not be significant:
- The Tilehouse Lane cutting would be through unsaturated Chalk and would not affect groundwater levels. Despite this, the fractured nature of the Chalk may provide preferential pathways to the groundwater table. There may, therefore be issues relating to groundwater quality resulting from turbidity or release of fluids from construction equipment. The CoCP requires selection, management and monitoring of material and construction practices to follow best practice, including spillage management. Therefore, the impact on groundwater from construction is likely to be negligible and no significant effect would occur;
 - Accidental spillages from the Colne Valley viaduct to the surface waters during construction would be managed by CoCP measures for working above water. Any impacts would be temporary and reversible, and no significant residual effects on the water environment or flood risk are anticipated; and
 - Where small private abstractions are remote from areas of excavation, impacts are predicted to be negligible and therefore not significant due to application of the CoCP.
- 13.5.4 The effects of construction identified below are those that fall outside the scope of the measures in the CoCP and/or may require special consideration in the design process. These focus on the potential that where the proposed route requires works in the saturated zone

they could impact on groundwater flows particularly in fractures and thus affect flows and water quality in the river and the public water supply abstractions, and on the potential impacts of works on the Mid Colne SSSI.

- 13.5.5 The nature and potential severity of the impacts of the viaduct on the River Colne and lakes of the SSSI will be assessed in the formal ES when the design has been developed and further information on the location of the piers and the construction methodology will be available. The construction of the viaduct across the River Colne would require a diversion of the watercourse over a short distance, to avoid the need for viaduct piers within or close to the river. This watercourse is of very high value and the construction works could have moderate potential impacts, but the diversion would be constructed in advance to meet the requirements of the EA in terms of flow capacity, and thus the impact on flow would be minor. There would be short lived and temporary impacts on water quality, but these would be managed by the CoCP and would also be minor. HS2 Ltd is continuing discussions with the EA to explore options for the diversion of the river during and following works, to keep disruption of the river to a practicable minimum. Due to the very high value of the river and lakes in the SSSI, this would be a significant effect.
- 13.5.6 A separate minor diversion to the Newyears Green Bourne may also be required. This would have slight, short term impacts, with no resulting significant effects. Confirmation of diversion works for both the River Colne and Newyears Green Bourne will be reported within the formal ES.
- 13.5.7 Tunnelling, piling and retaining wall construction could have the potential to impact on groundwater quality due to the migration of fluids or suspended bedrock particles giving rise to raised turbidity. Vertical migration of poorer quality surface water could be enhanced if piling methods do not contain adequate seals against surface strata. Notwithstanding the CoCP, there would be some potential risk for moderate impacts on groundwater quality, especially where construction takes place in layers of fissured (fractured) Chalk with high groundwater velocities that are most prevalent near large abstractions. Where fissures are also connected to high value receptors such as PWS or private boreholes, the impact on water quality and groundwater flows could be moderate, resulting in large or very large effects. This is primarily a concern within the Colne Valley viaduct southern approach embankment, in the area north of Moorhall Road and between Tilehouse Lane and Horn Hill. These effects are potentially significant and may require additional mitigation.
- 13.5.8 The piles and piers for the viaduct would pass into the high value groundwater receptor and be close to two of Affinity Water’s major PWS abstractions, cutting through their SPZ1. The construction of the piles could form a partial barrier to local groundwater flow. The impact to groundwater flow for these two PWS could, therefore, be moderate to very large due to the proximity of the piles to the abstraction sites. The effect could be significant, requiring further mitigation.
- 13.5.9 The Tilehouse Lane cutting would cut through a small section of Winter Hill Gravels which largely overlie the Chalk aquifer in this area. The route passes within 50m of a private abstraction (GW17) and through SPZ1 for a public water supply, both drawing water from the Chalk. The Winter Hill Gravels may contain discontinuous perched water, although any perched water within the gravels are considered to be a low value receptor with a negligible impact caused by the cutting and this would not be a significant effect⁸⁹.
- 13.5.10 The requirements for dewatering shallow groundwater for excavation works would be slight and short term but could have an effect on groundwater levels locally, particularly within the immediate area surrounding the construction of pile caps and any deep utility diversions in the

⁸⁹ Superficial deposits or shallow groundwater that is hydraulically separate from the deep aquifer.

area of the valley floor. The need for a river diversion and associated dewatering requirements cannot be fully evaluated until a final location for the piers, layout of the diversion and the construction methodology are available. However, for the majority of the Colne Valley groundwater levels are close to the surface in the floodplain gravels and so either working in the wet would be required, or some form of dewatering of the gravels. Both methods of construction would require appropriate planning and management, with compliance with CoCP procedures for managing runoff and discharge of water from construction. Dewatering would also have to comply with any conditions required by the EA. As a result, impacts to local groundwater and surface water, which are high value receptors, during construction would be minor and, therefore, not significant.

- 13.5.11 At this stage, it is considered that during viaduct construction temporary supports would be required in the River Colne and its floodplain. Scaffolding would occupy a minor portion of the floodplain. Any floodplain compensation would be in place prior to construction of the viaduct, and therefore the impact on river flood risk has been assessed as minor, resulting in an effect on local receptors that is not considered to be significant.
- 13.5.12 The construction worksites on Moorhall Road would lie within Flood Zone 2 and partially within Flood Zone 3 of the River Colne (see map CT-04-006). The National Grid Feeder Station would lie partially within Flood Zones 2 and 3. Site compounds and construction areas at risk of flooding could increase the risk of flooding elsewhere. In consideration of increases in flooding elsewhere, a potential slight adverse effect on local receptors could result, that is considered not significant. The site compounds for the Colne Valley viaduct, on Denham Way, and at the south portal of the Chiltern tunnel are both located in areas classified by the BGS as having a 'very high' susceptibility to groundwater flooding, however construction in these areas would not impact groundwater flow and would therefore not have a significant effect on local receptors.
- 13.5.13 Special precautions, in addition to the CoCP, may be required at worksites in dry valleys to ensure storage of construction materials is such that potential surface water contamination is avoided, particularly as the worksites in the area may be at risk from groundwater flooding in very wet periods. Application of these considerations at worksites would result in a negligible impact and an insignificant effect on water quality.

Likely residual significant effects

- 13.5.14 The permanent diversion to the River Colne would be a significant effect on the existing channel, but the new channel would be constructed to reduce, as far as reasonably practicable, effects upon the physical and ecological character of the river in the locality. Given the value of the surface water features at this location, additional mitigation is anticipated to be required.
- 13.5.15 There may be localised significant effects of temporary dewatering on groundwater levels, flows and quality during construction.
- 13.5.16 There could be potential significant effects of the Proposed Scheme on the operations of Affinity Water and private abstractions during the construction phase. It is anticipated that arrangements and undertakings will be agreed between HS2 Ltd and all stakeholders, including Affinity Water, and these will be reported in the formal ES.

Further mitigation

- 13.5.17 Further measures currently being considered but which are not yet part of the design include:
- The permanent diversion of the River Colne would be expected to stabilise in terms of flow and water quality without further mitigation as the diverted section becomes established.

In order to ensure that conditions within the watercourse are not compromised, monitoring would extend into operation until conditions have stabilised, with appropriate remedial action being taken if required, following discussion and agreement with the EA and other relevant parties;

- Where tunnelling, piling and retaining walls, or other below ground structures, are required:
 - Avoidance of works in the saturated zone, where reasonably practicable;
 - Installation of cut-off structures around excavations, and ensure cut-off structures are driven to sufficient depths to meet an underlying strata or zone of lower permeability; and
 - Selection of piling techniques to avoid creating pathways between the Chalk aquifer and shallower surface water or groundwater. In particular, withdrawal of sheet piles should be avoided, where practicable, if these have penetrated the lower permeability layers below the main gravel layers; and
- Monitoring would be used to quantify any actual impact during the construction phase on the aquifer or any PWS. Appropriate trigger levels for flow and quality would be required to underpin prompt decision-making in relation to a hierarchy of further mitigation. Consultations on the monitoring, flow and groundwater quality trigger levels and mitigation plans are ongoing with interested parties, which include Affinity Water and private water abstractors.

13.6 Operation

Assessment of impacts and mitigation

- 13.6.1 The Proposed Scheme has been designed to control impacts on the water environment through the following:
- Drainage has been designed to reduce the rate and volume of run-off from the railway and prevent an increase in flood risk;
 - Sustainable drainage system (SuDS), where appropriate, have been included to encourage water to soak back into the ground; and where drainage or cuttings intercept groundwater flow; and
 - SuDS would also provide opportunities to reduce, as far as reasonably practicable, the effects on water quality by reducing potential contaminants through filtration, vegetation adsorption or settlement.
- 13.6.2 Best practice pollution control guidance would be adopted as far as reasonably practicable for maintenance of the Proposed Scheme.
- 13.6.3 Where discharges are required, track and land drainage would discharge to a sewer or watercourse under an appropriate consent from Thames Water, LLFA and the EA, or the Canal and River Trust covering water quality and runoff rates. The portals, cuttings and embankments and associated access roads and hard standings would be designed to reduce as far as reasonably practicable peak runoff rates through use of Sustainable drainage system (SuDS) techniques. Overall there would be a negligible and insignificant effect on surface water from these sources.
- 13.6.4 The current viaduct design for the River Colne crossing has one pier footing in the river channel. As discussed in Section 13.4, if the piers cannot be realigned, a permanent short diversion would need to be installed. The diverted channel would be designed such as to maintain capacity in the watercourse resulting in a negligible change in flow upstream or

downstream of the diversion. No permanent effects would be anticipated. The pier placement and diversion will be considered in more detail and included in the formal ES.

- 13.6.5 Given the high value of the SSSI and the proposed discharges of surface water to the River Colne via downpipes on the viaduct piers, the need for and nature of treatment mechanisms to manage potential water quality impacts on the SSSI will be defined in ongoing discussion with the EA and Natural England, and reported in the formal ES. With appropriate mitigation there would be a negligible adverse impact upon the SSSI/River Colne/Savay Lake areas' chemical, physical, and biological condition (see map CT-02-006), resulting in negligible non-significant effects.
- 13.6.6 The operational impacts on groundwater and private water supplies would be negligible overall and would not be significant. Impacts on public water abstractions need to be assessed in more detail, and would depend on the depth that the majority of flow into abstraction boreholes took place compared to the depth of piling. Consultation is taking place with Affinity Water to confirm how to mitigate any potential effects and this will be reported in the formal ES.
- 13.6.7 Harvil Road would be permanently realigned as part of the Proposed Scheme, and raised above the 1 in 1000 year annual probability (0.1%) flood level on embankment. A clear span overbridge is proposed to allow the Newyears Green Bourne to flow beneath the road embankment. Enlarging the existing watercourse crossing, which currently poses an obstruction to flood flows, would have an impact on the risk of flooding to local receptors from the Newyears Green Bourne. Flood water levels upstream of the embankment would be reduced; however downstream flood water levels have the potential to increase (the precise effect is being modelled and would be reported in the formal ES). Although there is a beneficial effect upstream due to the reduction in flood risk, the potential impact on downstream receptors could result in a significant adverse effect, which will be determined through further modelling and reported in the formal ES.
- 13.6.8 The design of the Harvil Road overbridge across the Newyears Green Bourne would incorporate measures to prevent increases in the risk of flooding downstream. Such measures could potentially include construction of a flood storage area, channel and/or floodplain re-profiling, or replication of the capacity of the existing crossing within the new design. The formal ES will include details of appropriate mitigation.
- 13.6.9 The 3.3km long viaduct would span the 1 in 1,000 year annual probability (0.1%) floodplain. Although not modelled, water velocities in the floodplain are expected to be relatively low due to the width of the floodplain and presence of lakes. Thus the impact of piers within the floodplain on river flow patterns would be negligible and not significant. Regardless of the impact of the viaduct piers on the dynamic characteristics of the floodplain, the built volume of the piers within the floodplain would cause displacement of flood water through the removal of floodplain storage and causing a moderate impact on river flood risk, resulting in moderate effects on local receptors.
- 13.6.10 The need for a viaduct pier in the channel of the River Colne and the need for, and nature of, any diversion is still to be finalised, so the potential impact on flood risk cannot be fully assessed. The impact will be assessed and reported in the formal ES.
- 13.6.11 The impact of the National Grid Feeder Station in the floodplain of the Newyears Green Bourne on the risk of river flooding is minor, resulting in a non-significant effect on local receptors.

Likely residual significant effects

- 13.6.12 The residual effects on the surface water environment include those from the addition of piers for the viaduct to the lakes and the River Colne and a permanent diversion of the river. The consultation processes with the EA will ensure that any residual effect would be negligible, without the need for further mitigation. In order to ensure that conditions within the water maintains appropriate monitoring would be agreed with the Environment Agency and Natural England to ensure that the water environment stabilises following the modifications, with appropriate remedial action being taken if required.
- 13.6.13 There could be ongoing effects from construction on groundwater flow as a result of piles close to one of the PWS. Mitigation should continue from construction, as appropriate.

Further mitigation

- 13.6.14 Appropriate mitigation would be identified through discussion with the EA to ensure that surface water impacts from the viaduct piers and rail and non-rail drainage are reduced as far as reasonably practicable. These should include appropriate drainage design and selection of mitigation for the viaduct piers during construction.
- 13.6.15 Further measures currently being considered but which are not yet part of the design include:
- Hs2 Ltd will continue to discuss mitigation options with Affinity Water to explore options that would reduce, as far as reasonably practicable, the impact of any reduction in the yield of the source and impacts on customers.

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