LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 2 | Community Forum Area report

CFA12 | Waddesdon and Quainton

November 2013

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ES 3.2.1.12

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Department for Transport

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

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Structure of the HS2 Phase One Environmental Statement

The Environmental Statement (ES) documentation comprises:

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

1 Introduction

1.1 Introduction to HS2

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

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

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

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

1.1.5 Section 4 of Volume 1 describes the anticipated operational characteristics of HS2, including the anticipated frequency of train services. As Volume 1 shows, the frequency of trains is expected to increase over time and to increase further upon opening of Phase Two. In assessing the environmental effects of the Proposed Scheme the anticipated Phase 2 operational frequency has been used. For further detail of the anticipated operation of the Proposed Scheme in the Waddesdon and Quainton area (CFA12), see Section 2.4.

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

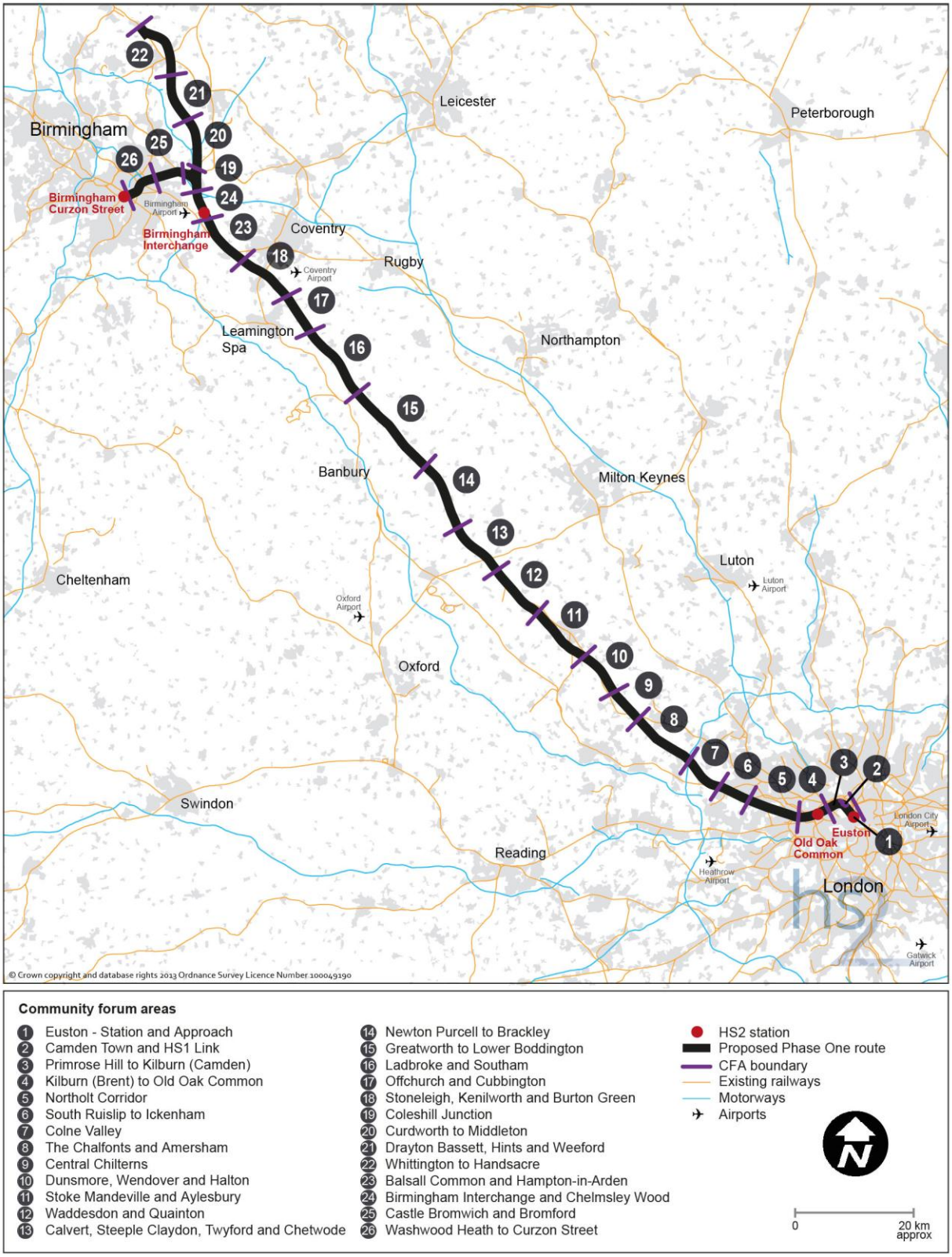
1.1.7 For consultation and environmental assessment purposes, the proposed Phase One route has been divided into 26 community forum areas (CFA), as shown in Figure 1. This has enabled wider public engagement on the Proposed Scheme design and on the likely adverse and beneficial effects.

1.2 Purpose of this report

1.2.1 This CFA report presents the likely significant effects of the construction and operation of the Proposed Scheme on the environment within CFA12 (Waddesdon and Quainton). The report describes the mitigation measures that are proposed for the purpose of avoiding,

reducing or managing the likely significant adverse effects of the Proposed Scheme on the environment within CFA12.

Figure 1: HS2 Phase One route and community forum areas



1.3 Structure of this report

1.3.1 This report is divided into the following sections:

- Section 1 – an introduction to HS2 and the purpose and structure of this report.
- Section 2 – overview of the area, description of the Proposed Scheme within the area and its construction and operation, and a description of the main local alternatives.
- Sections 3-13 – an assessment for the following environmental topics:
  - agriculture, forestry and soils (Section 3);
  - air quality (Section 4);
  - community (Section 5);
  - cultural heritage (Section 6);
  - ecology (Section 7);
  - land quality (Section 8);
  - landscape and visual assessment (Section 9);
  - socio-economics (Section 10);
  - sound, noise and vibration (Section 11);
  - traffic and transport (Section 12); and
  - water resources and flood risk (Section 13).

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

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

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

1.3.5 The maps relevant to Waddesdon and Quainton are provided in a separate corresponding document entitled Volume 2: CFA12 Map Book, which should be read in conjunction with this report.

1.3.6 The Proposed Scheme described in this report is that shown on the Map Series CT-05 (construction) (Volume 2, CFA12 Map Book) and CT-06 (operation) (Volume 2, CFA12 Map

Book). There is some flexibility during detailed design to alter the horizontal and vertical alignments and other details within the limits shown on the plans and sections submitted to Parliament and as set out in the Bill and this flexibility is included within the scope of the environmental assessment. Further explanation is provided in Volume 1, Section 1.4.

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

2 Overview of the area and description of the Proposed Scheme

2.1 Overview of the area

2.1.1 The Waddesdon and Quainton CFA covers approximately 10km of the Proposed Scheme in Aylesbury Vale District, from just south of the A41 Bicester Road (also known as Aylesbury Road) to the north-western tip of Sheephouse Wood, south-west of Calvert. The area includes the district wards of Waddesdon, Quainton, Grendon Underwood, Steeple Claydon and Marsh Gibbon. It extends from the parish of Waddesdon in the south-east, across Quainton and Grendon Underwood parishes to Calvert Green parish in the north-west.

2.1.2 Stoke Mandeville and Aylesbury (CFA 11) is located to the south and Calvert, Steeple Claydon, Twyford and Chetwode (CFA 13) is to the north, as shown on Figure 2.

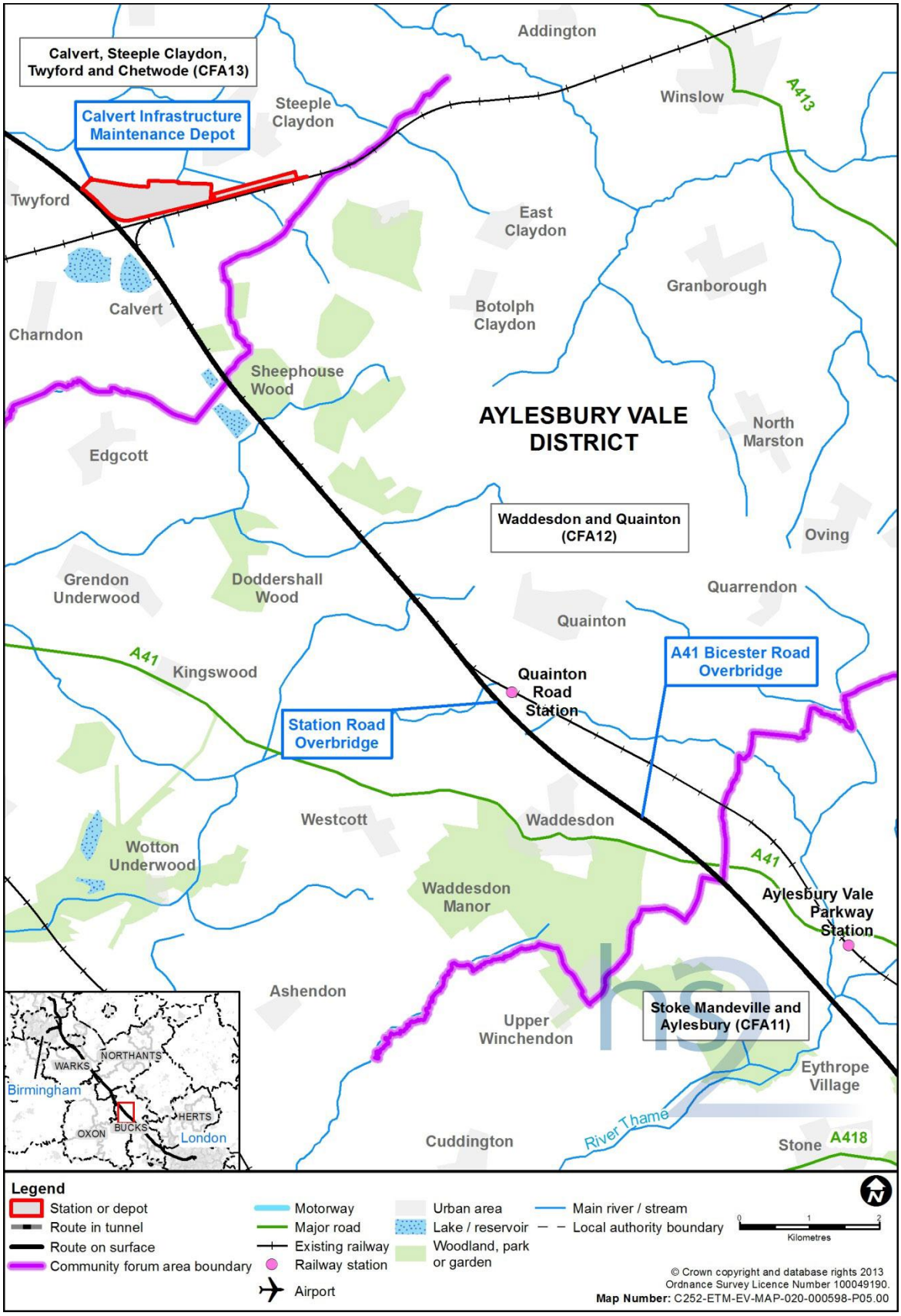
Settlement, land use and topography

2.1.3 The Waddesdon and Quainton area is predominantly rural comprising mixed agricultural land. This is influenced in the south by the Midvale limestone ridge and in the north by the clay lowlands. The topography is generally low-lying, gently undulating and crossed by several minor watercourses, with a few noticeable hills, such as Lodge Hill near Waddesdon, Quainton Hill north of Quainton and Finemere Hill within the northern part of the area. Development is typically scattered farmsteads and villages (see Maps CT-10-025 to CT-10-028 in Volume 2, CFA12 Map Book).

2.1.4 The village of Waddesdon is approximately 600m south-west of the Proposed Scheme, which will pass the southern edge of Quainton, approximately 1.5km south-west of the village centre. Westcott and Edgcott are more than 1.5km from the Proposed Scheme. Aylesbury is the nearest main town, approximately 3km to the south-east in the Stoke Mandeville and Aylesbury area.

2.1.5 The Proposed Scheme crosses two main watercourses, the River Ray and Muxwell Brook, which both run east to west. The River Ray crosses the route between Woodlands Farm and Woodlands Farm Cottages and Muxwell Brook follows the boundary of Sheephouse Wood and Calvert Landfill (see Maps CT-10-027 and CT-10-028 in Volume 2, CFA12 Map Book). In addition, the route crosses several small ponds and unnamed drains, and there are a number of similar water features within 1km of the route.

Figure 2: Area context map



Key transport infrastructure

2.1.6 The Proposed Scheme will run to the east of the A41 Bicester Road (also known as Aylesbury Road), the main highway through the area. This is a busy single carriageway

which runs between London and Wendlebury, linking Aylesbury with Bicester. At Watford it bisects the M25 at Junction 20 and terminates at Wendlebury where it joins the M40 at Junction 9.

2.1.7 The Proposed Scheme will run to the east of the Chiltern Main Line, which runs through the area.

2.1.8 The Aylesbury Link railway line also passes through the area and follows the line of the former Great Central Main Line (GCML) and is operational as far as the intersection with the Bicester to Bletchley Line at Claydon Junction, but disused north of Calvert. The Aylesbury Link railway line is currently a single track railway and runs up to a total of four freight train movements a day to and from the Calvert Landfill site.

2.1.9 The Proposed Scheme will run to the west of and parallel with the Aylesbury Link railway line for approximately 8km, between the former Quainton Road Station and the Bicester to Bletchley Line at Calvert.

2.1.10 Network Rail (NR) is working with East West Rail and other consortium to deliver the East West Rail Project which will improve the lines in this area. This will upgrade existing infrastructure on the Bicester to Bletchley Line and Aylesbury Link railway line, including enhanced rail freight and reinstated passenger services.

2.1.11 The Proposed Scheme will cross five local roads (including the A41) and 13 PRoW, which provide links between the scattered dwellings, Waddesdon and Quainton and the surrounding villages. The local roads provide routes to the larger settlements of Aylesbury, Bicester and Leighton Buzzard.

Socio-economic profile

2.1.12 To provide a socio-economic context for the area, data for the demographic character areas (DCA) of: Waddesdon; and Quainton, Shipton Lee and Greatmoor are used[1]. In total, the population of the DCA is approximately 3,200. The area's labour market outperforms England's as a whole; unemployment at 3.4% is lower than the national level of 7.4%, while 75.4% of the population aged 16-74 is economically active compared to the national figure of 69.9%[2]. There are approximately 700 people who work within the area[3].

Notable community facilities

2.1.13 The main shops and services are located in the village of Waddesdon with a few neighbourhood shops in Quainton and Calvert. Waddesdon has a range of local facilities, principally on the High Street. These include two churches, a village hall and a Methodist hall (both used as local meeting places), a doctor's surgery, a dental practice, a number of schools and nurseries including a children's centre run by Barnardos. There are also a number of public houses, veterinary surgeries, hairdressers, a convenience store, a restaurant, a takeaway food outlet and a hotel. Waddesdon also has a police station and fire station located on the High Street. Waddesdon Manor and gardens, which include a number of listed features, is a significant local and regional visitor attraction managed by

[1] A DCA represents a community that, depending on the area, may consist of a local ward, neighbourhood or village(s). DCA unemployment rates are aggregated in this section and they are separated out for each DCA in Section 10.3.
[2] Data comes from the 2011 Population Census.
[3] Data comes from the 2011 business register and employment survey.

National Trust. All these local facilities are located within or just beyond 1km of the Proposed Scheme. The nearest hospital is the Royal Buckinghamshire in Aylesbury.

Recreation, leisure and open space

2.1.14 Recreational infrastructure includes a number of allotments in Waddesdon, recreation ground at Waddesdon, facilities at Waddesdon Church of England School (a sports hall, all weather playing pitches and a dance studio that are available for hire) and a cricket ground at Waddesdon Manor. Waddesdon Manor has a woodland playground used by the local community as well as visitors to the Manor. The Buckinghamshire Railway Centre located at the former Quainton Road Station is adjacent to the Proposed Scheme and occupies a 10ha site. Nearby is a play area serving the new Sechfields residential estate. Several long distance walking and riding routes run through the area including the North Buckinghamshire Way, Swan's Way, Midshires Way and Bernwood Jubilee Way. A number of public footpaths and bridleways also link the villages and open spaces of Grendon and Doddershall Woods. Informal recreation spaces, which offer open access, include Grendon and Doddershall Meadows and several other local woods.

Policy and planning context

Planning framework

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

2.1.16 The South East Biodiversity Strategy[4] is relevant to the Waddesdon and Quainton area and provides a framework for the delivery of biodiversity targets and improvements across the region. The South East Biodiversity Strategy also identifies Biodiversity Opportunity Areas and Biodiversity Action Plan (BAP) targets for the improvement of biodiversity.

2.1.17 The following development plan documents have been considered and referred to where appropriate to the assessment. Where a policy document is not referred to within a particular technical section, it is due to the absence of policies of relevance to that topic:

- Buckinghamshire County Council Structure Plan[5];
- Buckinghamshire County Council Minerals and Waste Core Strategy DPD (MWCS) (2012)[6];
- Aylesbury Vale District Local Plan (Saved Policies)[7]; and
- Vale of Aylesbury Plan Strategy[8].

2.1.18 There are a number of key planning and environmental designations in the area, which include conservation areas, listed buildings, scheduled monuments, important archaeological sites, historic parks and gardens and ancient woodland. These are shown on Maps CT-10-25 to CT-10-028 (Volume 2, CFA12 Map Book).

[4] South East England Biodiversity Forum (2009), South East Biodiversity Strategy.

[5] Buckinghamshire County Council (1991), *Buckinghamshire Structure Plan 1991-2011* (Saved Policies).

[6] Buckinghamshire County Council (2012), *Minerals and Waste Core Strategy Development Plan Document.*

[7] Aylesbury Vale District Council (2007), *Aylesbury Vale District Local Plan* (Written Statement 2004 Saved Policies).

[8] Aylesbury Vale District Council (2013), *Vale of Aylesbury Plan Strategy 2011 – 2031* (Submission August 2013).

2.1.19 Emerging policies are not generally considered within this report, unless a document has been submitted to the Secretary of State for approval. It is worth noting that, although the Vale of Aylesbury Plan Strategy 2011-2031 has been submitted to the Secretary of State, until it is adopted the Aylesbury Vale District Local Plan (Saved Policies) still has weight.

Committed development

2.1.20 Developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme, are shown on Maps CT-13-025 to CT-13-028 (Volume 2, Cross Topic Appendix 1 Map Book) and listed in Volume 5: Appendix CT-004-000. Except where noted otherwise in Volume 5: Appendix CT-004-000, it has been assumed that these developments will have been completed by 2017. These are termed 'committed developments' and are treated as potential receptors from the Proposed Scheme. Notable committed developments within the area, which by virtue of being completed by 2017, form part of the future baseline for construction and operation, include:

- East West Rail (EWR) is a strategic project to improve the railway from Oxford to Bicester (Phase 1) and Bicester to Bletchley railway line, including the Aylesbury Link railway line (Phase 2), onwards to East Anglia. The EWR project proposes to provide the upgrade of existing operational rail lines and reinstating sections of disused rail for the provision of new, fast passenger and freight services. A TWA Order has been granted for Phase 1 and construction has commenced. Phase 2 has committed funding and will, where necessary, be subject to further planning applications and/or TWA applications;
- Calvert Strategic Waste Site Allocation Cs11 and CS12 (related application 11/20000/AWD Greatmoor Farm Calvert Landfill Site, Brackley Lane, Calvert Buckinghamshire). A strategic waste complex at Calvert Landfill Site and will include a facility for the recovery of energy from residual waste; and
- ref 10/00722/APP Faccenda Hatcheries, Quainton Buckinghamshire, HP22 4BY. Extension of time limit for application 07/00526/APP in respect of extensions to hatchery with alteration to access (renewal of 02/00571/APP).

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

2.1.22 No major developments, however, have been identified which are likely to have cumulative effects, when considered together with the Proposed Scheme within the Waddesdon and Quainton area.

2.2 Description of the Proposed Scheme

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

2.2.2 The Proposed Scheme will require some land on a permanent basis, key features of which are illustrated on the Map Series CT-06 (Volume 2, CFA12 Map Book). Land will also be required on a temporary basis for construction and is set out in Section 2.3.

2.2.3 In general, features are described from south to north along the route (and east to west for features that cross HS2).

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

- realignment of the A41 Bicester Road and Blackgrove Road crossings east of Waddesdon;
- realignment of the proposed layout of Station Road and re-prioritisation of junctions with Quainton Road and Fidlers Field Road;
- inclusion of additional habitat mitigation including in particular in the vicinity of Doddershall House; and
- relocation of the National Grid substation to the east side of the Proposed Scheme near to the Quainton auto-transformer feeder station.

Overview

2.2.5 The Proposed Scheme through the Waddesdon and Quainton area will be approximately 10km in length. It will commence just south of the A41 Bicester Road, near Fleet Marston, proceeding north-westwards, with Waddesdon to the south-west. It will pass through the southern edge of Quainton, near the Buckinghamshire Railway Centre, and will then run parallel to the Aylesbury Link railway line crossing over the River Ray and passing Finemere Wood. The route will exit the area at the north-west corner of Sheephouse Wood, to the south-east of Calvert (see Maps CT-06-047 to CT-06-053).

A41 Bicester Road realignment and overbridge

2.2.6 The Proposed Scheme will continue from the Stoke Mandeville and Aylesbury area (CFA11) on an approximately 950m long and up to 3m high embankment, running to approximately 600m past the existing A41 Bicester Road. The route will then continue north-west in a cutting up to 14m deep for approximately 450m. The A41 Bicester Road will be realigned to the north of its present alignment for a length of approximately 1.3km. The realigned road will run parallel and to the north-east of the Proposed Scheme between Hunters Farm and Wayside Farm. It will then cross over the Proposed Scheme, which will be in cutting, on an overbridge and run south westwards to rejoin the existing A41 Bicester Road approximately 600m west of The Grand Lodge. Key features of this section, which is approximately 1.4km long, will include (see Maps CT-06-047 and CT-06-048Maps):

- a replacement floodplain storage area to the west of the Proposed Scheme, which will be excavated and re-graded to approximately 1m below existing ground level[9];

[9] All replacement floodplain storage areas will be re-graded to tie back into existing ground level and returned to agriculture, wherever the farming practices are compatible with the land use.

- Putlowes auto-transformer station[10], with access along the existing A41 Bicester Road;
- landscape earthworks on both sides of the route and on the east side of the realigned A41 Bicester Road for the full length of this section, to integrate the Proposed Scheme and highway into the landscape and provide visual screening for local properties;
- planting on the eastern embankments of the realigned A41 Bicester Road to screen views of the new road and roundabout for local residents;
- two balancing ponds, one for highway drainage and one for railway drainage, to the east of the Proposed Scheme;
- new private access to Lower Blackgrove Farm and Lower Blackgrove Farm cottages from the realigned A41 Bicester Road;
- downgrading of the existing A41 Bicester Road on the west side of the Proposed Scheme between The Grand Lodge and Cranwell Farm to provide a private access;
- a land drainage area on the west side of the Proposed Scheme between the landscape earthworks and the existing A41 Bicester Road;
- an ecological mitigation area to provide habitat compensation to the west of the Proposed Scheme;
- removal of a length of the existing Blackgrove Road to the east of the route for approximately 300m. The remaining land will be treated in such a way that will be consistent with its end-use;
- an overbridge to take the A41 Bicester Road over the Proposed Scheme. The northern approach to the crossing will incorporate a lit roundabout connecting the realigned A41 to Blackgrove Road. The overbridge and roundabout will be up to 3m above existing ground level. On the west side of the overbridge the realigned road will connect to the existing A41 to the south of Waddesdon and west of The Grand Lodge;
- a T-junction to provide access to the existing A41 alignment past The Grand Lodge, providing local access;
- diversion of Footpath WAD/5 so that it follows the realigned Blackgrove Road and crosses the Proposed Scheme via the A41 Bicester Road overbridge; and
- a balancing pond for highway drainage on the west side of the Proposed Scheme to the south of the realigned A41 Bicester Road.

2.2.7 Construction of this section will be managed from the A41 Bicester Road overbridge satellite compound and Putlowes auto-transformer satellite compound (see Section 2.3).

[10] HS2 trains will draw power from overhead line equipment, requiring feeder stations and connections to the 400kV National Grid network. In addition to feeder stations, smaller auto-transformer stations will be required at more frequent intervals. There will be one feeder station and one auto-transformer station required in the local area.

Waddesdon south and north cuttings

2.2.8 The route will continue north-west in a cutting for approximately 1.1km from the A41 Bicester Road overbridge through farmland east of Waddesdon to the Waddesdon sewage treatment works. The cutting will be up to 16m deep. Curving gently towards the north-west, the route will then pass out of the cutting and on to an embankment, approximately 400m long and up to 3m high and then continue north-west in a further cutting, up to 5m deep for approximately 400m. Key features of this section, which is approximately 1.9km long, will include (see Maps CT-06-048 and CT-06-049):

- landscape earthworks on the west side of the route, from the A41 Bicester Road overbridge and on both sides of the route from 600m north of the overbridge to the northern end of this section, to integrate the route into the landscape and provide visual screening for local properties and to also provide sound mitigation for local properties on the west side of the route north of Glebe Farm;
- Footpath WAD/4 accommodation overbridge will provide public right of way (PRoW) connectivity and access for Glebe Farm over the Proposed Scheme. The overbridge will be up to 4m above existing ground level;
- noise fence barriers approximately 4m high and 200m long at the base of the cutting, on the west side of the Proposed Scheme to the east of Glebe Farm;
- Footpath WAD/3 accommodation underbridge to provide PRoW connectivity, access for Glebe Farm and access to the Waddesdon sewage treatment works below the Proposed Scheme. The crossing will be up to 3m below existing ground level;
- a pumping station, land drainage area and culvert immediately south of Footpath WAD/3 accommodation underbridge. The land drainage will discharge into an unnamed watercourse to the north-east of the Aylesbury Link railway line and will require a 500m long drainage channel and culvert through the existing railway embankment; and
- an ecological mitigation area to provide habitat compensation to the west of the Proposed Scheme.

2.2.9 Construction of this section will be managed from the A41 Bicester Road overbridge satellite compound (see Section 2.3).

Quainton south and Doddershall embankments

2.2.10 The Proposed Scheme will then continue onto embankment, up to 3m high, for approximately 1.2km to the Station Road overbridge to the west of the Buckinghamshire Railway Centre at Quainton. The route will proceed into an approximately 550m long cutting, up to 3m deep, until it converges with the existing Aylesbury Link railway line corridor. The two routes will then run parallel on an embankment up to 5m high and approximately 1.5km long. Key features of this section, which is approximately 3.2km long, will include (see Maps CT-06-049 to CT-06-051):

- land drainage areas on both sides of the Proposed Scheme, south-east of Needles Farm accommodation overbridge;

- a replacement floodplain storage area south-east of Needles Farm accommodation overbridge, which will be excavated to approximately 1m below existing ground level and re-graded;
- noise fence barriers approximately 4m high and 1km long, on the east side of the Proposed Scheme at the top of the embankment, running from south of the Needles Farm accommodation overbridge to the Station Road overbridge;
- Needles Farm accommodation overbridge to provide access to the land south of the Buckinghamshire Railway Centre. The overbridge will be up to 10m above existing ground level;
- a land drainage area to the east of the Proposed Scheme south-east of the existing Station Road;
- closure of a section of Station Road on either side of the crossroads with Quainton Road and provision of a turning head for access to the Buckinghamshire Railway Centre for long vehicles;
- seven replacement floodplain storage areas to the east and west of the Proposed Scheme between the existing and realigned Station Road; these will be excavated and re-graded to approximately 1m below existing ground level;
- a balancing pond for railway drainage to the west side of the route, north of the existing Station Road;
- an area of ecological mitigation to provide habitat compensation to the west of the route between the existing Station Road and the Station Road overbridge;
- two overbridges to take the realigned Station Road over the Proposed Scheme and the Aylesbury Link railway line. The overbridges will be up to 10m high;
- realignment of Station Road up to approximately 450m north of its existing alignment, to the east and west of the route, to connect the proposed Station Road overbridges to Quainton Road, Fidlers Field Road and Station Road;
- three balancing ponds for drainage of the realigned highway;
- removal of a length of the existing Fidlers Field Road to the east and west of the route for approximately 450m. This section of road will be replaced by the new road realignments. The remaining land will be treated in such a way that will be consistent with its end-use;
- a diverted access road to Doddershall House and Upper and Lower South Farms;
- landscape earthworks on the west side of the Proposed Scheme from north of Station Road overbridge to the end of this section, to integrate the cutting and embankment into the landscape and provide visual screening;
- a balancing pond for railway drainage to the east of the Proposed Scheme with associated access track from Fidlers Field Road;

- an area of ecological mitigation, which will provide habitat compensation for the loss of land at Grendon and Doddershall Meadows, on both sides of the route at the proposed Bridleway QUA/28A overbridge;
- Bridleway QUA/28A overbridge, to provide PRoW connectivity over the Proposed Scheme. The overbridge will be up to 12m above existing ground level;
- a land drainage area to the west and a balancing pond for railway drainage to the east of the Proposed Scheme, with an associated access track from Edgcott Road (also known as Shipton Lee Road);
- a replacement floodplain storage area on the east side of the route, to the east of the Aylesbury Link railway line, which will be excavated and re-graded to approximately 1m below existing ground level; and
- Footpath QUA/26 accommodation underbridge to provide PRoW connectivity and farm access under the Proposed Scheme. The crossing will be up to 2m below existing ground level.

2.2.11 Construction of this section will be managed from the Station Road overbridge and the Woodlands cutting satellite compounds (see Section 2.3).

Grendon Underwood embankment and Woodlands cutting

2.2.12 The Proposed Scheme will continue to run parallel to the Aylesbury Link railway line on its west side. The Proposed Scheme will be at approximately the same level as the Aylesbury Link railway line, on a series of embankments and cuttings. It will cross the River Ray approximately 7m above existing ground level. At the northern end of the section the route will run between the Calvert Landfill site, to the west, and Sheephouse Wood, to the east, for approximately 800m. Alongside Sheephouse Wood the Aylesbury Link railway line will be realigned to the east by up to 3m[11]. Key features of this section, which is approximately 3.6km long, will include (see Maps CT-06-051 to CT-06-053):

- landscape earthworks on the west side of the Proposed Scheme from the start of this section to approximately 250m north of the Edgcott Road overbridge, to integrate the route into the landscape and provide visual screening;
- Quainton auto-transformer feeder station to convert power from the adjacent National Grid sub-station to traction power for the high speed railway line, to the east of the Proposed Scheme, south of Edgcott Road. The power lines from the auto-transformer feeder station will cross the Aylesbury Link railway line;
- a National Grid sub-station to the north-east of the Edgcott Road overbridge and east of the meadow section of Finemere Wood nature reserve;
- relocation of an overhead electricity pylon and diversion of overhead power lines to accommodate the Proposed Scheme and provide a connection to the proposed National Grid sub-station;
- Edgcott Road overbridge on the south-east side of the current road alignment. The overbridge will be up to 6m above existing ground level with planting on the

[11] The realignment is within the Aylesbury Link railway corridor and will allow for a second track to be added as part of the East West Rail improvements.

approach embankments to provide visual screening and to integrate the structure into the landscape;

- a realigned access into the meadow section of Finemere Wood nature reserve;
- a replacement floodplain storage area to the south-east of Woodlands Farm, which will be excavated and re-graded to approximately 1m below existing ground level;
- a land drainage area to the west of the Proposed Scheme adjacent to Woodlands Farm Cottages;
- enhancement of the existing vegetation along the banks of the River Ray to reinforce the existing wildlife corridor;
- Adam's accommodation underbridge extending the existing underbridge under the Aylesbury Link railway line to maintain farm access under the route and maintain and enhance existing habitat links across the route for bats and other wildlife. The crossing will be up to 2m below existing ground level. The existing culvert for the River Ray which crosses the Proposed Scheme under the accommodation access underbridge will be extended;
- a vegetation management zone along the eastern side of the Aylesbury Link railway line from the River Ray to the Footpath CAG/2 underbridge south of Sheephouse Wood, and along the western side of the route from just south of Bridleway GUN/28 accommodation green overbridge to beyond the Waddesdon to Quainton area boundary. Existing vegetation will be removed in these zones as part of the mitigation approach for ecology;
- Bridleway QUA/36 accommodation green overbridge, a replacement of the existing crossing over the Aylesbury Link railway line to provide a multi-use crossing as a footpath and farm access, and to maintain and enhance existing habitat links across the route for bats and other wildlife. The overbridge will be up to 9m above existing ground level;
- areas of planting to maintain and enhance habitat corridors/links between existing woodland and the dedicated green crossing points across the Proposed Scheme. Between Finemere Wood and Sheephouse Wood, these planting areas will be purposefully set back from the route as part of the mitigation approach for ecology;
- Bridleway GUN/28 accommodation green overbridge, a replacement of the existing crossing over the Aylesbury Link railway line to provide a multi-use crossing point for a bridleway, footpath farm access, and to maintain and enhance existing habitat links across the route for bats and other wildlife. The overbridge will be up to 10m above existing ground level;
- realigned Bridleway GUN/25 along the western edge of the existing drainage ditch (known as the 'Mega Ditch');
- a balancing pond for railway drainage with maintenance access tracks to the west of the route, north of Oak Tree Farm;

- a balancing pond for railway drainage to the east of the route, south of Sheephouse Wood;
- realigned Footpath GUN/30 around the balancing pond and to the existing bridge under the Aylesbury Link railway line and the Footpath CAG/2 underbridge. The existing level crossing over the Aylesbury Link railway line will be stopped up;
- a replacement floodplain storage area to the south of Sheephouse Wood, which will be excavated and re-graded to approximately 1m below existing ground level;
- Footpath CAG/2 underbridge located adjacent to the existing underbridge on the Aylesbury Link railway line, to maintain and enhance existing habitat links under the route for bats and other wildlife. The crossing will be up to 1m below existing ground level and will also provide a maintenance access route to the balancing pond to the east of the Proposed Scheme;
- enhancement of existing vegetation along the banks of Muxwell Brook to improve an existing habitat corridor;
- extension of an existing flood relief culvert approximately 20m north of Footpath CAG/2 underbridge and of the Muxwell Brook culvert, which will both cross under the Aylesbury Link railway line;
- Sheephouse Wood mitigation structure will be provided to avoid potential impacts on bats crossing the HS2 corridor adjacent to Sheephouse Wood. This will extend from the south of Sheephouse Wood to its northern extent at Footpath SCL/13 green overbridge, a distance of approximately 800m. The structure will provide a physical barrier to bats and for purposes of this ES has been assessed as a box shaped enclosure. This will be up to approximately 10m above rail level. Lighting will be used, if required, to discourage bats from flying close to areas of wind turbulence around the structure. This will be designed for minimal light spillage;
- planting across the end of the woodland ride within Sheephouse Wood; and
- the single existing track of the Aylesbury Link railway line will be realigned eastwards, leaving space for the addition of a second NR track in the future within the existing railway boundary and providing space for the Sheephouse Wood mitigation structure. The track will be realigned by approximately 3m from 200m south of Footpath CAG/2 underbridge to the northern end of Sheephouse Wood.

2.2.13 Construction of this section will be managed from the Woodlands cutting/Quainton auto-transformer feeder station satellite compound and the School Hill green overbridge satellite compound (CFA13) (see Section 2.3).

2.3 Construction of the Proposed Scheme

2.3.1 This section sets out the strategy for construction of the Proposed Scheme in the Waddesdon and Quainton area, including:

- overview of the construction process;
- description of the advance works;
- description of the engineering works to build the railway;

- construction waste and material resources;
- commissioning the railway; and
- indicative construction programme.

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

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

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

Overview of the construction process

2.3.5 Building and preparing the railway for operation would comprise the following general stages.

- advance works, including: site investigations further to those already undertaken; preliminary mitigation works; preliminary enabling works;
- civil engineering works, including: establishment of construction compounds; site preparation and enabling works; main earthworks and structure works; site restoration and removal of construction compounds;
- railway installation works, including: establishment of construction compounds; infrastructure installation; connections to utilities; changes to the existing rail network and removal of construction compounds; and
- system testing and commissioning.

2.3.6 General provisions relating to the construction process are set out in more detail in Volume 1, Section 6.5 and the draft CoCP (see Volume 5: Appendix CT-003-000/1) including:

- the approach to environmental management during construction and the role of the Code of Construction Practice (draft CoCP, Section 3);
- working hours (draft CoCP, Section 5.2);
- the management of construction traffic (draft CoCP, Section 14); and
- the handling of construction materials (draft CoCP, Section 16).

Advance works

2.3.7 General information about advance works can be found in Volume 1, Section 6.4. Advance works will be required before commencing construction works and will typically include:

- further detailed site investigations and surveys;

- further detailed environmental surveys;
- advance mitigation works including, where appropriate, contamination remediation, temporary habitat creation and translocation, and built heritage survey and investigation;
- site establishment with temporary fence construction; and
- utility diversions.

Engineering works

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

- civil engineering works, such as earthworks and erection of bridges and viaducts; and/or
- railway installation works, such as laying ballast or slabs and tracks, and/or installing power supply and communications features.

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

2.3.10 In the Waddesdon and Quainton area there will be no main compounds and three civil engineering satellite compounds and one railway installation satellite compound (which will continue to use a compound previously established for the civil engineering works).

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

General overview of construction compounds

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

- space for the storage of bulk materials (aggregates, structural steel and steel reinforcement);
- space for the receipt, storage and loading/unloading of excavated material either onto or off the site;
- an area for the fabrication of temporary works equipment and finished goods;
- fuel storage;
- plant and equipment storage; and

- necessary operational parking.

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

2.3.14 Some compounds will also accommodate additional functions as listed below. Where this is the case they will be included in the description of the compound:

- railheads will provide a facility for connecting with the existing railway network to enable loading and unloading to and from trains delivering material to the HS2 site or removing excavated material;
- roadheads will require an additional area of land adjacent to the compound for the storage and loading and unloading of bulk earthworks materials which are moved to and from the site on public highways; and
- living accommodation for the construction workforce.

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

2.3.16 Further information on the function of compounds, including general provisions for their operation including security fencing, lighting, utilities supply, site drainage, codes of worker behaviour are set out in Volume 1, Section 6.6 and the draft CoCP, Section 5.6.

Construction traffic routes

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

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

Figure 3: Schematic of construction compounds for civil engineering works

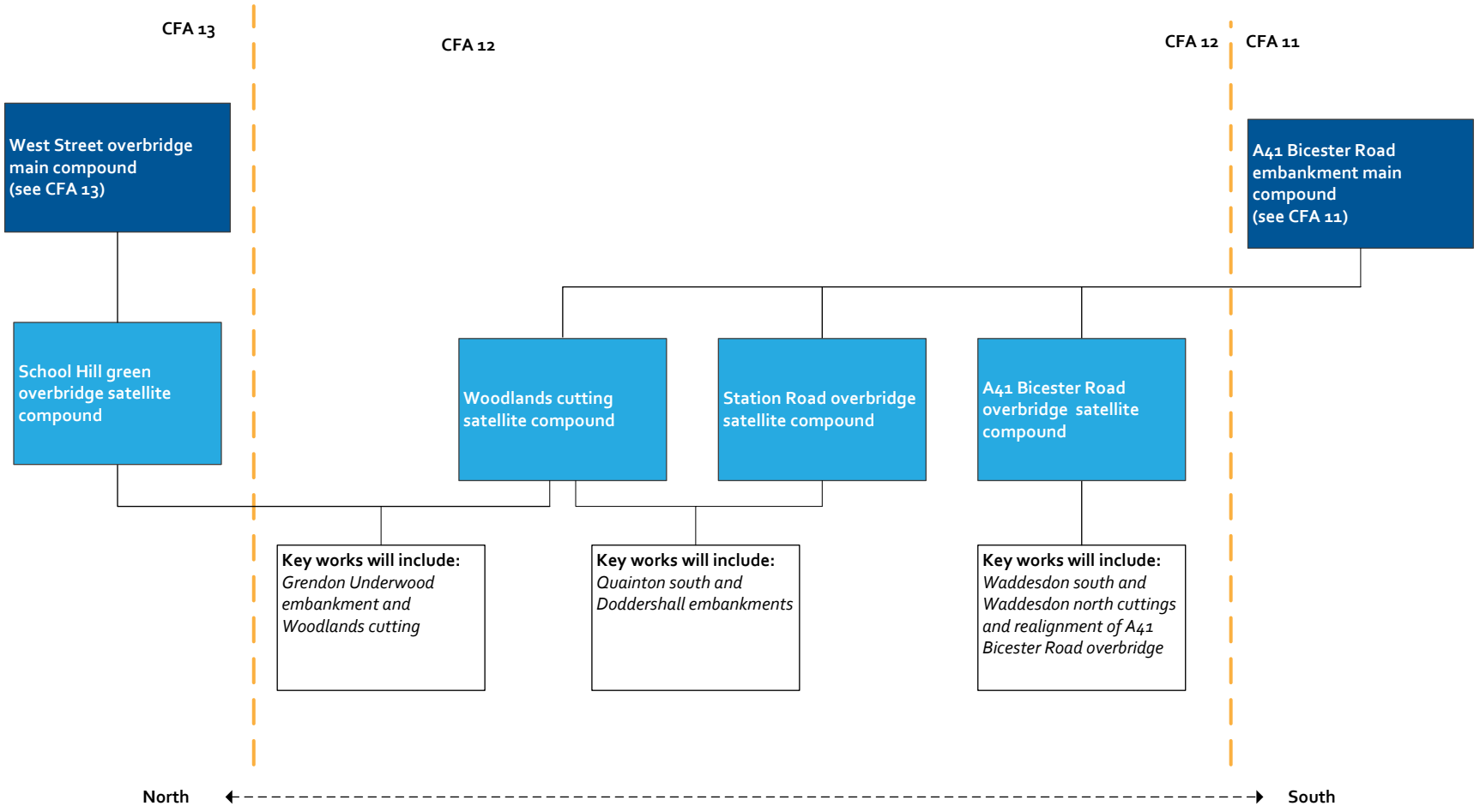
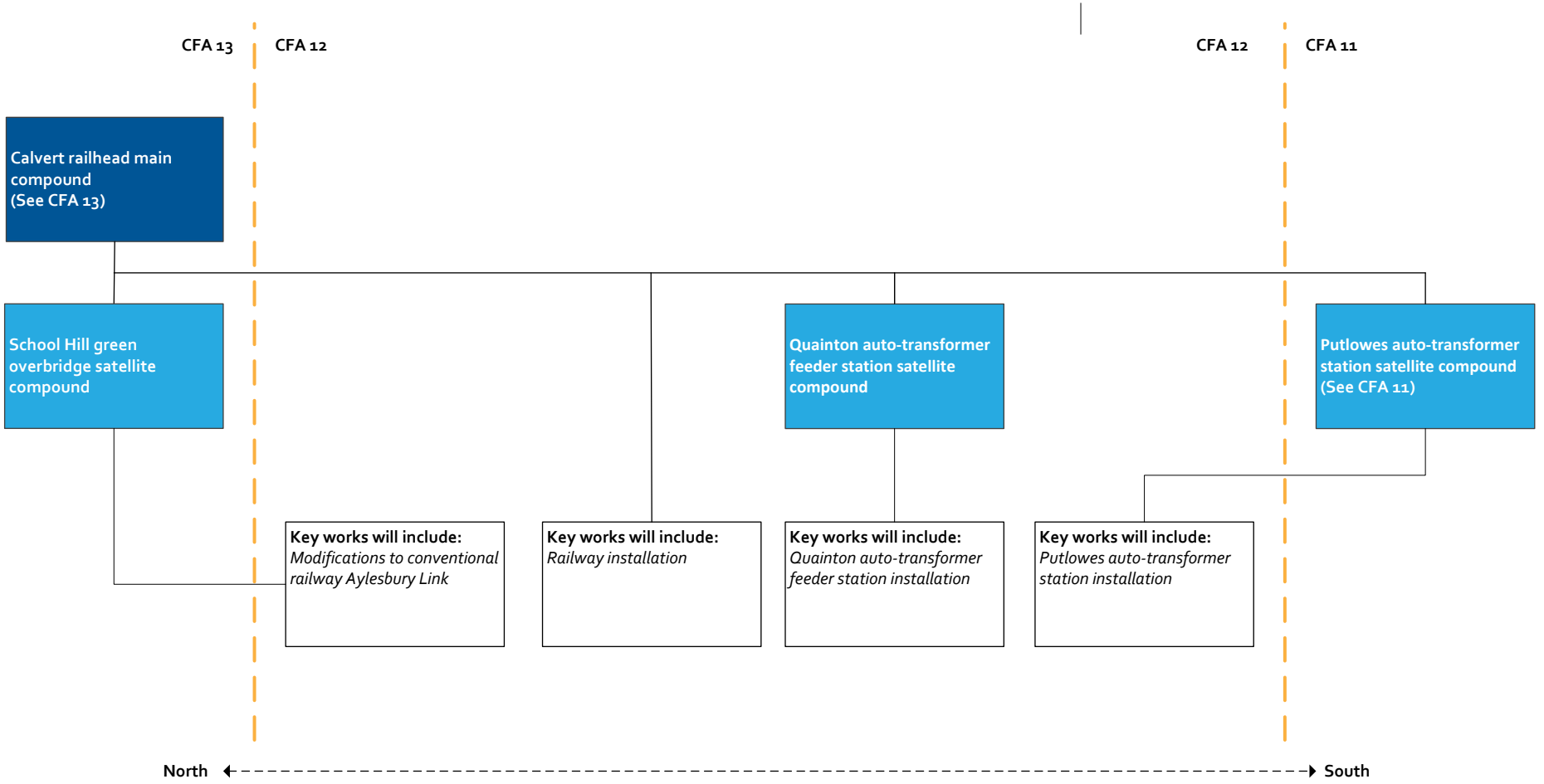


Figure 4: Schematic of construction compounds for railway installation works



A41 Bicester Road embankment main compound/Putlowes auto-transformer station satellite compound

2.3.19 This main construction compound is located within the Stoke Mandeville and Aylesbury area (CFA 11), but it will provide directly for the construction of the A41 Bicester Road embankment within the Waddesdon to Quainton area, and also provide support to three satellite compounds. After the civil engineering works are complete, this main compound will reduce in size to form the Putlowes auto-transformer station satellite compound for the railway installation phase of works. See CFA Report 11 for more information about the main compound.

2.3.20 The compound will include a roadhead for the receipt of earthworks material route wide.

2.3.21 The compound will provide living accommodation for between approximately 60 to 200 people for an estimated period of three years and six months.

2.3.22 The compound will also provide directly for railway systems installation works in the Waddesdon to Quainton area. The key railway systems installation in this section of the Proposed Scheme will be the Putlowes auto-transformer feeder station. Volume 1, Section 5.17 describes the typical power supply and Section 6.23 describes the associated construction activities.

A41 Bicester Road overbridge satellite compound

2.3.23 This compound will be used for civil engineering works only, between approximately the existing A41 Bicester Road and north of Waddesdon. The compound will:

- be operational for approximately three years, starting in 2017;
- support approximately 55 workers each day throughout much of the civil engineering works period; but will increase to a maximum of approximately 130 workers each day during the peak period of activity;
- not provide worker accommodation facilities;
- be accessed via the M40 and A41 from the west;
- be managed from the A41 Bicester Road embankment main compound (CFA 11); and
- include a roadhead for the receipt of earthworks material route wide.

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

- site clearance and enabling works;
- culverts and drainage;
- construction of bridges;
- cuttings, embankments and landscape earthworks;
- permanent fencing; and
- landscaping and planting.

2.3.25 The compound will be used to manage construction of the Waddesdon south and north cuttings and the A41 Bicester Road overbridge, which will take approximately three years to complete. Volume 1, Section 5.10 describes a typical overbridge, Section 5.2 describes a typical cutting. Sections 6.17 and 6.8 describe the associated construction activities respectively. Volume 1, Section 6.10 describes the typical construction sequences of a road diversion.

2.3.26 No demolitions or watercourse diversions will be required.

2.3.27 Diversion of one road and part-closure of one road will be required:

- permanent diversion of a 1.3km stretch of the A41 Bicester Road, passing westwards across the new A41 Bicester Road over bridge adjacent to existing Blackgrove Road; and
- permanent closure of a length of Blackgrove Road to the west of the route.

2.3.28 Temporary diversion of two private accesses will be required:

- access to Lower Blackgrove Farm and Lower Blackgrove Farm cottages during construction of the A41 Bicester Road realignment; and
- access to Waddesdon waste treatment works during construction of Footpath WAD/3 accommodation underbridge.

2.3.29 Alternative routes for five PRoW will be required:

- a temporary alternative route for Footpath WAD/5/1[12], to the north for a period of up to one year and six months, adding an additional 800m. It will then be permanently diverted across the realigned A41 Bicester Road, adding an additional 200m;
- a temporary alternative route for Footpath WAD/5/2, to the north for a period of approximately one year and six months, adding an additional 100m. It will then be permanently diverted to the eastern arm of the A41 Bicester Road/Blackgrove Road roundabout, adding an additional 400m;
- a temporary alternative route for Footpath WAD/4, to the north-west for a period of approximately six to nine months, adding an additional 100m. It will then be permanently diverted 50m to the west across the new Footpath WAD/4 accommodation overbridge, adding a negligible distance;
- a temporary alternative route for Footpath WAD/4A, to the west for a period of approximately six to nine months, adding an additional 100m. It will then be permanently reinstated along its existing alignment through the new Footpath WAD/3 accommodation underbridge; and
- a temporary alternative route for Footpath WAD/3, to the south for a period of six to nine months, adding an additional 450m. It will then be permanently diverted,

[12] The Buckinghamshire County Council subsection reference has been provided in instances where different sections of the footpath will be realigned in different ways, in order to differentiate between these sections.

approximately 150m to the east through the new Footpath WAD/3 accommodation underbridge, adding an additional 450m.

2.3.30 Diversion of eight utilities and the installation of two new utilities will be required, the key one being a permanent new UK Power Network, connecting electricity power to Putlowes auto-transformer station.

Station Road overbridge, Woodlands cutting/Quainton auto-transformer feeder station and School Hill green overbridge satellite compounds

2.3.31 These compounds will be used for civil engineering and railway installation works, working together on key works from north of Waddesdon to the south of Sheephouse Wood.

2.3.32 The Station Road overbridge compound will:

- be operational for approximately two years and nine months, starting in 2017;
- support approximately 45 workers each day throughout much of the civil engineering works period, which will increase to a maximum of approximately 100 workers each day during the peak period of activity;
- not provide worker accommodation facilities;
- be accessed via the M40, A41 and Station Road from the west and via the M1, A4146, A418, A41 and Station Road from the east; and
- be managed from the A41 Bicester Road embankment main compound (CFA 11).

2.3.33 Following the civil engineering works, the Woodlands cutting satellite compound will become the Quainton auto-transformer feeder station satellite compound for the rail installation works. The compound will:

- be in place for approximately seven years. During this period there will be civil engineering works for approximately three years and nine months, starting in 2017 followed by an approximately six month period of inactivity before the railway installation works, which will last for approximately two years and nine months, commence in 2021;
- support approximately 75 workers each day throughout much of the civil engineering works period, but will increase to a maximum of 210 workers each day during the peak period of activity, and support approximately 35 workers each day throughout the rail systems installations works period, increasing to a maximum of 60 workers each day during the peak period of activity;
- not provide worker accommodation facilities;
- be accessed via M40, A41, Station Road, Fidlers Field Road, Claydon Road, Lawn Hill/Edgcott Road or M40, A41, The Broadway, Edgcott Road, Grendon Road, Buckingham Road, Lawn Hill/Edgcott Road from the west and via M1, A421, Gawcott Road, Buckingham Road, Hillesden Road, Perry Hill, Lawn Hill/Edgcott Road from the east; additionally indivisible abnormal loads will access via Hillesden Road, Gawcott from the A421 and Radclive Road; and

- be managed from A41 Bicester Road embankment main compound (see Figure 3 and CFA Report 11) for the civil engineering works and from Calvert railhead main compound for the railway systems installation works (see Figure 4 and CFA Report 13).

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

- site clearance and enabling works;
- building demolition;
- culverts and drainage;
- construction of bridges;
- cuttings, embankments and landscape earthworks;
- permanent fencing;
- rail systems installation; and
- landscaping and planting.

2.3.35 Station Road overbridge and Woodlands cutting satellite compounds will be used to manage construction of the Quainton south and Doddershall embankments, which will take approximately three years and nine months to complete. Volume 1, Section 5.3 describes a typical embankment and Section 6.8 describes the typical construction sequences for embankments.

2.3.36 Woodlands cutting and School Hill green overbridge satellite compounds will manage construction of the Grendon Underwood embankment and the Woodlands cutting, which will take approximately three years and six months to complete. The School Hill green overbridge satellite compound will be managed from West Street overbridge main compound (see Figure 3, CFA Report 13), both compounds are located in the Calvert, Steeple Claydon, Twyford and Chetwode area. See the CFA 13 report for more information about these compounds. Volume 1, Section 5.2 describes typical cuttings and embankments. Volume 1, Section 6.8 describes the typical construction sequences for cuttings and embankments.

2.3.37 Demolition will be required at three properties and for six structures:

Table 1: Demolitions associated with Station Road overbridge, Woodlands cutting/Quainton auto-transformer feeder station and School Hill green overbridge satellite compounds

Description	Location
Commercial property, Timber farm shed	Fidlers Field Road
Railway bridge over Aylesbury Link railway line	Buckinghamshire Railway Centre
Residential property, The Lodge	Doddershall
Residential property, Woodlands Farm outbuilding	Off Edgcott Road
Railway bridge adjacent to Woodlands cutting	Lawn Hill
National Grid steel frame pylon	South of Edgcott Road

Description	Location
National Grid steel frame pylon	Adjacent to Edgcott Road
National Grid steel frame pylon	North of Edgcott Road
Railway bridge at Benfields	Greatmoor

2.3.38 Diversion of three roads will be required:

- permanent reinstatement of Needles Farm accommodation access, approximately 50m to the west, across the new Needles Farm accommodation overbridge;
- permanent reinstatement of Station Road, approximately 450m to the west, across the new Station Road overbridge; and
- permanent reinstatement of Edgcott Road, 50m to the east, across new Edgcott Road overbridge.

2.3.39 Alternative routes will be required for nine PRoW:

- Footpath QUA/31 remains open during construction. It will then be permanently diverted 350m to the east on the realigned Station Road, adding an additional 500m;
- Footpath QUA/24A remains open during construction. It will then be permanently diverted 200m to the east over Bridleway QUA/28A overbridge, adding an additional 215m;
- temporary closure of public Bridleway QUA/28A during construction, for a period of around six to nine months. It will then be permanently reinstated along its existing alignment to Bridleway QUA/28A overbridge;
- Footpath QUA/26 remains open during construction. It will then be permanently diverted, approximately 200m to the east across the new Footpath QUA/26 accommodation underbridge, adding an additional 200m;
- temporary closure of public Bridleway QUA/36 during construction, for a period of approximately nine to 12 months. It will then be permanently reinstated across the new Bridleway QUA/36 accommodation overbridge along its existing alignment;
- temporary closure of public Bridleway GUN/25 during construction, for a period of approximately six months. It will then be permanently reinstated 100m to the west across the new Bridleway GUN/28 accommodation overbridge;
- temporary closure of public Bridleway GUN/28 during construction, for a period of approximately six months. It will then be permanently diverted approximately 100m to the west across the new Bridleway GUN/28 accommodation overbridge;
- Footpath GUN/31 remains open during construction. It will then be permanently diverted, approximately 200m to the west across the new Bridleway GUN/28 accommodation overbridge, adding an additional 200m; and

- Footpath CAG/2 remains open during construction. It will then be permanently diverted, 100m to the west, through new Footpath CAG/2 underbridge, adding an additional 50m.

2.3.40 Diversion of seven utilities and the installation of three new utilities will be required, the key ones being:

- permanent reinstatement of National Grid high pressure gas transmission lines, between proposed Needles Farm accommodation overbridge and existing Station Road, approximately 300m to the east of the existing alignment;
- permanent reinstatement of Southern Gas high pressure gas storage mains, between proposed Needles Farm accommodation overbridge and existing Station Road, approximately 300m to the east of the existing alignment;
- permanent reinstatement of 400kV National Grid overhead electric transmission lines and pylons adjacent to Edgcott Road, 150m to the west from existing alignment; and
- permanent new National Grid Quainton Grid Supply Point adjacent to Edgcott Road to supply electricity power to Quainton auto-transformer feeder station.

2.3.41 Diversion of nine watercourses will be required:

- permanent diversion of one watercourse (drain) at Crossroads Farm, which will require a diversion of approximately 100m to the south with a culvert crossing under the railway;
- two watercourses (drain/ditch) off Edgcott Road, which will require diversions of approximately 200 and 300m respectively to the south with a culvert crossing under the railway;
- watercourses (drain/ditch and River Ray) off Woodlands Farm, which will require diversions of approximately 220m to the south with a culvert crossing under the railway;
- watercourses (drain/ditch and River Ray) off Woodlands Farm, which will require a diversion of approximately 250m to the north with a culvert crossing under the railway;
- a watercourse (drain/ditch) adjacent to redundant railway embankment, which will require a diversion of approximately 120m to the north with a culvert crossing under the railway;
- a watercourse (drain/ditch) at Greatmoor Farm, which will require a diversion of approximately 300m to the north with a culvert crossing under the railway;
- a watercourse (drain/ditch)at Upper Greatmoor Farm, which will require a diversion of approximately 200m to the north with a culvert crossing under the railway; and
- a drain from Sheephouse Wood (Muxwell Brook), which will require a diversion of approximately 1km to the south with a culvert crossing under the railway.

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

- Installation of the Quainton auto-transformer feeder station, which will be managed from the Quainton auto-transformer feeder station satellite compound only and take approximately two years and nine months; and
- the realignment of the Aylesbury Link railway line, which will be managed from the School Hill green overbridge only and take approximately one year and nine months in total.

2.3.43 For the realignment works, a short rail possession, of approximately two weeks, will be required to move the existing track up to 3m to the east, within the existing Network Rail boundaries, and to connect the new sections of track constructed in the Calvert, Steeple Claydon, Twyford and Chetwode area (CFA 13), to provide space for the Proposed Scheme. The connections will be made in order that, at the end of the rail possession, the operational rail traffic will use the new alignment following testing and commissioning. (CFA Report 13 provides more information about the phasing and works for the Aylesbury Link railway line realignment).

2.3.44 Volume 1, Section 5.17 describes the typical power supply and Section 6.23 describes the associated construction activities. Volume, Section 6.25 describes interfaces with the classic rail network.

West Street overbridge main compound

2.3.45 This construction compound is not located within the Waddesdon and Quainton area. However, it will provide support to the School Hill green overbridge satellite compound, as illustrated in Figure 3, which will provide directly for the construction of the Proposed Scheme adjacent to Sheephouse Wood within this area. It will also manage construction of the Sheephouse Wood mitigation structure. See CFA Report 13 for more information about this compound and the associated construction activities.

Calvert railhead main compound

2.3.46 This construction compound is not located within the Waddesdon and Quainton area, but it will provide support to all railway installation works within this area, as illustrated in Figure 4. See CFA Report 13 for more information about this compound.

2.3.47 Railway installation works in the Waddesdon and Quainton area will take approximately one year and six months, commencing in 2023.

2.3.48 The railway systems installation works will include track, overhead line equipment, communications equipment and traction power supply. The installation of track in open areas will be of standard ballast or slab track configuration. The track will be laid in a southerly direction away from the Calvert railhead main compound as far as the north portal of the Chilterns Tunnel in CFA 9, south of which track laying is managed from the West Ruislip Railhead (See CFA Report 6). Before the railway systems installation can commence, adequate civil engineering work will need to be completed to allow a continuous track laying sequence.

2.3.49 The railway systems installation has its own mobile welfare facilities for the site staff.

2.3.50 See Volume 1, Section 5.18 for a generic description of railway systems and Volume 1, Section 6.24 for a description of associated construction activities.

Construction waste and material resources

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

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

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

2.3.54 The quantity of surplus excavated material originating from the Waddesdon and Quainton area that will require off-site disposal to landfill as excavation waste is shown in Table 2. This is the forecast quantity of contaminated excavated material that is chemically unsuitable for reuse within the Proposed Scheme.

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

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

2.3.56 The quantity of demolition, construction and worker accommodation site waste forecast to be generated and the estimated quantities of waste for disposal to landfill are shown in Table 2.

Table 2: Estimated quantity of waste going to off-site disposal

Waste type	Estimated material quantities that will be generated (tonnes)	Estimated quantity of waste for off-site disposal to landfill (tonnes))
Excavation	2,844,890	0[1]
Demolition	11,689	1,169
Construction	46,684	4,669
Worker accommodation site	0	0
TOTAL	**2,903,263**	**5,838**

(1) Because none of the material is contaminated none of it is considered to be 'waste', hence the figure for waste is '0'.

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

Commissioning of the railway

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

Construction programme

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

Figure 5: Indicative construction programme

Construction activity	2016 quarters				2017 quarters				2018 quarters				2019 quarters				2020 quarters				2021 quarters				2022 quarters				2023 quarters				2024 quarters				2025 quarters			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Advance works																																								
Advance works																																								
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A41 Bicester Road embankment main compound	See CFA 11																																							
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Putlowes auto-transformer station																																								
A41 Bicester Road overbridge satellite compound																																								
Waddesdon south cutting																																								
A41 Bicester Road overbridge																																								
Footpath WAD/4 accommodation overbridge																																								
Waddesdon drop inlet culvert																																								
Waddesdon embankment																																								
Footpath WAD/3 accommodation overbridge																																								
Waddesdon north cutting																																								
Station Road overbridge satellite compound																																								
Woodlands cutting satellite compound																																								
Quainton south embankment																																								
Little Manor Holding culvert																																								
Needles Farm accommodation access overbridge																																								
Crossroads Farm culvert																																								
Quainton Road diversion																																								
Quainton cutting																																								
Station Road overbridge																																								
Station Road National Rail overbridge																																								

Construction activity	2016 quarters				2017 quarters				2018 quarters				2019 quarters				2020 quarters				2021 quarters				2022 quarters				2023 quarters				2024 quarters				2025 quarters			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Doddershall embankment																																								
Doddershall culvert no.1																																								
Doddershall culvert no.2																																								
Bridleway QUA/28A overbridge																																								
Doddershall culvert no.3																																								
Doddershall culvert no.4																																								
Doddershall culvert no.5																																								
Doddershall culvert no.6																																								
Doddershall culvert no.7																																								
Woods drop inlet culvert																																								
Footpath QUA/26 accommodation underbridge																																								
Woodlands cutting satellite compound																																								
School Hill green overbridge satellite compound	See CFA 13																																							
Woodlands cutting																																								
Quainton auto-transformer feeder station																																								
Edgcott Road overbridge																																								
Grendon Underwood embankment																																								
Woodlands culvert																																								
Adam's accommodation underbridge																																								
Finemere Wood culvert extension																																								
Bridleway QUA/36 accommodation green overbridge																																								
Greatmoor no.1 culvert																																								
Greatmoor no. 2 culvert																																								
Bridleway GUN/28 accommodation green overbridge																																								
Greatmoor no. 3 culvert																																								
Footpath CAG/2 underbridge																																								
Muxwell Brook culvert																																								
Sheephouse Wood south culvert																																								

Construction activity	2016 quarters				2017 quarters				2018 quarters				2019 quarters				2020 quarters				2021 quarters				2022 quarters				2023 quarters				2024 quarters				2025 quarters			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
West Street overbridge main compound	See CFA 13																																							
Sheephouse Wood mitigation structure																																								
Rail infrastructure and systems works																																								
Calvert railhead main compound	See CFA 13																																							
High speed railway installation																																								
Putlowes auto-transformer station satellite compound																																								
Putlowes auto-transformer installation																																								
Quainton auto-transformer feeder station satellite compound																																								
Quainton auto-transformer feeder station installation																																								
School Hill green overbridge satellite compound																																								
Aylesbury Link railway line modifications to the existing classic railway																																								
Commissioning																																								
Commissioning (until end 2026)																																								

Key

Construction works

Compound duration

2.4 Operation of the Proposed Scheme

Operational specification

2.4.1 Volume 1, Section 4.3 describes the envisaged operational characteristics of Phase One of HS2 as a whole and how they may change when Phase Two is also operational.

HS2 services

2.4.2 It is anticipated that initially there will be 11 trains per hour each way passing through the Waddesdon and Quainton area in the morning and evening peak hours, and fewer during other times. The first trains of the day would leave the terminus stations no earlier than 05:00 Monday to Saturday (and 08:00 on Sundays) and the last would arrive no later than midnight.

2.4.3 It is anticipated that with Phase One in place the frequency of services could rise to 14 trains per hour each way during peak hours, and that with Phase Two in place the frequency could rise to 18 trains per hour each way during peak hours. The assessment of sound, noise and vibration has taken into account the frequency during Phase Two.

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

Maintenance

2.4.5 Volume 1, Section 4.3 describes the maintenance regime for HS2.

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

2.4.7 Railway maintenance vehicles would be parked either at the Calvert infrastructure maintenance depot, or in the defined maintenance loops along the route. For this area the nearest maintenance loops will be to the south of Risborough Road, near Stoke Mandeville. The maintenance loops could also be used in the case that a passenger train could not continue unassisted to its destination.

Operational waste and material resources

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

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

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

2.4.11 Track maintenance waste and ancillary infrastructure waste (for example waste from depots, signalling locations, operations and maintenance sites) has been estimated using an average waste generation rate per kilometre length of total track. For this reason, both track maintenance waste and ancillary infrastructure waste has been reported for each area along the route.

2.4.12 The quantity of operational waste that will be reused, recycled and recovered (i.e. diverted from landfill) has been based on waste management performance data from Network Rail as follows:

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

2.4.13 On this basis, approximately 149 tonnes of operational waste will be reused, recycled and recovered during each year of operation of the Proposed Scheme in the Waddesdon and Quainton area. Approximately 31 tonnes will require disposal to landfill (see Table 3).

Table 3: Operational waste forecast for the Proposed Scheme

Waste source	Estimated quantity of waste generated per annum (tonnes)	Estimated quantity of waste for disposal to landfill per annum (tonnes)
Railway station and train	0	0
Rolling stock maintenance	0	0
Track maintenance	166	25
Ancillary infrastructure	14	6
TOTAL	**180**	**31**

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

2.5 Community forum engagement

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

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

- 3 April 2012 at Quainton Memorial Hall;
- 4 July 2012 at Quainton School;
- 17 September 2012 at Quainton School;

- 19 November 2012 at Quainton School;
- 4 February 2013 at Waddesdon Village Hall; and
- 11 September 2013 at Waddesdon Village Hall.

2.5.3 In addition to HS2 Ltd representatives, attendees at these community forum meetings typically included: local residents (and residents groups); public representatives; the local MP; 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:

- potential visual and noise impacts, and the effects on wildlife from road realignments and new road layouts and diversions, particularly the height of the original A41 Bicester Road realignment over the Proposed Scheme at Waddesdon and the proposed Station Road realignment at Quainton;
- potential impacts to multiple environmentally designated sites including: Grendon and Doddershall Meadows' Local Wildlife Site (LWS), Finemere Wood (a Site of Special Scientific Interest (SSSI) and ancient woodland and Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust nature reserve) and Sheephouse Wood (also an SSSI and ancient woodland), with concerns about land loss, impacts on grassland and species and impacts on the hydrology of wetland areas;
- potential impacts on the Bechstein's bat population (a European protected species with a population known to commute across the proposed rail route);
- potential impacts during both construction and operation on mature vegetation at Waddesdon Manor;
- potential impacts of and interface between the infrastructure maintenance depot, East West Rail proposals and the Greatmoor Energy from Waste (EfW) facility proposals at Calvert;
- potential community impacts from the auto-transformer station and associated infrastructure at Quainton;
- noise and visual impacts associated with the railway alignment being at surface level and a forum preference for this to be lowered;
- potential impacts on flood storage areas alongside existing corridors and flow of surface water; and
- the local desire for a bypass at Waddesdon.

2.5.5 In addition to the engagement through the community forums, the draft Environmental Statement and Design Refinement consultations were launched on 16 May 2013 for a period of eight weeks and closed on the 11 July 2013. As part of these consultations, members of local communities and other interested parties were notified, provided with information and invited to engage on issues pertinent to the draft Environmental Statement and the development of the scheme. Details of the local consultation events were provided on HS2 Ltd website, social media, posters at local venues, national and

regional advertising and to properties within 1km of the Proposed Scheme. In the Waddesdon and Quainton area consultation on the draft Environmental Statement was held on 31 May 2013 at Waddesdon village hall.

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

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

2.6 Route section main alternatives

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

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

Alignment in the vicinity of Fleet Marston

2.6.3 The Proposed Scheme will be on embankment between Putlowes Farm (within CFA11) and Lower Blackgrove Farm Cottages (within CFA12) and will cross five watercourses. The Proposed Scheme will cross them using culverts, enabling the natural gravitational flow of watercourses across the Proposed Scheme.

2.6.4 The Proposed Scheme differs from the January 2012 announced route, which was largely at existing ground level through this section.

2.6.5 An option evaluation exercise was proposed to attempt to reduce direct impacts to watercourses in the low-lying and flood prone valley between Putlowes Farm and Lower Blackgrove Farm Cottages. Three options were evaluated:

- Option A: the January 2012 announced scheme, with the provision of pumps to convey water across the route;
- Option B: the Proposed Scheme, raising the vertical alignment of the route to allow culverts to be installed; and
- Option C: the January 2012 announced scheme, with the provision of drop inlet culverts to aid flow of watercourses across the route.

2.6.6 Options A and Option C would have adverse effects on watercourses and floodplain management. They would require higher levels of maintenance (particularly Option C), which would be less safe to maintain due to the type of structures required, which would be less satisfactory on health and safety grounds. In comparison, Option B would potentially have visual and noise impacts on scattered local properties and the landscape

character of Waddesdon Manor Registered Park and Garden (RPG). However, Option B would have beneficial effects because it would allow the five water crossings to retain natural gravity-induced flows.

2.6.7 Option B was adopted as part of the Proposed Scheme because it will have the least impact on watercourses and the aquatic environment supported by them. It will also require less maintenance and so reduce the whole life cost.

A41 realignment to east of existing road alignment

2.6.8 The Proposed Scheme will cross underneath the A41 Bicester Road, which will be realigned to run parallel on the eastern side of the route between Lower Blackgrove Farm and a new three-armed roundabout located just west of Blackgrove Road. From this point, the realigned A41 Bicester Road will cross southwards over the HS2 route (which will be in cutting at this point) and connect back on to the existing A41 to the west of The Grand Lodge.

2.6.9 This differs from the January 2012 announced scheme and the scheme presented for the draft ES, which included the realignment of the A41 Bicester Road and Blackgrove Road across the Proposed Scheme via two elevated overbridges.

2.6.10 Three alternatives were initially considered for the A41 Bicester Road overbridge crossing of the route. In addition, discussions with the Waddesdon and Quainton Community Forum and Buckinghamshire County Council resulted in evaluation of an additional fourth alternative, essentially a bypass around the village of Waddesdon, with the objective of reducing traffic volumes passing through the village.

2.6.11 The following options were considered:

- Option A: the January 2012 announced scheme;
- Option B: an option based on a suggestion brought forward by Buckinghamshire County Council, with a realignment of the A41 Bicester Road along the north-eastern side of the route, diverging from the January 2012 announced scheme near Lower Blackgrove Farm cottages. A roundabout junction would be provided to connect with a short realignment of Blackgrove Road, with the realigned A41 Bicester Road then crossing south over the route. A further roundabout south of the route would provide facility off the roundabout for a future link to a bypass around the northern edge of Waddesdon. The A41 Bicester Road realignment would then run south to rejoin the existing A41 alignment west of The Grand Lodge;
- Option C: a proposal brought forward by Buckinghamshire County Council, involving realignment of A41 Bicester Road which would diverge from its existing alignment to the north of The Grand Lodge. The realignment would run parallel to the route on its southern side and skirt around the north of Waddesdon, connecting to the existing A41 Bicester Road to the north-west of the village and to the east of Glebe Farm. The option would also include access off the realigned Blackgrove Road to the north of Lapstone House, which would follow an existing track to the Waddesdon Sewage Treatment Works and would bisect an existing footpath (WAD/4/2); and

- Option D: the Proposed Scheme, a realignment of A41 Bicester Road in a location similar to Option B but without a roundabout on the southern side of the route.

2.6.12 Whilst Option C would divert traffic from passing through Waddesdon, the option would have potential noise as well as visual impacts on isolated properties and farm holdings to the east side of Waddesdon. It would also potentially require the demolition of two properties and the loss and severance of agricultural land. Furthermore, Option C would require a larger footprint for the A41 Bicester Road overbridge and, as a consequence, may have a greater visual impact on the setting and character of Waddesdon Manor Grade I RPG and The Grand Lodge Grade II listed building.

2.6.13 Option A would give rise to impacts on the setting and character of The Grand Lodge and the RPG at Waddesdon Manor similar to those described in Option C. It would also require the construction of two overbridges, one on the A41 Bicester Road and one on Blackgrove Road, as opposed to one in Options C, B and D.

2.6.14 With the exception of Option D, Option B would have the smallest footprint for the A41 overbridge crossing of the route due to the route being in deep cutting in comparison to the other options as the realigned A41 crosses over the route further to the north and west. Option B would also result in reduced visual impacts, and reduced impacts on biodiversity, noise, water, agriculture and cultural heritage. New signage and lighting would be extended as the road is currently lit approaching Waddesdon at The Grand Lodge. Traffic would be diverted away from The Grand Lodge and, with the proposed new A41 Bicester Road alignment on the east side of the Proposed Scheme, would result in a reduced visual impact on the Waddesdon Manor estate.

2.6.15 Option D would have similar beneficial aspects associated with Option B and would further reduce the visual impact and footprint of the A41 Bicester Road overbridge due to the inclusion of only one new roundabout. This option is preferred because it will reduce the visual impacts of the A41 Bicester Road overbridge for residential and transport receptors along the valley, including reducing the number of overbridges to one and removing the large earthworks associated with the approach embankments required under Options A or C. The configuration of Option D would also allow for the future provision of a bypass around the north of Waddesdon should this be subsequently progressed by others.

2.6.16 For these reasons, Option D was adopted into the Proposed Scheme.

Lower the route between the villages of Waddesdon and Quainton

2.6.17 Between the villages of Waddesdon and Quainton, the Proposed Scheme will be on a series of shallow embankments and in a deep cutting. This alignment is consistent with the January 2012 announced scheme.

2.6.18 The Waddesdon and Quainton Community Forum proposed that the route should be lowered. Two options were therefore evaluated:

- Option A: the January 2012 announced scheme; and
- Option B: a lower alignment in deeper cutting.

2.6.19 The community forum members suggested Option B in order to reduce the height and size of structures required for all the crossings in the area.

2.6.20 While Option B would potentially reduce noise and visual effects, it would require additional land. This option would also require the demolition of adjacent scattered properties along both sides of the route, and would create additional impacts and costs. Option B would also be constrained to the immediate north of Quainton, where the Proposed Scheme would run adjacent to and at a similar height as the existing Aylesbury Link railway line.

2.6.21 For these reasons Option B was not incorporated within the Proposed Scheme.

Station Road Subway, Quainton

2.6.22 The Proposed Scheme past Quainton will sever the existing Station Road alignment and an alternative road layout in this area to maintain local road links has been developed as described above. As part of this review the proposal for pedestrian and cyclist access across the HS2 route was also reviewed.

2.6.23 The following options were considered:

- Option A: the scheme presented in the draft ES which included a subway on the line of the existing Station Road; and
- Option B: the Proposed Scheme, incorporating a pedestrian/cyclist diversion over the route via the new Station Road overbridge and removal of the subway.

2.6.24 Option A would retain access across the route for non-motorised users (pedestrians and cyclists) along the current Station Road alignment. However the use of a subway, as originally considered, was met with some concerns by the local community due to perceived safety issues and suggestions were made for a pedestrian bridge over HS2. This would introduce an additional high structure into the local landscape which would increase visual impacts on residential and near-by transport receptors. Also, pedestrian and cyclist count surveys indicated that there would be only a low usage made of either a subway or footbridge at this location. The low usage and cost to construct and maintain would thus be poor value for money

2.6.25 Option B would require pedestrians and non-motorised users to take a diversion of some 500m along the realigned Station Road. Whilst this would require pedestrians and cyclists to follow the same route as vehicular traffic, this is the same as the current situation. However, to improve the safety of use, this option would include the provision of a footway alongside those sections of road realignment shared with the pedestrian diversion. Without the need to provide a separate structure, this would reduce construction and maintenance costs and reduce impacts arising from construction works including noise, archaeology and landscape.

2.6.26 For these reasons, Option B was adopted into the Proposed Scheme.

Buckinghamshire Railway Centre

2.6.27 The Proposed Scheme will pass the Buckinghamshire Railway Centre at, or near ground level, with some sections, on low embankment and in shallow cutting (see Map CT-06-050). The Proposed Scheme will include a revised road layout to maintain access to

Quainton (see the alternatives discussed for Station Road, Quainton within this section) and the need for noise mitigation has been identified.

2.6.28 The January 2012 announced scheme included a similar alignment.

2.6.29 An alternative route was proposed by the Buckinghamshire Railway Centre. Two options were therefore evaluated:

- Option A: the January 2012 announced scheme and the Proposed Scheme; and
- Option B: a shallow 'cut and cover' tunnel at this location.

2.6.30 It was suggested by Buckinghamshire Railway Centre that Option B would be preferred because it would retain all access routes and reduces noise effects.

2.6.31 It is acknowledged that potential operational noise and visual benefits could be achieved by putting the route in a green tunnel and could also simplify the design of the Station Road overbridge. However, the arrangements during construction would be complex and the work would require more land alongside the railway to be taken temporarily than Option A, resulting in additional temporary construction impacts. The route would also have to be lowered over an extended length, including adjacent to the Aylesbury Link railway line to the north of Quainton, which would result in increased excavated material, significant retaining works next to the Aylesbury Link railway line and would add to the cost of the Proposed Scheme.

2.6.32 For these reasons Option B has not been adopted in the Proposed Scheme.

Station Road, Quainton

2.6.33 The route will cross Station Road to the south of Quainton close to existing ground level to the north of Upper South Farm near Quainton. The Proposed Scheme includes a realignment of Station Road approximately 500m further north-west in this location and will cross over the Proposed Scheme and the Aylesbury Link railway line (see Map CT-05-050). The realigned section of Station Road will connect to the existing road to the north-east of the Buckinghamshire Railway Centre and to the south-west of Crossroads Farm. The original section of Station Road on the south side would be removed and replaced by a new junction and link road from the realigned Station Road to Quainton Road and Crossroads Farm. As part of the design refinement process prior to the adoption of the January 2012 announced scheme, consideration was given to the construction of the Station Road overbridge across the HS2 route following the existing road alignment. This option was subsequently not considered suitable because in order to avoid physical impacts on the adjacent properties, including the Buckinghamshire Railway Centre, construction within the existing road alignment would be particularly complex due to space constraints, it would also be time-consuming and expensive. In addition, the existing road would need to be closed during these works and a temporary diversion put in place which would have an impact on road users. Realignment of Station Road was therefore considered preferable.

2.6.34 The January 2012 announced scheme provided an indicative realignment of Station Road over HS2 approximately 200m to the north-west of its existing alignment. After the publishing of the January 2012 announced scheme, a proposal was made by

Buckinghamshire Railway Centre for a revised alignment. The two options considered were:

- Option A: the January 2012 announced scheme; and
- Option B: a new alignment for Station Road taking into consideration the suggestions made by the Buckinghamshire Railway Centre.

2.6.35 Option A would have similar potential visual, transportation, cultural heritage, and traffic noise effects as Option B, but would directly affect the Buckinghamshire Railway Centre and adjacent properties.

2.6.36 Option B by comparison would avoid the Buckinghamshire Railway Centre overflow car park and adjacent properties, and also maintain access for large vehicles to the centre. Option B, would however directly affect an area of wet woodland to the west of the Proposed Scheme and the proposed development associated with the extension of the Faccenda Hatchery. Option B was preferred overall because it would maintain the Buckinghamshire Railway Centre's current operational requirements.

2.6.37 As a result of further discussions with the local community and Buckinghamshire County Council a further refinement of Option B, Option C, was proposed as a result of these discussions. Option C would have similar benefits but reduced impacts on the area of wet woodland and whilst minimising direct impacts on the proposed extension to the Faccenda Hatchery. Option C would also change the traffic priorities to align with the predominant local traffic flow and to reduce the perceived incidence of headlights shining into residents' windows during hours of darkness.

2.6.38 For the above reasons Option C was adopted within the Proposed Scheme.

The Lodge (Doddershall Lodge)

2.6.39 The Proposed Scheme will require the demolition of The Lodge (see Map CT-05-050) as the route will pass through the land upon which this building stands. The January 2012 announced scheme would also require the demolition of this property.

2.6.40 Buckinghamshire County Council suggested the alignment be altered to avoid the demolition of The Lodge. However, this could not be achieved without affecting other properties in the area. The Proposed Scheme will be located immediately to the west of the existing Aylesbury Link railway line thus preventing any realignment of the route in an easterly direction. Any realignment to the west would move the line closer to Waddesdon and would potentially result in direct impacts upon other adjacent properties.

2.6.41 For these reasons the route has not been altered to avoid The Lodge.

Alignment north-west of Quainton

2.6.42 Between Quainton and Calvert the Proposed Scheme will follow the alignment of the existing Aylesbury Link railway line corridor. The route alignment between Quainton and Calvert is similar to the January 2012 announced scheme.

2.6.43 A proposal was put forward to move the route further to the east in the vicinity of Woodlands Farm in order to take advantage of an existing embankment to screen the Proposed Scheme. It was thought that this would make space for a further bund to be

installed on the western side of the realigned route to mitigate noise and visual intrusion on properties in the area.

2.6.44 The Proposed Scheme has been chosen specifically so that the route will run along the existing Aylesbury Link railway line corridor, in order to consolidate the existing transport infrastructure corridors and reduce impacts on open country. Moving the route away from the Aylesbury Link railway line was considered likely to create new impacts due to additional land requirements and the widening of the combined railway corridor.

2.6.45 Landscaping has been proposed as part of the Proposed Scheme in the section of Woodlands Farm Cottages in order to reduce the visual impacts.

2.6.46 For these reasons HS2 Ltd has not altered the route to the north-west of Quainton.

Auto-transformer feeder station and National Grid substation near Quainton

2.6.47 An auto-transformer feeder station will be required near Quainton, on the east side of the rail corridor (see Map CT-06-051). This will supply traction power to the Proposed Scheme. Power will be drawn from the existing 400kVa overhead grid network and will feed the auto-transformer feeder station from the new National Grid substation to be located on the eastern side of the route to the north of Edgcott Road.

2.6.48 The January 2012 announced scheme did not identify traction power supply locations.

2.6.49 National Grid proposed the site near Quainton and this site was included within the draft ES. It will be one of three auto-transformer feeder stations supplying high-speed traction power to the Proposed Scheme. The following alternatives at Quainton have been considered:

- Option A: the scheme as presented in the Draft ES- the National Grid substation located to the western side of the route and the auto-transformer feeder station located to the east of the route and the southern side of Edgcott Road;
- Option B: relocation of the auto-transformer feeder station to Aylesbury Vale as suggested by the Waddesdon and Quainton Community Forum; and
- Option C: the Proposed Scheme, a relocation of the National Grid substation to the eastern side of the route and northern side of Edgcott Road. The auto-transformer feeder station would remain on the east side of the route.

2.6.50 Option A was identified by National Grid as this location would be within one of a limited number of locations where the existing grid network has available capacity. This option, however, would require land from the Grendon and Doddershall Meadows LWS and would have adverse visual effects.

2.6.51 Option B would require extensive new power cables to be laid from Quainton to the proposed auto-transformer feeder station site within the Aylesbury Vale, which would adversely affect performance and reliability and increase costs. The laying of these cables would also result in environmental impacts along their length. Additionally, infrastructure to supply power to trains running along the route at Edgcott Road near Quainton would be needed, as for all options considered, and would therefore still give rise to impacts at that location.

2.6.52 Option C, located to the north-east of the Proposed Scheme, would also fulfil National Grid's operational requirements. This option would have a reduced visual impact and would avoid direct impacts on the Grendon and Doddershall Meadows LWS.

2.6.53 Overall, Option C would have the least adverse environmental effects whilst still fulfilling National Grid requirements and for these reasons has now been adopted as part of the Proposed Scheme.

Finemere Wood to Sheephouse Wood

2.6.54 The Proposed Scheme will follow the alignment of the Aylesbury Link railway line as close to ground level as possible between Finemere Wood and Sheephouse Wood. The route in this section is consistent with the January 2012 announced scheme.

2.6.55 At this location there is a known presence of Bechstein's bat, a rare and internationally important species that is protected under national and European legislation. The following four options were evaluated for this section of the route in order to explore the potential for avoiding or mitigating impacts on this and other wildlife species in this ecologically important area:

- Option A: the January 2012 announced scheme, with the alignment at the same level as the existing Aylesbury Link railway line;
- Option B: comprising a partial lowering of the route to approximately 5m below the level of the existing Aylesbury Link railway line;
- Option C: comprising a deeper retained cutting to lower the route to approximately 10m below the level of the Aylesbury Link railway line; and
- Option D: comprising a deep enclosed structure with a solid roof to lower the route to approximately 10m below the level of the Aylesbury Link railway line route.

2.6.56 Options A, B and C included the following provisions:

- three multi-use bridges would cross over the route of the Proposed Scheme;
- the overbridges would be positioned at appropriate locations to reduce disturbance of species;
- overbridges would include sufficient width and appropriate planting to encourage wildlife passage and provide habitat connectivity;
- vegetation management would be used to discourage bats flying over or along the railway corridor. Linear strips of vegetation adjacent to the railway corridor would be removed, and maintenance regular management would be undertaken to prevent regrowth, thus discouraging bat activity (foraging and commuting) close to passing trains);
- woodland and hedgerow planting would be provided away from the Proposed Scheme to enhance habitat connectivity between existing woodland; and
- barriers would be provided to reduce the impacts of turbulence, noise and light.

2.6.57 The option evaluation in this area extended beyond the CFA boundary into the adjacent Calvert, Steeple Claydon, Twyford and Chetwode area (CFA13) and is reported in this area report.

2.6.58 Option D was considered to replicate existing baseline conditions and maintain the existing commuting routes over the railway. This option, however, would require additional land to construct and would result in the loss of bat habitat and ancient woodland from Sheephouse Wood SSSI. It would also adversely affect watercourses in the area and generate a large quantity of excavated material. Construction of this option would be more complex, require a longer time period and would be more costly than the other options considered. Furthermore, due to both increased land take and longer construction period it would cause greater impacts on bats.

2.6.59 Options B and C, whilst being in cutting, would be less effective in avoiding striking bats compared to Option D. Like Option D, Options B and C would require additional land and would result in the loss of bat habitat and ancient woodland from Sheephouse Wood SSSI and would be complex and costly to construct. For these reasons, these options were not adopted in the Proposed Scheme.

2.6.60 Option A in comparison to the other options would not need additional land to construct and would therefore have a lesser effect on Sheephouse Wood SSSI and ancient woodland habitat. It would not generate excavated materials and would be simpler, quicker and less costly to construct. It would therefore have had less impact on bats during construction. When considered with the mitigation measures as described above (multi-use crossings, planting and vegetation management) in place and established, this option was considered to provide a suitable package of measures for reducing the risk of bat strike whilst also reducing wider environmental impacts as described above. For these reasons Option A was adopted for the draft ES.

2.6.61 Following late season surveys in 2012 the Proposed Scheme in this section was subsequently modified in order to take account of improved understanding of bat behaviour in the area and to enhance certain landscape features in order to encourage bat movement across these features. This included:

- an increase in the number of overbridge crossing points from three to five as described above; and
- enhancement of two existing underbridge crossings currently used by wildlife to cross under the Aylesbury Link railway line.

2.6.62 Following surveys in 2013 the mitigation measures were refined on a precautionary basis to include the use of a physical barrier to prevent emerging bats entering the HS2 rail corridor. The following options were considered to avoid potential impacts on bats crossing the HS2 corridor:

- Option A: the scheme as presented in the draft ES;
- Option A1: Option A with the addition of approximately 8m high vertical mesh screens either side of the route to provide physical separation between bats and passing trains;

- Option E: a horizontal realignment of the route to the west to provide for a box shaped enclosure over the route to provide a physical barrier to bats. The box shaped enclosure would extend from the south of Sheephouse Wood to its northern extent at Footpath SCL/13 green overbridge, a distance of approximately 800m. The enclosure would be approximately 10m above rail level. Lighting would be used if required to discourage bats from flying close to areas of wind turbulence and would be designed for minimal light spillage;
- Option F: a box structure using the design of a green tunnel but above ground; and
- Option G: the Proposed Scheme, a realignment of the Aylesbury Link railway line to the east to provide for a box shaped enclosure over the route, like the one for Option E.

2.6.63 Options A and A1 were discounted as they did not provide sufficient certainty, at this stage of the project, of physical separation of passing trains and any bats flying across the railway.

2.6.64 Option F was discounted at an early stage due to the additional land take and maintenance requirements, including porous portals, increased track separation and fire and ventilation equipment. This would involve further incursion west into the nature reserve at Calvert Jubilee, as well as into areas to the south. The construction and maintenance costs would also be higher and there would have been increased construction impacts.

2.6.65 Option E was discounted due to the additional landtake required, including acquisition of current operational and future landfill capacity, additional excavated materials and the impact on surface water drainage.

2.6.66 Option G will provide the certainty of physical separation required at this stage of the project, as well as avoiding the additional landtake and associated effects that would arise from Option E. Therefore, Option G has been adopted in the Proposed Scheme.

Replace viaducts over the River Ray and its tributary with embankment and culverts

2.6.67 The Proposed Scheme will cross the River Ray and the Muxwell Brook on embankment, with culverts to carry water under the route. This differs from the January 2012 announced scheme, as viaducts were proposed to cross all Flood Zone 3 areas.

2.6.68 With the benefit of more detailed floodplain information, options for shortening each viaduct by replacing part of each viaduct with embankments and/or culverts were considered at these locations as they offered the most potential to accommodate this design change. Whilst such a design change could increase impacts to the water environment, it would help reduce potential visual and operational noise and vibration impacts whilst reducing costs.

2.6.69 The results of a more detailed floodplain analysis showed that embankments and extended culverts at the River Ray and the Muxwell Brook crossings, in combination with flood compensation, would not be anticipated to affect the flood flow conveyance or lead to impacts to the functional capacity of the floodplains. In considering the impacts to the water environment, work has been undertaken to assess the existing flood conditions

from culverts within this section. It was noted that the existing Aylesbury Link railway line, which runs parallel to the January 2012 announced scheme in this section, crosses the River Ray and the Muxwell Brook in a series of culverts with limited impact to flood flow conveyance and floodplain capacity.

2.6.70 For these reasons, lengthened embankments and extended culverts at the River Ray and the Muxwell Brook crossings have been adopted into the Proposed Scheme.

3 Agriculture, forestry and soils

3.1 Introduction

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

3.1.2 The quality of agricultural land in England and Wales is assessed according to the Agricultural Land Classification (ALC) system, which classifies agricultural land into five grades from excellent quality Grade 1 land to very poor quality Grade 5 land. Grade 3 is subdivided into Subgrades 3a and 3b. The main issue in the assessment of the impacts on agricultural land is the extent to which land of best and most versatile (BMV) agricultural quality (Grades 1, 2 and 3a) is affected by the Proposed Scheme.

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

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

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

3.1.6 Details of published and publically available information used in the assessment, and the results of surveys undertaken within this CFA, are contained in Volume 5: Appendix AG-001-012.

3.2 Scope, assumptions and limitations

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

3.2.2 The study area for the agriculture, forestry and soils assessment covers all of the land that will be required for the construction and operation of the Proposed Scheme. The resources and receptors that are assessed within this area are agricultural land, forestry land and soils; together with farm and rural holdings. The assessments of the

impacts on agricultural land quality and forestry land are made with reference to the prevalence of BMV land and forestry in the general locality, taken as a wider 4km corridor centred on the Proposed Scheme.

3.2.3 Common assumptions that have been applied to the Proposed Scheme, such as the restoration of agricultural land to pre-existing quality, the handing back of land used temporarily to the original landowner and the non-replacement of capital items demolished, are set out in Volume 1. There are no assumptions or limitations that are specific to the assessment in this area.

3.3 Environmental baseline

Existing baseline

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

Soils and land resources

Topography and drainage

3.3.2 The main topographical features within the study area are described in detail in the landscape and visual assessment (Section 9). The area is influenced in the south by the Midvale limestone ridge and in the north by the clay lowlands. The topography is generally low-lying, gently undulating with most of the land at an altitude of 70 to 80m above Ordnance Datum (AOD). Hills of note within the area include Lodge Hill near Waddesdon, Quainton Hill north of Quainton and Finemere Hill which range in peak altitudes from 130 to 180m AOD.

3.3.3 The Proposed Scheme crosses two main watercourses, the River Ray and Muxwell Brook, which both run east to west, together with several minor watercourses. The River Ray crosses the route between Woodlands Farm and Woodlands Farm Cottages whilst Muxwell Brook follows the boundary of Sheephouse Wood and the Calvert Landfill site.

Geology and soil parent materials

3.3.4 The main geological features are described in the land quality assessment (Section 8). The bedrock geology mapped by the British Geological Survey (BGS) consists of the Ancholme Group comprised of a succession of different mudstones. The Group includes the Kimmeridge Clay and Ampthill Clay Formations, which outcrop towards the south of the route, underlain by the Weymouth, West Walton, Peterborough and Stewartby Formations which outcrop progressively further north.

3.3.5 On the hills the Wealden and Portland Group bedrock units are mapped. The Wealden Group comprises interbedded thick sandstones, siltstones, mudstones, limestones and clay ironstones, while the Portland Stone Formations is comprised of sandy limestone and sandstones with localised beds of silt and clay or mudstone.

3.3.6 The river tributaries are associated with superficial alluvial deposits, typically of silty clay material, but localised sands and gravels may exist.

Description and distribution of soil types

3.3.7 The characteristics of the soils are described by the Soil Survey of England and Wales[13] and shown on the National Soil Map[14]. The soils are grouped into associations of a range of soil types. They are described in more detail in Volume 5 and their distribution is shown on Map AG-02-012 (Volume 5, Agriculture, Forestry and Soils Map Book).

3.3.8 The most extensively mapped soil in the area is the Denchworth association which overlies mudstones and is typically stoneless, clayey, wet and poorly drained and as a result falls within Wetness Class (WC) IV[15]. There is an area of Ragdale soils to the north-east. These soils typically develop in chalky till and comprise soils which are loamy over clay, or clayey throughout the profile. They are seasonally waterlogged and of WC III or IV.

3.3.9 Evesham 2 soils are mapped in the area on the moderate slopes and are better drained. They are characterised by clay loams over deep clays and have calcareous subsoils which improves their structure. As a result they respond well to artificial drainage and may be improved from WC III or IV to WC II or III. Given the extensive network of drains across the area, it is considered likely that these soils are of WC II or III.

3.3.10 On the steeper slopes north of Quainton and around Waddesdon, the Aberford association is mapped. Aberford soils develop over limestone and are characterised by fine loamy calcareous and well-drained soils (WC1) with variable stone content.

Soil and land use interactions

Agricultural land quality

3.3.11 The principal soil/land use interaction in the study area is the quality of the agricultural land resource. The ALC is based on the identification of physical limitations to the agricultural capability of land resulting from the interactions of soil, climate and the site.

3.3.12 The main soil properties which affect the cropping potential and management requirements of land are texture, structure, depth, stoniness and chemical fertility. There are two distinct soil characteristics within the Waddesdon and Quainton area which are the dominant wet clayey soils on the gently undulating land and the better draining, loamy soils of the slopes and hilltops.

3.3.13 Climate does not in itself place any limitation on land quality in this section but the interactions of climate with soil characteristics are important in determining the wetness and droughtiness limitations of the land. The local agro-climatic data have been interpolated from the Meteorological Office's standard 5km grid point data set for three points within this area, and are set out in Volume 5: Appendix AG-001-012.

[13] Soil Survey of England and Wales (1984), *Soils and Their Use in South East England*.
[14] Cranfield University (2001), *The National Soil Map of England and Wales 1:250,000 scale*.
[15] The Wetness Class (WC) of a soil is classified according to the depth and duration of waterlogging in the soil profile and has six bands.

The data show the area to be moderately warm with an annual average rainfall of approximately 640mm per year. The average number of Field Capacity Days (FCD[16]) is 135 which is lower than the average for lowland England (150 days) and is considered to be favourable for providing opportunities for agricultural land working.

3.3.14 Gradient and microrelief, with complex changes of slope angle or direction over short distances, are not considered to represent a limitation to the grading of most of the Waddesdon to Quainton area, although it is locally limiting to the north of Quainton and north-east of Finemere Wood. Land steeper than 7° cannot be better than Subgrade 3b, and land steeper than 11° cannot be better than Grade 4.

3.3.15 The principal limiting factors determining agricultural land quality in this area are soil wetness and soil droughtiness. The severity of a droughtiness limitation is determined by soil texture and structure, which affect the available water capacity of the soil profile. When calculated against the demands of a growing wheat and potato crop in a specific locality (given by the climatic variables) a moisture balance is derived from which a droughtiness limitation can be assessed.

3.3.16 Within the wider study area, the soils of the Evesham 2 and Aberford associations, which are WC II or III, are assessed to be of Grade 2 and Subgrade 3a, depending on whether the topsoil texture is medium or heavy clay loam, and whether the topsoil is calcareous.

3.3.17 Soils of the Denchworth and Ragdale associations mapped across most of this section are typically of WC IV with largely non-calcareous clay loam topsoils and, under the applicable climatic conditions, are classified as Subgrade 3b (Full details are provided in Volume 5: Appendix AG-001-012).

3.3.18 Department for Environment, Food and Rural Affairs (Defra) mapping[17] indicates that there is generally a low likelihood of encountering BMV land in the Waddesdon and Quainton area, which makes the presence of such land a resource of high sensitivity in this locality owing to its relative scarcity.

Other soil interactions

3.3.19 Soil fulfils a number of functions and services for society in addition to those of food and biomass production which are central to social, economic and environmental sustainability. These are outlined in sources such as the Soil Strategy for England[18] and The Natural Choice: securing the value of nature[19], and include:

- the storage, filtration and transformation of water, carbon and nitrogen in the biosphere;
- support of ecological habitats, biodiversity and gene pools;
- support for the landscape;

[16] Field Capacity Day is a meteorological parameter which estimates the duration of the period when the soil moisture deficit is zero. Soils usually return to field capacity (zero deficit) during the autumn or early winter and the field capacity period, measured in days, ends in the spring when evapotranspiration exceeds rainfall and a moisture deficit begins to accumulate and opportunities for mechanised fieldwork are then possible.
[17] Defra (2005), *Likelihood of Best and Most Versatile Agricultural Land.*
[18] Defra (2009), *Soil Strategy for England.*
[19] Defra (2011), *The Natural Choice: securing the value of nature.*

- protection of cultural heritage;
- providing raw materials; and
- providing a platform for human activities, such as construction and recreation.

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

3.3.21 The floodplains and riparian zones of the River Ray and Muxwell Brook represent the functional flood environments, as set out in Section 13 with the soils functioning as water stores for flood attenuation, as well providing a habitat for ecology.

3.3.22 The presence of soil-borne cultural assets is detailed in Section 6. This area is characterised by heavy clay which was not conducive to prehistoric agriculture and there is little evidence for human activity until the establishment of the road network during the Roman period. This introduced a new pattern of settlement resulting in the appearance of isolated smallholdings on the clay uplands. The landscape in the early medieval and medieval periods would have been characterised by open strip fields which survive as extant ridge and furrow earthworks across the Quainton parish.

Land use

Land use description

3.3.23 Agricultural land in the Waddesdon and Quainton area is dominated by pasture although there are significant areas of combinable crops, particularly to the north and east of Waddesdon on land associated with the Waddesdon Estate. Blocks of arable land can also be found north of Doddershall House.

3.3.24 A number of environmental designations potentially influence land use within the study area. The whole area is a nitrate vulnerable zone (NVZ), which is an area in which nitrate pollution is a potential problem. Statutory land management measures apply which seek to reduce nitrogen losses from agricultural sources to water. Some agricultural land is also subject to management prescriptions associated with the Environmental Stewardship Scheme which seeks either generally (the Entry Level Scheme – ELS) or specifically (the Higher Level Scheme – HLS) to retain and enhance the landscape and biodiversity qualities and features of farm land. Holdings which have land entered into an agri-environment scheme are identified in Table 4.

3.3.25 There is very little woodland in the southern or central parts of the area, with the majority of woodland located to the north. Overall, woodland is estimated as occupying 11% of land in the area, which is slightly higher than the national average (10%). This includes ancient woodland such as Finemere, Sheephouse, Doddershall, Grendon, Romer, Balmore, Runts and Home Woods, which are remnant woodlands associated with the former Royal Forest of Bernwood.

Number, type and size of holdings

3.3.26 There is a mixture of owner-occupation and tenancies, with sizes of holdings ranging from small (1ha) holdings to large estates, and mixed enterprises including a dairy at Glebe Farm, Waddesdon. The boundaries of the holdings are shown on Maps AG-01-

025 to AG-01-028 (Volume 5, Agriculture, Forestry and Soils Map Book) along with the location of the main farm buildings. Field drainage is common throughout the study area, but no farms have been identified that undertake routine field irrigation of crops.

3.3.27 Table 4 sets out the sensitivity of individual holdings to change, which is determined by the extent to which they have the capacity to absorb or adapt to impacts, which in turn is determined primarily by their nature and scale. In general terms, larger holdings have a greater capacity to change enterprise mix and scale, can better absorb impacts and are less sensitive. Units that rely on the use of buildings (such as intensive livestock and dairy farms, and horticultural units) are less able to accommodate change and have a higher sensitivity. Smaller (less intensively used) units, such as pony paddocks associated with residential properties, have a low sensitivity. The holding/reference name provides a unique identifier and relates to Map Series AG-01- and Volume 5: Appendix AG-001-012.

Table 4: Summary characteristics of holdings

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA 12/1 Sunset Cottage	Residential with equestrian	9	None	None	Low
CFA 12/2 Waddesdon Estate	Arable and livestock	2,800	Widespread activities within the estate for public access and diversification	ELS and HLS	Medium
CFA 12/3 * Wayside Farm	Residential with equestrian	1	Not known	None	Low
CFA 12/4 Glebe Farm	Dairy	165	None	ELS	High
CFA 12/5 Needles Farm	Beef, arable	71	None	ELS	Medium
CFA 12/6 Faccenda Hatchery	Poultry (hatchery)	7	None	None	High if buildings affected
CFA 12/7 * Crossroads Farm, Quainton	Grazing	10	Not known	None	Low
CFA 12/8 Fieldside Farm	Grazing let to others	64	Buildings let for storage uses	None	Low
CFA 12/9 Upper South Farm	Beef, arable	142	None	None	Medium
CFA 12/10 Doddershall Estate	Beef, arable, forestry	567	None	ELS and HLS	Medium

Holding reference/name	Holding type	Holding size (ha)	Diversification	Agri-environment	Sensitivity to change
CFA 12/11 Hill Farm	Beef, sheep, arable	405	None	ELS and HLS	Medium
CFA 12/12 Crossroads Farm, Oving	Beef	75	None	ELS	Medium
CFA 12/13 Woodlands Farm	Residential with equestrian	5	None	None	Low
CFA 12/14 Oak Tree Farm	Beef	51	Agricultural contracting	ELS	Medium
CFA12/15 Woodland Farm Cottage 2	Residential with equestrian	5	None	None	Low
CFA12/16 * Littleton Middle Farm	Grazing	108	Not known	None	Medium
CFA12/17 * Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT) farmland	Grazing	33	Not known	None	Low
CFA12/18 * Fishery lake	Fishery	2	Not known	None	Low
CFA12/19 * Briar Hill Farm	Grazing	7	Not known	None	Low

* No Farm Impact Assessment interview conducted.

Future baseline

Construction (2017)

3.3.28 Two committed developments have been identified in this area that will affect agriculture, forestry and soils, namely:

- the Greatmoor EfW facility at Calvert. The construction of this plant which is assumed will be completed by 2017 will require the removal from agriculture of approximately 6.3ha of land classified as lower quality Subgrade 3b; a single agricultural occupier will be affected by the development; and
- the construction of a new hatchery facility at Quainton. This permission was granted over 10 years ago and although still extant has yet to be implemented. It will require a small area of lower quality agricultural land (< 1.0ha).

3.3.29 The future of agri-environment schemes is uncertain at present due to on-going reform of the Common Agricultural Policy. The majority of schemes seem likely to

cease over the next two to three years and replacements are uncertain. Whilst this will remove a level of support from the agricultural industry that has been used to offset some of the costs incurred in managing land in an environmentally responsible manner, it is unlikely to materially alter the way agricultural land is managed in the future. Whilst some field margins may be cropped closer to hedgerows and stocking rates may increase in some locations, the stocking and cropping baseline set out in the previous section is unlikely to change significantly.

Operation (2026)

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

3.4 Effects arising during construction

Avoidance and mitigation measures

3.4.1 During the development of the design, the following measures have been incorporated to avoid or mitigate adverse impacts on agriculture, forestry or soils during construction:

- bridges and/or underpasses to mitigate the effects of severance for Glebe Farm (CFA12/4), Needles Farm (CFA12/5), Doddershall Estate (CFA12/10) and Sheephouse Wood Farm (CFA13/2)[20]; and
- alignment of side roads to avoid affecting agricultural buildings at Blackgrove Road, the hatchery at Quainton (CFA12/6) and Upper Greatmoor Farm[21].

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

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

3.4.4 Compliance with the draft CoCP will reduce environmental impacts during construction. Of particular relevance to agriculture, forestry and soils are the following measures (see Volume 5: Appendix CT-003-000/1):

- the reinstatement of agricultural land which is used temporarily during construction to agriculture, where this is the agreed end use (draft CoCP, Section 6);

[20] Sheephouse Wood Farm is situated in CFA12 but forms part of the land farmed by CFA13/2. The impact of the Proposed Scheme on CFA13/2 is assessed in the CFA13 ES report.
[21] Situated close to the Proposed Scheme but not affected.

- the provision of a method statement for stripping, handling, storing and replacing agricultural and woodland soils to reduce risks associated with soil degradation on areas of land to be returned to agriculture and woodland following construction, based on detailed soil survey work to be undertaken prior to construction. This will include any remediation measures necessary following the completion of works (draft CoCP, Section 6);
- a requirement for contractors to pay due consideration to the impacts of extreme weather events and related conditions which may affect agriculture, forestry and soil resources during construction (draft CoCP, Section 5);
- arrangements for the maintenance of farm and field accesses affected by construction (draft CoCP, Section 6);
- the protection and maintenance of existing land drainage and livestock water supply systems, where reasonably practicable (draft CoCP, Section 16);
- the protection of agricultural land adjacent to the construction site, including the provision and maintenance of appropriate stock-proof fencing (draft CoCP, Sections 6 and 9);
- the adoption of measures to control the deposition of dust on adjacent agricultural crops (draft CoCP, Section 7);
- the control of invasive and non-native species; and the prevention of the spread of weeds generally from the construction site to adjacent agricultural land (draft CoCP, Section 9);
- the adoption of measures to prevent, as far as reasonably practicable, the spread of soil-borne, crop and animal diseases from the construction area (draft CoCP, Sections 6 and 9); and
- liaison and advisory arrangements with affected landowners, occupiers and agents, as appropriate (draft CoCP, Sections 5 and 6).

Assessment of impacts and effects

3.4.5 The cessation of existing land uses will be required in the area to construct and operate the Proposed Scheme. This includes not only the land on which permanent works will be sited, but also that required temporarily to facilitate the delivery of those permanent works.

3.4.6 All of the land required to implement the Proposed Scheme will, therefore, be affected during the construction phase. The land required for the construction and operation of the Proposed Scheme will, in places, sever and fragment individual fields and operational units of agricultural and forestry land. This will result in potential effects associated with the ability of affected agricultural interests to continue to access and effectively use residual parcels of land. There may also be the loss of, or disruption to, buildings and operational infrastructure such as drainage. The Scheme design seeks, however, to reduce this structural disruption, and to incorporate inaccessible severed land as part of environmental mitigation works.

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

Temporary effects during construction

Impacts on agricultural land

3.4.8 During the construction phase, the total area of agricultural land used will be approximately 285.1ha as shown in Table 5. Of this total some 118.1ha will be restored and available for agricultural use following construction.

Table 5: Agricultural land required for the construction of the Proposed Scheme

Agricultural land quality	Area required (ha)	Percentage of agricultural land	Area to be restored (ha)
Grade 1	0	0	0
Grade 2	0	0	0
Subgrade 3a	0	0	0
BMV subtotal	0	0	0
Subgrade 3b	285.1	100	118.1
Grade 4	0	0	0
Grade 5	0	0	0
Total agricultural land	285.1		118.1

3.4.9 Although BMV land in the study area is a receptor of high sensitivity, no such land will be disturbed during construction and the effect on lower quality Subgrade 3b agricultural land is not significant.

3.4.10 Following construction the land required temporarily will be primarily reinstated to its pre-existing agricultural condition. It is estimated that there will not be any significant surplus of topsoil or subsoil material arising from the Proposed Scheme in the area.

Nature of the soil to be disturbed

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

3.4.12 Successful soil handling is dependent upon stripping and handling being undertaken under appropriate weather and ground conditions using the appropriate equipment. The principles of soil handling are well established and set out in advisory material such as Defra's Code of Practice for the Sustainable Use of Soils[22]. These principles

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

will be followed throughout the construction period. Care will have to be taken when moving the Denchworth and Ragdale soils to avoid damage to soil structure as they are susceptible to compaction and smearing when moved in wet conditions or by inappropriate equipment and need particularly careful handling to avoid damage to soil structure.

3.4.13 Compliance with the CoCP will ensure the magnitude of impact on soil is low and significance of effect is negligible.

Impacts on holdings

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

3.4.15 The effects of the Proposed Scheme on individual agricultural and related interests during the construction period are summarised in Table 6. This table shows the total area of land required on a particular holding in absolute terms and as a percentage of the total area farmed. It also shows the area of land that will be returned to the holding following the construction period. The degree of impact is based on the proportion of the holding required rather than the absolute area of land. The holding/reference name provides a unique identifier and relates to Maps AG-01-025 to AG-01-028 (Volume 5, Agriculture, Forestry and Soils Map Book) and Volume 5: Appendix AG-001-012.

3.4.16 The effects of severance during construction are judged on the ease and availability of access to severed land. For the most part these will be same during and post-construction but occasionally they will differ between the two phases. The disruptive effects, principally of construction noise and dust, are assessed according to their effects on land uses and enterprises. Full details of the nature and significance of effects are set out in Volume 5: Appendix AG-001-012, Section 4. Where the area of land summed by ALC grade differs from the area of land summed by holding, the difference is because some holdings are affected in more than one CFA and some holdings include non-agricultural land. Where holdings are affected in more than one CFA the combined impact has been reported in the CFA report where the main holding is located.

Table 6: Summary of effects on holdings during construction

Holding reference/name	Total area required	Construction Severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA 12/1 Sunset Cottage	1.2ha (14%) Medium	Negligible	Negligible	Minor adverse	0.1ha

Holding reference/name	Total area required	Construction Severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA 12/2 Waddesdon Estate	75.9ha (3%) Negligible	No new severance Negligible	Negligible	Negligible	30.1ha
CFA 12/3 Wayside Farm	< 0.1ha (1%) Negligible	Negligible	Negligible	Negligible	< 0.1ha
CFA 12/4 Glebe Farm	44.6ha (27%) High	Accommodation structures provided Low	Negligible	Major adverse due to proportion of farm required, severance and high sensitivity of holding	22.7ha
CFA 12/5 Needles Farm	23.6ha (33%) High	Accommodation structure provided Low	Negligible	Major/moderate adverse due to proportion of farm required, severance and medium sensitivity of holding	16.3ha
CFA 12/6 Faccenda Hatchery	1.4ha (21%) High impact but holding not reliant on land for production. Negligible.	Negligible	Negligible	Negligible	0.2ha
CFA 12/7 Crossroads Farm, Quainton	7.4ha (76%) High	No access to severed land High	Negligible	Moderate adverse due to proportion of farm required, severance and low sensitivity of holding	4.2ha
CFA 12/8 Fieldside Farm	2.5ha (4%) Negligible	Negligible	Negligible	Negligible	1.6ha
CFA 12/9 Upper South Farm	37.6ha (26%) High	Access to severed land via public highway Medium	Negligible	Major/moderate adverse due to proportion of holding required, severance and medium sensitivity of holding	9.3ha
CFA 12/10 Doddershall Park	43.9 (8%) Low	Existing structure replaced Negligible	Negligible	Minor adverse	16ha
CFA 12/11 Hill Farm	23ha (6%) Low	Negligible	Negligible	Minor adverse	10.4ha

Holding reference/name	Total area required	Construction Severance	Disruptive effects	Scale of construction effect	Area to be restored
CFA 12/12 Crossroads Farm, Oving	4.3ha (6%) Low	No effective severance Negligible	Negligible	Minor adverse	0.4ha
CFA 12/13 Woodlands Farm	0.7ha (13%) Medium	Negligible	Negligible	Minor adverse	oha
CFA 12/14 Oak Tree Farm	5.2ha (10%) Medium impact	Negligible	Negligible	Moderate effect due to the proportion of the holding removed	1.9ha
CFA 12/15 Woodlands Farm Cottage 2	2.6ha (59%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding removed and low sensitivity	1.4ha
CFA12/16 Littleton Middle Farm	4.6ha (4%) Negligible	Negligible	Negligible	Negligible	4.6ha
CFA12/17 BBOWT farmland	7.0ha (21%) High	Negligible	Negligible	Moderate adverse due to the proportion of the holding removed and low sensitivity	3.9ha
CFA12/18 Fishery lake	0.4ha (17%) Medium impact but no impact on fishery lake downgraded to low.	Negligible	Negligible	Negligible	oha
CFA12/19 Briar Hill Farm	< 0.1ha (1%) Negligible	Small parcel severed to the east of the proposed Waddesdon bypass and accessed from highway; impact downgraded due to small parcel size to low	Negligible	Negligible	oha

3.4.17 Overall, seven holdings will experience moderate, major/moderate or major adverse effects during construction, which are significant.

3.4.18 No farm enterprises which are sensitive to noise or vibration emitted during the construction phase, for example intensive poultry houses, have been identified sufficiently near to the Proposed Scheme to experience significant effects. Although there will be some highway construction activity relatively close (70m) to the Faccenda hatchery (CFA12/6) the scale of activity proposed will not adversely affect

the agricultural activities undertaken. The more substantial engineering operations required for bridge and track construction will be more than 200m distant and will not adversely affect the agricultural activities undertaken.

Cumulative effects

3.4.19 No committed development has been identified in this area that will affect agricultural and forestry land or soils during the period of construction and thus there are no cumulative effects to report.

Permanent effects from construction

Impacts on agricultural and forestry land

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

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

3.4.21 Following construction and restoration, the area of agricultural land that will be permanently required will be 167.0ha, as shown in Table 7. A further approximately 2.1ha of forestry land will also be permanently removed.

Table 7: Agricultural and forestry land required permanently

Agricultural land quality	Total area required (ha)	Percentage of agricultural land
Grade 1	0	0
Grade 2	0	0
Subgrade 3a	0	0
BMV subtotal	0	0
Subgrade 3b	167.0	100
Grade 4	0	0
Grade 5	0	0
Total agricultural land	167	
Non-agricultural forestry land	2.1	

3.4.22 Following the restoration of land to agriculture there will be a permanent loss of approximately 167ha of Subgrade 3b agricultural land but this loss of lower quality land is not significant.

3.4.23 Some areas of agricultural land that are required for the construction of the Proposed Scheme will be restored for ecological and/or landscape mitigation and will be

removed from mainstream agricultural production. These areas include land adjacent to the Glebe Farm buildings, around Doddershall House, and between Romer and Sheephouse Wood. The assessment assumes that this land will not return to agriculture.

3.4.24 Approximately 4.0ha of agricultural land will be engineered to provide additional flood compensation capacity and will be subject to marginal downgrading in agricultural land quality. This agricultural assessment assumes this land will return to agriculture.

3.4.25 The total amount of forestry land required to implement the Proposed Scheme will comprise approximately 2.1ha, out of a total of 329.7ha (including non-agricultural land) required for construction of the Proposed Scheme. As the proportion of forest cover as a land use in the study area (11%) is greater than the average national land use forest cover (10%) the loss of this woodland will have a negligible effect, and is not significant. Insofar as forestry land may have some non-commercial value, for example in ecological or landscape terms, the qualitative assessment of this loss is addressed in the relevant sections.

Impacts on holdings

3.4.26 The permanent residual effects from the construction of the Proposed Scheme on individual agricultural and related interests is summarised in Table 8. The land required column refers to the area of land permanently required to operate the Proposed Scheme (in absolute terms and as a percentage of the overall area farmed). The degree of impact is based on the proportion of land required. The effects of severance are judged on the ease and availability of access to severed land once construction is completed and the impact on farm infrastructure refers mainly to the loss of or damage to farm capital, such as property, buildings and structures, and the consequential effects on land uses and enterprises. Full details of the nature and scale of effects are set out in Volume 5: Appendix AG-001-012.

Table 8: Summary of permanent effects on holdings from construction

Holding reference/name	Land required	Severance	Infrastructure	Scale of effect
CFA12/1 Sunset Cottage	1.1ha (12%) Medium	Negligible	Negligible	Minor adverse
CFA12/2 Waddesdon Estate	45.7ha (2%) Negligible	Widely dispersed holding; no new severance Negligible	Negligible	Negligible
CFA12/3 Wayside Farm	< 0.1ha (1%) Negligible	Negligible	Negligible	Negligible
CFA12/4 Glebe Farm	21.9ha (13%) Medium	Accommodation structures provided Low	Slurry lagoon removed High	Major adverse due to proportion of farm required, severance, loss of slurry lagoon and high sensitivity of holding

Holding reference/name	Land required	Severance	Infrastructure	Scale of effect
CFA12/5 Needles Farm	7.3ha (10%) Medium	Accommodation structure provided Low	Negligible	Moderate adverse due to proportion of farm required, severance and medium sensitivity of holding
CFA12/6 Faccenda Hatchery	1.2ha (18%) Medium but not reliant on land for production so downgraded to negligible	Negligible	Negligible	Negligible
CFA12/7 Crossroads Farm, Quainton	3.2ha (33%) High	Land accessible from public highway Medium	Negligible	Moderate adverse due to proportion of farm required, severance and low sensitivity of holding
CFA12/8 Fieldside Farm	0.9ha (1%) Negligible	Negligible	Negligible	Negligible
CFA12/9 Upper South Farm	28.2ha (20%) High	Access to severed land via public highway Medium	Small field shelter demolished impact downgraded due to size and utility of building Low	Major/moderate adverse due to severance and medium sensitivity of holding
CFA12/10 Doddershall Park	27.9ha (5%) Low	Existing structure replaced Negligible	Residential demolition High	Major/moderate adverse due to residential property demolition, the proportion of farm required, and medium sensitivity of holding
CFA12/11 Hill Farm	12.6ha (3%) Negligible	Negligible	Negligible	Negligible
CFA12/12 Crossroads Farm, Oving	3.9ha (5%) Low	Negligible	Negligible	Minor adverse
CFA12/13 Woodlands Farm	0.7ha (13%) Medium	Negligible	Small field shelter demolished impact downgraded due to size and utility of building Low	Minor adverse
CFA12/14 Oak Tree Farm	3.3ha (7%) Low	Negligible	Negligible	Minor adverse

Holding reference/name	Land required	Severance	Infrastructure	Scale of effect
CFA12/15 Woodlands Farm Cottage 2	1.2ha (27%) High	Negligible	Negligible	Moderate adverse due to proportion of farm required and low sensitivity of holding
CFA12/16 Littleton Middle Farm	0ha (0%) Negligible	No effective severance Negligible	Negligible	Negligible
CFA12/17 BBOWT farmland	3.1ha (10%) Medium	No effective severance Negligible	Negligible	Minor adverse
CFA12/18 Fishery lake	0.3ha (15%) Medium impact but no impact on fishery lake downgraded to low.	Existing structure replaced Negligible	Negligible	Negligible
CFA12/19 Briar Hill Farm	< 0.1ha (1%) Negligible	Small parcel severed, accessed from highway Low	Negligible	Negligible

3.4.27 Overall, it is likely that six holdings will experience moderate, moderate/major or major permanent adverse effects from the construction of the Proposed Scheme, which are significant. Two holdings are likely to cease as rural holdings (CFA12/7 and CFA12/15) as the residual land area will be too small. Three holdings incur demolitions though only one holding has a residential property demolished (CFA12/10); the other units lose farm buildings.A further holding has a slurry lagoon removed.

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

Cumulative effects

3.4.29 The development of the Energy for Waste plant at Calvert will require the removal from agriculture of approximately 6.3ha of lower quality land in Subgrade 3b. Although this will be in addition to the 167ha of Subgrade 3b land required for the Proposed Scheme, the loss of lower quality agricultural land is not significant. Similarly, the loss of less than 1ha of land for the new hatchery at Quainton is not significant.

3.4.30 No impact on forestry resources has been identified; and provided the works are undertaken in accordance with good practice there will be no cumulative impact on soil resources.

Other mitigation measures

3.4.31 Other mitigation measures that are proposed include ecological habitat creation and landscape planting, mainly on land that is presently used for agriculture. Soils from ancient woodland (where relevant) will be stored separately and will be utilised in this process, as discussed in Section 7. Mitigation will incorporate climate change adaptation and resilience measures, as far as practicable.

Summary of likely significant residual effects

3.4.32 A total of six holdings have been identified that will experience significant permanent adverse effects. Of these two are smallholdings that will effectively cease to function as rural land use holdings (Crosslands Farm, Quainton (CFA12/7) and Woodlands Farm Cottage 2 (CFA12/15)) as the residual land area will be too small and the use of compensation payments to purchase replacement land will not reduce the effects to not significant. For the other holdings, all will have sufficient residual land to be able to continue, though Glebe Farm (CFA12/4) is likely to cease dairy farming due to the scale of impacts (in terms of land loss and severance) coupled with the duration of the disturbance.

3.5 Effects arising from operation

Avoidance and mitigation measures

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

Assessment of impacts and effects

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

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

3.5.3 The hatchery at Quainton operates at present adjacent to a public highway and is not affected by road traffic noise and vibration. Although it is potentially a sensitive receptor it will lie some 250m distant from the Proposed Scheme and will not be affected adversely by operational noise. The dairy cows at Glebe Farm would be some 300m distant and will similarly not be affected adversely by operational noise. The best available evidence (set out in the SMR Addendum) suggests that livestock receptors more than 40m distant from will not be adversely affected by operational noise. There are no livestock buildings within 40m of the Proposed Scheme that will be affected adversely by operational noise.

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

Summary of likely significant residual effects

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

4 Air quality

4.1 Introduction

4.1.1 This section of the report provides an assessment of the impacts and likely significant effects on air quality arising from the construction and operation of the Proposed Scheme, covering nitrogen dioxide (NO_2), fine particulate matter (PM10 and PM2.5)[23] and dust.

4.1.2 With regard to air quality, the main potential effects are anticipated to result from the emissions of the above pollutants from construction activities and equipment and road traffic. Dust emissions could be associated with demolition, site preparation works, construction of bridges, cuttings and embankments, and the use of haul routes within the sites.

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

- Appendix AQ-001-012;
- Map AQ-01-012; and
- Maps AQ-02-012-01 to AQ-02-012-02.

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

4.2 Scope, assumptions and limitations

4.2.1 The assessment scope, key assumptions and limitations for the air quality assessment are set out in Volume 1, the SMR (Appendix CT-001-000/1), the SMR Addendum (Appendix CT-001-000/2) and appendices presented in Volume 5 (AQ-001-012). This report follows the standard assessment methodology.

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

4.2.3 The assessment of impacts arising from construction dust emissions has been undertaken using the methodology based on that produced by the Institute of Air Quality Management (IAQM)[24]. It is important to note that this methodology provides a means of assessing the scale and significance of effects that is partly dependent on the approximate number of receptors within close proximity to the dust-generating activities. In doing so, it assigns a lower scale of effect to cases where the number of properties is small, e.g. fewer than 10 properties within 20m of dust-generating activities. Thus, a single property very close to a construction site cannot experience a 'significant effect' as defined by this methodology. The assessment presented here

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

reaches a conclusion that incorporates this concept of significance being proportional to the number of people affected. However, in cases where less than 10 properties are within 20m of the construction activity, it will still be the case that mitigation in accordance with the CoCP will be applied.

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

4.3 Environmental baseline

Existing baseline

4.3.1 The environmental baseline reported in this section represents the environmental conditions identified within the study area. The air quality in the Waddesdon and Quainton area is typical of the generally rural nature of this part of Buckinghamshire, with concentrations of airborne pollutants well within air quality standards. There are few roads and these have low road traffic flows.

4.3.2 Estimates of background air quality have been obtained from Defra background maps[25] for 2012. These data are estimated for 1km grid squares for nitrogen oxides (NOx), NO2, PM10 and PM2.5. All average background pollutant concentrations are well within relevant air quality standards.

4.3.3 Aylesbury Vale District Council conducts routine diffusion tube monitoring at several locations. However, almost all of these are at roadside locations or in towns in locations that are away from the Proposed Scheme and are not affected by scheme related traffic. On this basis, these monitoring data are not relevant to this assessment and are not considered.

4.3.4 The available mapping and monitoring data indicate that all parts of the Waddesdon and Quainton area currently experience concentrations of NO2, PM10 and PM2.5 that meet air quality standards, as supported by the absence of any Air Quality Management Areas (AQMA) declared for these pollutants. Background mapping data are shown in Volume 5: AQ-001-012.

4.3.5 Potential receptors are primarily those residential properties close to construction activity and alongside roads where traffic flows will change as a consequence of construction activity or realignment of roads. Notable receptors in close proximity to construction activity are residential properties at Wayside Farm, Crossroads Farm, Upper South Farm, and Woodlands Farm, which will be close to sites of construction

[25] Defra; 2010 Based Background Maps for NOx, NO2, PM10 and PM2.5; http://laqm.defra.gov.uk/maps/maps2010.html; Accessed July 2013.

activity. Sheephouse Wood SSSI is sensitive to potential dust deposition and has been considered in relation to the haul route. The SSSI Ham Home-cum-Hamgreen Woods and Long Herdon Meadow are adjacent to the A41 west of Blackgrove Road, which is a construction lorry route. Receptors near roads where traffic flows will change as a result of construction activity include The Georgian Dolls House, Pear Tree Cottage, Winding Brook and Perry Hill Cottage. Receptors near roads subject to realignment include 145 Station Road, Wayside Farm and Woodlands Farm Cottages.

Future baseline

4.3.6 Section 2.1 and Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the future baseline for the assessment of effects from the construction and operation of the Proposed Scheme. The data used for the air quality assessment take account of predicted changes in traffic, which are derived from a combination of regional traffic growth factors and consideration of major locally consented schemes, as described in the Traffic and Transport section. In this way, the assessment accounts for cumulative effects

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

Construction (2017 to 2025)

4.3.8 Future background pollutant concentrations have been sourced from Defra background maps[26] for 2017, which predict NO2 and PM10 concentrations in 2017 to be lower than in the 2012 baseline.

Operation (2026)

4.3.9 Future background pollutant concentrations have been sourced from Defra background maps[26] for 2026, which predict NO2 and PM10 concentrations in 2026 to be lower than in the 2012 baseline.

4.4 Effects arising during construction

Avoidance and mitigation measures

4.4.1 Emissions to the atmosphere will be controlled and managed during construction through the route-wide implementation of the CoCP, where appropriate. The draft CoCP includes a range of mitigation measures that are accepted by the IAQM as being suitable to reduce impacts to as low a level as practicable. It also makes provision for the preparation of Local Environmental Management Plans (LEMP) which will set out

[26] Defra; Background Pollutant Concentration Maps; http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html; Accessed: July 2013.

how the project will adapt and deliver the required environmental and community protection measures within each area through the implementation of specific measures required to control dust and other emissions from activities in the area.

4.4.2 The assessment has assumed that the measures detailed in the draft CoCP (Volume 5: Appendix CT-003-000/1) will be implemented. These include:

- contractors being required to control dust, air pollution, odour and exhaust emissions during construction works (draft CoCP, Section 7);
- inspection and visual monitoring after engagement with the local authorities to assess the effectiveness of the measures taken to control dust and air pollutant emissions (draft CoCP, Section 7);
- cleaning (including watering) of haul routes and designated vehicle waiting areas to suppress dust (draft CoCP, Section 7);
- keeping material stockpiles away from sensitive receptors where reasonably practicable, also taking into account the prevailing wind direction relative to sensitive receptors (draft CoCP, Section 7);
- using enclosures to contain dust emitted from construction activities (draft CoCP, Section 7); and
- undertaking soil spreading, seeding and planting of completed earthworks as soon as reasonably practicable following completion of earthworks (draft CoCP, Section 7).

Assessment of impacts and effects

Temporary effects

4.4.3 Impacts from the construction of the Proposed Scheme could arise from dust-generating activities and emissions from construction traffic. As such, the assessment of construction impacts has been undertaken for human receptors sensitive to dust and exposure to NO_2 and PM10, as well as ecological receptors sensitive to dust deposition.

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

4.4.5 In the Waddesdon and Quainton area, dust-generating activities will comprise the construction of a series of cuttings and embankments and a number of bridges. Activities with the potential to generate dust at these sites are likely to include the demolition of buildings, earthworks required for the preparation of ground, bulk excavation, processing and stockpiling of fill materials, construction of structural embankments, landscaping, the construction and use of construction compounds, construction of permanent replacement road infrastructure and bridges and the movement of vehicles off site onto local roads with a possible associated transfer of dust and mud. The use of haul routes within sites also has the potential to generate dust.

4.4.6 Given the mitigation contained within the CoCP, including the use of LEMP where receptors are close to the haul route, the assessment of impacts arising from dust emissions has concluded that they will be slight temporary adverse at a small number of residential receptors and at the nature conservation sites Finemere Wood SSSI and Sheephouse Wood SSSI and negligible for all other receptors assessed. The effect will not be significant. The basis for this conclusion can be found in Volume 5: Appendix AQ-001-012.

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

4.4.8 Examination of the changes in traffic flows for the construction period along the affected roads has identified that there are three roads that meet the criteria for assessment. Temporary impacts at nearby properties have been assessed as slight adverse at worst, which will not have significant effects on receptors. This is because the background concentrations of NO2 and PM10 are low relative to thresholds defined in air quality standards.

4.4.9 The A41 Bicester Road will be a construction traffic route between 2017 and 2024, with an approximately one year and four months peak in activity due to the movement of excavated material from 2020. With regard to sensitive ecological habitats, an initial assessment predicted a potentially significant effect for parts of the Ham Home-cum-Hamgreen Woods SSSI located adjacent to the A41 Bicester Road, west of Blackgrove Road, for total NOx and nitrogen deposition.

4.4.10 Further detailed assessment has shown it is highly unlikely that the increase in nitrogen deposition rate will have a measureable effect on the plant communities within the SSSI and the integrity of the feature, largely because of the temporary nature of the increase and the fact that it affects only a small part of the SSSI. For these reasons, the effect is considered not to be significant.

Permanent effects

4.4.11 No permanent effects are anticipated to arise during construction of the Proposed Scheme.

Cumulative effects

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

Other mitigation measures

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

Summary of likely significant residual effects

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

4.5 Effects arising from operation

Avoidance and mitigation measures

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

Assessment of impacts and effects

4.5.2 Impacts from the operation of the Proposed Scheme relate mainly to changes in the nature of traffic. There are no direct atmospheric emissions from the operation of trains that will cause an impact on air quality and these have therefore not been assessed.

4.5.3 The assessment of operational traffic emissions has been undertaken for two scenarios in the operation year 2026; one without the Proposed Scheme scenario and one with the Proposed Scheme scenario. The traffic data include the additional traffic from future committed developments.

4.5.4 Traffic data in the Waddesdon and Quainton area have been screened to identify roads that require further assessment and to confirm the likely effect of the change in emissions from vehicles using those roads in 2026.

4.5.5 Three roads are predicted to meet the criteria for further assessment as a consequence of realignment; part of Blackgrove Road, Edgcott Road (also known as Shipton Lee Road) and Station Road. Worst case receptors for these realignments are predicted to experience negligible or small decreases in concentrations of NO_2 and PM_{10} and the effect will not, therefore be significant.

Cumulative effects

4.5.6 The traffic data used for the assessment include the traffic changes expected from the committed developments and therefore their impacts have been included within the assessment.

Other mitigation measures

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

Summary of likely significant residual effects

4.5.8 No significant residual effects are anticipated for air quality in this area during operation of the Proposed Scheme.

5 Community

5.1 Introduction

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

5.1.2 Key issues relating to the community assessment for this study area comprise:

- the temporary loss of access to and permanent loss of land at the Buckinghamshire Railway Centre's overflow car park in Quainton;
- impacts on residential amenity for properties and the village hall in Edgcott during construction of the Proposed Scheme; and
- impacts on amenity for users of St Leonard's Church in Grendon Underwood.

5.1.3 Further details of the community assessments and write-ups of open space surveys and recreational public rights of way (PRoW) surveys undertaken within the CFA are contained in Volume 5: Appendix CM-001-012.

5.1.4 Significantly affected community resources are shown in Maps CM-01-037 to CM-01-040 (Volume 5, Community Map Book).

5.1.5 The current assessment draws upon information gathered from local and regional sources including Buckinghamshire County Council and Buckinghamshire Railway Centre.

5.2 Scope, assumptions and limitations

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

5.3 Environmental baseline

Existing baseline

5.3.1 Baseline data on community resources was collected in areas up to 1km from the centre line of the Proposed Scheme and, additionally, up to 250m from the boundary of the land required for construction.

5.3.2 The study area includes the area of land required both temporarily and permanently for the construction and operation of the Proposed Scheme, together with a wider corridor within which receptors or resources could be affected by a combination of significant residual effects, such as noise, vibration, construction dust, poor air quality and visual intrusion. In addition, the study area has regard to the proposed routeing of construction traffic and takes account of catchment areas for community facilities which could be affected where crossed by the Proposed Scheme. As such, the study area includes land in and near to Waddesdon and Quainton. The rural parts of the wider area are characterised by farmland with woodland at its north-western extent. Waddesdon forms the key settlement within the area. Outside Waddesdon and

Quainton the population is scattered and mainly located in farmhouses and rural cottages.

Waddesdon

5.3.3 The village of Waddesdon straddles the A41 Bicester Road to the north-west of Aylesbury. The majority of the community facilities within the village are situated along the A41 and include a post office, The Lion public house, Waddesdon Church of England Primary School, St Michael and All Angels Church, a police station and several shops. There are also allotment gardens located on the eastern fringe of the village. Waddesdon Manor, a stately home open to the public, and Waddesdon Manor RPG are located west of Waddesdon. There are also several PRoW in the area including Midshires Way (Footpath QUA/19) and Swan's Way (Bridleway QUA/17) which pass to the east of Waddesdon along Footpath WAD/22 and then a section of Blackgrove Road. The Aylesbury Ring (Footpath WAD/4), North Bucks Way (Footpaths QUA/19 and WAD/3), Bernwood Jubilee Way (Footpath QUA/39) and the Midshires Way (Footpath QUA/19) also pass through the centre of the village.

Quainton

5.3.4 The village of Quainton is situated to the north of Waddesdon, centred on the intersection between Station Road and Lower Street. The majority of residential properties are clustered around Lower Street, Upper Street and Church Street. There are also some properties south of the centre of the village on Station Road including The Lodge. There is a range of community infrastructure in the village including: Holy Cross and St Mary Church of England and Long Crendon, Baptist churches, Quainton Church of England Combined Primary School, Buckinghamshire Railway Centre, a memorial hall, The George and Dragon public house and a village store. To the south of Quainton there is a children's play area on Station Road, The Buckinghamshire Railway Centre is approximately 1.2km south-west of Quainton on Station Road[27]. It is a working steam train museum and occupies a 10ha site on both sides of the existing Aylesbury Link railway line.

Grendon Underwood and Edgcott

5.3.5 The village of Grendon Underwood is located approximately 5km west of Quainton and approximately 1.5km south of Edgcott. It is a linear development centred along Main Street. Community facilities within the village include: a post office; local village shop; Grendon Underwood Combined School for pupils aged between 4 and 11 on Main Street; The Swan public house on Main Street; a village hall and its associated playing field on Main Street; and St Leonard's Church on the Broadway.

5.3.6 The village of Edgcott is situated approximately 6km to the northwest of Quainton. It is centred on Buckingham and Grendon Roads with some outlying farmsteads in the surrounding area. Community facilities in the village include local shops, St Michael's Church on Church Lane in the northern end of the village and playing fields near the junction of Grendon Road and Marsh Gibbon Road to the south. Springhill HM Prison and Grendon Young Offender Institution are located to the east of the village.

[27] Buckinghamshire Railway Centre; Home page; www.bucksrailcentre.org; Accessed: 14 August 2013.

Future baseline

Construction (2017)

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

Operation (2026)

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

5.4 Effects arising during construction

Avoidance and mitigation measures

5.4.1 A new entrance to the Buckinghamshire overflow car park following completion of works on the embankment has been incorporated into the scheme design to help minimise the adverse environmental impacts during the remainder of the construction period.

5.4.2 The draft CoCP includes a range of provisions that will help mitigate community effects associated with construction within this area, including the following (see Volume 5: Appendix CT-003-000/1):

- appointment of community relations personnel (draft CoCP, Section 5);
- community helpline to handle enquires from the public (draft CoCP, Section 5);
- sensitive layout of construction sites to reduce nuisance (draft CoCP, Section 5);
- where reasonably practicable, maintenance of PRoW for pedestrians, cyclists and equestrians around the perimeter of construction sites and across entry and exit points (draft CoCP, Section 5);
- monitoring and management of flood risk and other extreme weather events which may affect community resources during construction (draft CoCP, Sections 5 and 16);
- specific measures in relation to air quality and noise will also serve to reduce impacts for the neighbouring communities including discretionary noise insulation for sensitive community resources and, in special circumstances, temporary rehousing (draft CoCP, Sections 7 and 13); and
- where reasonably practicable, the avoidance of large goods vehicles operating adjacent to schools during drop off and pick up periods (draft CoCP, Section 14).

Assessment of impacts and effects

5.4.3 Details of all assessments of community resources are included in Volume 5: Appendix CM-001-012. Each assessment form presents information that explains the rationale for determining the rating for sensitivity of the affected community resource, magnitude of impact and the assessment of significance.

Waddesdon

Temporary effects

5.4.4 No significant temporary effects have been identified for the community of Waddesdon.

Permanent effects

5.4.5 No significant permanent effects have been identified for the community of Waddesdon.

Quainton

Temporary effects

Community infrastructure

5.4.6 To the south-west of Quainton, the Proposed Scheme will pass to the west of the Buckinghamshire Railway Centre. The Railway Centre (situated on the southern side of Station Road) also uses a piece of land on the northern side of the road, just to the west of the existing railway tracks, as an overflow car park and display field. Approximately 14,500m^2 (60% of the total area (24,100m^2)) of this car park, including the entrance to the car park, is within the land required for construction of the embankment for the Proposed Scheme. Construction of the Doddershall embankment will take approximately nine months during which time the use of this site as a car park will not be possible.

5.4.7 Annual attendance at the Buckinghamshire Railway Centre has ranged between 28,000 and 42,000 people in recent years[28]. The centre has around 1,000 members, many of whom volunteer at the facility. During the spring and summer terms, the centre hosts school visits from a large catchment area of approximately 80km. Over 40 special events, for which the overflow car park is used, are held each year attracting large numbers of enthusiasts.

5.4.8 With the overflow car parking facility out of use due to the lack of an entrance during the construction phase, the Centre's ability to hold special events, which attract higher visitor numbers, may be affected. Given this, and that there are no comparable facilities in the local area, the temporary loss of the overflow car park will be a moderate adverse effect and is considered to be significant.

[28] Figures supplied by Buckinghamshire Railway Centre via email 8 March 2013.

Permanent effects

Residential properties

5.4.9 One residential property, The Lodge, which is south-west of Quainton near to the Buckinghamshire Railway Centre, will be demolished (see Map CT-05-050, Volume 2, CFA12 Map Book). This demolition will be required because the property is within the area required for construction of the Proposed Scheme. It is considered that the permanent loss of this one residential property will be a minor adverse effect and therefore it is not significant at a community level.

Community infrastructure

5.4.10 The Proposed Scheme will permanently require approximately 9,600m^2 (approximately 40%) of the land at the Buckinghamshire Railway Centre's overflow car park site. Whilst a new entrance to the site will be provided so that the field can be accessed after construction is complete, given that the car parking capacity will be reduced by over 40%, which may affect the ability to hold special events in future, the permanent loss of land is considered to be a moderate adverse effect and is therefore significant.

Grendon Underwood and Edgcott

Temporary effects

Residential properties

5.4.11 Approximately 40 residential properties in Edgcott, located on Grendon Road and Buckingham Road, are predicted to experience in-combination effects arising from the construction activities coordinated by several of the construction compounds that are within CFA13 including the West Street overbridge main compound; the Calvert railhead main compound; the School Hill overbridge satellite compound; the Aylesbury Link satellite compound; and the Bicester to Bletchley (rail systems) compound. Durations for the compound operations can be found in Section 2.3 and Figure 5. These in-combination effects are:

- significant noise effects due to the HGV traffic using Grendon Road and Buckingham Road; and
- significant increases in HGV movements along these roads to access the compounds described above.

5.4.12 The combination of these effects will have a major adverse effect on residential amenity and is therefore considered to be significant.

Community infrastructure

5.4.13 St Leonard's (Church of England) Church is situated on the junction between the Edgcott Road and Main Street in Grendon Underwood. The Church is open every day and, as well as holding services, it organises friendship lunches, social events and discussion groups. There is also a Bears Club for pre-school children and their carers and a junior youth club for children aged 7-11. The nearest alternative Church of England Church is St Michael's Church in Edgcott, approximately 2km away.

However this is not directly comparable as the range of other community services it provides are not the same.

5.4.14 St Leonard's is predicted to experience in-combination effects arising from the construction activities coordinated by several of the construction compounds that are within CFA13 including the West Street overbridge main compound; the Calvert railhead main compound; the School Hill overbridge satellite compound; the Aylesbury Link satellite compound; and the Bicester to Bletchley (rail systems) compound. Durations for the compound operations can be found in Section 2.3 and Figure 5. These in-combination effects are:

- significant noise effects due to the HGV traffic the Broadway; and
- significant increases in HGV movements along the Broadway to access the compounds described above.

5.4.15 The church is expected to be able to continue to function without serious disruption. However, considering that this is the only church in the village, which provides a range of community services and given the duration of construction activities that give rise to these in-combination effects, there will be a moderate adverse effect on amenity, which is considered to be significant.

5.4.16 There is a village hall on Buckingham Road in Edgcott. This provides a venue for local events including quiz nights and jumble sales. The nearest alternative village hall is in Calvert approximately 2.5km north of Edgcott.

5.4.17 Edgcott village hall is predicted to experience in-combination effects arising from the construction activities coordinated by several of the construction compounds that are within CFA13 including the West Street overbridge main compound; the Calvert railhead main compound; the School Hill overbridge satellite compound; the Aylesbury Link satellite compound; and the Bicester to Bletchley (rail systems) compound. Durations for the compound operations can be found in Section 2.3 and Figure 5. These in-combination effects are:

- significant noise effects due to the HGV traffic using Buckingham Road; and
- significant increases in HGV movements along Buckingham Road to access the compounds described above.

5.4.18 The village hall is likely to be able to continue its operations without serious disruption. However, given the duration of construction activities in this area and the lack of an alternative hall in the village these in-combination of these effects will have a moderate adverse effect on amenity; this is therefore considered to be significant.

Cumulative effects

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

Other mitigation measures

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

5.4.21 HS2 Ltd will continue to work with the owners of Buckinghamshire Railway Centre to assist them with the identification of suitable alternative overflow car parking. If alternative car parking is provided in the same locality this would fully mitigate the effect.

Summary of likely significant residual effects

5.4.22 There will be a temporary significant effect on amenity for residential properties on Grendon Road and Buckingham Road and the village hall in Edgcott. There will also be temporary significant amenity effects for users of St Leonard's Church in Grendon Underwood. In addition, there will be significant effects due to the temporary loss of access during construction of the Proposed Scheme to the Buckinghamshire Rail Centre's overflow car park and the permanent loss of approximately 40% of land at this site.

5.5 Effects arising from operation

Assessment of impacts and effects

5.5.1 No significant effects have been identified during operation.

Other mitigation measures

5.5.2 The assessment has concluded that no significant adverse effects will arise during operation in relation to community resources, residential properties, open space and recreational PRoW. Therefore no further mitigation is proposed.

Summary of likely significant residual effects

5.5.3 No significant adverse effects will arise from the operation of the Proposed Scheme.

6 Cultural heritage

6.1 Introduction

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

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

6.1.3 Maps showing the location of the key environmental features can be found in Map Series CT-10 (Volume 2, CFA12 Map Book). The location of all designated and non-designated heritage assets can be found in Maps CH-01-037 to CH-01-040 and Maps CH-02-019 to CH-02-020-R1 (Volume 5, Cultural Heritage Map Book). Detailed reports on the cultural heritage character and surveys undertaken within the local area are contained in the Volume 5 Appendices. These include:

- Appendix CH-001-012 – Baseline Report;
- Appendix CH-002-012 – Gazetteer of Heritage Assets;
- Appendix CH-003-012 – Impact Assessment Table; and
- Appendix CH-004-012 – Survey Reports.

6.1.4 Throughout this section, assets within the study areas are identified with a unique reference code, WADXXX; further detail on these assets can be found in the gazetteer in Volume 5: Appendix CH-002-012.

6.1.5 Engagement has been undertaken with the Buckinghamshire County Council planning archaeologist and conservation officer with regard to the nature of the cultural heritage assets within the local area.

6.2 Scope, assumptions and limitations

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

6.2.2 The setting of all designated heritage assets within the Zone of Theoretical Visibility (ZTV) of the Proposed Scheme has been considered. The study area within which a detailed assessment of all assets, designated and non-designated, has been carried out, is defined as the land required, temporarily and permanently, to construct the Proposed Scheme plus 500m. For the purposes of this assessment, any assets within the 10mm settlement contour are included within the assessment.

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

6.2.4 In undertaking the assessment the following limitations were identified:

- the LiDAR[29] data examined did not encompass the full extent of the study area; and
- all areas of survey as identified in the archaeological risk model[30] were not available for survey.

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

6.3 Environmental baseline

Existing baseline

6.3.1 In compiling this assessment, documentary baseline data was collected from a variety of sources as set out in Volume 5: Appendix CH-001-012.

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

- walkover and site reconnaissance from areas of public access or in locations where access was granted. This was undertaken to understand the character and form of heritage assets and the historic landscape; to review the setting of assets; and to identify previously unknown assets;
- desk-top review of remote sensing data LiDAR, aerial photographs and hyperspectral data (see Volume 5: Appendix CH-004-012); and
- a programme of non-intrusive surveys including fieldwalking (see Volume 5: Appendix CH-004-012).

Designated assets

6.3.3 One designated heritage asset is located partially or wholly within the land required, temporarily or permanently, for construction of the Proposed Scheme (see Volume 5, Cultural Heritage Map Book). A small linear strip of Sheephouse Wood (WAD110), located immediately south of the Proposed Scheme adjacent to the landfill south-east of Calvert is, designated as ancient woodland and an asset of high value and will extend into the land required temporarily and permanently for the construction of the Proposed Scheme.

[29] Light detection and ranging (LiDAR) is a high resolution remote sensing technique to capture 3D data.
[30] The archaeological risk model is an approach that enables the identification of those areas of the Proposed Scheme where archaeological assets are known or suspected and provides a mechanism for the prioritisation of the programme of survey.

6.3.4 The following designated assets are located within the ZTV (see Maps CH-02-019 to CH-02-020-R1, Volume 5, Cultural Heritage Map Book):

- two scheduled monuments: a medieval Market Cross at Quainton (within grouping WAD023); and Hogshaw medieval earthworks (WAD119);
- four Grade I listed buildings: Waddesdon Manor (within grouping WAD006); Church of St Mary and the Holy Cross (within grouping WAD023); Claydon House (within grouping WAD112); and Church of All Saints (within grouping WAD112);
- eight Grade II* listed buildings: Church of St Michael (within grouping WAD016); Numbers 40 to 54, Church Street (within grouping WAD023); Brudenell House (within grouping WAD023); Cross Farmhouse (within grouping WAD023); Quainton Market Cross (within grouping WAD023); Townsend Farmhouse (within grouping WAD023); Church of St Mary (within grouping WAD028); and Doddershall House (within grouping WAD066);
- a total of 28 areas of ancient woodland: These form discrete clusters of woodland at Finemere East (WAD092); Finemere West (WAD093); Romer Wood (WAD106); Greatsea Wood (WAD107); Home Wood (WAD109); and Shrubs Wood (WAD111);
- three conservation areas: Waddesdon (WAD016); Quainton (WAD023); and Middle Claydon (WAD112);
- one Grade I RPG: Waddesdon Manor (WAD006);
- one Grade II RPG: Claydon (WAD112); and
- a total of 111 Grade II listed buildings, the majority of which lie in the conservation areas of Waddesdon, Quainton, Middle Claydon and Botolph Claydon.

Non-designated assets

6.3.5 The following non-designated asset of high value lies partially within the land required, temporarily or permanently, for the construction of the Proposed Scheme:

- Doddershall Deserted Medieval Village (WAD063).

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

- a number of ridge and furrow earthworks located: south of the Buckinghamshire Railway Centre (WAD026); west of Crossroads Farm (WAD030); north of Crossroads Farm (WAD032); north of the Buckinghamshire Railway Centre (WAD033); north-east of the Lodge (WAD037); south of Upper South Farm (WAD038); north of Upper South Farm (WAD042); south-west of Civil War earthwork (WAD043); north of possible Civil War earthwork (WAD044); west of Glebe Farm (WAD125); south of railway cottage (WAD129);

north of Lower South Farm (WAD128); and west of Doddershall Deserted Medieval Village (WAD059);

- four hedgerows and groups of hedgerows that may qualify as historically important under the Hedgerow Regulations 1997 Criteria for Archaeology and History[31] (WAD051; WAD054; WAD061; WAD062)
- Cranwell Farm ridge and furrow, associated with possible settlement earthworks (WAD002);
- possible Romano-British settlement at Glebe Farm (WAD015);
- putative location of a watermill (WAD083);
- pond bay at Lee Wood (WAD084);
- area of Iron Age remains (WAD117);
- Romano-British ditches at two locations (WAD020; WAD040); and
- Chapell Hill (WAD065).

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

- the Lodge at Doddershall (WAD036);
- the Aylesbury Link railway line (also known as the London Extension of the Great Central Line) (WAD018);
- the former GCML (also known as the disused Aylesbury and Buckingham Line) (WAD046);
- ridge and furrow earthworks east of Glebe Farm (WAD012);
- earthworks of unknown date to the north-west of Glebe Farm (WAD011);
- remains of the former Wotton Tramway (WAD027);
- former brickworks near Upper South Farm (WAD035);
- former driveway to Doddershall House (WAD052);
- the disused Grendon Underwood and Princes Risborough Line (WAD073);
- course of a former medieval road, now a footpath (WAD115);
- earthworks of unknown date adjacent to the River Ray (WAD081); and
- eight railway features have been identified, and are considered to be of low value (WAD064; WAD071; WAD078; WAD080; WAD082; WAD094; WAD095; WAD100).

[31] Hedgerow Regulations (1997) Statutory Instrument 1997 No. 1160.

6.3.8 All non-designated heritage assets within 500m of the land required, temporarily or permanently, for construction of the Proposed Scheme are listed in the gazetteer in Volume 5: Appendix CH-002-012 and identified on Maps CH-01-037 to CH-01-040 (Volume 5, Cultural Heritage Map Book). These include a number of assets with upstanding remains, the settings of which have been considered, for example:

- The Buckinghamshire Railway Centre (WAD021);
- Railway Cottage (WAD053); and
- Woodlands Farm (WAD085).

Cultural heritage overview

6.3.9 The study area lies within the northern area of Buckinghamshire, where the geology is dominated by undulating claylands comprised of heavy blue-grey clays. These clays fall into two distinct geological bands which run approximately north-east/south-west. Further details of the geology of the area are contained in Section 8, Land Quality.

6.3.10 The watercourses within the study area are local streams and tributaries, the largest being the River Ray and no river terraces or gravels are recorded. As such, it is unlikely that remains of Lower or Middle Palaeolithic date will be recorded within the study area. These watercourses include alluvial deposits along their length. Such deposits have the potential to 'seal in' deposits of palaeo-environmental and archaeological interest.

6.3.11 No remains of Palaeolithic, Mesolithic or Neolithic (pre-2,400 BC) date have been recorded within the study area and the potential for such remains is considered to be limited; the heavy clay and lack of major watercourses does not represent a favourable landscape for early settlement.

6.3.12 Evidence for Bronze Age (circa 2,400-700 BC and Iron Age (circa 700 BC-AD43) activity within the study area is limited; this is likely to be a function of a lack of fieldwork, but may reflect the land use of the claylands for livestock, as opposed to agriculture. A total of seven 'mill mounds' are recorded. Although these mill mounds are likely to be of post-medieval date, an example investigated in the Calvert, Steeple Claydon, Twyford and Chetwode area (CFA13) is probably a Bronze Age burial mound, and those within the present study area might conceivably have prehistoric origins. One possible mill mound lies within the land required, temporarily or permanently, for construction of the Proposed Scheme (WAD122).

6.3.13 Akeman Street, a Roman (AD43-AD410) road originating in the mid-1st-century AD, extends into the study area (WAD001). A small Roman town, Fleet Marston, lies at the intersection of Akeman Street and two other roads. It is considered within the cultural heritage assessment for Stoke Mandeville and Aylesbury (CFA11). A Roman settlement has been found adjacent to Akeman Street, partially within and around Waddesdon Manor RPG (WAD006). A watching brief at Waddesdon School (located beyond the defined study area) found ditches of a Late Iron Age/Roman period field system, and Roman pottery and tiles were found by field walking immediately to the west of the school. Further Roman ditches, probably relating to agricultural land

division, and finds have been recorded during archaeological works across the southern half of the study area (WAD020 and WAD040).

6.3.14 There are no sites of early medieval date (AD 410 – AD 1066) recorded within the study area, although Waddesdon, Quainton, Doddershall and Shipton Lee are all recorded in the Domesday survey, suggesting at least Late Saxon origins for these settlements. This lack of evidence may indicate a refocusing of settlement back onto lighter soils in the early medieval period, away from the Roman road network.

6.3.15 The study area formed part of the Royal Forest of Bernwood throughout the medieval period (1066-1540) and included a mosaic of habitat and land use types including woodland. It should be noted that 'forest' in this sense does not necessarily mean woodland or trees. The word may have originally been derived as a description of a place outside the ordinary law, and subject to special laws concerned with preserving game, specifically deer. The legal forest was nearly always much larger than the physical woodland.

6.3.16 Elements of Bernwood Forest survive as remnant ancient woodland in the northern part of the study area (WAD087; WAD088; WAD092; WAD093; WAD106; WAD107; WAD109; WAD110; WAD111), and there is potential for medieval earthwork banks and linear features to survive in these woods.

6.3.17 Most Buckinghamshire villages reduced in size in the later medieval period, and the earthwork remains of shrunken and deserted medieval villages are recorded at Warmstone, Shipton Lee, and Doddershall. The earthwork remains of Doddershall Deserted Medieval Village (WAD063) are extant within the boundary of the land required, temporarily or permanently, for construction of the Proposed Scheme. Doddershall House itself was a former manorial centre, and includes several moated sites and earthworks of medieval date (WAD066; WAD067). A former grange is recorded near to Shipton Lee (WAD058), and a medieval chapel and hermitage, associated with the grange are recorded from documentary sources in Finemere Wood, probably near Three Points Lane (WAD099).

6.3.18 Extensive ridge and furrow earthworks of medieval origin are recorded across the study area. Those within Quainton parish have been identified as forming a 'priority township'[32] by English Heritage, due to their extent and survival.

6.3.19 Several pond-bays, water management features potentially of medieval date, are recorded within the study area at Shipton Lee (WAD084) and Nor Pye Pond (WAD086).

6.3.20 The region was repeatedly fought over during the English Civil Wars. An earthwork, possibly originating as a civil war artillery battery (but potentially a reused medieval moated site) lies immediately adjacent to the land required, temporarily or permanently, for construction of the Proposed Scheme at Lower South Farm (WAD050).

[32] Hall, D. and English Heritage (2001) *Turning the plough – Midlands open fields: landscape character and proposals for management,* Nottinghamshire County Council, UK.

6.3.21 A large number of buildings within the study area date from the post-medieval and early modern periods (1540-1900). Waddesdon Manor, a particularly large Grade I listed house, lies to the east of the study area, and is set in an extensive landscaped park (WAD006). Doddershall House, a large 16th-century manor house, is Grade II* listed and lies to the east of the land required for the construction of the Proposed Scheme (WAD066). Claydon House, the centre of the Verney Estate, is also Grade I listed and situated within designed parkland (WAD112).

6.3.22 Post-medieval industry is represented by the former course of the Wotton Tramway (WAD027) and by the brickworks at Upper South Farm (WAD035).

6.3.23 The Proposed Scheme largely follows the route of the London Extension of the Great Central Railway (now known as the Aylesbury Link railway line), a railway line established in the 19th-century (WAD018). Modern development within the study area is very limited, comprising small areas of housing on the outskirts of villages, and modern clay pits excavated to the south of Sheephouse Wood, which have subsequently been reused as a landfill.

Future baseline

Construction (2017)

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

6.3.25 The proposed Greatmoor EfW facility (planning application ref 11/20000/AWD) will remove all archaeological assets within that application area, and alter the setting of the Grade II listed Lower Greatmoor Farm. The assessment of impacts arising from the construction of the Proposed Scheme therefore assumes that the setting of Lower Greatmoor Farm will be as detailed in the planning application for the EfW facility.

Operation (2026)

6.3.26 By 2026, the Greatmoor EfW facility will be complete and the associated hedgerow and woodland copse planting will have become established. The assessment of impacts arising from the operation of the Proposed Scheme therefore assumes that the setting of Lower Greatmoor Farm will be as detailed in the planning application for the EfW facility.

6.4 Effects arising during construction

Avoidance and mitigation measures

6.4.1 The draft CoCP sets out the provisions that will be adopted to control effects on cultural heritage assets. The provisions include the following (see Volume 5: Appendix CT-003-000/1):

- management measures that will be implemented for assets that are to be retained within the land required, temporarily or permanently, for construction of the Proposed Scheme (draft CoCP, Section 8);
- the preparation of project wide principles, standards and techniques for works affecting heritage assets (draft CoCP, Section 8);

- a programme of archaeological investigation and recording to be undertaken prior to/or during construction works affecting the assets (draft CoCP, Section 8); and
- a programme of historic building investigation and recording to be undertaken prior to modification or demolition of the assets (draft CoCP, Section 8).

6.4.2 The following measures have been incorporated into the design of the Proposed Scheme to reduce impacts on assets:

- construction of the scheme in cutting past Waddesdon Manor to reduce the impact upon the setting of the associated RPG (WAD006) and village (WAD016);
- realignment of the A41 further to the north-west so the overbridge is at ground level rather than on high embankment;
- positioning of the auto-transformer feeder station at Quainton on the eastern side of the Proposed Scheme, in order to reduce the impact upon the setting of Doddershall House (WAD066); and
- the provision of landscape bunds and planting to further reduce the setting impact at both Waddesdon Manor RPG (WAD006) and Doddershall House (WAD066).

Assessment of impacts and effects

Temporary effects

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

6.4.4 Doddershall House, Well and Gatepiers (WAD066) is a complex of assets of high value. The construction of the Doddershall embankment approximately 300m from the house will disrupt the rural character of the building, cause changes to the local sound environment and alter views across the former estate to the west. In addition, the immediate landscape to the north will be used for the creation of grassland habitat, and an access road will run immediately adjacent to the listed gate piers during the construction period, for approximately three years and nine months. This will result in a medium adverse impact and a major adverse effect.

6.4.5 Waddesdon Manor Grade I RPG and the listed buildings within the registered park (WAD006) are assets of high value. There will be a temporary alteration to the setting of the park caused by the construction of the Waddesdon south cutting and the Waddesdon north cutting to the north of The Grand Lodge. This will constitute a low adverse impact, lasting for approximately three years, and a moderate adverse effect.

6.4.6 Upper South Farm Grade II listed building (WAD041) is an asset of moderate value. The character and setting of the building will be altered by construction activities

associated with the Doddershall embankment and Quainton cutting, lasting for approximately three years and nine months and located 60m from the building. Its rural character will be largely lost. This will constitute a medium adverse impact and a moderate adverse effect.

6.4.7 Lower South Farmhouse and Barns, both Grade II listed (WAD049) are assets of moderate value. Construction activities associated with screening bunds and overbridges and the Doddershall embankment and Quainton cutting, will last for approximately three years and nine months and will be visible within the setting of these assets, altering their character. This will constitute a medium adverse impact and moderate adverse effect.

6.4.8 Claydon Grade II RPG and Middle Claydon Conservation Area is a complex of high value assets (WAD112). The construction of the infrastructure maintenance depot and temporary rail head in the Calvert, Steeple Claydon, Twyford and Chetwode area (CFA13) will affect the character and wider setting of the assets throughout the construction period. This will constitute a low adverse impact and moderate adverse effect.

Cumulative effects

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

Permanent effects

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

Physical Impacts

6.4.11 There are a number of ridge and furrow earthworks: to the south of the Buckinghamshire Railway Centre (WAD026); to the west of Crossroads Farm (WAD030), to the north of the Crossroads Farm (WAD032); to the south-west of the possible Civil War earthwork (WAD043); to the north of the possible Civil War earthwork (WAD044); to the north of Wayside Farm (WAD123); to the north of Lower South Farm (WAD128); and to the south of Railway Cottage (WAD129). These are assets of moderate value because they form part of the Quainton priority township. These will be almost entirely removed by construction of the main trace, screening bunds and the Station Road overbridge. This will constitute a high adverse impact and major adverse effect.

6.4.12 Doddershall Deserted Medieval Village (WAD063) is an asset of high value. The surviving earthworks of the medieval village will be partially removed by construction of the Proposed Scheme, screening bunds, balancing pond, and the planting around Doddershall House. Although they have been previously affected by the Aylesbury Link railway line, the land required to construct the Proposed Scheme expands the railway corridor and so will have a greater impact upon the medieval village. It will also further isolate the surviving northern earthworks and sever the link with Doddershall

(WAD066) to the south. This will constitute a high adverse impact and major adverse effect.

6.4.13 Possible mill mound (WAD122) is an asset of low value. This will be removed by the construction of the Waddesdon south cutting. This will constitute a high adverse impact and moderate adverse effect.

6.4.14 Earthworks of unknown date near to Glebe Farm (WAD011) are an asset of low value. This will be removed by the construction of the Waddesdon south cutting. This will constitute a high adverse impact and moderate adverse effect.

6.4.15 Roman ditches in two locations (WAD020; WAD040) are assets of moderate value. These would be partially removed by the realignment of services across Station Road. This will constitute a medium adverse impact and moderate adverse effect.

6.4.16 The railway bridge (WAD034)over Buckinghamshire Railway Centre railway lines near to The Lodge (WAD036), railway bridge at Lawn Hill near Edgcott Road (also known as Shipton Lee Road) (WAD078), and railway bridge near Lower Greatmoor Farm (WAD100) are assets of low value. The bridges will be removed. This will constitute a high adverse impact and moderate adverse effect.

6.4.17 Ridge and furrow earthworks to the east of Glebe Farm (WAD012), and to the north of Wayside Farm (WAD123), assets of low value, will be largely removed. This will constitute a high adverse impact and moderate adverse effect.

6.4.18 The Lodge at Doddershall, a non-designated building dating from c. 1900 (WAD036) and now a residential property an asset of low value, will be demolished. This will constitute a high adverse impact and moderate adverse effect.

6.4.19 Historically important hedgerows, adjacent to possible Civil War earthwork (WAD051), and separately at Doddershall Deserted Medieval Village (WAD062) are assets of moderate value. The hedgerow will be almost entirely removed by the construction of the railway lines for the Proposed Scheme and screening bunds. This will constitute a high adverse impact and major adverse effect.

6.4.20 The partial removal of earthworks in the northern part of Doddershall deserted medieval village (WAD063) will remove a key element of the historic landscape around Doddershall (WAD136), an asset of medium value. This will result in a medium adverse impact and moderate adverse effect upon this historic landscape component.

Impacts on the setting of heritage assets

6.4.21 Doddershall House, Well and Gatepiers (WAD066) is a complex of assets of high value. Planting of grassland habitat will take place adjacent to the house, and will largely remove the deserted medieval village associated with the house. This will constitute a medium adverse impact, because of the loss of the associated village remains, and major adverse effect.

6.4.22 Claydon Grade II RPG and Middle Claydon Conservation Area is a complex of high value assets (WAD112). The construction of the infrastructure maintenance depot and temporary railhead in the Calvert, Steeple Claydon, Twyford and Chetwode area

(CFA13) will sever the relationship between Claydon House and parts of its former estate. This will constitute a low adverse impact and moderate adverse effect.

Permanent cumulative effects

6.4.23 There are no inter-project effects on cultural heritage.

Other mitigation measures

6.4.24 Other mitigation measures to further reduce the significant effects described will be considered during the detailed design and will take account of heritage assets. These measures will include the identification of suitable locations where advance planting can be undertaken to reduce the impact on the setting of assets and where the physical impact on, in particular below ground assets, can be reduced through the design of earthworks.

Summary of likely residual significant effects

6.4.25 A range of archaeological assets will be permanently lost due to the construction of the Proposed Scheme; these assets include: the remains associated with Doddershall Deserted Medieval Village (WAD063), a possible mill mound (WAD122) and Roman ditches in two locations (WAD020; WAD040). A programme of archaeological works will be prepared to investigate, analyse, report and archive these assets.

6.4.26 The Proposed Scheme will result in the demolition of The Lodge at Doddershall (WAD036), which is non-designated, and several non-designated several railway bridges. A programme of built heritage works will be prepared to investigate, analyse, report and archive these assets.

6.4.27 The setting of several historic settlements, buildings and landscapes will be affected by the presence of the constructed Scheme, including landscaping, overbridges and other associated infrastructure. This presence will affect these assets through physical loss or severance of landscape elements or disruption of landscape associations that contribute to their value. These include: Doddershall House, Well and Gatepiers (WAD066) and the Claydon RPG and conservation area (WAD112), Stoke House (SMA007), Hall End (SMA023), Sedrup (SMA041), and Lower Hartwell (SMA053). Earthworks near Glebe Farm, ridge-and-furrow in ten separate locations and sections of two historically important hedgerows will also be removed. Further consideration will be given to the historic vegetation and landscapes as part of the planting and landscape design.

6.5 Effects arising from operation

Avoidance and mitigation measures

6.5.1 The following measures have been incorporated into the design of the Proposed Scheme to reduce the impacts and effects on assets:

- noise mitigation measures have been included within the scheme design to reduce potential impacts on identified assets; and
- landscape planting will progressively over time reduce impacts on the setting of the designated assets within the study area as it matures during the operational phase.

Assessment of impacts and effects

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

6.5.3 The Grade II listed Upper South Farm (WAD041), an asset of medium value, will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a moderate adverse effect.

6.5.4 The Grade II listed Lower South Farm (WAD049), an asset of medium value, will have its setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a moderate adverse effect.

6.5.5 The complex of buildings at the Grade II* listed Doddershall House (WAD066), a group asset of high value, will have their setting changed by the movement of trains and the associated increase in noise. This will constitute a medium adverse impact and a major adverse effect.

6.5.6 Claydon Grade II RPG and Middle Claydon Conservation Area is a complex of high value assets (WAD112). The operation of the infrastructure maintenance depot in the Calvert, Steeple Claydon, Twyford and Chetwode (CFA13) will affect the character of these assets, which will experience noise and visual intrusion, and will include lighting which will change the night-time setting of the Park. This will constitute a low adverse impact and moderate adverse effect.

Cumulative effects

6.5.7 Assessment of inter-project effects on cultural heritage assets arising from the interaction of the Proposed Scheme with cumulative development projects has been undertaken. These are listed in Section 2 and shown on Maps CT-13-025 to CT-13-028 (Volume 2, Cross Topic Appendix 1 Map Book). No significant cumulative effects have been identified in relation to cultural heritage.

Other mitigation measures

6.5.8 The Proposed Scheme includes a number of design measures to address potential impacts and significant effects. No additional operational mitigation measures beyond those included within the Proposed Scheme design have been identified.

Summary of likely residual significant effects

6.5.9 The setting of several historic settlements, buildings and landscapes will be affected visually and by noise once the Proposed Scheme becomes operational. This includes: the complex of listed buildings at Doddershall House (WAD066), Upper South Farm (WAD041), Lower South Farm (WAD049) and the Claydon RPG and conservation area

(WAD113). Although the effects described above will remain significant, in due course visual effects will reduce as planting matures and the new railway assimilates into the landscape.

7 Ecology

7.1 Introduction

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

7.1.2 The principal ecological issues affecting ecological resources in this area are:

- fragmentation of habitat used by Bechstein's bat (and assemblage of 12 other bat species);
- habitat loss and fragmentation at the Grendon and Doddershall Meadows Local Wildlife Site (LWS); and
- loss and fragmentation of scrub habitats used by black hairstreak butterflies.

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

- ecological baseline data (Appendix EC-001-002, EC-002-002, EC-003-002, and EC-004-002);
- register of local/parish level effects which are not described individually in Volume 2 are reported in Volume 5: Appendix EC-05-002; and
- data obtained from bat trapping/radio tagging study of bats in the Bernwood Forest carried out in 2012 and 2013 (Volume 5: Appendix EC-006-002).

7.1.4 As well as survey data, the assessment draws on existing information gathered from national organisations and from regional and local sources including: Buckinghamshire and Milton Keynes Environmental Records Centre; Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT); the Amphibian and Reptile Group for Buckinghamshire; North Bucks Bat Group; Bernwood Forest Bechstein's Project, and the Upper Thames (Berkshire, Bucks and Oxon) Branch of Butterfly Conservation.

7.2 Scope, assumptions and limitations

7.2.1 The scope and methodology of the ecological assessment are introduced in the SMR (Volume 5: Appendix CT-001-000/1) and SMR Addendum (Volume 5: Appendix CT-001-000/2). Further detail, including the study area for individual surveys, is provided within the SMR Addendum. The assessment methodology is summarised in Section 8 of Volume 1, along with route-wide assumptions and limitations. Limitations associated with particular surveys are reported in Volume 5: Appendices EC-001-002, EC-002-002, EC-003-002, and EC-004-002.

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

7.2.3 Access was not obtained to all of the land area where general habitat survey (Phase 1 habitat survey) was proposed, including Sheephouse Wood SSSI and land to the south of Edgcott Road including Grendon and Doddershall Meadows LWS. Further details are provided in Appendices EC-001-002 to EC-004-002 in Volume 5. However, in addition to the standard range of surveys described in the SMR, where direct access could not be obtained to woodland for bat surveys at Sheephouse Wood, Hewin's Wood, Decoypond Wood, Grendon and Doddershall Woods, Greatsea Wood and Romer Wood, radio tracking surveys of several species of bat were undertaken in close proximity to those woodlands.

7.2.4 These surveys were carried out to establish the range of species present and, their use of the habitats that will be affected by the Proposed Scheme. Effort was focused on woodland species including Bechstein's, Natterer's, Daubenton's and brown long-eared bats, as these species frequently use hedgerows and other habitat corridors to move between roosts and foraging areas. A number of bats were trapped in mist nets and fitted with radio tags so their movement through the landscape could be recorded, and their roosting locations determined.

7.2.5 Bat radio tracking surveys in this area were carried out alongside those of the North Bucks Bat Group and the Bernwood Forest Bechstein's Group. HS2 Ltd. has worked in coordination with these organisations by sharing information on radio tagged bats, in order to limit the numbers of bats that were caught and to make best use of the data obtained from the surveys. Further information is provided in Volume 5: Appendix EC-006-002.

7.2.6 The ecological baseline is derived from our understanding of the habitats and species present based on survey work conducted between May 2012 and September 2013, and all other data made available for inclusion.

7.2.7 During this period habitat removal and modification associated with construction works for the Greatmoor EfW facility was being undertaken and therefore the environmental baseline was subject to change during this period.

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

7.2.9 The precautionary approach to the assessment that has been adopted identifies the likely significant ecological effects of the Proposed Scheme.

7.3 Environmental baseline

Existing baseline

7.3.1 This section describes the ecological baseline relevant to the assessment: the designated sites, habitats and species recorded in this area. Further details are provided in the reports and maps presented in Volume 5 (Appendices EC-001-002 to EC-004-002 and Map Series EC-01 to EC-12, Volume 5, CFA12 Ecology Map Book). Statutory and non-statutory designated sites are shown on Maps EC-01-025 to EC-01-028 (Volume 5, CFA12 Ecology Map Book).

7.3.2 Land required for the construction of the Proposed Scheme and that adjacent to it consists of a rural landscape and farmland habitats predominate throughout, including arable fields, improved pasture and an extensive network of intact hedgerows. A complex of large ancient woodlands which form parts of the former Bernwood Forest is present in the north of this area. Unimproved grassland is present at Grendon and Doddershall Meadows LWS. Aquatic habitats include the River Ray and its tributaries, several drainage channels, and numerous ponds.

Designated sites

7.3.3 There are four SSSI relevant to the assessment in this area; each is of national value. They are all designated for ancient woodland and assemblages of plants, woodland birds and invertebrates. They are:

- Finemere Wood SSSI (47.9ha) – a large ancient woodland supporting rich communities of native plants, birds, insects and other animals. In particular the wood contains populations of butterflies, including the wood white and black hairstreak, which are both endangered)[33] and that have a highly localised distribution in southern England. There are a wide variety of woodland and scrub nesting birds. The northern and southern parts of the SSSI are directly adjacent to areas of the Proposed Scheme that will be used for ecological compensation and close to utilities (overhead power lines) that are within the land required for the construction of the Proposed Scheme;
- Grendon and Doddershall Woods SSSI (67ha) – features cited as reasons for its designation include a network of wet woodland rides, and breeding bird and butterfly populations. Notable species include nightingale and purple emperor butterfly. The SSSI is located approximately 325m south of the land required for the construction of the Proposed Scheme;
- Ham Home-cum-Hamgreen Woods SSSI (23ha) – designated for mixed and yew woodland, parts of which are ancient semi-natural woodland. Notable species include black hairstreak butterfly and breeding nightingale. It is approximately 2km from land required for the construction of the Proposed Scheme but approximately 100m of the site's boundary is adjacent to the A41 Bicester Road, which will be used by construction traffic; and
- Sheephouse Wood SSSI (56.9ha) – designated for the presence of ancient woodland. Species cited in the SSSI designation include three species of woodpecker, woodcock and black hairstreak butterfly. The extent of land required for the construction of the Proposed Scheme is directly adjacent to the western edge of the SSSI and areas that will be used for ecological compensation are adjacent to the wood's northern and southern boundaries. The northern edge of the wood forms the boundary with Calvert, Steeple Claydon, Twyford and Chetwode (CFA13).

[33] Fox, R., Warren, M.S., and Brereton, T.M. (2010). A new Red List of British Butterflies, Species Status 12; 1-32. Joint Nature Conservation Committee, Peterborough.

7.3.4 Five LWS and three Biological Notification Sites (BNS) are relevant to the assessment, and each is of county/metropolitan value. They are:

- Grendon and Doddershall Meadows LWS (24.5ha) – designated for diverse grassland, scrub and pond habitats. Plants that are uncommon in Buckinghamshire are present, including sneezewort and fen bedstraw. The LWS is crossed by the Proposed Scheme;
- Waddesdon Common LWS (16.9ha) – designated for unimproved species-rich grassland. It supports a number of plants that are rare or scarce in Buckinghamshire including distant sedge, fen bedstraw, tubular water-dropwort, brown sedge and lesser spearwort. The LWS is partly within the land required for construction of the Proposed Scheme;
- Waddesdon Station Complex LWS (2ha) – designated for calcareous species-rich grassland, which is the best example of this habitat remaining in north Buckinghamshire, as well as wetland vegetation and an assemblage of notable plants. The LWS is partly within the land required for construction of the Proposed Scheme;
- Greatsea and Romer Wood LWS (36.9ha) – designated for the presence of large areas of woodland much of which is replanted although it retains older woodland at the margins. The open rides through the wood are species rich. The site is adjacent to land required for ecological mitigation;
- Sunny Hill Farm Pastures LWS (7.4ha) – designated for grassland of similar character to that at Waddesdon Common from which it is separated by a minor road. The site is adjacent to land required for construction of an access route to the north of the Aylesbury Link railway line;
- Waddesdon Park BNS (457ha) is designated for parkland with old trees that are important for lichens which are present in 65ha of the site around Waddesdon Manor, the remainder is farmed. Part of the site's northern boundary is adjacent to the A41 that is affected by the construction of the A41 Bicester Road overbridge;
- Blackgrove meadows BNS (171ha) is designated for wetland birds and also contains an important hedgerow. It is adjacent to a drain that will be modified during the construction of the Proposed Scheme; and
- an unnamed BNS comprising a track leading to the Aylesbury Link railway line (the name used for this site hereafter) (0.7ha) to north of Oak Tree Farm comprises a narrow track with hedges which is designated for its county uncommon plants including spiny restharrow which are characteristic of calcareous habitats. Although there are extensive areas of calcareous vegetation in the south of Buckinghamshire it is scarce in the north of the

county, hence this site of county/metropolitan value[34].The BNS will be partly within the land required for construction of the Proposed Scheme.

7.3.5 BBOWT's Finemere Wood nature reserve includes a large area of semi-improved grassland in addition to Finemere Wood SSSI. The western edge of the grassland is within the land required for the construction of the Proposed Scheme. This site is not subject to formal designation as an LWS and as such its value is described only in terms of its habitat quality.

7.3.6 In addition to the areas of ancient woodland that fall within designated sites, one further area of un-named ancient semi-natural broadleaved woodland of approximately 1.5ha is present within the land required for the construction of the Proposed Scheme adjacent to the Calvert Landfill south-east of Calvert. It was historically part of the large area of ancient woodland that is designated as Sheephouse Wood SSSI but is separated from it by the Aylesbury Link Railway[35]. Ancient woodland represents an irreplaceable resource.

Habitats

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

Woodland

7.3.8 The majority of ancient woodland in the area is within designated sites -Sheephouse Wood SSSI, Finemere Wood SSSI, Grendon and Doddershall Woods SSSI and Greatsea and Romer Wood LWS.

7.3.9 Sheephouse Wood is ancient semi-natural broadleaved woodland and most is an example of the habitat of principal importance lowland mixed deciduous woodland as identified in Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006)[36], and a local Biodiversity Action Plan (BAP) habitat. Soil type and drainage vary across the site with corresponding variety in dominant species. The main stand type is described in the SSSI citation as lowland hazel-pedunculate oak woodland, with smaller amounts of wet field maple woodland concentrated along the north and east margins. There is a diverse range of associated tree species including wild service tree, an ancient woodland indicator species. The shrub layer and ground flora are also diverse and contain a number of ancient woodland indicators. The larger part of this woodland, to the east of the Aylesbury Link railway line is of national value in accordance with its designation as an SSSI, the smaller fragment to the west of the railway is discussed separately.

7.3.10 Finemere Wood is largely ancient semi-natural woodland and parts are the habitat of principal importance lowland mixed deciduous woodland. The majority comprises oak standards over hazel with scattered field maple, aspen and ash. Areas of ancient ash maple woodland are of note, as are stands of old hornbeam coppice. The shrub layer is very

[34] In addition to LWSs, there is a category of sites that are in the process of being reviewed and assessed against the LWS criteria. These sites are known as Biological Notification Sites (BNSs) and until the programme of review has been completed, it is important they are treated in the same way as LWSs.
http://www.buckinghamshirepartnership.co.uk/assets/content/Partnerships/BMKBP/docs/Biodiversity%20and%20Planning%20in%20Bucks%20Section%203.pdf

[35] The cultural heritage chapter discusses Sheephouse Wood in its entirety and therefore information on the extent and boundaries of the ancient woodland, and on the effects of the Proposed Scheme are described differently in the two chapters.

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

diverse, as is the ground flora which contains several ancient woodland indicators including wood anemone, woodruff, yellow archangel and wood barley. It is of national value.

7.3.11 Ham Home-cum-Hamgreen Woods is largely ancient semi-natural woodland and parts are the habitat of principal importance lowland mixed deciduous woodland. It is dominated by oak with frequent maple, ash, willow and wild service tree. The shrub layer includes wych elm, hawthorn, privet and blackthorn. It is of national value. The older woodland at the margins of Greatsea and Romer Wood is dominated by pedunculate oak and ash with less frequent field maple, and occasional wild service tree. The shrub layer is well-developed and ground flora contains a limited range of ancient woodland indicator species including bluebell. This habitat resembles the National Vegetation Community (NVC) for ash maple woodland W8 *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland. It is of county/metropolitan value.

7.3.12 The majority of Greatsea and Romer Wood is recent plantation of pedunculate oak and pine, with a limited ground flora, but nonetheless is important as a large area of ancient replanted woodland. It is of district/borough importance. The approximately 1.5ha strip of ancient semi natural woodland adjacent to Calvert Landfill was once part of Sheephouse Wood, from which it is has been split by the construction of the Aylesbury Link railway line. It resembles the NVC community for ash maple woodland W8 *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland. The canopy is dominated by pedunculate oak, with the shrub layer dominated by bramble, field rose, hawthorn and hazel. It includes several ancient woodland indicator species including wood millet, midland hawthorn and hairy wood-rush. The area is the habitat of principal importance lowland deciduous woodland, and is a local BAP habitat. Due to its quality and proximity to other ancient woodlands, it is of county/metropolitan value, despite its small size.

Grassland

7.3.13 The majority of unimproved and semi-improved grassland within this area is at Grendon and Doddershall Meadows LWS, Waddesdon Common LWS, Waddesdon Station Complex LWS, Greatsea and Romer Wood LWS and the BNS along track leading to the Aylesbury Link railway line for which the reasons for designation are discussed above. All are of county/metropolitan value as per their designation.

7.3.14 Grendon and Doddershall Meadows LWS contains an extensive area of grassland likely to qualify as the habitat of principal importance lowland meadow. Species composition varies but the presence of oxeye daisy, lady's bedstraw, black knapweed, bird's-foot trefoil, sorrel and meadow barley are indicative of habitat quality. Wetter areas contribute to the diversity of the site with species such as ragged robin.

7.3.15 Waddesdon Common LWS consists of seven fields of which some contain diverse grassland lying on ridge and furrow. It includes stands of crested dogs tail and black knapweed grassland MG5 *Cynosurus cristatus – Centaurea nigra* grassland, and meadow foxtail great burnet MG4 *Alopecurus pratensis Sanguisorba officinalis* grassland. Both are good examples of their type with large populations of several characteristic species, as well as some county-rare or scarce species. Although varying in quality, all fields contain some species indicating the presence of the habitat of principal importance lowland meadow.

7.3.16 Waddesdon Station Complex LWS contains areas likely to qualify as the habitat of principal importance lowland calcareous grassland, comprising a number of characteristic species such as glaucous sedge, wild parsnip and field scabious. A flushed area with meadow sweet and areas of semi-improved neutral grassland are also present.

7.3.17 The wide woodland rides at Greatsea and Romer Wood LWS are diverse with wet and drier grassland including ragged robin, greater bird's-foot trefoil, lesser spearwort, devil's-bit scabious, fairy-flax and heath woodrush. The grassland is of moderate extent and diversity, and contains six county-scarce species.

7.3.18 The track leading to the Aylesbury Link railway line may have developed on calcareous rubble and includes narrow strips of calcareous grassland to each side. They are dominated by red fescue and common bent, and contain meadow oat grass in addition to other calcareous grassland indicator species noted in its description as a designated site.

7.3.19 Outside of these designated sites there are further areas of more species rich vegetation, as follows:

- the grassland at Finemere Wood nature reserve is dominated by crested dog's tail and red fescue, with limited diversity and abundance of broad leaved species, including wild carrot, yellow rattle, agrimony and common fleabane. It broadly matches the crested dog's tail – black knapweed grassland community MG5 *Cynosurus cristatus-Centaurea nigra* grassland. This grassland has been managed to increase its diversity, but currently most of the broad leaved species are sparsely distributed and there is little variation in the plant communities present. It is of district borough value;
- small areas of disturbed but species rich marshy grassland along parts of the Muxwell Brook include abundant glaucous sedge and carnation sedge (scarce in Buckinghamshire), as well as occasional southern marsh orchid (rare in Buckinghamshire) and ragged robin. They are similar to the crested dog's tail – marsh marigold NVC community MG8 *Cynosurus cristatus-Caltha palustris* grassland. Although lowland meadow, these areas are small, and encroachment by coarse grasses has reduced their quality. They are of district/borough value; and
- semi-improved grassland near Oak Tree Farm, parts of which contain occasional cowslip and black knapweed, is similar to MG5*Cynosurus cristatus-Centaurea nigra* grassland. It is small and isolated and the few broadleaved species were present in small quantities. It is of local/parish value.

7.3.20 Other grassland habitat in this area within or adjacent to land required for the construction of the Proposed Scheme is dominated by improved and species-poor neutral grassland.

Watercourses

7.3.21 The two largest watercourses in this area are the River Ray and the Fleet Marston Brook. Habitat quality is poor on both watercourses which are characterised by uniform channels, dense shading and limited growth of aquatic and marginal plants. Therefore, watercourses are of local/parish value.

Hedgerows

7.3.22 Most hedges within the Proposed Scheme are to the north of Waddesdon in the southern part of the area where there is a network of well managed and moderately species-rich hedges. Of the approximately 30km of hedgerows entirely or partially within the land required for the construction of the Proposed Scheme 23 qualify as important hedgerows (under the wildlife and landscape criteria of the Hedgerows Regulations 1997[37]) and all are habitats of principal importance. The most abundant woody species in the area are hawthorn, blackthorn, rose species and pedunculate oak. Hedges of similar quality are frequent locally, and characteristically abundant in the Thames and Avon Vales of which this area is part[38]. The hedgerow network within the Proposed Scheme is of district/borough value.

Ponds

7.3.23 Approximately 34 ponds are within or adjacent to the land required for the construction of the Proposed Scheme and most are near Woodlands Farm. Eleven ponds are known to support great crested newts, and therefore qualify as habitats of principal importance. Three ponds were considered to be of sufficient quality to require further survey for plants and aquatic invertebrates. Two were subsequently recorded as having limited diversity, while a pond north of Edgcott Road had a higher species diversity for invertebrates including several species of water beetle and dragonfly/damselfly larvae. However, it has been created relatively recently and contains colonies of the invasive plant New Zealand pygmyweed[39]. None of these ponds is of more than local/parish value.

7.3.24 For the purpose of this assessment ponds that have been identified as requiring habitat survey but where access has been unavailable are considered to be of up to district/borough value.

Scrub

7.3.25 Areas of scrub, mainly along the Aylesbury Link railway line and River Ray corridor are dominated by hawthorn with occasional rose and willow species, as well as areas of false-oat grass. The habitat along the Aylesbury Link railway line is largely continuous along the southern side of the railway line, but there are gaps along the northern side between Benfields overbridge and Sheephouse Wood. This habitat is of local/parish value.

Traditional Orchards

7.3.26 One small area of traditional orchard is located near Woodlands Farm. It is a habitat of principal importance and a local BAP habitat. With fewer than 10 trees, it is of local/parish value.

[37] The Hedgerows Regulations 1997 (1997 No. 1160). London. Her Majesty's Stationery Office. The Hedgerows Regulations 1997 comprise two criteria for determining whether a hedgerow is important or unimportant: Wildlife and Landscape, and Archaeology and History. The Ecology Chapter and the Technical Appendix for hedgerows refer to the Wildlife and Landscape criteria. Therefore it is likely that there will be differences between the total number of important hedgerows in the Ecology and the Cultural Heritage sections of the ES.

[38] Thames and Avon Vales Natural Area, English Nature, undated. http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/englands/naturalareas.aspx Accessed 10/08/13

[39] New Zealand pygmyweed is an invasive plant listed in Schedule 9 to the Wildlife and Countryside Act 1981 (as amended). It is illegal to plant or otherwise cause to grow in the wild any plant listed on Schedule 9 of the Act.

Wetland

7.3.27 The large drain, referred to as the Mega Ditch[40] forming a flood compensation area within the FCC Environment Ltd waste facility, is within the land required for the construction of the Proposed Scheme. The base of the ditch contained small areas of standing water and extensive areas of aquatic marginal vegetation including great reedmace, angelica, water mint, yellow iris and soft rush. Although distinctive, the vegetation present is not species rich and does not contain any locally rare species. It is of local/parish value.

Protected and/or notable species

7.3.28 A summary of the species relevant to the assessment is provided in Table 9.

Table 9: Protected and/or notable species

Species/ Group	Value	Receptor	Baseline and rationale
Bats	National	A population of Bechstein's bat associated with Grendon and Doddershall Woods, Sheephouse Wood, Finemere Wood, Ham Home Wood and Ham Green Wood and intervening habitat north and south of the Proposed Scheme (Volume 5: Appendix EC 003-002).	Radio-tracking studies and desk-top data have recorded population of Bechstein's bat comprising at least three colonies each containing several maternity roosts either side of the Proposed Scheme. A colony containing at least nine roosts (with a peak count of 52 bats) was recorded within Finemere Wood. Additional roosts were identified in nearby Romer Wood with associated foraging habitat in Greatsea, Romer, Runts and Balmore Woods. There are also single roosts in Sheephouse Wood and Decoypond Wood. Surveys and desk top study data provided records of a colony of several roosts in Doddershall Wood including a maternity roost of 65 bats, approximately 1km south of the Proposed Scheme, and there are nearby roosts at Hewin's Wood and close to Doddershall House, these include a published record late summer 2013 for a tree roost at Doddershall House[41]. The third colony is at Ham Home Wood and Ham Green Wood which is approximately 700m from the Akeman Street disused railway and has a peak count of approximately 95 bats in a nearby hedgerow tree. Bechstein's bats were recorded crossing the Aylesbury Link railway line at the following key locations: - Grendon Junction: crossing point associated with a flightline along the Muxwell Brook between Hewin's Wood, Grendon Wood and Doddershall Wood, and Finemere Wood; - Benfield's overbridge; crossing point associated with a flightline between Hewin's Wood, Grendon Wood and Doddershall Wood, and hedgerows between Sheephouse Wood and Finemere Wood; - Costello underbridge: associated with a flightline between Grendon Wood and Doddershall Wood, and Sheephouse Wood via linear vegetation along the Edgcott Road, Calvert Landfill (including the Mega Ditch), above the Costello underbridge and along the southern edge of Sheephouse Wood; and

[40] Deepened and widened diversion of the Muxwell Brook close to Sheephouse Wood and adjacent to parts of the Bridleway GUN/25, containing scattered scrub and wetland vegetation.
[41] Information on this record was obtained from BBOWT press release followed the completion of 2013 survey work in support of the ES, and that exact location and size of the roost is yet to be officially confirmed.

Species/ Group	Value	Receptor	Baseline and rationale
			- along the western boundary of Sheephouse Wood: following a similar flightline to that to the associated with the Costello underbridge between Grendon Wood and Doddershall Wood, and Sheephouse Wood, but, then flying along the Bridleway GUN/25 and crossing into Sheephouse Wood. It is not known if bats using recently recorded roost at Doddershall House cross the Proposed Scheme, however on a precautionary basis, crossing of the route in this location cannot be ruled out. Bechstein's bat commutes along the Aylesbury Link line, between Finemere fishing lake to habitat to the south of the Edgcott Road. They also commute along the route of the Aylesbury Link railway line, the Mega Ditch and the Bridleway GUN/25 between Benfields overbridge and Sheephouse Wood. To the northeast of the Proposed Scheme Bechstein's bat use hedgerows and tree lines as a flightline to commute from Finemere Wood to Greatsea, Romer, Balmore, Runt's and Sheephouse Wood. Bechstein's bat are a specialist of woodland habitats [42] and, therefore, other small areas of habitat such as watercourses, hedgerows, and treelines that provide connectivity between large woodland blocks are considered likely to be important to maintaining conservation status of the population. Due to their preference for woodland habitat it is likely that the majority of Bechstein's bat activity is restricted to large woodlands and associated habitat in the north of this area. Bechstein's bats are a very rare species in the UK[43] and are also classified as near threatened at the European level[44]. The roosts in this area are near the north-westerly edge of this species range in the UK. Consequently, maternity colonies of these bats are uncommon and are important to maintain the favourable conservation status of the UK population of Bechstein's bat.
	Regional	Barbastelle bat population present between Edgcott and Waddesdon.	Radio-tracking surveys identified a non-breeding female barbastelle roost in a small woodland to the southwest of Waddesdon, located 1.5km from the Proposed Scheme. This non-breeding female was also recorded foraging along the Akeman Street disused railway line between Edgcott Road and Grendon Junction. Desk top study records indicate very limited activity of this species, with the closest records from Runt's Wood, one confirmed roost within 7km of the land required, and few records for bats in flight. This species is rare[45], and restricted to southern and central England, with very few breeding sites known. It is classified as near threatened at the European level. Consequently maintaining their range and numbers is important in maintaining favourable conservation status.

[42] Hill, D.A. and Greenway, F. (2006). Putting Bechstein's bat on the map. Report to Mammals Trust UK.
[43] Bat Conservation Trust (2012). The state of the UK's bats: National Bat Monitoring Programme Population Trends 2012. BCT. London.
[44] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora, The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance.
[45] Bat Conservation Trust (2012). The state of the UK's bats: National Bat Monitoring Programme Population Trends 2012. BCT. London.

Species/ Group	Value	Receptor	Baseline and rationale
	Regional	Assemblage of bats associated with woodland habitat using the Aylesbury Link railway line and nearby woodland habitat from the Edgcott Road to Calvert Jubilee LWS (in CFA 13) (Volume 5: Appendix EC 003-002).	The vegetation along the Aylesbury Link railway and nearby woodland, as well as adjoining hedges, scrub and water bodies provide foraging, roosting and commuting habitat for an assemblage of woodland bat species. During surveys conducted by Hs2 Ltd maternity colonies of Daubenton's, brown long-eared (12 bats at Finemere Wood), Natterer's (peak count of 65 bats in Finemere Wood), whiskered (minimum of 15 bats), and Brandt's bats have all been recorded in the larger areas of woodland, with smaller roosts brown-long eared and whiskered bat present in vegetation along the Aylesbury Link railway and adjacent bridleway. These species use a range of features as commuting habitat, including the Aylesbury Link railway line between Edgcott Road and Calvert Jubilee LWS in CFA13, the Muxwell Brook and Mega Ditch, and the Akeman Street disused railway. They were recorded crossing the Proposed Scheme via the Adam's accommodation underbridge, at Grendon Junction, Benfield's overbridge, and to the south of Sheephouse Wood and various points along the wood's western boundary. Daubenton's, Natterer's, brown long-eared, whiskered and Brandt's bats are frequently associated with woodland. The latter two species are considered to be rare and their presence as part of the recorded assemblage is notable. Maternity roosts of these species are therefore important to maintain the unusually diverse assemblage and strong populations of woodland bats.
	County/ metropolitan	Populations of serotine and noctule and Leisler's bats associated with the existing railway corridor between Finemere fishing lake and Sheephouse Wood.	Radio-tracking studies have recorded noctule bat breeding, roosting and foraging habitat in Grendon and Doddershall Woods. One Leisler's bat was radio tagged on the Aylesbury Link railway line adjacent to Calvert Jubilee LWS in CFA13 and subsequently recorded foraging in that area. Data from transect surveys confirmed the presence of serotine bat foraging adjacent to the Aylesbury Link railway line between Greatmoor Farm and Sheephouse Wood. The highest *Nyctalus* species activity was directly to the south of Sheephouse Wood and a hedgerow connecting Finemere Wood with the Aylesbury Link railway line. There are very few records for Leisler's bat in Buckinghamshire and the presence of these three species as part of the wider assemblage of bats present in this area is of note.
	County/ metropolitan	Populations of common and soprano pipistrelle bats associated with the existing railway corridor and nearby woodland.	Radio-tracking studies identified maternity colonies of common pipistrelle in the Adam's underbridge (peak count of 22 bats) north of the River Ray, and a further maternity roost at a residential property adjacent to Buckinghamshire Railway Centre. Low numbers of roosting bats were recorded in trees at Greatmoor Farm, adjacent to the Mega Ditch and existing railway corridor vegetation. Bats use the existing rail corridor as a commuting route, travelling to foraging sites in Sheephouse Wood and Finemere Wood. A maternity colony of soprano pipistrelle was recorded north of Edgcott Road approximately 50m west of the land required, and another was 1km to the east. Soprano pipistrelle are also considered likely to commute extensively along the Aylesbury link railway line as they roost close to common pipistrelle colonies and have similar commuting routes in elsewhere in this area. The presence of maternity roosts is integral to maintaining populations over extensive areas.

Species/ Group	Value	Receptor	Baseline and rationale
	Up to county/ metropolitan	Population of Nathusius' pipistrelle bat associated with the Aylesbury Link railway line.	Static monitoring surveys along and adjacent to the Aylesbury Link railway line recorded moderate levels of Nathusius' pipistrelle activity, but no roosts were recorded. Most activity was associated with the most northerly point of the Mega Ditch and at the Finemere fishing lake. Nathusius' pipistrelle is a rare bat the levels of activity in this area are unlikely to occur frequently in Buckinghamshire.
	Up to county/ metropolitan	Assemblage of bats present in the central part of this area – north of Station Road to Edgcott Road.	Data from transect surveys, which included coverage of woodland and permanent pasture, is typical for the habitats present in this area. In addition to common and soprano pipistrelle, activity for a range of less common species was recorded, including moderate activity of *Myotis* bats, noctule bats and low activity of whiskered, Brandt's (both considered to be rare nationally) as well as a single Leisler's bat (considered to be scarce nationally and rare in Buckinghamshire).
	Up to county/ metropolitan	Bat assemblage present in arable land northeast of Waddesdon.	Habitat of arable fields with intact hedges was predominantly used by common and soprano pipistrelle bats with low levels of activity for brown long-eared, noctule and *Nyctalus/Eptesicus*. A maternity roost of common pipistrelle with estimated 10-20 individuals was recorded within 100m of the Proposed Scheme. This indicates a limited assemblage of species with low numbers of uncommon species. However, maternity roosts are important in maintaining populations over extensive areas.
Terrestrial Invertebrates	Regional	Populations of black hairstreak in the vicinity of the Proposed Scheme.	Desk study records indicate approximately 40 black hairstreak colonies are within the vicinity of the Proposed Scheme in this area and the adjoining part of CFA13. The majority are associated with ancient woodland including Finemere Wood, Sheephouse Wood and Grendon and Doddershall Woods. The closest colonies are at Grendon Junction, the Akeman Street disused railway at Three Points Lane, and along the River Ray. Black hairstreak are endangered in the UK[46] and have a restricted distribution that follows a belt of clay soils between Oxfordshire in the south-west and Cambridgeshire the north-east. The populations in this area are important in maintaining the distribution of black hairstreak in the southern part of this range[47].
	Regional	Invertebrate assemblage associated with habitat along the Akeman Street disused railway from Grendon Junction to the A41.	Partially cleared scrub and grassland habitat contained eleven Nationally Scarce/Nationally Notable species recorded in 2013 Appendix EC-002-004. Desktop records include a number of Red Data Book species from this locality. Its value is given as regional (rather than national) due to its small size and the small extent of open sward grassland supporting the notable species.
	Local/parish	Invertebrate assemblage associated with the BBOWT Finemere Wood nature reserve.	The semi-improved grassland at this site is probably of recent origin. It supported a single Nationally Notable species of weevil *Hypera meles*.

[46] Fox, R., Warren, M.S., and Brereton, T.M. (2010). A new Red List of British Butterflies, Species Status 12; 1-32. Joint Nature Conservation Committee, Peterborough.
[47] UK Butterflies black hairstreak http://www.ukbutterflies.co.uk/species.php?species=pruni Accessed: 13th October.

Species/ Group	Value	Receptor	Baseline and rationale
Amphibians	County/ metropolitan	Great crested newt metapopulation[48] associated with breeding ponds in BBOWT's Finemere Wood nature reserve and the adjoining part of the Calvert Estate, as well as ponds near Woodlands Farm and to the east of Calvert Landfill.	Field survey data confirmed small populations in five ponds and medium populations in three ponds. Two ponds containing small populations are present in land required for the construction of the Proposed Scheme, of which one is an area required solely for ecological mitigation. Five further breeding ponds were identified through desk study records; no population size assessment could be made. The overall metapopulation is of a medium size and meets the criteria for county significance[49]; there is no indication that unsurveyed ponds would contain populations of sufficient size to increase the level at which the metapopulation is valued.
	Up to county/ metropolitan	Great crested newt metapopulation associated with ponds close to the Akeman Street disused railway north of Woodham.	Analysis of desk study data identified a potential metapopulation of undetermined size, present in three ponds and other breeding ponds in this area could form part of the same metapopulation. None are within land required for the construction of the Proposed Scheme. It is reasonable to assume that these ponds could contain medium populations that would meet criteria for county value, but based on their number and extent, it is unlikely that the potential metapopulation would exceed this value.
	Up to county/ metropolitan	Great crested newt metapopulation associated with ponds at Calvert Landfill.	Analysis of desk study records identified the potential presence of a great crested newt metapopulation of undetermined size in three ponds. None are within land required for the construction of the Proposed Scheme. It is reasonable to assume that these ponds could contain medium populations, but based on their number and extent, it is unlikely that the potential metapopulation would exceed this value.
	Up to county/ metropolitan	Great crested newt metapopulations associated with three ponds at unaccessed land south-east of Station Road.	Desk study records indicate that these ponds contain great crested newt but it was not possible to determine population size. None are within land required for the construction of the Proposed Scheme. It is reasonable to assume that these ponds could contain medium populations that would meet criteria for county value, but based on their number and extent, it is unlikely that the potential metapopulation would exceed this value.
	Up to county/ metropolitan	Potential great crested newt metapopulations associated unaccessed land within and adjacent to Grendon and Doddershall Meadows LWS.	A number of ponds and large areas of terrestrial habitat suitable for great crested newt are present in this location. Six waterbodies are within land required for the construction of the Proposed Scheme. Due to the extent of suitable habitat and connectivity between ponds it is reasonable to assume that a medium population may be present, but, based on their number and extent, it is unlikely that the potential metapopulation would exceed the stated value.

[48] A metapopulation is a group of spatially separated populations of the same species which interact at some level.
[49] Buckinghamshire and Milton Keynes Environmental Records Centre (2009) Criteria for the Selection of Local Wildlife Site in Berkshire, Buckinghamshire and Oxfordshire.

Species/ Group	Value	Receptor	Baseline and rationale
	Up to county/ metropolitan	Great crested newt metapopulation associated with ponds at unaccessed land north and immediately south of Station Road.	Surveys and desk study data identified a population of a small size, based on survey results from one pond to the north of Station Road. This pond is within the land required for the construction of the Proposed Scheme. A number of associated ponds and areas of terrestrial habitat suitable for great crested newt are also present in this area. Due to the extent of suitable habitat and connectivity between ponds it is reasonable to assume that a medium metapopulation may be present, but, based on their number and extent, it is unlikely that the potential metapopulation would exceed the stated value.
	Up to county/ metropolitan	Great crested newt metapopulation potentially present in ponds east of Waddesdon.	Field survey results indicate a population of a small size is present in a single pond within the land required for the construction of the Proposed Scheme to the west of Blackgrove Road, Waddesdon with a peak count of nine great crested newts. There are several associated ponds in this area, in arable farmland and generally with poor habitat connectivity, however it is possible that some may contain medium populations.
	Up to county/ metropolitan	Great crested newt population associated with a pond near Woodham.	Analysis of desk study records indicates that a population of great crested newts is present in a single pond within the land required for the construction of the Proposed Scheme close to the southern end of the Akeman Street disused railway. It is not possible to estimate population size but it is unlikely that the population would exceed the stated value.
	District/ borough	Great crested newt breeding pond near Fieldside Farm, Doddershall.	Field survey results indicate a low population size class is present with a peak count of a single great crested newt.
Birds	County/ metropolitan	Breeding bird assemblage to the north of Waddesdon.	Field surveys recorded 60 bird species in this area, including three probable yellow wagtail breeding territories. Desk study records also include tree pipit, lesser spotted woodpecker and kingfisher but it is undetermined whether these birds are breeding. The yellow wagtail population is of county significance (more than 1% of the county population).
	County/ metropolitan	Barn owl population to the north of Waddesdon.	Four breeding pairs of barn owls were recorded within this area. The barn owl population is of county significance (more than 1% of the county population).
	County/ metropolitan	Breeding bird assemblage to the east of Waddesdon.	Field surveys recorded 60 bird species within this area. Notable breeding records were three confirmed and two probable lapwing, one probable grey partridge and five probable yellow wagtail territories. Desk study records were as for the area north of Waddesdon. The yellow wagtail is of county significance (more than 1% of the county population).
	County/ metropolitan	Barn owl population to the east of Waddesdon.	Three breeding pairs of barn owl were recorded within this area. The barn owl population is of county significance (more than 1% of the county population).
	County/ metropolitan	Barn owl population to the north-west of Quainton.	Two breeding pairs of barn owl were recorded within this area. The barn owl population is of county significance (more than 1% of the county population).

Species/ Group	Value	Receptor	Baseline and rationale
	County/ metropolitan	Breeding bird assemblage associated with land east of Edgcott.	Field surveys recorded 63 bird species. Notable records were one confirmed oystercatcher, one probable grasshopper warbler and a little ringed plover breeding territory. Desk study records also include tree sparrow; however, it is undetermined whether this species is breeding. The oystercatcher, grasshopper warbler and a little ringed plover populations is of county significance (more than 1% of the county population).
	District/ borough	Barn owl population associated with land east of Edgcott.	One potential nest location for barn owls was recorded within this area. This does not meet criteria for county/metropolitan significance, however barn owl nest sites are typically infrequent, and if occupied, this would maintain populations over a substantial amount of local habitat in this area.
	District/ borough	Red kite population to the north-west of Quainton.	Two red kite nests were recorded within this area. Red kites are scarce breeders and require specific woodland habitat to breed as such these records are likely to be a notable in the Aylesbury Vale area.
	Local/parish	Breeding bird assemblage north-west of Quainton.	Field surveys recorded 48 bird species within this area. Desk study records also include woodcock but it is undetermined if this species is breeding.
Wintering birds	Local/parish	Wintering bird assemblage associated with land near Waddesdon and Quainton.	Field surveys recorded 64 bird species in this area. Notable species recorded were wintering kingfisher, marsh tit, grey partridge and merlin. Desk study records also include lesser spotted woodpecker and barn owl. Other records were for common and widespread wintering bird species typical of open countryside and woodland.
Reptiles	County/ metropolitan	Assemblage of common reptiles near the Aylesbury Link railway line, Woodlands Farm and Oak Tree Farm.	The assemblage comprised three species; common lizard, slow worm and grass snake, the latter species present in high population densities. These populations are probably linked by railway and river corridors to those in the southern part of CFA 13 on land at Calvert Landfill, at Calvert Jubilee LWS, and on nearby parts of the Aylesbury Link railway line. A single adder was also recorded at the last location. They meet criteria for designation of LWS in Buckinghamshire due to the presence of three species and also due to the presence of adder.
	Up to county/ metropolitan	Grass snake population potentially present at Grendon and Doddershall Meadows.	Ponds, ditches and rough grassland present in this area could potentially support large populations of grass snake, which would meet criteria for county importance.
	Local/parish	Assemblage of common reptiles near Glebe Farm, Wayside Farm and Bucks Railway Centre in the south of this area.	Small to medium populations of grass snake and common lizard were recorded at these locations which were separate from other known populations in the area. Habitat suitable for similar populations is widespread and abundant locally.

Species/ Group	Value	Receptor	Baseline and rationale
Plants	County/ metropolitan	Assemblage of notable plant species present at Waddesdon Station LWS.	There are a number of records for heath dog violet, which is near threatened[50] and county rare[51], as well as for uncommon plants of open habitat; fine-leaved sandwort, good-king-henry and dwarf spurge.
	County/ metropolitan	Assemblage of notable plant species at Grendon and Doddershall Meadows LWS.	There are a few records for heath spotted orchid, bottle sedge, respectively county rare and county scarce.
	County/ metropolitan	Assemblage of notable plant species present at Waddesdon Common LWS	There are records of tubular water-dropwort, a species of principal importance, with several county rare and uncommon plant species including distant sedge, meadow thistle, fen bedstraw and saw wort.
	County/ metropolitan	Assemblage of notable plant species present Sunny Hill Farm Pastures LWS	Tubular water-dropwort, a species of principal importance, has been recorded here with the near threatened round-fruited rush. County rare species recorded from this site include brown sedge and three-leaved water crowfoot.
	Local/parish	Common gromwell present near Quainton.	There is a single recent record for common gromwell, which is county scarce from scrub habitat near Quainton.
Otter	District/ borough	Otter population associated with the River Ray.	Field surveys recorded a single otter spraint on the River Ray, confirming that otter(s) are present within this catchment. One area with potential to be used as a holt was identified, but with no evidence of use. No records of otter were provided in the desk study. Quality of habitat is poor and the known otter activity in the area is concentrated on watercourses to the north of this area.
Aquatic invertebrates	District/ borough	Aquatic invertebrate assemblage associated with the wet section of the Mega Ditch.	Two 'Notable' beetle species and moderate diversity of macroinvertebrate taxa including shrimp, stonefly nymph, riffle beetle, and a variety of caddis larvae are present. This includes several families that are highly sensitive to organic pollution.
	Local/parish	Aquatic invertebrate assemblage at Marston Brook.	Field surveys recorded a single snail species *Anisus leucostoma* of local interest. The macroinvertebrate assemblage is of a very low diversity.
	Local/parish	Aquatic invertebrate assemblage at the River Ray.	Field surveys recorded a low diversity of common species including freshwater shrimp and mayfly larvae.

[50] Cheffings, C. and Farrell, L. (2006), *The Vascular Plant Red Data List for Great Britain* and *A tool for assessing the current conservation status of vascular plants on SSSIs in England* (2006).
[51] Buckinghamshire and Milton Keynes Environmental Records Centre (2009), *Criteria for the Selection of Local Wildlife Site in Berkshire, Buckinghamshire and Oxfordshire*.

Species/ Group	Value	Receptor	Baseline and rationale
	Local/parish	Aquatic invertebrate assemblage at the Muxwell Brook.	Low numbers and diversity of invertebrates were recorded during field surveys of the remaining parts of the Muxwell Brook other than the Mega Ditch).
Badger	Local/parish	Badger populations near Sheephouse Wood, Calvert, Quainton, Woodlands Farm and Waddesdon.	Twenty two badger setts were recorded within 500m of the land required for the construction of the Proposed Scheme, including three main setts, six subsidiary setts and one annexe set. The remaining 12 setts are outliers or unidentified sett types. Bait marking surveys identified two distinct territories along the embankment of the Aylesbury Link railway line near Sheephouse Wood and near Calvert. Habitat suitable for badgers is present throughout much of the Proposed Scheme. Badgers are common and widespread in Buckinghamshire and the UK, and the species is not threatened or vulnerable.
Water vole	Negligible	Potential water vole population associated the River Ray.	Suitable habitat is limited and field surveys found no evidence of presence. Two desk study records are reported from this area but both are over 10 years old. No large populations of water vole are known to exist close to this area.
Hazel dormouse	Negligible	Potential dormouse population potentially present in Sheephouse Wood and associated hedgerow network.	There was no access for surveys at Sheephouse Wood, or Finemere Wood however surveys were completed in suitable nearby, including ancient woodland adjoining Calvert Landfill, hedges adjoining Finemere Wood, and at Calvert Jubilee LWS in CFA13. Although suitable habitat is abundant there is a single recent record only, from 2009 from a small wood near Hilsdon approximately 2.7km from the land required
Fish	Negligible	Fish assemblages of the River Ray and Muxwell Brook.	No fish were recorded during surveys and poor quality habitat was recorded at these locations.
White-clawed crayfish	Negligible	White-clawed crayfish population potentially present at Fleet Marston Brook, Doddershall Brook and the River Ray.	During scoping surveys, the majority of habitat was identified as unsuitable. Where surveys were scoped in, no white-clawed crayfish were recorded.

Future baseline

Construction (2017)

7.3.29 A summary of the known developments which are assumed to be mostly built and occupied prior to construction of the Proposed Scheme is provided in Section 2.1 of this report, with further details provided in Appendix CT-004-000 of Volume 5. These developments will affect the character and value of ecological resources as follows.

7.3.30 Construction of the Greatmoor EfW facility, the associated incinerator bottom ash (IBA) processing facility, and access road from the A41 (along the disused Akeman Street railway) has commenced and the facility will be complete and operational in 2017/18, at the start of construction of the Proposed Scheme. This development includes amendments to the restoration contours of a permitted landfill (Pit 6) and

habitat creation elsewhere in Calvert Landfill that will be complete 2019 (and up to 2042 for Pit 6). The site is situated immediately southwest of the Aylesbury Link railway line. The development will result in an in-combination effect with the Proposed Scheme principally through habitat change. Habitat clearance is underway at Lower Greatmoor and along the track-bed of the Akeman Street railway (vegetation in the Mega Ditch and blackthorn scrub on the margins of the disused railway are being partially retained). The ongoing use and subsequent restoration of Pits 4, 5 and 6 will result in the replacement of existing areas of standing water and largely bare ground, with woodland, scrub, species-rich grassland and new water bodies. In the medium term (at least 20 years), this is likely to result in an increase in the numbers of great crested newt, black hairstreak and foraging bats (amongst other species) in this area. The facility and some of the associated buildings will be lit to allow night time operation. There will be no floodlighting or high level lighting (other than on the aircraft warning lights on the 95m high chimney stack), and measures to limit light spillage and glare will be implemented. However, it is possible that lighting along the access road on the northern boundary of the facility could result in some light spillage into the Mega Ditch that could affect bats.

7.3.31 The Proposed Scheme will run in parallel with the Aylesbury Link railway line from Station Road to the junction with the Bicester Bletchley Line (Claydon Junction). The Aylesbury Link railway line is currently single-tracked with regular freight services of up to four trains a day associated with the landfill at Calvert. The East West Rail project proposes to upgrade the Aylesbury Link railway line in this area to increase the frequency of train services by 2017. The Proposed Scheme will realign the Aylesbury Link eastward, although this will beentirely within the railway corridor thus minimising loss of adjacent habitat. However, some small scale clearance of line-side vegetation within the railway corridor is likely prior to the construction of the Proposed Scheme. The implementation of the Proposed Scheme is unlikely to involve significant vegetation clearance and any reduction in habitat for reptiles, breeding birds, amphibians and badger, and for foraging, commuting and roosting bats is likely to be limited.

7.3.32 Management of parts of Grendon and Doddershall Meadows LWS under Higher Level Stewardship or a successor scheme, and ongoing management of grassland at Finemere Wood BBOWT Nature Reserve is likely to change the habitats and associated assemblages of species over time. Improved management of these sites will increase their diversity of grassland plants and invertebrates, but the sites are unlikely to exceed their currently stated ecological value.

7.3.33 Otter populations are increasing due to water quality improvements in river basins and other factors[52]. Their range is expected to increase throughout this area and, by the time of operation, it is possible that otter could be more numerous.

[52] Tracking Mammals Partnership (2009) *UK Mammals Update 2009*. JNCC, Peterborough.

Operation (2026)

7.3.34 There are no known committed developments or changes to management in this area that will affect the operational baseline, beyond those described above in relation to the construction baseline.

7.4 Effects arising during construction

Avoidance and mitigation measures

7.4.1 The following measures have been included as part of the design of the Proposed Scheme and avoid or reduce impacts to features of ecological value:

- Footpath QUA/26 accommodation underbridge, located to the south of Quainton auto-transformer station will provide a potential crossing point for commuting bats;
- Footpath CAG/2 underbridge at the Muxwell Brook at the south western corner of Sheephouse Wood SSSI will extend the access currently provided by Costello's underbridge and retain its value as a crossing point for commuting bats. The minimum proposed width is 3.5m and as such it will be suitable for the woodland bat species present in this area;
- while not specifically designed for bats the overbridges at Bridleway QUA/28A overbridge, Edgcott Road overbridge, Bridleway QUA/36 accommodation green overbridge, Bridleway GUN/28 accommodation green overbridge, Footpath SCL/13 green overbridge, Calvert green overbridge; and School Hill Road overbridge will provide physical structures over the railway that will limit severance between existing habitats used as flightlines by bats;
- the Adam's accommodation underbridge near the River Ray, which provides a crossing point for bats is being retained in the Proposed Scheme;
- ensuring that the Proposed Scheme avoids habitat loss from Sheephouse Wood SSSI;
- minimising habitat loss within the Mega Ditch which provides a sheltered and unlit corridor for commuting and foraging bats; and
- the mature blackthorn scrub known to support colonies of black hairstreak will be retained if the Akeman Street disused railway from A41 to the Greatmoor EfW facility is used for construction access.

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

Assessment of impacts and effects

Designated sites

7.4.3 The Proposed Scheme will cross Grendon and Doddershall Meadows LWS on the Doddershall embankment, immediately west of the Aylesbury Link railway line that already crosses the site. To the west, additional land is required for a landscape

earthwork that will be parallel to the Proposed Scheme. In the eastern part of the site (which is understood to contain the most diverse grassland habitat) there will be a balancing pond and small area of flood compensation, both required for the nearby Quainton auto-transformer feeder station.

7.4.4 Grendon and Doddershall Meadows is designated principally for damp species rich neutral grassland habitat, for which conservation status depends on maintaining habitat extent and continuity so that plant and invertebrate assemblages can survive in the long term.

7.4.5 Approximately 11.6ha of damp neutral grassland for which the site is designated will used during construction. Following construction, the area of the LWS required for rail infrastructure will be approximately 1.9ha. The Proposed Scheme will also further fragment the site, leading to increased edge effects and separated populations of plants and invertebrates, with a consequent increased risk of local extinction. Due to the extent of habitat loss and fragmentation there will be a permanent adverse effect on the integrity of the site, which will be significant at the county/metropolitan level.

7.4.6 Waddesdon Common LWS is located partially within land required for construction of the Proposed Scheme. Factors important to its integrity include the maintenance of the extent and species assemblage of the unimproved species-rich lowland meadow for which the site is designated. A construction access route to the north of the Aylesbury Link railway line and connection of a drainage channel to an existing watercourse will affect approximately 1.1ha (6%) of the site. It is assumed that the construction of the access route will involve habitat removal and is, therefore, a permanent effect. There are a few records of notable plant species for the site as a whole and none for the parts of the LWS affected by the Proposed Scheme; however, the absence of records cannot confirm that notable plant species or assemblages will not be affected during construction. Although the majority of the habitat will be unaffected, its extent will be reduced and there is potential for adverse changes to those plant assemblages present. A loss of this magnitude will result in a permanent adverse effect on the integrity of the site that is significant at up to the county/metropolitan level.

7.4.7 At Waddesdon Station Complex LWS the construction access route to enable the construction of the culvert headwall and drainage channel to the north of the Aylesbury Link railway line will result in approximately 0.1ha (2%) of habitat loss from the site. The maintenance of the extent of the habitats and the species assemblage for which the site is designated are important to maintaining its integrity. The majority of the site will remain unaffected by construction and a reduction in extent and loss of plant assemblage of this extent will result in a permanent effect that is significant at the district/borough level.

7.4.8 Construction of the Bridleway QUA/36 accommodation green overbridge and a drain to an attenuation pond will result in the permanent loss of approximately 0.4ha (65%) of the unnamed BNS comprising a track leading to the Aylesbury Link railway line. This will require the removal of hedgerows and calcareous grassland habitat for which the site is designated. Habitat loss of this extent and magnitude will result in an adverse effect on the integrity of the site that is significant at the county/metropolitan level.

7.4.9 No impacts of habitat loss will occur at Sheephouse Wood SSSI. As described in the future baseline, the horizontal alignment of the Proposed Scheme avoids any incursion into the site, and allows East West Rail to be constructed within the existing railway corridor. Although the western edge of the SSSI will be adjacent to the area to be used for construction of the Proposed Scheme, any change in noise or air pollution will be highly localised and temporary.

7.4.10 No significant effects on site integrity are expected at Ham Home-cum-Hamgreen Woods as changes in air quality will be for period of construction only. Therefore there will be no long-term build up in NOx deposition or a measurable change in plant species diversity.

7.4.11 No impacts will occur at Finemere Wood SSSI or Grendon and Doddershall Woods SSSI as both are sufficiently distant from construction activities that could result in adverse effects. For similar reasons there will be no impacts at Greatsea and Romer Wood LWS, Sunny Hill Farm Pastures LWS or Waddesdon Park BNS.

Habitats

7.4.12 Approximately 1.5ha of ancient woodland along the bridleway adjacent to the landfill south-east of Calvert will be removed by the alignment of the Proposed Scheme and associated engineering earthworks. The conservation status of ancient woodland is dependent on maintaining, amongst other things, its extent and species composition and connectivity to similar habitat. As ancient woodland cannot be fully recreated the loss would remain a permanent adverse effect that is significant at the county/metropolitan level.

7.4.13 The Proposed Scheme will remove approximately 11.6ha of lowland meadow from Grendon and Doddershall Meadows LWS and 1.1ha of the same habitat at Waddesdon Common. Lowland meadow is a rare and declining habitat in the UK. It declined by 97% between 1930 and 1984[53], with significant annual losses since then. The remaining estimated resource in the UK is 10,000 to 15,000ha and the estimated resource in Buckinghamshire is 450ha[54]. In this context the loss of habitat of this extent from two of the larger remaining areas of lowland meadow in Buckinghamshire, represents a permanent adverse effect on the conservation status of lowland meadow that is significant at the county/metropolitan level.

7.4.14 The loss of approximately 0.4ha of an unnamed BNS on the track leading to the Aylesbury link railway line will reduce the already limited extent of lowland calcareous grassland in north Buckinghamshire, however, there are approximately 350ha the county as a whole. Therefore the loss of 0.4 ha from the BNS of which a proportion comprises calcareous grassland and will lead to a permanent adverse effect on conservation status that is significant at the district/borough level.

7.4.15 Twenty three important hedgerows will be affected. Historically the extent of this habitat has declined in Buckinghamshire. Thus, the proportion and extent of

[53] Ant Maddock, ed. (2008), *UK Biodiversity Action Plan Priority Habitat Descriptions Lowland Meadows* From: UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG For more information about the UK Biodiversity Action Plan (UK BAP) visit http://www.jncc.gov.uk/page-5155

[54] Buckinghamshire and Milton Keynes Biodiversity Parnership, *Lowland Meadows Habitat Action Plan* http://www.buckinghamshirepartnership.gov.uk/biodiversity/biodiversity-action-plan/lowland-meadows/ Accessed: 15/08/13.

important hedgerows are integral to the conservation status of this habitat and so is the continuity of the network as a system of wildlife corridors. Much of the loss is in the area to the north of Waddesdon where they will be removed for the construction of the Waddesdon south cutting, Waddesdon embankment, Waddesdon north cutting and Quainton south embankment. During construction, approximately 3.3km of important hedges will be removed in this area. Habitat loss of this extent will result in a permanent adverse effect on the conservation status of hedgerows that will be significant at the district/borough level.

7.4.16 It is considered unlikely that any other effects on habitat receptors at more than the local/parish level will occur. Local/parish level effects are listed in Volume 5: Appendix EC-005-002.

Species

7.4.17 The removal or disturbance of habitat features that are utilised by bats during breeding, hibernation or migrating between roosts are considered to have the potential to result in adverse effects on the bat populations or assemblages during construction. However, the point at which such impacts are considered likely to result in a significant adverse effect on the conservation status of the population concerned will differ dependent on the status of the species concerned.

7.4.18 None of the known Bechstein's roosts will be removed during construction in this area or in Calvert, Steeple Claydon, Twyford and Chetwode (CFA 13), but the loss of connecting and surrounding habitat could affect them. The connectivity of hedgerow and other boundary features, such as mature trees and watercourses that connect to woodland are important to the conservation of this species by providing habitat linkages between roosts and foraging areas. If there is no mitigation, the removal or disturbance of habitat features that are utilised by roosting Bechstein's bat or commuting between roosts and foraging sites has the potential to result in an adverse effect on the population Bechstein's bat. Construction of the Proposed Scheme between the Edgcott Road and the northern end of Sheephouse Wood will involve clearance of vegetation on the Aylesbury Link railway line and the Bridleway GUN/25 which are associated with the key crossing points and flightlines utilised by Bechstein's bats (see Table 9). The associated reduction of access to foraging habitat could affect the viability of the Bechstein's breeding colonies in this area.

7.4.19 Recently published information confirmed the presence of a Bechstein's bat roost in tree on land at Doddershall, within 500m of the alignment of the Proposed Scheme[55]. The very limited activity in this location from radio tracking surveys (confined to a single record in August 2013) indicates that it is unlikely there are regularly used flightlines that cross the route of the Proposed Scheme in this location. However, it is possible that bats from this roost could cross the Proposed Scheme.

[55] BBOWT (2013) Wildlife more important than speed http://www.bbowt.org.uk/news/2013/09/13/wildlife-more-important-speed-hs2-say-environmentalists Accessed 14th October 2013.

7.4.20 The overbridges and underpasses already described would provide a degree of habitat connectivity for Bechstein's bat. However, without additional mitigation[56], the habitat loss and resulting fragmentation of flightlines for Bechstein's bats described in Table 9 will reduce connectivity between roosts and foraging areas. It could result in bats being unable to reach foraging areas or having to expend additional energy to do so, and having to forage for longer periods and use sub optimal habitat. As such, without additional mitigation, the fragmentation of foraging and commuting habitat associated with the construction of the Proposed Scheme will result in a permanent adverse effect on the conservation status of this Bechstein's bat population that is significant at the national level.

7.4.21 Data shows that the Akeman Street disused railway line is used occasionally by low numbers of barbastelle bats for foraging and as a flightline. The removal of vegetation and fragmentation of flightlines where the Proposed Scheme crosses the Akeman disused railway at Grendon Junction could disrupt the movement of barbastelle in this area. Due to the limited amount of activity recorded and the distance of the roost from the affected habitat there will be no significant effect on the conservation status of the barbastelle bat population in this area.

7.4.22 The assemblage of bats associated with the woodland habitats in the northern part of this area will be affected by the loss of approximately 5km of vegetation along the Aylesbury Link railway line between the Edgcott Road and School Hill in CFA 13. It will also involve removal or modification of features known to provide bat flightlines over the Proposed Scheme at Grendon Junction and Benfields overbridge in this area, and at the School Hill overbridge in CFA 13. These habitats are important in maintaining the numbers and diversity of bats associated with woodland habitats in this area, for which favourable conservation status depends on the connectivity between roosting and foraging areas.

7.4.23 This 5km section of the Aylesbury Link railway line is used in its entirety by Daubenton's bats for commuting to and from foraging localities both sides of the Proposed Scheme. Parts of the corridor are also used by Brandt's, whiskered bats, brown long-eared bats and Natterer's bats as flightlines to commute to foraging habitats either side of the Proposed Scheme. The movement across the Proposed Scheme by these species, as well as Daubenton's bat is concentrated at the Adam's underbridge, Grendon Junction, Ditchburns overbridge, Costello underbridge and from the western edge of Sheephouse Wood. The Adam's underbridge and Costello underbridge, used by brown long-eared, Brandt's, and whiskered bats are retained in the Proposed Scheme. The overbridges and underpasses already described will provide a degree of habitat connectivity. However, in the absence of additional mitigation these structures will not fully mitigate the adverse effects on the assemblage of woodland bat species present.

7.4.24 The removal of woodland adjacent to Calvert Landfill site will involve the removal of a small maternity roost of brown long-eared bats. Vegetation clearance in this area will

[56] Proposed additional mitigation provision is discussed in the subsequent section under the heading 'other mitigation'. The measures detailed are committed and are described here as 'additional' to distinguish them from the avoidance/mitigation measures that formed a fundamental aspect of the engineering design.

also fragment rail-side habitat which, in turn, could also indirectly affect additional maternity roosts of brown long-eared as well as those of Brandt's, whiskered and Daubenton's bats. Breeding females from colonies of these species that roost in Sheephouse Wood regularly cross the Aylesbury Link railway line to access foraging habitat to the west, including water bodies at Calvert Landfill site including the Mega Ditch.

7.4.25 Without additional mitigation, the removal of vegetation along the Aylesbury Link railway line and loss of features providing crossing points over the Proposed Scheme would result in a permanent adverse effect on the conservation status of this assemblage of woodland bats that is significant at the regional level.

7.4.26 Noctule, serotine and Leisler's bats use habitats for roosting and foraging within and adjacent to Finemere Wood, Sheephouse Wood and Grendon and Doddershall Woods. These species utilise linear vegetation and its fragmentation will have some effect on commuting and foraging behaviour, but these species are frequently recorded flying high in open habitats and as such they are less likely to be affected by habitat fragmentation arising from the Construction of the Proposed Scheme. As such, there will be no significant effect on the conservation status of the populations of noctule, serotine and Leisler's bats in this area.

7.4.27 Vegetation removal within the land required for the construction of the Proposed Scheme on the Aylesbury Link railway line and the Bridleway GUN/25 could disrupt movement for this Nathusius' pipistrelle bats that have been recorded foraging either side of the Proposed Scheme at Calvert Landfill, Finemere fishing lake and at Calvert Jubilee LWS in CFA13. Although moderate levels of activity were recorded during static monitoring, the location of roosts and flightlines are unknown, as is the relative quality of foraging habitat present at different water bodies. Therefore as a precautionary assessment, it is assumed that without mitigation habitat removal along Aylesbury Link railway line would result in a permanent adverse effect on the conservation status of this Nathusius' pipistrelle population that would be significant at up to the county/metropolitan level.

7.4.28 Common pipistrelle bats will be affected. Like other species, favourable conservation status depends on maintaining roosts and foraging habitat, and linkages between them. The extension of the Adam's accommodation underbridge and River Ray culvert will result in the loss of a common pipistrelle maternity roost in the existing structure. Common pipistrelle commute and forage widely along the Aylesbury Link railway line, from Station Road to Sheephouse Wood, and it is likely that bats from the maternity roost in a building close to the Buckinghamshire Railway Centre use the rail-side vegetation to reach foraging habitat at Sheephouse Wood. Though this roost will not be directly affected, without mitigation loss of access to foraging areas could affect its long-term viability. It is likely that soprano pipistrelle bats use similar habitat and would also be affected by the construction of the Proposed Scheme in this area. Without mitigation, the loss and fragmentation of roosts will result in a permanent adverse effect on the conservation status of the species concerned that would be significant at the county/metropolitan level.

7.4.29 The removal of vegetation along the Aylesbury Link railway line north of Station Road to Edgcott Road and fragmentation of the adjoining hedges could also affect

conservation status of populations of other bat species potentially present in this area, including whiskered/Brandt's, noctule and Leisler's bats. Without mitigation, fragmentation of potential commuting routes is likely to result in an adverse effect on the conservation status of the bats assemblage, which will be significant at up to the county/metropolitan level.

7.4.30 Construction of the Proposed Scheme will affect black hairstreak butterflies at Grendon Junction, and at Calvert Jubilee LWS (see CFA 13 report). Factors important to maintaining conservation status of this species include the extent and connectivity of habitat. Especially important is mature blackthorn (which is the larval food plant) in warm sheltered locations, which facilitates egg laying and the development of larvae. A colony of black hairstreak is present associated with hedgerows and scrub within the land required for the construction of the Proposed Scheme at Grendon Junction. The extent of this colony that will remain following the construction of the Greatmoor EfW facility access road is uncertain but any remaining habitat will be lost due to the construction of Bridleway QUA/36 Accommodation Green Overbridge and Grendon Underwood Embankment. Black hairstreak do not generally move great distances and have a limited ability to colonise new areas of habitat. As such, habitat removal at Grendon Junction could permanently sever those black hairstreak colonies located to the east and west of the land required for the construction of the Proposed Scheme at Finemere Wood and along the Muxwell Brook. Such severance could reduce genetic exchange between numerous colonies of black hairstreak that are present in these large woods. However, in the context of the approximately 40 colonies present in this area, the loss of a single colony and partial removal of further colonies in CFA 13, will have a limited effect on the conservation status of black hairstreak. Equally the genetic exchange between the colonies present within larger woodlands (Finemere Wood, Sheephouse Wood, Grendon and Doddershall Woods, Hewin's Wood, Hamgreen Wood, and Romer and Greatsea Woods) will reduce adverse effects on conservation status caused by habitat severance and fragmentation. The effects of habitat loss and fragmentation on the conservation status of black hairstreak in this area will be significant at the district/borough level.

7.4.31 Great crested newts will be adversely affected. The conservation status of great crested newts depends on the presence of ponds with ample aquatic vegetation and suitable terrestrial habitats including woodland, scrub and grassland; and on the continuity of terrestrial habitats to provide links between breeding ponds. Based on survey data and desk-top study records the Proposed Scheme will affect up to four metapopulations of great crested newt and single ponds that provide breeding habitat for great crested newts.

7.4.32 Metapopulations of great crested newt are potentially present at Grendon and Doddershall Meadows LWS and in a group of water bodies north of Station Road. Single ponds will be removed at both sites, respectively for the construction of a balancing pond and for the construction of the Station Road overbridge. Neither area was fully surveyed but in both cases, on the basis of information from aerial photographs, breeding and terrestrial habitat is of sufficient extent and quality for medium size populations to be present. Without mitigation, the removal of populations of this size would be an adverse effect on the conservation status of great crested newts that is significant at up to the county/metropolitan level.

7.4.33 A metapopulation present at BBOWT's Finemere Wood nature reserve and the adjoining part of the Calvert Estate, as well as ponds on the opposite side of the Aylesbury Link railway line near Woodlands Farm and at Calvert Landfill will be partially within land required for the construction of the Proposed Scheme. The great crested newt mitigation proposals for the Greatmoor EfW facility indicate that the metapopulation will still be present at the start of construction, though the number and location of ponds will have changed. Construction of Grendon Underwood Embankment and bridleway accommodation at the Green Overbridge QUA/36 will involve the removal of one pond containing a low population of great crested newt. A route for on-site construction traffic will result in the loss of a single breeding pond supporting a low population size class of great crested newt, to the west of Blackgrove Road, Waddesdon. The construction and maintenance access along the Akeman Street disused railway will be largely on the access road provided as part of the development of the Greatmoor EfW facility. However, close to the A41 the access for Proposed Scheme will affect a single pond containing a low population of great crested newt. Without mitigation, the loss of breeding populations of this size from these locations will have a significant adverse effect on the conservation status of great crested newt, which is significant at the district/borough level.

7.4.34 The construction of the Proposed Scheme will involve loss of nest sites and foraging habitat that will affect six confirmed barn owl territories in this area.

7.4.35 A single nest site and a proportion of associated foraging habitat for a barn owl pair to the north of Quainton will be affected by the construction of the Station Road Overbridge. Two of the three nest sites and a proportion of associated foraging habitat for a pair to the north of Waddesdon will be affected by the construction of landscape earthworks associated with the Waddesdon South cutting and an onsite construction traffic route south of Waddesdon Sewage Treatment Works. The presence of nesting sites, often in holes in trees or undisturbed buildings adjacent to rough grassland and fields, wood and watercourse edges with food sources are important to the conservation status of barn owls. It is unlikely that the pairs present in these areas will be viable due to the loss of nest sites and the extent of the loss of foraging habitat associated with the construction of the Proposed Scheme. Two pairs of barn owl are of county importance in Buckinghamshire and as such there will be a permanent adverse effect on the conservation status of this species of significance at the county/metropolitan level.

7.4.36 The territories of four further pairs of barn owl will be affected by the construction of the Proposed Scheme, although sufficient habitat will remain and there will be no significant adverse effects on their conservation status; as follows:

- two of the five nest sites and a proportion of associated foraging habitat for a pair between Woodlands Farm and the River Ray will be affected by the construction of replacement floodplain storage and a drain to an attenuation pond near Oak Tree Farm;
- a proportion of foraging habitat associated with a pair near to the east of Waddesdon will be removed by the construction of landscape earthworks associated with the A41 Bicester Road realignment;

- a proportion of foraging habitat associated with a pair near Railway Cottage will be removed by the construction of the Doddershall embankment; and
- a proportion of foraging habitat associated with a pair near Upper Greatmoor Farm will be removed by the construction of the Grendon Underwood embankment.

7.4.37 Scrub and grassland close to the Aylesbury Link railway line, near Woodlands Farm and at the FCC landfill facility, together with nearby habitat in the southern part of Calvert, Steeple Claydon, Twyford and Chetwode (CFA 13), supports an assemblage of widespread reptile species of county/metropolitan value. The conservation status of these species depends on maintaining the extent and connectivity of habitat, and limited levels of disturbance. Prior to the construction of the Proposed Scheme, construction of the Greatmoor EfW facility will alter the distribution of reptiles in this area. However, the Proposed Scheme is still likely to adversely affect reptiles through the construction of the Bridleway GUN/28 accommodation green overbridge and the Bridleway QUA/36 accommodation green overbridge, as well the Grendon Underwood embankment. More extensive loss and disturbance of contiguous reptile habitat will occur in CFA 13; for the construction of the Calvert Cutting, FCC Environment Ltd. waste transfer sidings, the chords to access the Infrastructure Maintenance Depot (IMD) and for the realignment of the Aylesbury Link railway line to the east of the Proposed Scheme and diversion of the Addison Road over-bridge. None of the populations known to be present are likely to be completely removed, but, loss and fragmentation of habitat on and adjacent to the Aylesbury Link railway line will extend for 4.7km from River Ray to the northern end of Calvert Jubilee LWS, and for 3.7km from Main Street, Charndon to Queen Catherine Road. Due to the extent of habitat loss and habitat fragmentation, there will be a permanent adverse effect on the conservation status of these reptile populations that will be significant at the county/metropolitan level.

7.4.38 The removal of approximately 11.6ha of grassland, ponds and ditches at Grendon and Doddershall Meadows LWS will affect grass snake. Given the extent and quality of habitat it is possible that a large population of grass snake will be present. The loss of approximately half of the available habitat could have an adverse effect on the population potentially present that would be significant at up to the county/metropolitan level.

7.4.39 Based on records provided in the desk study, the Proposed Scheme will affect notable plant species. Common gromwell will be removed near Quainton. Records of other notable species within 100m, where there is potential for colonies to be wholly or partially removed, include heath dog violet at Waddesdon Station Complex LWS, and bottle sedge and heath spotted orchid at Grendon and Doddershall Meadows LWS. The loss of these plant assemblages would lead to an adverse effect that is significant at the county/metropolitan level.

7.4.40 No adverse effects are expected for the following species receptors which form part of the baseline and are valued at district/borough level or above:

- invertebrate assemblage associated with the Akeman Street disused railway as habitat retained during construction of the access road for Greatmoor EfW

facility would also be retained in the construction of the Proposed Scheme, if used for construction and maintenance traffic;

- aquatic invertebrate assemblage associated with the Mega Ditch as this channel will be retained in its current form during the construction of the Proposed Scheme;
- all great crested newt metapopulations other than those discussed near Finemere Wood, to the west of Blackgrove Road, the Akeman Street disused railway and the potential metapopulations at Grendon and Doddershall Meadows and near Station Road. All remaining populations are located at a sufficient distance from land required for construction of the Proposed Scheme and works will not affect their conservation status; and
- all remaining barn owl populations identified in Table 9 are located at a sufficient distance from land to be required for construction of the Proposed Scheme to remain unaffected.

Other mitigation measures

7.4.41 This section describes additional measures designed to reduce or compensate for significant ecological effects. These include grassland habitat creation, provision of receptor sites for reptiles and great crested newt, green bridges, underpasses and linear woodland planting to provide habitat connectivity for bats, as follows:

- planting of linear vegetation across the seven green overbridges located between Bridleway QUA/28A and School Hill to mitigate for the loss of habitat connectivity for bats and black hairstreak butterflies;
- Footpath QUA/26 accommodation underbridge, located to the south of Quainton auto-transformer station designed to provide a cross sectional area of approximately 18m^2 to increase its value for commuting bats, in particular Bechstein's bat;
- four areas of grassland, scrub and aquatic habitat for amphibians and reptiles between Cranwell Farm and Glebe Farm;
- two areas of grassland habitat creation for losses at Grendon and Doddershall Meadows LWS;
- translocation of ancient woodland soils to areas where woodland is to be created between Finemere and Sheephouse Woods; and
- planting of new hedgerows between Waddesdon and Edgcott Road.

7.4.42 Habitat loss from Grendon and Doddershall Meadows LWS will be mitigated by restoration of damp neutral grassland on areas affected during construction and creation of drier grassland on the landscape earthwork. Approximately 30ha of additional species-rich grassland will be created on adjacent fields. These fields have similar topography and are likely to have similar soils to the LWS. Therefore, they are likely to be suitable for replicating the damp species-rich neutral grassland for which the site is designated. They will also be used as a receptor site for grassland that will be translocated from the LWS. Details of approaches to grassland habitat creation

and translocation are provided in the principles of mitigation in Volume 5: Appendix EC-008-001. Due to the extent of habitat creation and measures to ensure the establishment there will be no significant effect on the conservation status of lowland meadow.

7.4.43 Prior to the use of land at Waddesdon Common LWS the affected grassland habitat will be translocated to the receptor site described for Grendon and Doddershall Meadows LWS in accordance with the principles of ecological mitigation outlined in Volume 5: Appendix EC-008-001. The affected area of the site will be restored post-construction. Following implementation, no significant adverse effect on the conservation status of lowland meadow is anticipated.

7.4.44 Following construction of the drainage channel to the attenuation pond at the BNS on the track leading to the Aylesbury link disused railway the affected calcareous habitat (and associated hedges) will be reinstated. Similarly the habitat present at Waddesdon Station Complex LWS will be reinstated on completion of works requiring access. There will be no long-term adverse effects on the integrity of these sites.

7.4.45 Ancient woodland habitat is irreplaceable. The loss of 1.5ha of ancient woodland will be compensated for by salvaging the ancient woodland soils and seedbank during construction and translocating it to areas of woodland planting adjacent to Sheephouse Wood or other nearby ancient woodlands. The broadleaved woodland planting proposed in this area will increase the extent of woodland habitat and the level of connectivity with existing parcels of ancient woodland. The planting will utilise native tree species of local provenance; dead wood and coppice stools will also be translocated where appropriate. While not fully replicating the woodland that will be lost, the large increase in woodland extent will maintain the integrity of woodland in the area. When mature the new woodland will result in a beneficial effect that is significant at the district/borough level, but will be of benefit to some species prior to maturity.

7.4.46 New hedgerows will be planted to compensate for those removed. Fourteen kilometres of new hedges will be planted and the species composition of the new hedges will be tailored to match that of those in the surrounding area. There will be temporary adverse effects whilst the new hedges become established and mature. Following establishment and maturation of planting (in 10-15 years) it is expected that any adverse impacts on hedgerows and the wildlife corridors they create will be reduced to a level which will not result in any significant effect on the conservation status of the habitat.

7.4.47 Mitigation for the loss of habitat connectivity north of the Edgcott Road overbridge to School Hill includes linear planting on the five green overbridges in this area that will provide safe crossing points for wildlife, particularly for bats. These multi-purpose structures will include planted habitat corridors of between 25 and 30m in width as follows:

- Bridleway QUA/36 accommodation green overbridge 200m west of Finemere Wood will replace the existing level crossing at Grendon Junction. This will reinstate a movement corridor between Finemere Wood and Hewin's Wood and Grendon and Doddershall Woods. This corridor comprises the Akeman

Street Disused Railway and Muxwell Book which are used by Bechstein's, Natterer's, Daubenton's, Brandt's and brown long-eared bats;

- Bridleway GUN/28 accommodation green overbridge 100m east of Upper Greatmoor Farm will replace the existing Benfields overbridge at this location. It will replicate an existing link between Sheephouse Wood and Finemere Wood to Grendon and Doddershall Woods. Survey records show that Bechstein's bats cross the Proposed Scheme at this point;
- Footpath SCL/13 green overbridge is adjacent to planting on the northern boundary of Sheephouse Wood SSSI. The overbridge will provide links to habitats to the west of the Proposed Scheme and provide crossing locations for Daubenton's, brown long-eared, Brandt's, whiskered, common pipistrelle and soprano pipistrelle bats. For further details see Volume 2, CFA Report 13;
- Calvert green overbridge will include an access road for the waste transfer siding. It will include planting that will provide crossing points for the movement of Daubenton's, brown long-eared, and Bechstein's bats recorded roosting in Decoypond Wood as well as Natterer's, common pipistrelle and soprano pipistrelle bats. For further details see Volume 2, CFA Report 13; and
- School Hill green overbridge to be constructed to the east of the existing bridge to carry School Hill Road over the route of the Proposed Scheme and to provide a crossing point for the movement of Daubenton's, common pipistrelle and soprano pipistrelle bats that move from Sheephouse Wood, Decoypond Wood and Shrubs Wood. Planting will be on the side of the carriage way, with highway lighting directed away from it. For further details see Volume 2, CFA Report 13.

7.4.48 Planting on the green bridges will comprise a double row of tall scrub that will provide a sheltered habitat corridor suitable for commuting bats. A network of planted areas on either side of the Proposed Scheme will guide bats to crossing points and link existing woodlands, as shown on Maps CT-06-052-L1, CT-06-053, CT-06-053-02, CT-06-053-L1, CT-06-054 and CT-06-055 (Volume 2, CFA12 Map Book). These include realignment of hedges at the north-western corner of Finemere Wood to provide clearer connectivity with Bridleway QUA/36 accommodation green overbridge, as well as linear woodland to act as flightlines from Finemere Wood, Romer and Greatsea Woods and Sheephouse Wood to Bridleway GUN/28 accommodation green overbridge. This planting will enable bats to move between the aforementioned woods to the east of the Proposed Scheme to Hewin's Wood and Grendon and Doddershall Woods to the west.

7.4.49 For Bechstein's bats as well other species, the proposed mitigation described above will mitigate the fragmentation of hedges and treelines that currently link woodland either side of the Proposed Scheme north of the Edgcott Road to School Hill Road and thus enable the bats to reach habitat required for breeding and foraging. The total area of woodland planting is over 20ha and this will compensate for the loss of foraging habitat that will occur from the removal of woodland along the Aylesbury Link railway line.

7.4.50 The proposed planting will not be sufficiently mature to provide habitat linkages immediately. As such fragmentation of habitats used by Bechstein's bats and other species will still arise in the years following construction. In order to reduce the time for establishment, replacement habitats will be created where reasonably practicable prior to construction of the Proposed Scheme. In accordance with the principles of ecological mitigation provided in Volume 5 Appendix CT-001-000/2, this will include measures to ensure that the temporary habitat severance that could fragment habitat for bats is addressed during construction. These include the retention of habitat corridors for as long as possible and the use of movable screens to provide connectivity between vegetation used by commuting bats.

7.4.51 Survey undertaken suggests that there is no frequently used crossing point for Bechstein's to the south of Edgcott Road. However, the recent record close to Doddershall House means that crossing of the route of the Proposed Scheme cannot be ruled out. As a precaution, mitigation for the potential presence of Bechstein's bat will be provided as follows:

- Bridleway QUA/28A will include a planted habitat corridor designed to provide a sheltered habitat corridor suitable for commuting bats;
- Edgcott Road overbridge will include a planted habitat corridor designed to provide a sheltered habitat corridor suitable for commuting bats. The design will include a close-boarded fence to minimise the potential adverse effect on bats of light spillage from the Quainton auto-transformer station and nearby National Grid sub-station; and
- Footpath QUA/26 accommodation underbridge will be designed to provide a cross sectional area of approximately 18m^2 in order to provide a larger opening that will encourage use by commuting bats. It will include a suitable headwall structure and associated earthworks and fencing (where required) that will help to 'funnel' bats towards the underbridge.

7.4.52 In addition each structure will be linked by linear planting parallel to the Proposed Scheme that will provide flightlines to crossing points. Measures to limit the effects of habitat severance until linked planting establishes will be provided in accordance with the principles of ecological mitigation provided in Volume 5 Appendix CT-001-000/2.

7.4.53 The mitigation described above will also provide flightlines that will benefit other species of bat recorded in this area.

7.4.54 The loss of a common pipistrelle maternity roost in the underbridge of the Aylesbury Link railway line, a maternity roost of brown long-eared bats in a tree near Calvert landfill, as well as other common and soprano pipistrelle roosts, will be addressed by provision of suitable replacement roosting habitat. Replacement roosting provision will be provided within woodland planting that will be provided between Sheephouse Wood and Finemere Wood in accordance with the Principles of Ecological Mitigation as detailed within Volume 5 Appendix CT-001-000/2.

7.4.55 Following the implementation of the measures proposed it is expected that any adverse effects arising from the construction of the Proposed Scheme will be reduced

to the local/parish level or below. There will be no significant effect on the conservation status of the bat species concerned.

7.4.56 HS2 Ltd will continue to monitor the Bechstein's population in this area of the route during the period up to construction, and if it is demonstrated that any of the above measures are not required to maintain conservation status of local populations, then the mitigation provision may be reduced accordingly.

7.4.57 The loss of a colony of black hairstreak butterfly and the potential for fragmentation of colonies either side of the Proposed Scheme will be addressed by planting blackthorn on green bridges and in the habitat creation areas described above in relation to mitigation for bats. This will reconnect colonies and greatly increase available habitat once blackthorn is sufficiently mature to provide habitat for egg-laying (estimated at 10-15 years). Following maturation of habitat there will be no adverse effects on the conservation status of black hairstreak in this area.

7.4.58 Compensatory habitat to address impacts on great crested newt populations at near Finemere Wood, to the west of Blackgrove Road, the Akeman Street disused railway and the potential populations at Grendon and Doddershall Meadows and near Station Road will be provided within approximately 68ha of ecological habitat creation area in accordance with the principles of mitigation identified within Volume 5 Appendix CT-001-000/2. This will include the provision of replacement ponds, terrestrial habitat and hibernation habitat sufficient to maintain the favourable conservation status of the population affected. The areas of habitat creation are as follows:

- approximately 20ha of new woodland and woodland edge habitat between Finemere Wood and Sheephouse Wood;
- pond creation within the 30ha of land available for grassland creation adjacent to Grendon and Doddershall Meadows LWS;
- 3.8ha of habitat to the west of the A41 Bicester Road realignment; and
- other areas available for translocation, in the event that great crested newt are present in ponds that could not be accessed for survey, are present near Cranwell Farm Footbridge on the eastern side of the Proposed Scheme (5.1ha), to the north of Glebe Farm (4.0ha) and between the Station Road realignment and the Proposed Scheme to the north of Crossroads Farm (3.3ha).

7.4.59 The creation of these habitats will be sufficient to maintain the numbers and distribution of great crested newt currently present and as such, there will be no adverse effects on the conservation status of great crested newts in this area.

7.4.60 Extensive areas of reptile habitat will be created in this area and in the southern part of CFA 13, most notably the habitat compensation areas for Grendon and Doddershall Meadows (30ha), the margins of linear planting linking Finemere, Sheephouse and Decoypond Wood. Together, these areas will reinstate habitat linkages and provide sufficient area for translocation of animals from land required for the construction of the Proposed Scheme. As such, there will be no adverse effects on the conservation status of reptiles in this area.

7.4.61 Any notable plant species affected by the construction of the Proposed Scheme at Grendon and Doddershall Meadows LWS, Waddesdon Common LWS and Waddesdon Station Complex LWS will mitigated through the translocation of these plants as part of the habitat translocation at these sites described in mitigation of designated sites. There will be no adverse effects on the conservation status of the notable plant populations concerned.

7.4.62 Mitigation measures to address the potential killing, injury and disturbance of badgers will be provided in accordance with the ecological principles of mitigation identified within Volume 5: Appendix CT-001-000/2. This will include the provision of badger-proof fencing and replacement setts where necessary. New planting within the ecological mitigation areas will benefit badgers present in those areas by improving foraging habitat and providing new opportunities for sett creation.

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

Summary of likely residual significant effects

7.4.64 The mitigation, compensation and enhancement measures described above reduce the effects to a level that is not significant except for the loss of 1.5ha of ancient woodland adjacent to the landfill south-east of Calvert.

7.4.65 Ancient woodland is irreplaceable. However, there would be a corresponding permanent beneficial effect due to the increased area of broadleaved woodland and woodland connectivity in the area in the area between the River Ray and Sheephouse Wood resulting from extensive new woodland planting.

7.4.66 The permanent loss of one barn owl nest site and associated foraging habitat will be a residual significant effect. However, if the proposed mitigation measures for barn owl are implemented through liaison with landowners, the residual effect on barn owl would be reduced to a level that is not significant.

7.5 Effects arising from operation

Avoidance and mitigation measures

7.5.1 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:

- seven green overbridges located between Bridleway QUA/28A and School Hill which provide crossing points at a sufficient height above the Proposed Scheme to reduce potential killing of bats through contact with trains; and
- provision of three underbridges – Footpath QUA/26 accommodation underbridge, Adam's accommodation underbridge and Footpath CAG/2 underbridge allow bats to fly beneath the Proposed Scheme.

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

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

7.5.4 Due to the large areas over which bats forage it is likely that any loss of, or displacement from, suitable foraging habitat in the vicinity of the Proposed Scheme would in itself amount to only a small proportion of the wider available resource. However, the impact of any such disturbance or displacement could be greatly increased if bats are hampered in moving between breeding sites, hibernation sites and other roosts which they commonly utilise.

7.5.5 Bechstein's bat and several other bat species present in this area require habitat connectivity in order to move between foraging and roosting sites. They will be affected by habitat fragmentation during the operation of the Proposed Scheme in a similar way to that described during construction. Radio tracking surveys carried out in 2012 and 2013 demonstrated that Bechstein's bats and other species associated with woodland habitat use linear vegetation to reach the Aylesbury Link railway line and that much of their movement across the Proposed Scheme was concentrated at the crossing points identified in Table 9, of which those at Grendon Junction and Benfields overbridge are important in linking the maternity colonies present in Finemere Wood and Grendon and Doddershall Woods. Therefore the mitigation provided by crossing points and planting of new habitat corridors, and measures to address the temporary loss of connectivity as new habitat matures described for construction effects will also mitigate for the effects of habitat fragmentation during operation.

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

7.5.7 The green overbridges, underpasses and associated planting provide crossing points to channel bats to the existing key crossing points at the Adam's underbridge, Grendon Junction, Benfields overbridge and the Costello underbridge, that have been

demonstrated by radio tacking surveys to link roosts and foraging areas. In addition, the potential crossing of bats near Doddershall House will be addressed by the provision of an underbridge of appropriate size to be used by a range of bat species, and the planting to be provided on the Edgcott Road overbridge and Bridleway QUA/28A as described in Section 7.4. This will reduce the risk of killing and injury, but will not fully mitigate these effects in the operational phase of the Proposed Scheme. Bats may continue to commute along vegetation close to the Aylesbury Link railway line, resulting in increased risk of collision. In addition bats were recorded crossing the route of the Proposed Scheme along the western boundary of Sheephouse Wood This includes Bechstein's as well as Brandt's and Daubenton's bats.

7.5.8 Without additional mitigation, the ongoing loss of individuals of these species over several generations, particularly where roosts are present close to the Proposed Scheme could, have an adverse effect on their conservation status significant at the national level for Bechstein's bat, the regional level for the assemblage of woodland bat species, and at the county level for Nathusius' bat.

7.5.9 Due to their ability to fly at height and to cross open habitat there will be no significant adverse effects from killing and injury to Leisler's, noctule or serotine bats. Although the operation of the Proposed Scheme may result in the incidental killing and injury of common and soprano pipistrelle bats, this is not likely to have an adverse effect on their conservation status.

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

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

Other mitigation measures

7.5.12 This section describes and assesses additional elements designed to reduce or compensate for significant ecological effects.

7.5.13 These include the following measures (such as habitat manipulation and excluding bats from the Proposed Scheme) to discourage bat species from foraging close to the Proposed Scheme:

- Sheephouse Wood mitigation structure will be provided to avoid potential impacts on bats crossing the HS2 corridor adjacent to Sheephouse Wood. This

will extend from the south of Sheephouse Wood to its northern extent at Footpath SCL/13 green overbridge, a distance of approximately 800m. The structure will provide a physical barrier to bats and for purposes of this ES has been assessed as a box shaped enclosure. This will be up to approximately 10m above rail level. Lighting will be used, if required, to discourage bats from flying close to areas of wind turbulence around the structure. This will be designed for minimal light spillage;

- areas of new planting providing habitat linkages for bats between the Finemere Wood and the School Hill which are set back from the Proposed Scheme to encourage species to avoid it as much as possible;
- vegetation management will be carried out to a width of approximately 20m along the eastern side of the Proposed Scheme between the Adam's accommodation underbridge and the Footpath CAG/2 underbridge, and between Bridleway QUA/36 accommodation green overbridge and Bridleway GUN/28 accommodation green overbridge to the southwest, to remove tall vegetation and hence reduce the risk of bats flying close to trains;
- in order to provide mitigation that will be effective for Bechstein's bat roosting to the south of Edgcott Road, vegetation along the Aylesbury Link Railway line will be removed where necessary from the Station Road overbridge to the River Ray in order to restrict bat movements to crossing points; and
- planting, where appropriate,along the Proposed Scheme will provide alternative flightlines to guide bats to crossing points and therefore reduce risk of bats colliding with trains.

7.5.14 Following the implementation of the measures proposed it is anticipated that any adverse effects on bats as consequence of the operation of the Proposed Scheme will be reduced to the local/parish level or below. There will be no significant effect on the conservation status of the species concerned.

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

Summary of likely residual significant effects

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

8 Land quality

8.1 Introduction

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

8.1.2 Potentially contaminated areas of land have been identified that could affect, or be affected by, the construction of the Proposed Scheme (for example contaminated soils may need to be removed or the construction may alter existing contamination pathways). Each of these areas has been studied to evaluate the scale of potential impacts caused by existing contamination (if present) and what needs to be done to avoid significant consequences to people and the wider environment. In addition, a review has been undertaken to establish whether the operation of the Proposed Scheme will lead to contamination of its surrounding environment and what needs to be done to prevent such contamination.

8.1.3 The main environmental features of this area include the River Ray, Sheephouse Wood SSSI, Finmere Wood SSSI, Grendon and Doddershall Meadows LWS located at the northern end of the study area, and the existing Aylesbury Link railway line, alongside which the Proposed Scheme will run through much of the Waddesdon and Quainton area.

8.1.4 The main land quality issues in this area include:

- the clay pits at the northern end of the study area, to the south-east of Calvert Landfill site;
- the existing Aylesbury Link railway line and two spurs of an unnamed disused railway, the first of which lies on the west side of the Proposed Scheme to the north-east of Oak Tree Farm and the second of which lies on the east side of the Proposed Scheme to the east of Upper South Farm; and
- drying beds associated with the former Waddesdon Sewage Treatment Works at Glebe Farm.

8.1.5 Calvert Landfill lies to the north of the study area and is dealt with in the Land quality report for the Calvert, Steeple Claydon, Twyford and Chetwode area.

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

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

- Appendix LQ-001-012: Land quality appendix.

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

8.1.8 Engagement has been undertaken with the Aylesbury Vale District Council and the Environment Agency regarding contaminated land and with Buckinghamshire County Council regarding mineral resources. Information has been received on mineral extraction and Mineral Safeguarding Areas and land contamination.

8.2 Scope, assumptions and limitations

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

8.2.2 Baseline data were reviewed for the area of land required to construct the Proposed Scheme excluding areas of utility works on the highway together with a buffer extending out for a minimum of 250m, but in the case of groundwater data up to 1km. This is defined as the study area. With respect to land quality issues, utility works within the highway are a low risk construction activity, as most of the excavation works will be within the highway construction layers, and reinstatement will be made with highway construction materials.

8.2.3 Familiarisation visits to the study area were made in July 2012 where the location of the Proposed Scheme was viewed from points of public access only. Due to access constraints not all sites considered to have the greatest potential for contamination were visited. However, the purpose of site visits is to verify desktop information and the lack of complete site walkovers is considered unlikely to have substantially affected the land quality assessment.

8.3 Environmental baseline

Existing baseline

8.3.1 Unless otherwise stated, all features described in this section are presented on Maps LQ-01-025 to LQ-01-028 (Volume 5, Land Quality Map Book).

Geology

8.3.2 This section describes the underlying ground conditions within the study area. It first describes any made ground present, followed by near surface superficial deposits and lastly describes the deeper bedrock geology. The geological mapping is illustrated on Map WR-02-012 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

8.3.3 The Proposed Scheme in this study area will mostly cross agricultural land; however, a cover of made ground may be present in built up areas of the study area as a result of previous cycles of development.

8.3.4 Geological mapping shows that there are two areas of made ground deposits, in the vicinity of clay pits, both part of the wider Calvert Landfill site (see current and historical land use section below) along the west side of the Proposed Scheme, opposite Sheephouse Wood.

8.3.5 Superficial drift deposits are absent from the majority of the area according to existing records, with the exception of Alluvium associated with water courses, consisting of clay, silt, sand and gravel, and an area of Head deposits consisting of clay, silt, sand and gravel to the north of Waddesdon.

8.3.6 The bedrock geology underlying the study area consists of the Ancholme Group composed of a succession of different mudstones from 30 to 100m thick. The Group includes the Kimmeridge Clay and Ampthill Clay Formations, which outcrop towards the south of the route, underlain by the Weymouth, West Walton, Peterborough and Stewartby Formations which outcrop progressively further north.

Groundwater

8.3.7 To the north of Waddesdon, the River Alluvium and the Head deposits have been designated by the Environment Agency as Secondary A aquifers. The Ancholme Group has been designated by the Environment Agency as Unproductive strata.

8.3.8 No groundwater Source Protection Zones (SPZ) are present in the study area.

8.3.9 A search for groundwater and surface water abstractions in the study area confirmed that there are no licensed groundwater abstractions for public water supply or other purposes within 1km of the route.

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

Surface waters

8.3.11 The River Ray crosses the route near Woodlands Farm. The route will also cross or pass near to a series of unnamed connected drains, and tributaries of the River Ray, in this area. There are no surface water abstractions in this study area.

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

Current and historical land use

8.3.13 Current potentially contaminative land uses include:

- existing Aylesbury Link railway line that runs along the proposed route for the central and northern sections of this study area (see Maps LQ-01-027 and LQ-01-028 in Volume 5, Land Quality Map Book);
- planning permission for the landfilling of the former clay pits (Calvert Landfill pit 6) associated with the planning permission for Greatmoor EfW facility (see Map LQ-01-028, H7 in Volume 5, Land Quality Map Book); and
- planning permission for the excavation and landfilling of Calvert Landfill pits 7 and 8 to the east and south of pit 6 (see Map LQ-01-028, H8 in Volume 5, Land Quality Map Book). However further excavation has been voluntarily forgone

in association with the grant of planning permission for the Greatmoor EfW facility.

8.3.14 Historical potentially contaminative land uses include:

- clay pits at Calvert Landfill (see Map LQ-01-028, F8);
- former Waddesdon Sewage Treatment Works at Glebe Farm (see Map LQ-01-026, H8 in Volume 5, Land Quality Map Book);
- disused railway spurs to the north-east of Oak Tree Farm and east of Upper South Farm (see Map LQ-01-026, C6 in Volume 5, Land Quality Map Book); and
- potentially infilled water features along the route.

Other regulatory data

8.3.15 Regulatory data reviewed include pollution incidents, radioactive and hazardous substances consents and environmental permits (previously landfill, Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) licences).

8.3.16 Notable data are as follows:

- a planning application and an IPPC licence application for the Greatmoor EfW facility; and
- a substantiated pollution incident from fly tipping west of the Buckinghamshire Railway Centre (see Map LQ-01-026, D6 in Volume 5, Land Quality Map Book).

Mining/mineral resources

8.3.17 The Buckinghamshire County Council Minerals and Waste Core Strategy DPD[57], confirms that the route will not pass through any Minerals Consultation/Safeguarding Area(s).

8.3.18 There are no current mining or quarrying activities within the study area.

Geo-conservation resources

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

Receptors

8.3.20 The sensitive receptors that have been identified within this study area are summarised in Table 10.

Table 10: Summary of sensitive receptors

Issue	Receptor type	Receptor description	Receptor sensitivity
Land Contamination	People	Residents in existing properties	High

[57] Buckinghamshire County Council (2012), *Minerals and Waste Core Strategy Development Plan Document*.

		Workers e.g. in industrial facilities and existing railway	Moderate
	Controlled waters	Secondary A aquifer of the Alluvium and Head deposits	Moderate
		River Ray and associated tributaries and drains	High
	Ecological	Sheephouse Wood SSSI	High
	Built environment	Buildings and property	Low to high
		Underground structures and services	Low

Future baseline

8.3.21 There are currently no identified committed development sites within the study area which are likely to change the land quality baseline during either construction or operation of the Proposed Scheme.

8.4 Effects arising during construction

Avoidance and mitigation measures

8.4.1 The construction assessment takes into account the mitigation measures contained within the draft CoCP (see Volume 5: Appendix CT-003-000/1). The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme. Its requirements in relation to work in contaminated areas will ensure the effective management and control of the work. Such requirements include:

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

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

- Environment Agency CLR11 Model Procedures for the Management of Land Contamination (2004)[58]; and
- British Standard BS10175 Investigation of Potentially Contaminated Sites (2011)[59].

8.4.3 Where significant contamination is encountered, a remedial options appraisal will be undertaken to define the most appropriate remediation techniques. This appraisal will be undertaken based on multi-criteria attribute analysis that considers environmental, resource, social and economic factors in line with Sustainable Remediation Forum UK's publication A Framework for Assessing the Sustainability of Soil and Groundwater Remediation (2010)[60]. The preferred option will then be developed into a remediation strategy, in consultation with regulatory authorities prior to implementation.

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

8.4.5 In addition to the excavation and treatment of contaminated soils, where necessary ground (landfill) gas and leachate control systems within affected old backfilled sites, will be installed on a temporary or permanent basis, to ensure that ground (landfill) gas and leachate migration pathways are controlled and do not adversely affect the Proposed Scheme or the wider environment as a consequence of the Proposed Scheme.

Assessment of impacts and effects

8.4.6 The route of the Proposed Scheme crosses slightly undulating ground in the study area. As such, the route will be constructed at ground level, in cutting, and on embankment.

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

8.4.7 Construction works will include earthworks, utility diversions, deep foundations, temporary dewatering and other activities. In addition, road infrastructure works will also be required within this section of the Proposed Scheme.

8.4.8 There will be an auto-transformer station and auto-transformer feeder station in this area at Putlowes and at Quainton respectively. The Putlowes auto-transformer station will be located to the north-east of Cranwell Farm and the Quainton feeder station will be located near Edgcott Road (also known as Shipton Lee Road). A National Grid sub-station will be located to the north-east of the Edgcott Road overbridge.

8.4.9 There will be no main compounds and three civil engineering satellite compounds and one railway installation satellite compounds (which will continue to use a compound previously established for the civil engineering works).

Land contamination

8.4.10 In line with the assessment methodology, as set out in the SMR, SMR Addendum and its appendices, an initial screening process was undertaken (identified in the methodology as Stages A and B) to identify areas of current or historical contaminative use within the study area and to consider which of these areas might pose contaminative risks for the Proposed Scheme. In total, 11 areas were considered during this screening process; three of these areas were taken forward to more detailed risk assessments (Stages C and D), in which the potential risks were assessed more fully. The majority of the areas undergoing the more detailed risk assessments were infilled domestic water wells and ponds. All areas assessed are shown on Maps LQ-01-025 to LQ-01-028 (Volume 5, Land Quality Map Book) and those considered as potentially posing a risk to the Proposed Scheme are labelled with a reference number. The sites undergoing the more detailed risk assessments were as follows:

- railway land associated with the disused railway spurs to the north-east of Oak Tree Farm and east of Upper South Farm;
- drying beds associated with the former Waddesdon Sewage Treatment Works at Glebe Farm; and
- clay pits to the south-east of Calvert Landfill associated with clay excavation. No known infilling of these pits has occurred to date.

8.4.11 Conceptual site models (CSM) have been produced for the six areas taken to Stage C and D assessments. The detailed CSM are provided in Volume 5 (Appendix LQ 001-017, Section 3) and the results of the baseline risk assessments are summarised in this section. Potentially contaminated areas have been grouped and considered together, where appropriate. The following factors have determined the need for Stage C and D assessments:

- whether the area is within the land required for the construction of the Proposed Scheme or associated offline works; e.g. roads;
- the vertical alignment, i.e. whether the Proposed Scheme is in cutting or on embankment;

- the presence of underlying Principal or Secondary A aquifers or nearby watercourses; and
- the presence of adjacent residential properties or sensitive ecological receptors.

8.4.12 A summary of the baseline CSM is provided in Table 11. The impacts and baseline risks quoted are before any mitigation is applied. The assessed baseline risk is based on the information provided at the time of the assessment. Where limited information is available, it is based on precautionary, worst case assumptions and may therefore report a higher risk than that which actually exists.

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

Area ref [1][2]	**Area name**	**Main potential impacts**	**Main baseline risk** [3]
12-3	Aylesbury Link and disused railway spurs north-east of Oak Tree Farm and east of Upper South Farm (Map LQ-01-026 centred on grid reference C6)	Exposure of off-site human receptors (residential and commercial) to contamination by direct contact, ingestion and inhalation of contaminants in windblown, soil-derived dusts.	Moderate/low
		Exposure of off-site human receptors (residential and commercial) to contamination by inhalation of migrating ground-gas and volatile vapours from contaminated water.	Low
		Exposure of off-site human receptors (residential and commercial) to asphyxiative or explosive gases.	Moderate
		Exposure of Alluvium aquifer to leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater.	Very low
		Surface run-off to the Alluvium aquifer or surface water features.	Low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI and Grendon and Doddershall Meadows LWS) to lateral migration of contaminants in groundwater, through culverts and surface run-off.	Low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI and Grendon and Doddershall Meadows LWS) to contact with contaminants in windblown dusts.	Very low
		Exposure of off-site properties to lateral migration and build-up of asphyxiative or explosive gases.	Moderate
		Exposure of off-site properties to direct contact of property with contaminants in soil and surface water/groundwater.	Very low
12-4	Drying beds associated with the former Waddesdon Sewage Treatment Works (Map LQ-01-026 grid reference H8)	Exposure of off-site human receptors (residential and commercial) to contamination by direct contact, ingestion and inhalation of contaminants in windblown, soil-derived dusts.	Moderate/low
		Exposure of off-site human receptors (residential and commercial) to contamination by inhalation of migrating ground-gas and volatile vapours from contaminated water.	Low
		Exposure of off-site human receptors (residential and commercial) to asphyxiative or explosive gases.	Moderate
		Exposure of off-site properties to lateral migration and build up of asphyxiative or explosive gases.	Moderate

Area ref [1][2]	Area name	Main potential impacts	Main baseline risk [3]
		Exposure of off-site properties to direct contact of property with contaminants in soil and surface water/groundwater.	Very low
12-11	Clay pits to the south-east of Calvert Landfill (Map LQ-01-028 centred on Grid Reference F8)	Exposure of Muxwell Brook to leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater.	Very low
		Surface run-off to Muxwell Brook	Low
		Exposure of Alluvium aquifer to leaching of contaminants from soil to groundwater and vertical and lateral migration in groundwater.	Very low
		Surface run-off to Alluvium aquifer.	Low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI) to lateral migration of contaminants in groundwater and surface run-off.	Low
		Exposure of off-site ecological receptors (Sheephouse Wood SSSI) to contact with contaminants in windblown dusts.	Very low

(1) Each area is assigned a unique identification number (See Volume 5: Appendix LQ-001-012).
(2) CSMs have been prepared as part of the detailed land contamination methodology (refer to Volume 5: Appendix LQ-001-012) for baseline, construction and post-construction.
(3) The moderate or high risks identified reflect the uncertainty in existing baseline information. Whilst there are unlikely to be properties or receptors that experience the reported high or moderate existing baseline risk in the absence of site investigation a precautionary, worst case risk is reported in the table.

Temporary effects

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

8.4.14 Table 12 presents the summary of the construction effects obtained from a comparison of the baseline and construction impacts. The construction risk assessment takes into account the implementation of the mitigation measures set out within the draft CoCP. The details of these comparisons are presented in Volume 5: Appendix LQ-001-012.

8.4.15 The baseline and construction CSM have been compared to determine the change in level of risk to receptors during the construction stage, and thus to define the level of effect at the construction stage. Where there is no change between the main baseline risk and the main construction risk, the temporary effect significance is deemed to be negligible even if the risk is assessed to remain as high. This will be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the construction boundary.

Table 12: Summary of temporary (construction) effects

Area ref	Area name	Main baseline risk	Main construction risk (1)	Temporary effect and significance
12-3	Aylesbury Link and disused railway spurs north-east of Oak Tree Farm and east of Upper South Farm	Very low to moderate	Very low to moderate	Minor adverse effect (not significant)
12-4	Drying beds associated with the former Waddesdon sewage works	Very low to moderate	Very low to moderate	Negligible (not significant)
12-11	Clay pits to the south-east of Calvert Landfill	Very low to low	Low to moderate/low	Minor adverse effect (not significant)

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

8.4.16 The main construction risk is the risk from the construction of the Proposed Scheme assuming that any mitigation measures as set out in the draft CoCP have been implemented. In Table 12 the temporary effect and significance has been determined by calculating the change in risk between the main baseline risk (present risk under current conditions) and the main post-construction risk. Therefore, where there is no change between the main baseline risk and the main construction risk, the temporary effect significance is deemed to be negligible even if the risk is deemed to be high. For more information see Volume 5: Appendix LQ-001-012.

8.4.17 The results of the assessment indicate that, the construction phase is expected to have minor adverse to negligible effects on the receptors overall, but these effects are not significant.

8.4.18 There may be a minor adverse effect on receptors from construction activities if contaminated material is encountered at a number of sites located either on or near the construction area. These comprise the railway land along the Aylesbury Link railway line and along the disused railway spurs to the north-east of Oak Tree Farm and east of Upper South Farm, and the clay pits to the south-east of Calvert Landfill, although there has been no recorded infilling of these pits to date. This could occur during the widening of the existing rail corridor and at new cuttings. In accordance with the CoCP ground investigations and risk assessments will be undertaken in advance of construction works commencing where required. With the implementation of mitigation measures within the CoCP the effects will not be significant.

8.4.19 The construction sites located in this area will include the storage of potentially hazardous substances, such as fuels and lubricating oils. They may also be used for temporary storage of potentially contaminated soils. Implementation of the measures outlined in the draft CoCP will manage risks from the storage of such materials.

Permanent effects

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

8.4.21 Table 13 includes the summary of the permanent (post-construction) effects obtained from a comparison of the baseline and post-construction impacts and whether these are significant. The details of these comparisons are presented in Volume 5: Appendix LQ 001-012.

Table 13: Summary of permanent (post-construction) effects

Area ref	Area name	Main baseline risk	Main post-construction risk(1)	Post-construction effect and significance
12-3	Aylesbury Link and disused railway spurs north-east of Oak Tree Farm and east of Upper South Farm	Very low to moderate	Very low to moderate	Negligible (not significant)
12-4	Former Waddesdon Sewage Treatment Works	Very low to moderate	Very low to moderate	Negligible (not significant)
12-11	Clay pits to the south-east of Calvert Landfill	Very low to low	Very low to low	Negligible (not significant)

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

8.4.22 The magnitude of the permanent effects and their significance have been determined by calculating the change in risk between the main baseline risk and the main post-construction risk. Therefore, where there is no change between the main baseline risk and the main post-construction risk, the permanent effect significance is deemed to be negligible even if the risk is assessed to remain as high. This will be the case where the construction of the Proposed Scheme does not alter the risks from an existing potentially contaminated site that is outside the construction boundary.

8.4.23 In Table 13, the permanent effect and significance has been determined by calculating the change in risk between the main baseline risk (present risk under current conditions) and the main post-construction risk. Therefore, where there is no change between the main baseline risk and main post-construction risk, the post-construction effect significance is deemed to be negligible even if the risk is deemed to be high. For more information see Volume 5: Appendix LQ-001-012.

8.4.24 The results of the assessment indicates that there will, be an overall negligible effect, and none of the post-construction effects of land contamination impacts predicted are significant. However, in the event that unexpected contamination is encountered during the construction of the route in this area, this will be remediated as described in the draft CoCP resulting in an overall beneficial effect.

8.4.25 There are anticipated to be no significant cumulative permanent effects.

Mining/mineral resources

8.4.26 There are no areas in this part of the route that are currently being worked with respect to mining or mineral resources and no designated areas for future mining or minerals extraction.

8.4.27 Planning permission exists for the excavation of clay to facilitate the landfilling of Calvert Landfill pits 7 and 8 to the east and south of pit 6 (see Map LQ-01-028, H8 in

Volume 5, Land quality Map Book). However further excavation has been voluntarily forgone in association with the grant of planning permission for the Greatmoor EfW facility.

Geo-conservation sites

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

Other mitigation measures

8.4.29 The draft CoCP details the approach to managing potential land contamination matters. At this stage, no additional mitigation measures are considered necessary to mitigate risks from land contamination at construction phase beyond those set out in the draft CoCP and instigated as part of required remediation strategies. However, in addition to the excavation and treatment of contaminated soils, it may also be necessary to install ground (landfill) gas and leachate control systems at areas of historical infilling, on a temporary or permanent basis, to ensure that ground (landfill) gas and leachate migration pathways are controlled and do not adversely affect the Proposed Scheme or the wider environment as a consequence of the Proposed Scheme. Any additional mitigation measures associated with effects from Calvert Landfill, located to the north of this study area are dealt with in the Land quality report for the Calvert, Steeple Claydon, Twyford and Chetwode area.

Summary of likely significant residual effects

8.4.30 No likely significant adverse effects are anticipated with the application of the mitigation measures detailed above.

8.5 Effects arising from operation

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

Avoidance and mitigation measures

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

Assessment of impacts and effects

8.5.3 Putlowes auto-transformer station will be located to the north-east of Cranwell Farm, and Quainton auto-transformer feeder station located near Edgcott Road. An auto-transformer station can, in principle, be a source of contamination through accidental discharge or leaks of coolant. However, the proposed auto-transformer station, in common with other modern substations, will use secondary containment appropriate to the level of risk.

8.5.4 The operation of the trains may give rise to minor contamination through leakage of hydraulic or lubricating oils. However, such leakage or spillage is expected to be very small and unlikely to result in significant contamination.

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

Other mitigation measures

8.5.6 The draft CoCP details the approach to managing potential land contamination matters. No additional mitigation measures are considered necessary to mitigate risks from land contamination at construction phase beyond those set out in the draft CoCP and instigated as part of required remediation strategies.

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

Summary of likely significant residual effects

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

9 Landscape and visual assessment

9.1 Introduction

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

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

9.1.3 Principal landscape and visual issues in the area include:

- temporary effects to LCA and visual receptors during construction arising from the presence of construction plant, removal of existing vegetation and severance of agricultural land; and
- permanent landscape and visual effects during operation arising from the presence of new engineered landforms cutting across the existing landscape; the presence of highway infrastructure (overbridges), overhead line equipment, noise fence barriers, and the regular passage of high speed trains.

9.1.4 Main elements will include: the realignment of the A41 Bicester Road (also known as Aylesbury Road), Waddesdon south cutting, Station Road overbridge, Doddershall embankment, the National Grid substation, Edgcott Road overbridge, and Grendon Underwood embankment.

9.1.5 A separate but related assessment of effects on the setting of heritage assets is included in Section 6. Further details on the landscape and visual assessment, including engagement, baseline information and assessment findings, are presented in Volume 5: Appendix LV-001-012, comprising the following:

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

9.1.6 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 Buckinghamshire County Council, Aylesbury Vale District Council, and National Trust. Summer field surveys, including photographic studies of LCA and visual assessment of viewpoints, were undertaken from July to October 2012 and from May to June 2013. Winter surveys were undertaken from January to March 2013.

9.2 Scope, assumptions and limitations

9.2.1 The assessment scope, key assumptions and limitations for the landscape and visual assessment are set out in Volume 1, the SMR (Volume 5: Appendix CT-0001-000/1) and the SMR Addendum (Volume 5: Appendix CT-0001-000/2). This report follows the standard assessment methodology.

9.2.2 The study area has been informed by the construction and operational phase zones of theoretical visibility (ZTV), which are shown on Maps LV-07-043 to LV-07-047 and LV-08-043 to LV-08-047 (Volume 5, Landscape and Visual Assessment Map Book). The ZTV has been produced in line with the methodology described in the SMR Addendum (Volume 5: Appendix CT-001-000/2), and is an indication of the visibility of the Proposed Scheme. Tall construction plant (e.g. cranes and piling rigs) are excluded from the ZTV for the construction phase and overhead line equipment is excluded from the ZTV for the operational phase, but these are described and taken in to account in the assessment of effects on LCA and visual receptors.

9.2.3 LCA and visual receptors within approximately 1km of the Proposed Scheme have been assessed. Long distance views of up to 1.75km have been considered at selected locations such as Simber Hill, Quainton and up to 2.5km at Lodge Hill, Waddesdon.

Limitations

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

9.2.5 Viewpoints that do not have a representative photograph for both the winter and summer months include: Viewpoint 139.2.001: View east from Upper South Farm, Quainton; Viewpoint 139.2.002: View north-east from Lower South Farm, Quainton; Viewpoint 141.2.001: View north-east from Doddershall House, Viewpoint 142.2.001: View south-west from dwellings near Middle Farm, Shipton Lee; Viewpoint 143.2.001: View north-east from Woodlands Farm; Viewpoint 142.3.002: View south-east from the Bernwood Jubilee Way PRoW (Footpath QUA/39), Shipton Lee; and Viewpoint 143.2.002: View north-east from Oak Tree Farm.

9.3 Environmental baseline

Existing baseline

Landscape baseline

9.3.1 The area is located within a gently undulating landscape containing a number of hills of which the most notable are Lodge Hill, Waddesdon Hill, Simber Hill, Finemere Hill and Knowl Hill. The villages of Waddesdon and Quainton are located in the southern part of the area, but beyond these the character is rural and open with settlement generally dispersed. The majority of land use is agricultural with a mix of arable crops and pasture. The northern part of the study area is more heavily wooded with large areas of ancient woodland, including Doddershall Wood, Grendon Wood, Finemere Wood and Sheephouse Wood. To the north, the current landfill site near Calvert is in contrast to the surrounding rural character of the area. This falls partly within the study area north-west of Greatmoor.

9.3.2 Principal historic landscape elements include the registered park and gardens (RPG) and listed structures at Waddesdon Manor and Claydon House, and a number of listed buildings dispersed throughout the area, including Doddershall House to the west of Quainton. Claydon House, a National Trust owned property, is located approximately 3km north-east of the Proposed Scheme.

9.3.3 The A41 Bicester Road is the primary road within the area and connects Fleet Marston to Westcott. A network of B roads connects the scattered settlements and farmsteads throughout the Waddesdon and Quainton area. Well-signposted PRoW throughout this landscape include the following:

- Aylesbury Ring;
- Bernwood Jubilee Way;
- Midshires Way;
- North Buckinghamshire Way; and
- Swan's Way.

9.3.4 The LCA have been determined with reference to the Landscape Plan for Buckinghamshire[61] and The Aylesbury Vale Landscape Character Assessment[62].

9.3.5 Descriptions of all LCA are provided in Volume 5: Appendix LV-001-012 Part 2. For the purposes of this assessment, the study area has been sub-divided into nine discrete LCA, five of which are likely to be affected. A summary of these five LCA is provided below. The LCA are shown on Maps LV-02-043 to LV-02-047 (Volume 5, Landscape and Visual Assessment Map Book).

Westcott Clay lands LCA

9.3.6 This LCA is a low lying, gently undulating farmed landscape with an open agricultural character. The area features few visual detractors and is unified by a consistent hedgerow pattern which results in a good landscape condition. Despite the predominantly agricultural character the presence of the A41 reduces tranquillity in the south of the area resulting in a medium tranquillity for the LCA as a whole. The presence of four promoted PRoW and a designated conservation area at Quainton mean the landscape has a district level value. On this basis, the area has a medium sensitivity to change.

Quainton Hill LCA

9.3.7 This LCA comprises a series of distinct steeply sloping hills, including Simber Hill and Grange Hill. The elevated landform affords characteristic long distance views across the surrounding low-lying vale landscape. The area features an irregular pattern of pastoral fields bounded on the lower hill slopes by mature hedgerows. This contributes a sense of visual unity and the condition of the landscape is considered to be good. There is no highway access in the LCA, however visual and audible intrusion

[61] Buckinghamshire County Council (2001), *Landscape Plan for Buckinghamshire Part 1: Landscape Character Assessment, Buckinghamshire County Council, Aylesbury*.
[62] Jacobs (2008), *Aylesbury Vale Landscape Character Assessment*, prepared for Buckinghamshire County Council and Aylesbury Vale District Council, Jacobs, Glasgow.

from the lower lying landscape to the south, which includes the A41 Bicester Road and the Aylesbury Link railway line, results in a medium tranquillity. As the area falls within the Quainton-Wing Hills and Brill-Winchendon Hills Area of Attractive Landscape it has a regional value[63]. Therefore, this area has a high sensitivity to change.

Kingswood Wooded Farmland LCA

9.3.8 This LCA is an undulating landscape with a mix of pasture and arable land dispersed throughout the area. The landscape contains areas of ancient woodland which, along with numerous mature hedgerow trees, confers a wooded farmland character and is considered in good landscape condition. Despite the predominantly agricultural character the tranquillity overall is considered medium due to the influence of the busy A41 to the south and the presence of the Calvert Landfill site just beyond the north-eastern boundary of the LCA (within Calvert Clay Pits LCA, see Volume 5: Appendix LV-001-012, Part 2). With the presence of PRoW, Grendon and Doddershall Wood SSSI, designated ancient woodland, and notable archaeological monuments, the area is valued at a regional level. Therefore, this area has a high sensitivity to change.

Finemere Hill LCA

9.3.9 This LCA is an undulating landscape with a mix of pasture and arable land generally dispersed throughout the area. It contains areas of ancient woodland which, along with numerous mature hedgerow trees, confers a wooded farmland character and results in a good landscape condition. A lack of vehicular access and the large areas of woodland creating a sense of seclusion mean that this LCA has a high level of tranquillity. With the presence of PRoW, Finemere Wood SSSI, and ancient woodland the area is valued at a regional level. Therefore, this area has a high sensitivity to change.

Claydon Bowl LCA

9.3.10 This LCA comprises a ridge of higher ground around the edges which slopes to lower ground in the centre to form a bowl. Located in the centre is the Grade II designated Claydon House Parkland RPG. The area supports mixed farming and contains several ancient semi-natural woodlands including Sheephouse Wood SSSI. The LCA generally has a strong hedgerow pattern that unifies the area. As a result the condition of the landscape is considered good. Tranquillity is considered to be high, given a low level of settlement, relative low number of publicly accessible highways, and only an infrequent freight service (up to four trains a day) using the Bicester to Bletchley railway south of Steeple Claydon and the Aylesbury Link railway line to the south-west of the LCA. The landscape is associated with the Claydon House Estate and Parkland and therefore has a national level value. Therefore, this area has a high degree of sensitivity to change.

[63] Jacobs (2008), *Aylesbury Vale: Areas of Attractive Landscapes*, prepared for Aylesbury Vale District Council and Buckinghamshire County Council, Jacobs, Glasgow.

Visual baseline

9.3.11 Descriptions of the identified representative viewpoints are provided in Volume 5: Appendix LV-001-012 Part 2. A summary description of the distribution and types of receptors most likely to be affected is provided in this section. The viewpoints are shown on Maps LV-03-043 to LV-03-047 and LV-04-043 to LV-04-047 (Volume 2, CFA12 Map Book). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport.

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

9.3.13 Residential receptors have a high sensitivity to change and are located at dispersed properties along both sides of the Proposed Scheme. Views within the study area are typically rural across agricultural fields with occasional agricultural buildings and electricity pylons visible. The combination of gently undulating topography and intervening hedgerow vegetation bordering fields generally limits the extent of views. However to the south the flatter, lower lying topography affords more open views across large arable fields from residential receptors at Lower Blackgrove Farm. To the north the elevated landform of Finemere Hill and Knowl Hill also affords long-distance views from residential properties at Finemerehill House and Knowlhill Farm.

9.3.14 Recreational receptors, also with a high sensitivity to change, are located on PRoW throughout the study area, including the Midshires Way, the Bernwood Jubilee Way, and the North Buckinghamshire Way. The viewpoints are typically located in rural agricultural locations, with pastoral or arable fields forming the foreground and vegetated field boundaries providing some degree of enclosure. The undulating topography and intervening hedgerow vegetation generally limits the extent of views. However there are long distance views from the summit of Simber Hill over the surrounding vale landscape.

9.3.15 Viewpoints for people travelling along scenic roads have a medium sensitivity to change and are located on Quainton Road, Station Road and Edgcott Road. People travelling on main roads have a low sensitivity to change and are located on the A41 Bicester Road. These views are largely rural in nature and overlook adjacent arable and pastoral land with roadside vegetation generally limiting the extent of views.

Future baseline

9.3.16 A summary of the committed developments which are assumed to be built and occupied prior to either the construction of operation of the Proposed Scheme is provided below, along with the consequential effect on the character of LCA and nature of views. Developments that will introduce new visual receptors that may be significantly affected are also described. These developments are listed in Volume 5: Appendix CT-004-000 and shown on Maps CT-13-025 to CT-13-028 (Volume 2, Cross Topic Appendix Map Book).

Construction (2017)

9.3.17 The Greatmoor EfW facility development will comprise a large building (180m long, 70m wide and 52m high) including a chimney stack (up to 95m high). In addition, a new access road will be introduced along the route of the Akeman Street disused railway line to connect the facility with the A41. The EfW structure is assumed to be completed by 2017 with landfill operations continuing through to 2026. This will

introduce a large industrial complex into the north of the Kingswood Wooded Farmland LCA around Greatmoor.

9.3.18 The development will also introduce night-time lighting. However, due to the relatively large size of this LCA and the influence of the existing landfill operations nearby within the adjacent Calvert Clay Pits LCA to the north-west, the overall sensitivity of this area will be unchanged for the assessment of effects during construction. Views from residential receptors located on Finemere Hill and Knowl Hill will overlook the development.

Operation (year 1 – 2026)

9.3.19 By 2026, hedgerow and woodland copse planting established as part of the Greatmoor EfW facility will have established to a certain extent and will lead to an increase in the woodland cover in the north of Kingswood Wooded Farmland LCA. This will represent only a small increase within this well-wooded LCA. Therefore the sensitivity of this area will be unchanged for the assessment of effects by year 1 of operation.

9.3.20 Phased landfill restoration as part of the Greatmoor EfW facility will be such that by 2026 Calvert Clay Pits LCA, also partly within the Calvert, Steeple Claydon, Twyford and Chetwode area (CFA13), is likely to be subject to a level of restoration. This will replace existing landfill operations with a landscape of pasture and woodland planting and will also introduce new PRoW through the area. The planting of hedgerows and woodland copses will increase woodland cover substantially and will serve to improve landscape condition. In addition the replacement of landfill operations will increase tranquillity and the introduction of new PRoW will increase landscape value. The sensitivity of this area will therefore increase to medium for the assessment of effects during year 1 of operation.

9.3.21 Views from residential receptors located on Finemere Hill and Knowl Hill will overlook the development. Although new recreational receptors would be introduced to the south-west of Sheephouse Wood by the Greatmoor EfW facility near Calvert, these will be suitably represented by viewpoint 147.3.001.

9.4 Temporary effects arising during construction

9.4.1 The construction works that have been taken into account in determining the effects on landscape and visual receptors across the Waddesdon and Quainton area include:

- construction of the A41 Bicester Road overbridge and associated road realignment;
- presence of the A41 Bicester Road roadhead and Blackgrove Road roadhead and associated vehicular traffic;
- construction of Footpath WAD/4 accommodation overbridge and Footpath WAD/3 accommodation underbridge;
- construction of Needles Farm accommodation overbridge;
- construction of the Station Road overbridge;

- removal of vegetation along the Aylesbury Link railway line between Upper South Farm and Sheephouse Wood;
- construction of the Bridleway QUA/28A overbridge;
- construction of Doddershall embankment;
- construction of the Edgcott Road overbridge, Quainton auto-transformer feeder station and National Grid substation;
- construction of Adam's accommodation underbridge and Grendon Underwood embankment;
- construction of Bridleway QUA/36 accommodation green overbridge and Bridleway GUN/28 accommodation green overbridge;
- construction of Sheephouse Wood mitigation structure; and
- general earthworks along the Proposed Scheme requiring cut/fill, vegetation removal, modification of landform and the presence of construction plant and machinery.

Avoidance and mitigation measures

9.4.2 As is commonplace with major infrastructure works, the scale of the construction activities means that works will be visible in many locations and will have the potential to give rise to significant temporary effects which cannot be mitigated practicably. Such effects are temporary and vary over the construction period depending on the intensity and scale of the works at the time. The assessment of landscape and visual effects has been based on the activities occurring during the peak construction phase, which is defined as the period during which the main civil engineering works will take place, including establishment of construction compounds, main earthworks and structure works. The effects associated with the peak construction phase in this area will generally be considered to be long term given the construction programme (see Section 2.3). Overall, civil engineering works in this area will be undertaken between the middle of 2017 and the start of 2021. The A41 Bicester Road embankment main compound (located within the adjacent Stoke Mandeville and Aylesbury CFA11), will be in place for approximately four years. Satellite construction compounds will be in place for between approximately two years and nine months and three years and nine months. The civil engineering works at most individual sites along the route in this area will occur for a period of between approximately six months and three years. Effects during other phases of works are likely to be lesser due to less construction equipment being required at the time and a reduced intensity of construction activity. The permanent effects of the presence of the Proposed Scheme are described in the operational assessment section.

9.4.3 Measures that have been incorporated into the draft CoCP to avoid or reduce landscape and visual effects during construction include the following (see Volume 5: Appendix CT-003-000/1):

- maximising the retention and protection of existing trees and vegetation where possible (draft CoCP, Section 12);

- use of well-maintained hoardings and fencing (draft CoCP, Section 5);
- designing lighting to avoid unnecessary intrusion onto adjacent buildings and other land uses (draft CoCP, Section 5);
- replacement of any trees intended to be retained which may be accidentally felled or die as a consequence of construction works (draft CoCP, Section 12); and
- appropriate maintenance of planting and seeding works and implementation of management measures, to continue through the construction period as landscape works are completed (draft CoCP, Section 12).

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

Assessment of temporary impacts and effects

9.4.5 The most apparent changes to landscape character and viewpoints during construction will relate to the temporary presence of construction plant, the removal of existing landscape elements such as trees, hedges and agricultural land, and the creation of cuttings up to 16m deep, and embankments approximately 5m high.

9.4.6 Construction in this area will chiefly comprise the building of major infrastructure including the A41 Bicester Road overbridge and associated road realignment to the north-east of the Proposed Scheme, Waddesdon south cutting, Footpath WAD/4 accommodation overbridge, Needles Farm accommodation overbridge, Station Road overbridge, Bridleway QUA/28A overbridge, Edgcott Road overbridge, Quainton auto-transformer feeder station, the National Grid substation, Bridleway QUA/36 accommodation green overbridge and Bridleway GUN/28 accommodation green overbridge.

9.4.7 Changes to landscape character and viewpoints will relate to the temporary presence of construction plant and the removal of existing landscape features, such as trees, hedges and agricultural land. In addition, the removal of vegetation along the Aylesbury Link railway line between Upper South Farm and Sheephouse Wood will be notable.

9.4.8 The height of the construction plant and the close proximity of construction activities to viewpoints, coupled with the absence of intervening screening (apart from the site hoardings) will result in significant visual effects during construction. The topography in certain locations and the retention of intervening hedgerows and trees will partially screen low level construction activity.

Landscape assessment

9.4.9 The following section describes the likely significant effects on LCA during construction. All LCA within the study area considered to experience an effect that will not be significant (minor or negligible) are described in Volume 5: Appendix LV-001-012 Part 4.

Westcott Claylands LCA

9.4.10 The Proposed Scheme will pass through this LCA between Blackgrove Road and Fidlers Field Road, crossing a number of agricultural fields. Construction impacts will include the removal and severance of hedgerows in fields adjacent to the Proposed Scheme, thereby adversely affecting the existing strong hedgerow pattern. This will be apparent between Glebe Farm and Station Road and to the east of Briar Hill Farm with the construction of the realignment of the A41 Bicester Road overbridge.

9.4.11 The construction of cuttings and embankments and temporary earthworks will affect the gently undulating topography of the LCA. This will be most apparent to the north-east of Waddesdon with the construction of the Waddesdon south cutting (maximum depth 12m). The character of the area will be affected by the presence of construction plant and activities associated with the A41 Bicester Road overbridge, Footpath WAD/4 accommodation overbridge, Needles Farm accommodation overbridge, and Station Road overbridge construction works. This will introduce temporary but uncharacteristic elements in the rural landscape across the LCA and will impact the rural setting. Construction activities will occur approximately 1.3km away from Quainton and therefore will have a limited impact on the setting of the conservation area.

9.4.12 Construction activity will introduce large scale earthworks, vehicles, and lighting into the area, which is likely to reduce tranquillity for much of the LCA. This will be particularly noticeable around Station Road overbridge satellite compound to the south-west of Quainton and around the A41 Bicester Road overbridge satellite compound and road head to the south-east of Briar Hill Farm. In addition the A41 road to the south will be used for the route-wide mass haul movement.

9.4.13 A partial loss of a number of existing characteristics will occur, including changes to the natural topography, loss of the existing strong hedgerow pattern and the introduction of construction plant into the rural landscape. Therefore, the magnitude of change is considered to be medium.

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

Quainton Hill LCA

9.4.15 The Proposed Scheme will not run directly through this LCA but will pass approximately 1.6km to the south west. Construction plant and activity within the adjacent LCA, to the south and to the west, will be perceptible and will affect the rural setting of the LCA. Construction plant and activities associated with Station Road overbridge will be seen against the backdrop of Lodge Hill in characteristic views south from Simber Hill.

9.4.16 The presence of construction activities in this exposed landscape will reduce the tranquillity within the LCA, particularly from the exposed Simber Hill.

9.4.17 As the Proposed Scheme passes approximately 1.6km to the south-west of the LCA, direct impacts on landscape components will not occur. However, the intervisibility of construction activities within adjacent LCA will impact the rural setting and will reduce tranquillity. It is considered that the magnitude of change in this LCA will be medium.

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

Kingswood Wooded Farmland LCA

9.4.19 The Proposed Scheme will pass through this LCA along the route of the existing railway between Buckingham Road and Sheephouse Wood. The removal of approximately 4.5km of mature vegetation along the Aylesbury Link railway line will occur and will be particularly apparent. There will be some removal of hedgerow vegetation from adjacent fields which will affect the existing characteristic hedgerow pattern. This includes two areas of pre-18th century enclosure; between Doddershall House and Edgcott Road and around Greatmoor. The construction of cuttings and embankments and temporary earthworks will affect the existing topography of the LCA, but will not be wholly uncharacteristic within this undulating LCA.

9.4.20 The key impact on the character of the area will be associated with the presence of temporary construction plant in the rural landscape. This will be required for the construction of a number of overbridges, including Bridleway QUA/28A overbridge, and Edgcott Road overbridge Bridleway. There will be a particular concentration of construction activity associated with the auto-transformer feeder station at Quainton and National Grid substation off Edgcott Road.

9.4.21 Construction activity will introduce vehicles, disturbance and lighting into a rural area of medium tranquillity. This will reduce tranquillity locally for the duration of the works, particularly around Woodlands cutting satellite compound off Edgcott Road and along the A41 road to the south which will be used for the routewide mass haul movement.

9.4.22 Construction activities will result in the loss of characteristic elements including mature vegetation and field hedgerows. In addition, the presence of construction plant and concentrations of construction activity will locally reduce tranquillity and substantially alter the rural setting of the LCA. Therefore the overall magnitude of change will be high.

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

Finemere Hill LCA

9.4.24 The Proposed Scheme will pass approximately 150m to the south west of the character area. Construction will involve no loss of characteristic landscape elements within the LCA. However there will be intervisibility with construction plant within Kingswood Wooded Farmland LCA to the south and west which will affect the rural setting of the LCA.

9.4.25 The disturbance of construction activity will reduce tranquillity, particularly within the east of the LCA between Hogshaw Farm and Kitehill Farm.

9.4.26 Overall, these impacts will affect the rural character and setting of this LCA. Therefore the overall magnitude of change will be medium.

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

Claydon Bowl LCA

9.4.28 This LCA is located within CFA 12 and CFA13 (Calvert, Steeple Claydon, Twyford and Chetwode) to the north and is also reported in Volume 2 CFA Report 13, Section 9.

9.4.29 The Proposed Scheme will pass along the south-western edge of this LCA for approximately 2.3km and the Calvert IMD will be located south of Steeple Claydon in CFA13 (also reported within section 7, Ecology). Construction activities associated with the IMD, temporary railhead and waste transfer sidings will introduce large volumes of construction plant and activity and will impact the rural setting of the area. Tall cranes used to construct overbridges such as Bridleway GUN/28 accommodation green overbridge and Footpath SCL/8 overbridge in CFA13, will be perceptible in characteristic views from higher ground, such as Knowl Hill and Steeple Claydon.

9.4.30 Construction of Grendon Underwood embankment and the Calvert cutting will result in the loss of a linear belt of approximately 1.5ha of ancient woodland separated from the south-western edge of Sheephouse Wood by the Aylesbury Link railway line. However this will not involve loss of woodland from the area designated as a SSSI. Also severance and loss of hedgerow vegetation will occur along the Aylesbury Link railway line east of Calvert and the former Bicester to Bletchley railway south of Steeple Claydon. In addition, hedgerow vegetation will be lost to the south-west of the LCA with construction of the waste transfer sidings, and to the west in CFA13 with the construction of Calvert IMD and temporary railhead. This will impact the existing strong hedgerow pattern within the LCA.

9.4.31 The construction of the Calvert cutting (maximum 10m depth), including retaining walls; mitigation earthworks along the northern edge of the IMD and topsoil temporary stockpiles will all have a noticeable impact in an area where the landscape is generally flat and open.

9.4.32 The introduction of large volumes of construction activity into the area, including tall cranes, vehicles and lighting, will reduce tranquillity within the LCA. In particular the route-wide mass haul will introduce large volumes of traffic into the west of the LCA with the use of School Hill and Addison Road.

9.4.33 The concentration of construction activity associated with the Calvert IMD and temporary railhead (within CFA13) will be uncharacteristic in the rural setting. Also the loss of characteristic landscape elements such as hedgerows and agricultural land will substantially alter the rural character and setting of the area. In addition, the emerging engineered profiles will be uncharacteristic in this relatively flat landscape. Therefore, the magnitude of change will be high.

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

Visual assessment

9.4.35 The following section describes the likely significant effects on visual receptors during construction. The construction assessment has been undertaken during winter, in line with best practice guidance, to ensure a robust assessment. However, in some cases, visibility of construction activities may be reduced during summer when vegetation, if present in a view, will be in leaf. Where residential receptors experience significant

effects at night-time arising from additional lighting, these are also presented in this section. Representative viewpoints within the study area considered to experience an effect that will not be significant (minor or negligible) are described in Volume 5: Appendix LV-001-012 Part 4.

9.4.36 The number attributed to each viewpoint identifies their locations which are shown on Maps LV-03-043 to LV-03-047 (Volume 2, CFA12 Map Book). In each case, the middle number (xxx.**x**.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport.

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

Viewpoint 130.4.001: View west from the A41, Fleet Marston

9.4.38 The Proposed Scheme will lie approximately 125m from this viewpoint. During the construction phase, activities associated with the realignment of the A41 Bicester Road will be visually prominent to the right of the existing A41 Bicester Road. This activity will involve the removal of mature hedgerow trees along the lane leading to Lower Blackgrove Farm which will open up views to the right background. Also, activities associated with Putlowes auto-transformer station will be clearly visible in the centre of the middle ground. The construction of the Bicester Road Embankment will also be visible in the background, but filtered through the mature vegetation lining the lane to the right of view. Views to the left will be heavily filtered by existing roadside vegetation. In addition increased traffic levels associated with the routewide mass haul movement will be visible along the A41 road. Overall this construction activity will represent a substantial change in close proximity to visual receptors. Therefore, the magnitude of change will be high.

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

Viewpoint 132.2.001: View south-west from residential property at Lower Blackgrove Farm

9.4.40 The Proposed Scheme will lie approximately 450m away from this viewpoint. Construction of the realigned A41 Bicester Road (Waddesdon bypass) will be the most clearly visible element to the centre of the view at the end of the lane leading across the arable field, approximately 300m away. Views of construction activities associated with the A41 Bicester Road overbridge will be visible in the background but filtered through the intervening hedgerow. Overall the introduction of this large scale construction activity will cause substantial changes in the existing open view of agricultural land, and in proximity to the visual receptor. Therefore, the magnitude of change will be high.

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

9.4.42 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 132.3.001: View south-east from PRoW (Footpath WAD/5) near Blackgrove Road

9.4.43 The Proposed Scheme will lie approximately 100m from the viewpoint. Construction activities associated with the realigned A41 Bicester Road and Bicester Road embankment will be clearly visible across the arable field, approximately 100m from the viewpoint in the foreground. Activities will include topsoil stripping and earthworks. Tall plant used to construct the A41 Bicester Road overbridge (250m away) will also be visible in the right of the view beyond the existing Blackgrove Road, with views filtered through intervening roadside hedgerow vegetation. Overall this construction activity will represent substantial changes in the existing view of arable farmland, and will occur in proximity to the visual receptor. Therefore, the magnitude of change will be high.

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

Viewpoint 131.2.001: View north-east from dwelling at Wayside Farm, Blackgrove Road

9.4.45 Construction activities associated with the Waddesdon south cutting will be clearly visible to the left of the view along Blackgrove Road, approximately 90m from the viewpoint. This will include topsoil stripping, vegetation removal and earthwork construction. In addition, there will be views of the construction of Bicester Road Embankment, albeit filtered through intervening roadside vegetation. This activity will represent a substantial change in the existing view, in close proximity to the viewpoint. Therefore, the magnitude of change will be high.

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

9.4.47 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 134.3.001: View south-west from the Aylesbury Ring PRoW (Footpath WAD/4/2) near Lapstone House off Blackgrove Road

9.4.48 The Proposed Scheme will lie approximately 400m from the viewpoint. Construction activities associated with Waddesdon south cutting and Waddesdon embankment will be visible across the centre of the view in front of Glebe Farm buildings. Tall plant associated with the construction of Footpath WAD/4 accommodation overbridge will also be visible behind the small copse of woodland, approximately 500m away. Rising topography in the left middle ground and hedgerow vegetation within the centre middle ground will restrict views of the Proposed Scheme. Overall this activity will represent a substantial change in the existing rural view, but will be partially restricted by intervening topography and vegetation. Therefore, the magnitude of change will be medium.

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

Viewpoint 135.3.002: View north-east from a PRoW (Footpath WAD/3/4) north of Glebe Farm

9.4.50 The Proposed Scheme will lie approximately 130m from the viewpoint. Construction activities associated with Waddesdon embankment and Waddesdon north cutting will be clearly visible within the foreground across the arable field. In addition, 3m high temporary material stockpile bunds and a construction access track along the length of the Proposed Scheme will be clearly visible across the view. Overall, this construction activity will cause substantial changes to the existing view. Therefore, the magnitude of change will be high.

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

Viewpoint 136.3.001: View south-west from the Bernwood Jubilee Way, North Buckinghamshire Way, Midshires Way and Tramway Trail PRoW (Footpath WAD/4A/1)

9.4.52 The Proposed Scheme will lie approximately 130m from the viewpoint. Construction of Waddesdon embankment and Waddesdon north cutting will be clearly visible to the right of the view across the arable field, and in the left of the view at the end of the mature hedgerow. Material stockpiles approximately 3m high will be clearly visible directly in front of the viewer to the right of the view within the arable field. Views of tall plant used to construct the Footpath WAD/4 accommodation overbridge will be available within the left background, although heavily filtered through intervening hedgerow vegetation in the centre of the view. Overall this construction activity will cause substantial changes in the existing rural view, but will be partially filtered by intervening hedgerow vegetation. Therefore, the magnitude of change will be medium.

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

Viewpoint 135.4.001: View north from Quainton Road between Quainton and Waddesdon

9.4.54 The Proposed Scheme will lie approximately 150m from the viewpoint. Activities associated with the construction of Quainton south embankment, including 3m high temporary topsoil storage stockpiles, will be clearly visible 100m in front of the viewer within the arable field. In addition, the tall plant used in the construction of the Needles Farm accommodation overbridge will also be visible in the left of the view, filtered through intervening foreground vegetation. This construction activity will be visible, located close to the viewer and uncharacteristic within the existing rural view. Therefore, the magnitude of change will be high.

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

Viewpoints 137.4.001: View south-west from Station Road, Quainton

9.4.56 The Proposed Scheme will lie approximately 200m from the viewpoint. The construction of Quainton south embankment will be clearly visible within the pastoral field in the centre and right of the view. Tall plant used in the construction of Station

Road overbridge will be clearly visible in the right of the view. Also the Station Road satellite construction compound and works associated with the realignment of Station Road will be visible to the right of the existing road in the middle ground. Hedgerow vegetation will restrict views to the left of the view. This construction activity will be highly visible but will represent additional development in an already developed area. Therefore, the magnitude of change will be medium.

9.4.57 The medium magnitude of change assessed against the high sensitivity of these receptors will result in moderate adverse effects.

Viewpoint 138.3.001: View south-west from the Midshires Way PRoW (Footpath QUA/6/1) on Simber Hill, Quainton

9.4.58 The Proposed Scheme will lie approximately 2km from the viewpoint. Tall plant associated with the construction of Station Road overbridge will be visible to the right of the Buckinghamshire Railway Centre. Vegetation removal along the existing railway will be noticeable to the right of the view. Overall this construction activity will bring about changes in the view but will be viewed as a series of components in the wider flat agricultural vale against the backdrop of Lodge Hill. This will also occur at a distance of over 2km from the viewpoint. Therefore, the magnitude of change will be low.

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

Viewpoint 139.2.001: View east from Upper South Farm, Quainton

9.4.60 The Proposed Scheme will lie approximately 180m from the viewer. The works to construct the new access track to Upper South Farm will be clearly visible in front of the existing mature woodland. Vegetation losses along the existing railway line in the centre and left of the view will be apparent and will open up views to subsequent construction activities associated with Quainton cutting. The construction of Station Road overbridge will be visible in the centre of the view heavily filtered through the intervening mature woodland. Overall, this construction activity will introduce plant and infrastructure that are visible and uncharacteristic within the existing view of a rural landscape. Therefore, the magnitude of change will be high.

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

9.4.62 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 139.2.002: View north-east from Lower South Farm, Quainton

9.4.63 The Proposed Scheme will lie approximately 400m from the viewpoint. Tall plant used to construct Bridleway QUA/28A overbridge will be clearly visible in the centre of the view in front of the existing railway, 500m from the viewer. Vegetation clearance along the Aylesbury Link railway line will also be apparent across the centre of the view and will reduce the wooded nature of the view, and open up views to the subsequent construction of Doddershall embankment. However, views will be intermittently screened by intervening hedgerow vegetation on the left of the view and by vegetation associated with the Doddershall civil war battery in the centre of

the view. Overall construction activity will represent a substantial change to the existing rural view, but views will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

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

9.4.65 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 141.2.001: View north-east from Doddershall House

9.4.66 The Proposed Scheme will lie approximately 425m from the viewpoint. Construction of Quainton auto-transformer feeder station, the National Grid Substation, and Edgcott Road overbridge will be visible around 750m away from the viewer, partially filtered by intervening hedgerows. Within the centre of the view, activities associated with the construction of Doddershall embankment will be visible across the centre of the middle ground. Overall, these activities will represent a substantial change in the existing rural view, but views will be partially filtered by intervening hedgerow vegetation. Therefore, the magnitude of change will be medium.

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

9.4.68 Additional night-time lighting associated with Woodlands cutting satellite compound approximately 700m away in the centre of the view will be seen against a baseline featuring only faint night-time lighting from the residential property nearby and from distant public realm lighting in Quainton, 2.2km to the east. Therefore, the magnitude of change to this receptor at night will be medium, resulting in a moderate adverse effect.

Viewpoint 142.2.001: View south-west from dwellings near Middle Farm, Shipton Lee

9.4.69 The Proposed Scheme will lie approximately 650m away from the viewpoint. Activities associated with the construction of Doddershall embankment, including removal of vegetation, will be clearly visible along the line of the Aylesbury Link railway line to the left of the view. The Edgcott Road National Grid transmission pylon relocation works will also be clearly visible in the centre middle ground, with one National Grid transmission pylon moving approximately 200m to the east. Tall plant associated with Woodlands embankment satellite construction compound, Quainton auto-transformer feeder station, National Grid substation, and Edgcott Road overbridge will be visible in the centre of the view above the intervening topography and hedgerow vegetation in the centre of the middle ground. Overall this construction activity will be highly visible from this receptor, but partially restricted by intervening topography and vegetation, and will not be wholly uncharacteristic of the existing view which contains infrastructure such as pylons. Therefore, the magnitude of change will be medium.

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

9.4.71 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 142.4.001: View west from public highway south of Shipton Lee

9.4.72 Construction activities associated with Quainton auto-transformer feeder station will be prominent in the foreground of the viewpoint approximately 30m away. This will include the removal of roadside vegetation and a concentration of construction plant and equipment associated with Woodlands embankment satellite construction compound. Construction of Edgcott Road overbridge will also be clearly visible along the road. Views of the construction of the National Grid substation will be heavily filtered by roadside vegetation on the right of the view. This activity will represent a substantial change in close proximity to the viewpoint. Therefore, the magnitude of change will be high.

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

Viewpoint 143.2.002: View north-east from dwellings south of Woodlands Farm

9.4.74 Construction of Edgcott Road overbridge and Quainton auto-transformer feeder station will be clearly visible in the right middle ground of the view, approximately 300m away. The relocation of Buckingham Road National Grid transmission pylon 200m to the east will be visible in the right of the view. In addition vegetation losses will be apparent across the centre middle ground of the view with the removal of vegetation along the existing railway. This will reduce the wooded nature of the view and will open up views of the construction of the National Grid substation. In combination, these construction activities will represent substantial changes, and in close proximity to the viewpoint. Therefore, the magnitude of change will be high.

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

9.4.76 Additional night-time lighting associated with Woodlands embankment satellite construction compound will be seen against a baseline featuring intermittent light from passing motor vehicles, faint light from nearby residential properties and distant night glow from Quainton. This, however, will be visible at proximity to the visual receptor. Therefore, the magnitude of change to this receptor at night will be medium, resulting in a moderate adverse effect.

Viewpoint 143.2.001: View north-east from Woodlands Farm

9.4.77 The construction of Grendon Underwood embankment and Adam's accommodation underbridge along the route of the existing railway will be clearly visible in the foreground of the view, approximately 50m away. In addition, views of tall plant associated with Edgcott Road overbridge, Quainton auto-transformer feeder station and the National Grid substation will be visible, partially filtered by intervening vegetation along the River Ray. This construction activity will represent substantial changes in the existing predominantly rural view in proximity to the visual receptor. Therefore the magnitude of change will be high.

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

9.4.79 Additional night-time lighting associated with Woodlands embankment satellite construction compound will be perceptible approximately 650m away in the right background of the view. This will be seen against a baseline featuring only faint night-time lighting from the residential property nearby. Therefore, the magnitude of change to this receptor at night will be medium, resulting in a moderate adverse effect.

Viewpoint 146.2.001: View west from Finemerehill House, Finemere Hill

9.4.80 The Proposed Scheme will lie in the middle ground, approximately 675m from the viewpoint. Due to the elevated position the viewer will see the construction activities against an expanse of wooded farmland. Tall plant associated with the construction of the Bridleway GUN/28 accommodation green overbridge will be visible above the small copse of trees as a relatively small element in this panoramic view. Activities associated with the construction of Grendon Underwood embankment, Sheephouse Wood mitigation structure and Calvert cutting will be clearly visible along the route of the Aylesbury Link railway line. This will include the removal of vegetation lining the railway. These construction activities will introduce new visible features but will be seen within the context of the wider panoramic view which contains existing industrial features including the Aylesbury Link railway line. Therefore, the magnitude of change is considered to be medium.

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

9.4.82 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 146.3.002: View west from the Claydon Woods Circular Walk (Footpath GUN/33/1) and PRoW (Bridleway GUN/28/1) between Sheephouse Wood and Greatsea Wood

9.4.83 The Proposed Scheme will lie in the foreground, approximately 450m from the viewpoint. Vegetation loss will be clearly apparent in the view, with the removal of the hedgerow across the left and centre foreground and the removal of mature vegetation along the Aylesbury Link railway line in the background. This will open up views to subsequent construction activities associated with Grendon Underwood embankment along the route of the existing railway line and Sheephouse Wood mitigation structure to the left of Sheephouse Wood. In addition, views of tall plant associated with the construction of the Bridleway GUN/28 accommodation green overbridge will be available in the middle ground behind the intervening copse of mature trees. Overall this construction activity will represent a noticeable change within the view, but will be partially filtered by intervening vegetation and will not be wholly uncharacteristic of a view containing a landfill site and existing railway line. Therefore, the magnitude of change will be medium.

9.4.84 The medium magnitude of change assessed alongside the high sensitivity of these receptors will result in moderate adverse effects.

Viewpoints 148.2.001: View south from Knowlhill Farm, Knowl Hill

9.4.85 The Proposed Scheme will lie in the background of the view, approximately 1km from the viewer. Activities associated with the construction of Grendon Underwood embankment will be visible along the Aylesbury Link railway line and will include vegetation clearance. Tall plant associated with the construction of the Bridleway GUN/28 accommodation green overbridge will also be visible and filtered through existing mature hedgerow trees. Views towards the site are heavily screened on either side of the view by mature woodland. Construction activities will create a noticeable change in the view, however this will occur over 1km from the visual receptor and views will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

9.4.86 The medium magnitude of change assessed alongside the high sensitivity of these receptors will result in moderate adverse effects.

9.4.87 The night-time effect of construction lighting will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Cumulative effects

9.4.88 Section 2.1 and Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the construction of the Proposed Scheme. There are no known developments which are assumed to be under construction at the same time as the Proposed Scheme which will result in a consequential cumulative effect on LCA or visual receptors. Cumulative developments which have been considered in the assessment are shown on Maps CT-13-025 to CT-13-028 (Volume 5, Cross Topic Map Book).

Other mitigation measures

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

Summary of likely significant residual effects

9.4.90 These effects will be temporary and revisable in nature lasting only for the duration of the construction works. Further consideration will be given to these effects through the application of the controls set out in the CoCP. Any residual effects will generally arise from the widespread visibility of construction plant and vegetation loss from residential receptors, PRoW and main roads throughout the study area.

9.5 Permanent effects arising during operation

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

- the presence of high speed trains;
- realignment of the A41 Bicester Road, associated lighting;
- Waddesdon south cutting;
- Footpath WAD/4 accommodation overbridge;
- Needles Farm accommodation overbridge;
- noise fence barriers;
- Station Road overbridge;
- Bridleway QUA/28A overbridge;
- Doddershall embankment;
- Quainton auto-transformer feeder station;
- Edgcott Road overbridge;
- National Grid substation near Quainton;
- Adam's accommodation underbridge;
- Grendon Underwood embankment; and
- Sheephouse Wood mitigation structure and associated lighting.

Avoidance and mitigation measures

9.5.2 The operational assessment of impacts and effects is based on year 1 (2026), year 15 (2041) and year 60 (2086) of the Proposed Scheme. A process of iterative design and assessment has been employed to avoid or reduce adverse effects during operation. Measures that have been incorporated into the design include:

- the replacement of the A41 Bicester Road overbridge and Blackgrove overbridge by the new A41 Bicester Road overbridge and associated realignment of the A41 to the north. This will reduce the landscape impact on the adjacent Waddesdon Parkland and Blackgrove Vale LCA, and will reduce the visual impacts from surrounding residential, recreational and transport receptors;
- the route within the 16m deep Waddesdon south cutting will reduce visual impacts from Waddesdon;
- embankment and cuttings such as Doddershall embankment and the highway realignment at Station Road, have been shaped so as to integrate the Proposed Scheme into the character of the surrounding landscape;
- where it is considered that a noise fence barrier will create a visual impact on neighbouring residential properties, such as to the south of Quainton, planting will be provided for screening where reasonably practicable;
- balancing ponds, for example to the south of Lower Blackgrove Farm and to the south of Quainton, will be integrated into the landscape to

alleviate flooding and where possible will also provide opportunities for biodiversity; and

- planting, including native broad-leaved woodland, shrub and hedgerows will be implemented to screen views from neighbouring residential properties and adjacent PRoW and to aid integration of the Proposed Scheme into the landscape. Selection of species will take into account potential climate change impacts associated with the quality and availability of water and increase in pests and diseases in the future. This will be implemented at various locations along the Proposed Scheme such as adjacent to the A41 Bicester Road overbridge and adjacent to the Quainton auto-transformer station.

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

Assessment of impacts and effects

9.5.4 The likely significant effects on the landscape character and viewpoints during operation will arise from:

- new engineered landforms cutting across the existing landscape;
- the introduction of large infrastructure into the rural environment, including that associated with the auto-transformer feeder station at Quainton and the nearby National Grid substation will also give rise to significant effects along with the introduction of elevated road bridges and overhead line equipment;
- the presence of noise fence barriers which will create a man-made linear feature; and
- the presence of regular high speed trains.

9.5.5 At a number of locations, views of the Proposed Scheme will be obscured by the rising landform, existing intervening hedgerows and trees and the route being within a cutting. Furthermore, effects will be further reduced over time as planting established as part of the Proposed Scheme matures.

Landscape assessment

9.5.6 This section describes the significant effects on LCA during year 1, year 15 and year 60 of operation. Effects that will not be significant for LCA are presented in Volume 5: Appendix LV-001-012 Part 4.

9.5.7 The assessment of effects by year 15 assumes proposed planting has grown by approximately 450mm a year (i.e. trees will be 7-7.5m high). The assessment of effects by year 60 assumes all planting has reached its fully mature height.

Westcott Claylands LCA

9.5.8 The Proposed Scheme will pass through this LCA within cutting up to a maximum of 12m deep and on an embankment up to a maximum of 3m high. Landscape impacts of the Proposed Scheme will include:

- engineered landforms cutting across the natural gently undulating landform which will be uncharacteristic in the surrounding landscape;

- presence of overhead line equipment and high speed trains prominent on the embankment, which will introduce large infrastructure within a predominantly rural context;
- presence of elevated overbridges including the A41 Bicester Road overbridge, Footpath WAD/4 accommodation overbridge, Needles Farm accommodation overbridge, and Station Road overbridge. These features will be prominent within the gently undulating landscape. Other structures include farm access crossings and the Station Road overbridge; and
- presence of approximately 3m high noise fence barriers as a distinct linear feature south of Quainton, contrasting with the natural landscape.

9.5.9 There will be a reduction in tranquillity within the LCA resulting from the presence of trains in the predominantly rural context. In addition the realignment of the A41 Bicester Road to the north of its present alignment will introduce traffic and street lighting into the east of the LCA, reducing tranquillity here. The Proposed Scheme, however, will pass approximately 1.3km away from Quainton and therefore will have a limited impact on the setting of the conservation area.

9.5.10 Therefore, due to partial loss of existing characteristics of the character area, the magnitude of change is considered to be medium by year 1 of operation.

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

9.5.12 By year 15 and beyond to year 60 of operation, the maturity of planting and establishment of land cover will result in greater landscape integration of the Proposed Scheme and reduce effects to becoming not significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Kingswood Wooded Farmland LCA

9.5.13 The Proposed Scheme will pass through this LCA predominantly on embankment between 1m and 5m high. Landscape impacts of the Proposed Scheme will include:

- presence of large scale infrastructure associated with an auto-transformer feeder station at Quainton and a National Grid substation;
- engineered landforms including Quainton cutting, Doddershall embankment and Grendon Underwood embankment, which will cut across the natural undulating landform and will be uncharacteristic in the context of the adjacent landscape;
- presence of overhead line equipment and high speed trains visible on the embankment, which will introduce infrastructure and will impact the rural setting; and
- intervisibility of elevated overbridges, including Bridleway QUA/28A overbridge and Edgcott Road overbridge within the natural undulating landscape.

9.5.14 There will be a reduction in tranquillity of the character area resulting from the presence of trains. Reduction in tranquillity will also be associated with the visual

presence of large infrastructural elements in the predominantly rural context of the LCA.

9.5.15 Therefore, due to these substantial changes, the magnitude of change is considered to be high by year 1 of operation.

9.5.16 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect by year 1 of operation.

9.5.17 By year 15 of operation, planting and land cover will have established to a certain level and will help to achieve greater landscape integration of the scheme into the well-wooded rural landscape, including through:

- reducing the influence of large infrastructural elements;
- reducing the influence of engineered landforms and highway infrastructure; and
- partially screening the overhead line equipment and passing trains on embankment.

9.5.18 However, the semi-mature planting will appear juvenile adjacent to the mature ancient woodland of Finemere Wood and therefore will not fully integrate into the surrounding landscape. In addition, there will remain some intervisibility with Quainton auto-transformer feeder station, National Grid substation and elevated structures such as Edgcott Road overbridge. This will impact the rural setting of the LCA and will result in a medium magnitude of change by year 15 of operation.

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

9.5.20 By year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming not significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Claydon Bowl LCA

9.5.21 The Proposed Scheme will run along the south-western boundary of this LCA and the IMD will be located south of Steeple Claydon. Landscape impacts of the Proposed Scheme will include:

- presence of the Calvert IMD south of Steeple Claydon, the waste transfer sidings east of Calvert and the Sheephouse Wood mitigation structure to the south-west of Sheephouse Wood. This will introduce large infrastructure within a predominantly rural context. This will impact intervisibility from Steeple Claydon and Knowl Hill and the surrounding lower ground;
- presence of engineered landforms, including Calvert cutting (maximum 10m depth) and elevated overbridges such as Addison Road overbridge which will be uncharacteristic in the context of the adjacent landscape. However, earthworks profiling will help to integrate these structures into the gently undulating topography;

- presence of lighting around the IMD, which will impact the night-time character to the south of Steeple Claydon; and
- presence of high speed trains moving through the landscape.

9.5.22 There will be a reduction in tranquillity as a result of the presence of trains in a predominantly rural context. Operations and night-time lighting within the Calvert IMD will be particularly apparent from Steeple Claydon, and the new waste transfer sidings will be apparent from Knowl Hill.

9.5.23 Therefore, due to the major alteration to existing features of the character area, the magnitude of change is considered to be high by year 1 of operation.

9.5.24 The high magnitude of change, assessed alongside the high sensitivity of the character area, will result in a major adverse effect by year 1 of operation.

9.5.25 By year 15 of operation, mitigation planting and land-cover will have established sufficiently to achieve greater landscape integration of the Proposed Scheme into the agricultural landscape, including through:

- reducing the influence of the large infrastructural elements on the character of the landscape south of Steeple Claydon and east of Calvert whilst integrating with existing vegetation patterns;
- reducing the influence of engineered landforms and elevated highway infrastructure on the natural topography and character of the landscape, particularly Addison Road overbridge, Footpath SCL/8 overbridge and School Hill green overbridge; and
- reducing the intervisibility of the overhead line equipment and trains within the IMD to the south of Steeple Claydon.

9.5.26 Mitigation earthworks and planting along the northern edge of the IMD will serve to help integrate this feature into the natural topography of the LCA. However, the IMD and associated features will remain apparent and largely uncharacteristic within the rural landscape. Therefore the magnitude of change will be medium by year 15 of operation.

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

9.5.28 By year 60 of operation, the maturity of planting will further integrate the Proposed Scheme into the landscape resulting in effects becoming not significant. This is reported in Volume 5: Appendix LV-001-012.

Visual assessment

9.5.29 This section describes the significant effects on visual receptors during year 1, year 15 and year 60 of operation. Effects that will not be significant on visual receptors are presented in Volume 5: Appendix LV-001-012 Part 4.

9.5.30 For each viewpoint the following assessments have been undertaken:

- effects during winter of year 1 of operation;

- effects during summer of year 1 of operation;
- effects during summer of year 15 of operation; and
- effects during summer of year 60 of operation.

9.5.31 Where significant effects have been identified, an assessment of effects at night-time arising from additional lighting has also been undertaken.

9.5.32 The number identifies the viewpoint locations which are shown on Maps LV-04-043 to LV-04-047-R1 (Volume 2, CFA12 Map Book). In each case, the middle number (xxx.x.xxx) identifies the type of receptor that is present in this area – 2: Residential, 3: Recreational, 4: Transport.

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

Viewpoint 130.4.001: View west from the A41, Fleet Marston

9.5.34 The realigned A41 Bicester Road will be the most visible element in the foreground of the view. Putlowes auto-transformer station and overhead line equipment will also be clearly visible in the centre of the view at the junction of the existing A41, approximately 150m away. In addition, there will be filtered views of the overhead line equipment in the background of the view, above a line of mitigation earthworks seen as restored farmland. The Proposed Scheme will represent a substantial change in close proximity to the view, but will be largely characteristic of the existing view containing the busy A41 Bicester Road. Therefore, the magnitude of change will be medium.

9.5.35 The medium magnitude of change assessed alongside the low sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.36 In the summer of year 1 of operation, existing planting to the right of the middle ground will provide additional screening towards the overhead line equipment. However Putlowes auto-transformer station and the overhead line equipment will remain clearly visible in the centre of the view. Therefore the magnitude of change is considered to remain medium, with the overall moderate adverse effect unchanged.

9.5.37 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 132.2.001: View southwest from residential property at Lower Blackgrove Farm.

9.5.38 The overhead line equipment will be visible approximately 450m away. This will be visible above a line of mitigation earthworks associated with the realignment of the A41 in the background of this view. These earthworks will appear as restored farmland. In addition the A41 Bicester Road overbridge and associated earthworks will appear as a raised element in the right background of the view. Proposed mitigation planting will not be sufficiently mature to screen views of the Proposed Scheme. Therefore, the magnitude of change is considered to be medium.

9.5.39 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.40 The view of the Proposed Scheme in the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-075 (Volume 2, CFA12 Map Book).

9.5.41 During the summer of year 1 of operation the view towards the Proposed Scheme will be similar to the winter view as it is largely across an open arable field. Therefore the magnitude of change is considered to remain medium and will also remain a moderate adverse effect.

9.5.42 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.43 By year 15 and beyond to year 60 of operation, planting established on the boundaries as part of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.44 The view of the Proposed Scheme in the summer of year 15 of operation is illustrated on the photomontage shown in Figure LV-01-238 (Volume 2, CFA12 Map Book).

Viewpoint 132.3.001: View south-east from PRoW (Footpath WAD/5/2) near Blackgrove Road

9.5.45 The A41 Bicester Road overbridge and realignment will be clearly visible across the foreground of the view approximately 200m away. The overhead line equipment will also be clearly visible above mitigation earthworks restored to farmland. This will also restrict views towards the hill farmland of the Eythrope Estate to the left of the view. The Proposed Scheme will represent substantial changes in the existing view of predominantly rural landscape, in proximity to the visual receptor. Therefore, the magnitude of change will be high.

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

9.5.47 In the summer of year 1 of operation, the magnitude of change remains as high and the open nature of the view will mean the overall effect will remain as a major adverse effect.

9.5.48 By year 15 and beyond to year 60 of operation, planting established adjacent to the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 131.2.001: View north-east from dwelling at Wayside Farm, Blackgrove Road

9.5.49 The top of overhead line equipment will be visible approximately 90m away to the left of the view as the Proposed Scheme enters the Waddesdon south cutting. In addition, filtered views of the overhead line equipment located upon the Bicester Road embankment will be available to the right, above a line of mitigation earthworks restored to farmland. The introduction of this infrastructure will result in a change in

the existing view at close proximity to the visual receptor. Therefore the magnitude of change will be medium.

9.5.50 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.51 In summer of year 1 of operation, effects will be unchanged from winter due to the close proximity of the Proposed Scheme and the juvenile state of the proposed mitigation planting adjacent to Waddesdon south cutting.

9.5.52 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.53 By year 15 to year 60 of operation, planting established adjacent to the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce the effects to not be significant. These are reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 134.3.001: View south-west from the Aylesbury Ring PRoW (Footpath WAD/4/2) near Lapstone House off Blackgrove Road

9.5.54 The overhead line equipment upon Waddesdon embankment will be visible within the centre middle ground of the view, approximately 700m away. This will be visible above a line of mitigation earthworks restored to farmland. Intervening landform and vegetation in the middle ground will restrict views beyond. The small copse of woodland in the centre middle ground will filter views towards Footpath WAD/4 accommodation overbridge around 500m away. Intervening landform and vegetation in the left middle ground will restrict views beyond. The Proposed Scheme will cause a change to the existing view, but this will be partially filtered by intervening vegetation and topography. Therefore, the magnitude of change will be medium.

9.5.55 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.56 In the summer of year 1 of operation, the screening effects of small groups of existing trees in the middle ground will reduce effects to not be significant.

9.5.57 By year 15 and beyond to year 60 of operation, planting established on the eastern side of the Proposed Scheme will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 135.3.002: View north-east from a PRoW (Footpath WAD/3/4) north of Glebe Farm

9.5.58 The Proposed Scheme will be upon the 3m high Waddesdon embankment in the foreground of this view, approximately 130m away. The overhead line equipment will be clearly visible above a line of mitigation earthworks restored to farmland. The Proposed Scheme will be highly visible, at proximity to the viewer, and uncharacteristic within the existing rural view. Therefore, the magnitude of change will be high.

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

9.5.60 In summer of year 1 of operation, effects will be unchanged due to the open nature of the view.

9.5.61 By year 15 of operation, although planting along the Waddesdon embankment will have matured and will provide some screening, the overhead line equipment will remain visible beyond. The magnitude of change will therefore be medium, giving rise to a moderate adverse effect.

9.5.62 By year 60 of operation, the further growth and maturity of the proposed planting along the Waddesdon embankment will provide sufficient screening of the Proposed Scheme and effects on this viewpoint will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 135.4.001: View north from Quainton Road between Quainton and Waddesdon

9.5.63 The Proposed scheme will be on the 3m high Quainton south embankment in the middle ground of this view, approximately 150m away. The overhead line equipment will be clearly visible across the view above a line of mitigation earthworks restored to farmland. Needles Farm accommodation overbridge will be visible in the left middle ground, filtered through intervening foreground vegetation. Overall the Proposed Scheme will cause a substantial change in the existing rural view, in proximity to the visual receptor. Therefore, the magnitude of change will be high.

9.5.64 The high magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.65 In the summer of year 1 of operation, the screening provided by small groups of existing trees in the middle ground will reduce effects to not be significant.

9.5.66 By year 15 and beyond to year 60 of operation, planting established adjacent to the Proposed Scheme and along the existing road will have matured, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 137.4.001: View south-west from Station Road, Quainton

9.5.67 The overhead line equipment and approximately 3m high noise fence barrier will be visible in the middle ground of the view, approximately 200m away. Station Road overbridge will be visible as an elevated feature to the right middle ground, replacing the existing overbridge in the same location. Roadside hedgerows and vegetation lining the existing railway in the foreground will partially filter views to the left and right of the view. Proposed mitigation planting in front of the noise fence barrier will be in a juvenile state at year 1 and will offer little visual screening. Despite the presence of the existing infrastructure, the Proposed Scheme will cause a noticeable change to the existing view. Therefore, the magnitude of change will be medium.

9.5.68 The medium magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.69 The view of the Proposed Scheme in the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-078 (Volume 2, CFA12 Map Book).

9.5.70 In the summer of year 1 of operation, vegetation in the foreground will provide greater screening towards the Proposed Scheme. Vegetation lining the existing railway will partially filter views to Station Road overbridge in the right middle ground. The overhead line equipment and noise fence barrier will remain clearly visible and therefore effects will be unchanged from winter.

9.5.71 By year 15 and beyond to year 60 of operation, planting established adjacent to the Proposed Scheme will have matured to a certain extent, providing additional screening to the elements of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 139.2.001: View east from Upper South Farm, Quainton

9.5.72 The new Upper South Farm access track in front of the existing mature woodland will be visible in the foreground of the view, approximately 150m away. The overhead line equipment will also be visible above a line of mitigation earthworks seen as restored farmland. Views of Station Road overbridge will be heavily filtered through the existing woodland. Overall the Proposed Scheme will represent a substantial change in the existing rural view, at close proximity to the viewpoint. Therefore, the magnitude of change will be high.

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

9.5.74 During the summer of year 1 of operation overhead line equipment will remain visible to the left of view. However the existing woodland in the right of view will screen views towards Station Road overbridge. Therefore, the magnitude of change will be medium, resulting in a moderate adverse effect.

9.5.75 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.76 By year 15 and beyond to year 60 of operation, planting established as part of the Proposed Scheme will further obscure visibility resulting in effects that will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 139.2.002: View north-east from Lower South Farm, Quainton

9.5.77 The Proposed Scheme will be on the 2m high Doddershall embankment and will lie approximately 500m away in this view. The overhead line equipment will be the only visible element above a line of intervening mitigation earthworks restored to farmland. Bridleway QUA/28A overbridge will also be visible, although partially filtered by intervening hedgerow vegetation. Views will also be intermittently filtered by intervening hedgerow vegetation and by vegetation associated with the historic civil war battery earthwork. Overall the Proposed Scheme will represent a change, but views will be partially restricted by intervening vegetation and earthwork mitigation. Therefore, the magnitude of change will be medium.

9.5.78 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.79 In the summer of year 1 of operation, intervening vegetation will offer greater intermittent screening towards the Proposed Scheme and will reduce effects to not be significant. This is reported in Volume 5 Appendix LV-001-012 Part 4.

9.5.80 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.81 By year 15 and beyond to year 60 of operation, planting established as part of the Proposed Scheme will further obscure visibility resulting in effects that will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 141.2.001: View north-east from Doddershall House

9.5.82 The Proposed Scheme will be on the 3m high Doddershall embankment. The overhead line equipment will be clearly visible above a line of mitigation earthworks restored to farmland. Edgcott Road overbridge will be visible 700m away as a raised element within the undulating landscape, partially filtered through intervening vegetation. Views to the right will be restricted by mature vegetation. The introduction of the Proposed Scheme will cause a change in the existing rural view, but views will be partially filtered by intervening vegetation. Therefore, the magnitude of change will be medium.

9.5.83 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.84 In the summer of year 1 of operation, the screening provided by small groups of existing trees in the middle ground will reduce effects to not be significant.

9.5.85 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.86 By year 15 and beyond to year 60 of operation, planting established along Doddershall embankment and adjacent to Edgcott Road overbridge will have matured and will largely obscure views of the Proposed Scheme. This will reduce effects to not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 142.2.001: View south-west from dwellings near Middle Farm, Shipton Lee

9.5.87 The National Grid substation will be visible in the middle ground of this view, approximately 500m away, filtered through existing hedgerow vegetation. The overhead line equipment will be visible upon the 3m high Doddershall embankment to the left of the view, approximately 650m away along the route of the existing railway line. Views of the Quainton auto-transformer feeder station will also be available in the centre of the view 350m away, obscured by intervening topography and hedgerow vegetation. The Proposed Scheme will cause a substantial change in the existing rural view, but views will be intermittently screened by intervening vegetation and topography. Therefore, the magnitude of change will be medium.

9.5.88 The medium magnitude of change assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.89 In the summer of year 1 of operation, the screening provided by hedgerow vegetation in the middle ground will reduce effects to not be significant.

9.5.90 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.91 By year 15 and beyond to year 60 of operation, planting established adjacent to the National Grid substation and Quainton auto-transformer feeder station will have matured, providing screening to the Proposed Scheme. Therefore the effects will remain not be significant. This is reported in Volume 5: Appendix LV-001-012, Part 4.

Viewpoint 142.4.001: View west from public highway south of Shipton Lee

9.5.92 The Quainton auto-transformer feeder station will be visible in the foreground of the view approximately 30m away. Edgcott Road overbridge will also be visible approximately 300m away. Views of the National Grid substation will be filtered by roadside vegetation on the right of the view. This large scale infrastructure will represent a substantial change to the existing view, in close proximity to the visual receptor. Therefore, the magnitude of change will be high.

9.5.93 The high magnitude of change assessed alongside the medium sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.94 In summer, the effects will be unchanged adjacent to the Quainton auto-transformer feeder station on the left of the view due to mitigation planting still being juvenile.

9.5.95 By year 15 and beyond to year 60 of operation, planting established adjacent to Quainton auto-transformer feeder station will have matured, providing screening to both the auto-transformer feeder station and Edgcott Road overbridge. While taller elements within the auto-transformer feeder station will remain visible, the overall effect will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 143.2.002: View east from dwellings south of Woodlands Farm

9.5.96 Edgcott Road overbridge will be visible in the right middle ground of this view. The overhead line equipment will be visible upon the 5m high Woodlands embankment in the centre of the middle ground but views will be filtered by intervening vegetation. The Proposed Scheme will represent the addition of new components that are highly visible and uncharacteristic within the existing view. Therefore, the magnitude of change will be high.

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

9.5.98 The view of the Proposed Scheme in the winter of year 1 of operation is illustrated on the photomontage shown in Figure LV-01-080 (Volume 2, CFA12 Map Book).

9.5.99 In the summer of year 1 of operation, vegetation within the left middle ground will provide greater screening towards the overhead line equipment. However due to the relatively open nature of the view in the centre and right the overall effects will be unchanged from winter.

9.5.100 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.101 By year 15 of operation, planting along the River Ray will have matured and will largely screen views towards the overhead line equipment in the left of the view. Proposed planting along the existing road will have matured to a certain extent, however Edgcott Road overbridge will remain visible above this. Therefore the magnitude of change will be medium, giving rise to a moderate adverse effect.

9.5.102 By year 60 of operation, planting established along the existing road will have matured, largely screening views of Edgcott Road overbridge; the effect will therefore not be significant. This is reported in Volume 5 Appendix LV-001-012 Part 4.

Viewpoint 143.2.001: View north-east from Woodlands Farm

9.5.103 The 5m high Grendon Underwood embankment and Adam's accommodation underbridge, will be visible in the foreground of this view, approximately 50m away. The overhead line equipment will also be clearly visible upon embankment. Edgcott Road overbridge, Quainton auto-transformer feeder station and the National Grid substation will be visible but filtered by intervening vegetation along the River Ray. The Proposed Scheme will represent substantial changes in the existing view in close proximity to the visual receptor, therefore the magnitude of change will be high.

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

9.5.105 In the summer of year 1 of operation, vegetation along the River Ray will provide greater screening towards Edgcott Road overbridge. However, Grendon Underwood embankment will remain clearly visible, therefore effects will be unchanged from winter.

9.5.106 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.107 By year 15 and beyond to year 60 of operation, planting along the River Ray will have matured and will largely screen views towards Adam's accommodation underbridge and Edgcott Road overbridge. However the lack of mitigation planting along Grendon Underwood embankment in this location will mean that the magnitude of change will remain high, giving rise to a major adverse effect which is considered significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Viewpoint 146.2.001: View west from Finemerehill House, Finemere Hill

9.5.108 The Proposed Scheme will be visible against an expanse of wooded farmland. Bridleway GUN/28 accommodation green overbridge will be clearly visible to the centre of the view above the small copse of trees approximately 800m from the viewer. The overhead line equipment will also be visible across much of the view. Sheephouse Wood mitigation structure will also be partially visible to the left of Sheephouse Wood in the right middle ground of the view. The Proposed Scheme will cause a substantial change to the existing view, but within the context of the wider panorama containing an existing railway line and a landfill site the magnitude will be medium.

9.5.109 The medium magnitude of change, assessed alongside the high sensitivity of the receptor will result in a moderate adverse effect in the winter of year 1 of operation.

9.5.110 During summer the existing vegetation in the middle ground and background will provide some additional screening towards the Proposed Scheme. The overhead line equipment however, will remain largely visible across the view, and the Bridleway GUN/28 accommodation green overbridge will remain visible in the centre of the view above the small copse of trees. The new immature planting across the middle ground of the view will not offer any screening at year 1. Consequently, the magnitude of change will remain medium, resulting in a moderate adverse effect.

9.5.111 The night-time effect of lighting during year 1 of operation will not be significant. This is reported in Volume 5: Appendix LV-001-012 Part 4.

9.5.112 By year 15 and beyond to year 60 of operation, planting established adjacent to the Proposed Scheme will have matured and will largely screen views towards Bridleway GUN/28 accommodation green overbridge. This is reported in Volume 5: Appendix LV-001-012 Part 4.

Cumulative effects

9.5.113 Section 2.1 and Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the operation of the Proposed Scheme. The consequential cumulative effect of these committed developments on LCA and viewpoints is described below. These developments are shown in Maps CT-13-025 to CT-13-028 (Volume 2, Cross Topic Appendix 1 Map Book).).

9.5.114 Due to the combined presence of the Proposed Scheme and Greatmoor EfW facility, effects on the following receptors, which are significant when considering the operation of the Proposed Scheme on its own, will be further affected:

- Kingswood Wooded Farmland LCA will be further affected by the presence of the Greatmoor EfW facility and associated infrastructure; and
- Views west from Finemerehill House, Finemere Hill (146.2.001) will be further affected by the presence of the EfW facility in the left middle ground.

9.5.115 The following receptors, which will not be significantly affected by the operation of the Proposed Scheme on its own, will be significantly adversely affected when considering the combined presence of other developments:

- viewpoint 146.3.002: view west from the Claydon Woods Circular Walk (Footpath GUN/33/1) and PRoW (Bridleway GUN/28/1) between Sheephouse Wood and Greatsea Wood. Views of the EfW building will be clearly visible in the left of the view and, in combination with views of the Proposed Scheme, will result in a moderate adverse effect at year 1 of operation; and
- viewpoint 148.2.001: view south from Knowlhill Farm, Knowl Hill. Views of the EfW building will be clearly visible in the centre middle ground and, in combination with views of the Proposed Scheme, will result in a moderate adverse effect at year 1 of operation.

Other mitigation measures

9.5.116 The permanent effects of the Proposed Scheme on landscape and visual receptors have been substantially reduced through incorporation of the measures described previously. Effects by year 1 of operation may be further reduced by establishing planting early in the construction programme, which will be considered during the detail design stage. This would provide additional screening and greater integration of the Proposed Scheme into the landscape. However, no other mitigation measures are considered practicable due to the high visibility of elements of the Proposed Scheme and the sensitivity of the surrounding receptors.

Summary of likely significant residual effects

9.5.117 As no other mitigation measures are considered reasonably practicable at this stage, the permanent residual significant effects during operation remain as described above. In most cases, significant effects will reduce over time as the proposed mitigation planting matures and reaches its designed intention. However, the following residual effects will remain following year 15 of operation:

- effects on the character of Claydon Bowl LCA, arising from the continued presence of the Proposed Scheme within characteristic views from elevated locations around Steeple Claydon and Knowl Hill, and its impact on the setting of the rural landscape. These effects will reduce by year 60 of operation, following greater maturity of the proposed planting;
- effects on the character of Kingswood Wooded Farmland LCA, due to the influence of the Quainton auto-transformer feeder station and National Grid substation on the rural landscape. These effects will reduce by year 60 of operation, following greater maturity of the proposed planting;
- effects on views from recreational receptors WAD/3 near Glebe Farm (135.3.002) arising from visibility of the overhead line equipment on embankment at close proximity;
- effects on views from residences on Edgcott Road (143.2.002) and at Woodlands Farm (143.2.001), arising from visibility of the Proposed Scheme including Edgcott Road overbridge and the lack of planting adjacent to Grendon Underwood embankment resulting in the continued visibility of the overhead line equipment; and
- cumulative effects on Kingswood Wooded Farmland LCA, views west from Finemerehill House (146.2.001), views west from PRoW between Sheephouse Wood and Greatsea Wood (146.3.002) and views south from Knowlhill Farm (148.2.001). This will be due to the combined presence of the Proposed Scheme and the Greatmoor EfW facility.

10 Socio-economics

10.1 Introduction

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

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

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

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

Construction

10.1.4 The proposed construction works will have relevance in terms of socio-economics in relation to the potential employment opportunities arising from construction in the local area (including in adjacent CFA).

Operation

10.1.5 The proposed operation of the route will have relevance in terms of socio-economics in relation to the potential employment opportunities created by new business opportunities.

10.2 Scope, assumptions and limitations

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

10.2.2 There have been no variations to the socio-economic assessment methodology arising from engagement with stakeholders and community organisations.

10.3 Environmental baseline

Existing baseline

Study area description

10.3.1 Section 2 of this report provides a general overview of the Waddesdon and Quainton area which includes data of specific relevance to socio-economics notably

demographic and employment data. The following provides a brief overview of the area in terms of employment, economic structure and labour market[64].

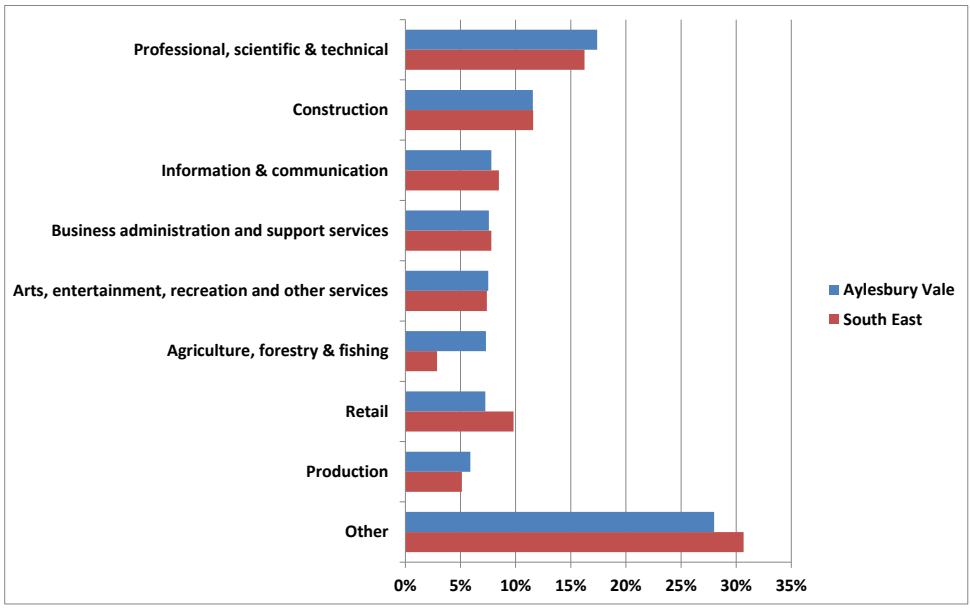
10.3.2 The Waddesdon and Quainton area is predominately rural with residential communities. The area of land required for the construction of this section of the Proposed Scheme lies within the Aylesbury Vale District in Buckinghamshire.

10.3.3 Where possible, baseline data has been gathered on demographic character areas (DCA)[65] to provide a profile of local communities. Volume 5: Appendix SE-001-000 shows the location of the DCA. The area contains two DCA – Waddesdon DCA and Quainton, Shipton Lee and Greatmoor DCA.

Business and labour market

10.3.4 Within Aylesbury Vale District the professional, scientific and technical services sector accounts for the largest proportion of businesses (17%), with the construction (12%), information and communication (8%) and business administration and support services (8%) sectors also accounting for large numbers of businesses within the district. This is shown in Figure 6[66]. For comparison within the South East region the professional, scientific and technical services sector also accounts for the largest number of businesses (16%), with construction (12%), retail (10%) and information and communication (9%) sectors also accounting for relatively large numbers of businesses within the region[67].

Figure 6: Business sector composition in Aylesbury Vale District and the South East[68,69]



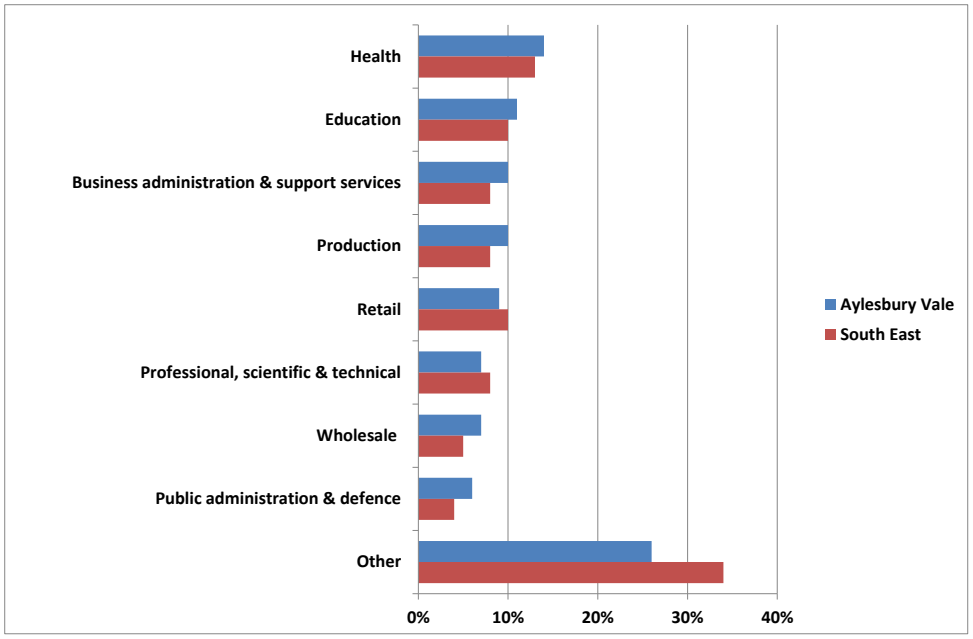
[64] Further information on the socio-economics baseline, with regard to business and labour market profile, within the area are contained in the Volume 5 (Appendix SE-001-000).
[65] DCAs have been determined through an understanding of local context and aim to be aligned as closely as possible to groups of lower super output areas (LSOAs).
[66] The Figure presents the proportion of businesses within each business sector in the district but not the proportion of employment by sector.
[67] Office for National Statistics (ONS) (2011), *UK Business: Activity, Size and Location 2011*, ONS, London. Please note 2011 data has been presented to provide an appropriate comparison with 2011 Census data.
[68] 'Other' includes accommodation and food services; motor trades; wholesale, transport and storage; finance and insurance; property; public administration and defence; education; and health sectors.
[69] ONS (2012), *UK Business: Activity, Size and Location 2011*, ONS, London.

10.3.5 Approximately 69,000 people worked in Aylesbury Vale District while 500 people worked within Waddesdon DCA, and 200 within Quainton, Shipton Lee and Greatmoor DCA[70].

10.3.6 According to the ONS Business Register and Employment Survey 2011, the sector with the highest proportion of employment in Aylesbury Vale is health (14%) which accounts for a higher proportion of jobs than in both the South East and England (12%). Education makes up 10% of employment in the district, comparable to that recorded for both the South East (10%) and England as a whole (9%). Business administration and support services accounts for 9% of employment in the district, compared to 8% recorded across both the South East and England as a whole. This is shown in Figure 6.

10.3.7 Key sectors, in terms of employment for Waddesdon DCA are arts, entertainment, recreation and other services (32%) and property (14%). For Quainton, Shipton Lee and Greatmoor DCA the main sectors are education (20%), retail (20%), construction (12%) and production (12%).

Figure 7: Proportion of employment by industrial sector in Aylesbury Vale District and the South East[71,72]



10.3.8 According to the 2011 Census[73], the employment rate[74] within the district in 2011 was 72% (which represents 91,000 people), higher than 68% recorded for the South East and 65% for England as a whole. There are high levels of commuting out of the area as shown by the discrepancy between the number of jobs in the district and the number of residents in employment. The employment rate in the Waddesdon DCA was 77% and 66% in Quainton, Shipton Lee and Greatmoor DCA.

[70] ONS (2012) *Business Register and Employment Survey 2011*, ONS, London.
[71] 'Other' includes accommodation and food services, arts, entertainment, recreation and other services, construction, information and communication, motor trades, transport and storage (including postal), financial and insurance, property, production and agriculture, forestry and fishing.
[72] ONS (2012) *Business Register and Employment Survey 2011*, ONS, London.
[73] ONS (2012), *Census 2011*, ONS, London.
[74] The proportion of working age (16-74 years) residents in employment. Employment comprises the proportion of the total resident population who are 'in employment' and includes full-time students who are employed.

10.3.9 In 2011, the unemployment rate for the district in 2011 stood at 5% which was lower than the England average of 7%. The unemployment rate in the Waddesdon DCA was 3% and 4% in Quainton, Shipton Lee and Greatmoor DCA[75].

10.3.10 According to the 2011 Census, 32% of Aylesbury Vale District residents aged 16 and over were qualified to National Vocational Qualification Level 4 (NVQ4), compared to 30% in the South East and 27% in England, while 17% of residents had no qualifications, which is lower than that recorded both for the South East (19%) and England (23%). In 2011 28% of Waddesdon DCA residents aged 16 and over were qualified to NVQ4 level, compared to 36% in Quainton, Shipton Lee and Greatmoor DCA. The proportion of residents with no qualifications was 20% in Waddesdon DCA, and 16% in Quainton, Shipton Lee and Greatmoor DCA.

10.3.11 The two DCAs are each predominantly residential areas, within a rural area recording high rates of employment, low unemployment and high levels of qualifications attainment.

Future baseline

Construction (2017)

10.3.12 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2017. Implementation of all outstanding development consents and land allocations will result in additional jobs being accommodated by 2017, specifically at the Greatmoor Farm 'Energy from Waste' facility[76].

Operation (2026)

10.3.13 Volume 5: Appendix CT-004-000 provides details of the developments which are assumed to have been implemented by 2026. There are no consents or allocations in this area which are expected to accommodate additional material employment between 2017-2026.

10.4 Effects arising during construction

Avoidance and mitigation measures

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

10.4.2 The draft CoCP includes a range of provisions that will help mitigate the socio-economic effects associated with construction within this local area including:

- consulting businesses located close to hoardings on the design, materials used and construction of the hoarding, to reduce impacts on access to and visibility of their premises (draft CoCP, Section 5);

[75] Unemployment figures have been rounded. DCA unemployment rates are presented for each DCA in this chapter while in Section 2 they are shown in aggregate.
[76] It has not been possible to calculate net additional employment for this development owing to insufficient information about existing employment on site.

- reducing nuisance through sensitive layout of construction sites (draft CoCP, Section 5);
- applying best practicable means (BPM) during construction works to reduce noise (including vibration) at sensitive receptors (including local businesses) (draft CoCP, Section 13);
- requiring contractors to monitor and manage flood risk and other extreme weather events which may affect socioeconomic resources during construction (draft CoCP, Sections 5 and 16); and
- site specific traffic management measures including requirements relating to the movement of traffic from business and commercial operators of road vehicles, including goods vehicles (draft CoCP, Section 14).

Assessment of impacts and effects

Temporary effects

Change in business amenity value

10.4.3 No non-agricultural businesses[77] have been identified within the area that are expected to experience significant amenity effects as a result of the Proposed Scheme.

Isolation

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

Construction employment

10.4.5 There are plans to locate construction compounds for the Proposed Scheme at the following locations:

- A41 Bicester Road overbridge satellite compound;
- Station Road overbridge satellite compound/Woodlands cutting satellite compound;
- Quainton auto-transformer feeder station satellite compound; and
- School Hill green overbridge satellite compound (located in CFA13).

10.4.6 The use of these sites will result in the creation of up to 500 person years of construction employment[78] opportunities, or approximately 50 full-time equivalent jobs[79], which, depending on skill levels required and the skills of local people, are potentially accessible to residents in the locality and to others living further afield. The impact of the direct construction employment creation has been assessed as part of the routewide assessment (see Volume 3).

[77] Possible employment loss in agricultural businesses as a result of the Proposed Scheme is being estimated at the route-wide level.
[78] 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.
[79] Based on the convention that 10 employment years is equivalent to one full time equivalent job.

10.4.7 Direct construction employment created by the Proposed Scheme will also lead to opportunities for local businesses to supply the project or to benefit from expenditure of construction workers. The impact of the indirect construction employment creation has been assessed as part of the routewide assessment (see Volume 3).

Cumulative effects

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

10.4.9 Cumulative effects arise in relation to the accumulation of individual resource based job displacement/losses on a local labour market. These effects are assessed as part of the routewide assessment (see Volume 3).

Permanent effects

Businesses

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

10.4.11 From an employment perspective, no significant direct effects on non-agricultural employment have been identified and the Proposed Scheme is not anticipated to result in the displacement or possible loss of jobs within this area.

Cumulative effects

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

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

Other mitigation measures

10.4.14 The assessment has concluded that there are no significant adverse effects arising during construction in relation to businesses directly affected by the Proposed Scheme.

10.4.15 The construction of the Proposed Scheme offers considerable opportunities to businesses and residents along the line of route in terms of supplying goods and services and obtaining employment. HS2 Ltd is committed to working with its suppliers to build a skilled workforce that fuels further economic growth across the UK.

Summary of likely significant residual effects

10.4.16 There are no significant effects identified in this assessment that will arise during construction.

10.5 Effects arising during operation

Avoidance and mitigation measures

10.5.1 No mitigation measures are proposed during construction within this area.

Assessment of impacts and effects

Resources with direct effects

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

Change in business amenity

10.5.3 No non-agricultural businesses have been identified within the area that are expected to experience significant amenity effects as a result of the Proposed Scheme.

Operational employment

10.5.4 Operational employment will be created at locations along the route including stations, train crew facilities and infrastructure/maintenance depots which are considered unlikely to be accessed by residents of the area.

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

10.5.6 The impact of operational employment creation has been assessed as part of the routewide assessment (see Volume 3).

Cumulative effects

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

Other mitigation measures

10.5.8 The assessment has concluded that operational effects within this section of the route will be either negligible or beneficial and therefore mitigation is not needed.

Summary of likely significant residual effects

10.5.9 There are no significant effects identified in this assessment arising during operation.

11 Sound, noise and vibration

11.1 Introduction

11.1.1 This section reports the assessment of the likely noise and vibration significant effects arising from the construction and operation of the Proposed Scheme for the Waddesdon and Quainton area on:

- people, primarily where they live ('residential receptors') in terms of a) individual dwellings and b) on a wider community basis, including any shared community open areas[80]; and
- community facilities such as schools, hospitals, places of worship, and also commercial properties such as offices and hotels, collectively described as 'non-residential receptors' and 'quiet areas[81]'.

11.1.2 The assessment of likely significant effects from noise and vibration on agricultural, community, ecological or heritage receptors and the assessment of tranquillity are presented in Sections 3, 5, 6, 7 and 9 of this report respectively.

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

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

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

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

- Scope and Methodology Report (SMR) (Appendix CT-001-000/1); and
- SMR addendum (Appendix CT-001-000/2).

11.1.7 More detailed information and mapping regarding the sound, noise and vibration assessment for Waddesdon and Quainton is available in the relevant appendices in Volume 5:

[80] 'shared community open areas' are those that the emerging National Planning Practice Guidance identifies may partially offset a noise effect experienced by residents at their dwellings and are either a) relatively quiet nearby external amenity spaces for sole use by a limited group of residents as part of the amenity of their dwellings or b) a relatively quiet external publicly accessible amenity space (e.g. park to local green space) that is nearby.

[81] Quiet areas are defined in the Scope and Methodology Report as either Quiet Areas as identified under the Environmental Noise Regulations or are resources which are prized for providing tranquillity (further information is provided in Section 9).

- sound, noise and vibration, route-wide assumptions and methodology (Appendix SV-001-000);
- sound, noise and vibration baseline (Appendix SV-002-012);
- sound, noise and vibration construction assessment (Appendix SV-003-012);
- sound, noise and vibration operation assessment (Appendix SV-004-012); and
- Map Series SV-01, SV-02, SV-03 and SV-04 (Volume 5, Sound, noise and vibration Map Book).

11.2 Environmental baseline

Existing baseline

11.2.1 The existing baseline sound environment for this area is varied. The largest village in the area is Waddesdon and there are rural farms and cottages, along with further small settlements, distributed throughout the area.

11.2.2 The dominant transportation sound sources include road traffic on the A41, Quainton Road, Station Road and Blackgrove Road. Trains are also audible close to the railway line between Aylesbury and to the north east of Waddesdon, and very occasionally from the line that serves the Calvert Landfill site.

11.2.3 The A41 is a busy main road, running through the centre of Waddesdon. It carries a relatively large volume of traffic, including cars and heavy goods vehicles. At properties close to the A41, the sound of road traffic is dominant and gives rise to relatively high local sound levels with typical daytime values of up to 75dB[82]. At locations in the village further from the A41, sound levels during the day are typically 50dB, typically dropping by 7 to 10dB during the night[83] dependent upon location.

11.2.4 Quainton Road runs from the A41 in Waddesdon to Quainton further north. Properties in the north of Waddesdon, adjacent to this road, experience daytime sound levels of around 60dB, typically dropping by 10dB during the night. Properties further from the A41 experience lower sound levels from traffic due to increased distance, and in some cases a degree of screening. The soundscape in these areas consists of intermittent local road traffic underpinned by the constant sound of more distant road traffic (from the A41). Intermittent aircraft over-flights and natural sounds are also present.

11.2.5 Dwellings along Blackgrove Road experience the constant sound of distant road traffic and intermittent local road traffic, along with the sounds of aircraft over flight and natural sounds. There are also a number of farmhouses in this area which typically experience the sound from distant road traffic at relatively low levels along with intermittent sounds from farm equipment. Daytime sound levels at these properties are typically around 50dB.

[82] Quoted dB values at residential areas refer to the free-field 16 hour daytime (07:00 to 23:00) equivalent continuous sound pressure level, $L_{pAeq,16hr.}$
[83] Night-time sound levels refer to the free-field 8 hour night-time (23:00 to 07:00) equivalent continuous sound pressure level, $L_{pAeq,8hr.}$

11.2.6 Properties along Station Road to the south of Quainton, typically experience daytime sound levels of around 50dB from vehicles on this road, along with natural sounds and railway traffic, including steam trains. Sounds from farming activities are also occasionally audible. Night-time sound levels in this area are typically 6 to 7dB lower than the daytime levels.

11.2.7 In the north of the study area there are a number of more remote properties. The sound environment in these areas includes vehicles using local roads, the sound of occasional aircraft over-flights, natural sources and agricultural activities. Sound levels at these properties vary from location to location, dependent on the proximity of local sources, but are typically between 45 and 55dB during the daytime. Night-time sound levels are typically around 8 to 10dB lower than the daytime levels.

11.2.8 Further information on the existing baseline, including baseline sound levels and baseline monitoring results, is provided for this area in Volume 5: Appendix SV-002-012.

11.2.9 It is likely that the majority of receptors adjacent to the line of route are not currently subject to appreciable vibration[84], save for those receptors closest to existing railways. On a precautionary basis, vibration from the Proposed Scheme has therefore been assessed at all receptors using specific thresholds, below which receptors will not be affected by vibration, as described in Volume 1, Section 8. No vibration baseline measurements have therefore been undertaken.

Future baseline

11.2.10 Without the Proposed Scheme, existing sound levels in this area are likely to increase slowly over time. This is primarily due to road traffic growth. Changes in car technology may offset some of the expected sound level increases due to traffic growth on low speed roads. On higher speed roads[85], tyre sound dominates and hence the expected growth in traffic is likely to continue to increase ambient sound levels.

Construction (2017)

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

Operation (2026)

11.2.12 The assessment is based upon the predicted change in sound levels that result from the Proposed Scheme. The assessment initially considered a worst case (that would overestimate the change in levels) by assuming that sound levels would not change from the existing baseline year of 2012/2013. Where significant effects were identified

[84] Further information is available in the Volume 5: Appendix SV-001-000, the SMR and its Addendum.
[85] Tyre noise typically becomes the dominant sound source for steady road traffic at speeds above approximately 30mph.

on this basis, the effects have been assessed using a baseline year of 2026 to coincide with the proposed start of passenger services. The future baseline is for the sound environment that would exist in 2026 without the Proposed Scheme.

11.3 Effects arising during construction

Local assumptions and limitations

Local assumptions

11.3.1 The construction arrangements that form the basis of the assessment are presented in Section 2.3 of this report.

Local limitations

11.3.2 In this area, there are a number of locations where the land or property owners did not permit baseline sound level monitoring to be undertaken at their premises. However, sufficient information has been obtained to undertake the assessment. Further information is provided in Volume 5: Appendix SV-002-012.

Avoidance and mitigation measures

11.3.3 The assessment assumes the implementation of the principles and management processes set out in the draft CoCP (Section 13) which are:

- Best Practicable Means (BPM) as defined by the Control of Pollution Act 1974 (CoPA) and Environmental Protection Act 1990 (EPA) will be applied during construction activities to reduce noise (including vibration) at neighbouring residential properties;
- as part of BPM, mitigation measures are applied in the following order:
  - noise and vibration control at source: for example the selection of quiet and low vibration equipment, review of construction methodology to consider quieter methods, location of equipment on site, control of working hours, the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings[86]; and then
  - screening: for example local screening of equipment or perimeter hoarding;
- where, despite the implementation of BPM, the noise exposure exceeds the criteria defined in the draft CoCP, noise insulation or ultimately temporary re-housing will be offered in accordance with the draft CoCP noise insulation and temporary re-housing policy;
- lead contractors will seek to obtain prior consent from the relevant local authority under Section 61 of CoPA for the proposed construction works. The consent application will set out BPM measures to reduce construction noise, including control of working hours, and provide a further assessment of construction noise and vibration including confirmation of noise insulation/temporary re-housing provision;

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

- contractors will undertake and report such monitoring as is necessary to assure and demonstrate compliance with all noise and vibration commitments. Monitoring data will be provided regularly to and be reviewed by the Nominated Undertaker and will be made available to the local authorities; and
- contractors will be required to comply with the terms of the draft CoCP and appropriate action will be taken by the Nominated Undertaker as required to ensure compliance.

11.4 Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.4.1 The mitigation measures will reduce noise inside all dwellings such that it does not reach a level where it would significantly affect[87] residents.

Residential receptors: direct effects – communities

11.4.2 The avoidance and mitigation measures in this area will avoid airborne construction noise adverse effects[87] on the majority of receptors and communities. Residual temporary noise or vibration effects are identified later in this section.

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

11.4.4 In locations with lower existing sound levels[88], construction noise effects[87] are likely to be caused by changes to noise levels outside dwellings. These may be considered by the local community as an effect on the acoustic character of the area and hence be perceived as a change in the quality of life. These effects are considered to be significant when assessed on a community basis taking account of the local context[89].

11.4.5 In this area, the mitigation measures reduce the effects of outdoor construction noise on the acoustic character around the local residential communities such that the adverse effects identified are considered to be not significant.

Residential receptors: indirect effects

11.4.6 Construction traffic is likely to cause adverse noise effects on residential receptors along the Grendon Road/Buckingham Road where they pass through Edgcott (CSV12-C02) – approximately 40 dwellings located immediately adjacent to the road are forecast to experience an increase in outdoor noise levels of around 5dB during the months of peak activity (further information on traffic flows is provided in Section 12: Traffic and Transport).

11.4.7 These adverse effects[87] would be a change in the acoustic character of the area such that there is a perceived change in the quality of life and are considered significant when assessed on a community basis taking account of the local context[89].

[87] Information is provided in the emerging National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk
[88] Further information is provided in Volume 5: Appendix SV-001-000.
[89] Further information is provided in Volume5: Appendix SV-001-000 and SV-003-012.
[90] Refer to Volume 5: Appendix CT-004-000.

Non-residential receptors: direct effects

11.4.8 Significant construction noise or vibration effects on non-residential receptors are unlikely to occur in this area.

Non-residential receptors: indirect effects

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

- Grendon Road/Buckingham Road where they pass through Edgcott affecting Edgcott Village Hall (CSV12-N04). This effect is associated with a forecast increase in wayside noise levels of around 5dB in the months of peak activity (further information on the construction traffic is provided in Section 12: Traffic and transport); and
- The Broadway in Grendon Underwood affecting St Leonard's Church (CSV12-N05). This effect is associated with a forecast increase in wayside noise levels of around 5dB in the months of peak activity (further information on the construction traffic is provided in Section 12: Traffic and Transport).

Cumulative effects from the Proposed Scheme and other committed developments

11.4.10 This assessment has considered the potential cumulative construction noise effects of the Proposed Scheme and other committed developments[90]. In this area, there are a small number of committed developments, but these are too far from the receptors affected by the Proposed Scheme to add significant noise impacts. Accordingly, construction noise from the Proposed Scheme is unlikely to result in any significant cumulative noise effects.

Summary of likely residual significant effects

11.4.11 The avoidance and mitigation measures reduce noise inside all dwellings from the construction activities such that it is does not reach a level where it would significantly affect[87] residents.

11.4.12 The measures also reduce the effect of outdoor construction noise on the acoustic character around the local residential communities such that the effects are not considered to be significant.

11.4.13 Construction traffic on Grendon Road/Buckingham Road and Buckingham Road/Gawcott Road is likely to cause significant noise effects on adjacent residential and non-residential receptors where it passes through Waddesdon and Edgcott and by receptors north of Gawcott respectively.

11.4.14 HS2 Ltd will continue to seek all reasonably practicable measures to further reduce or avoid these significant effects. In doing so HS2 Ltd will continue to engage with stakeholders to fully understand the receptor, its use and the benefit of the measures. The outcome of these activities will be reflected in the Environmental Minimum Requirements.

11.5 Effects arising during operation

Local assumptions and limitations

Local assumptions – service pattern

11.5.1 The effects of noise and vibration from the operation of the Proposed Scheme have been assessed based on the highest likely train flows, including the Phase Two services. Trains are expected to be 400m long during peak hours and a mix of 200m and 400m long trains at other times.

11.5.2 The passenger service timetables for Phase One and Phase One with Phase Two services are described in Volume 1[91]. As reasonable worst case this assessment is based upon a maximum service pattern for Monday to Saturday including Phase Two services. Passenger services will start at or after 05:00 from the terminal stations and in this area will progressively increase to the number of trains per hour in each direction on the main lines set out in Table 14. This maximum number of services is assumed to operate every hour from 07:00 to 21:00. The number of services will progressively decrease after 21:00 and the last service will arrive at terminal stations by 24:00. Train speeds are shown in Table 14.

Table 14: Train flows and speeds

Description of line	Time period for peak daytime train flows	Maximum number of tph in each direction with Phase Two services (Phase One only maximum tph in each direction is set out in brackets)	Speed
Main line between London and the north	07:00 – 21:00 hours	18 (14)	330kph for timetabled trains (assumed 90% of services), and 360kph for 10% of services

Avoidance and mitigation measures

11.5.3 The development of the Proposed Scheme has, as far as reasonably practicable, kept the alignment away from main communities and low in the ground. These avoidance measures have protected many communities from likely significant noise or vibration effects.

Airborne noise

11.5.4 HS2 trains will be quieter than the relevant current European Union specifications. This will include reduction of aerodynamic noise from the pantograph that otherwise would occur above 300kph (186mph) with current pantograph designs, drawing on proven technology in use in East Asia. The track will be specified to reduce noise, as will the maintenance regime. Overall these measures would reduce noise emissions by approximately 3dB at 360kph compared to a current European high speed train operating on the new track. Further information is provided in Volume 5: Appendix SV-001-000.

[91] The change in noise and vibration effects between the different timetables is assessed in Volume 1.

11.5.5 To avoid or reduce significant airborne noise effects, the Proposed Scheme incorporates noise barriers in the form of landscape earthworks and noise fence barriers. Noise barrier locations are shown in Map Series SV-05 (Volume 2, CFA12 Map Book).

11.5.6 Generally, the assessment has been based on noise barriers having a noise reduction performance equivalent to a noise barrier with a top level 3m above the top of the rail, which is acoustically absorbent on the railway side, and which is located 5m to the side of the outer rail. In practice, barriers may differ from this description, but will provide the same acoustic performance. For example, where noise barriers are in the form of landscape earthworks they will need to be higher above rail level to achieve similar noise attenuation to a 3m barrier because the crest of the earthwork will be further than 5m from the outer rail.

11.5.7 Noise effects are reduced in other locations along the line by landscape earthworks provided to avoid or reduce significant visual effects and engineering structures such as cuttings and safety fences on viaducts (where noise barriers are not required). The location of these barriers is also shown in Map Series SV-05 (Volume 2, CFA12 Map Book).

11.5.8 Significant noise effects from the operational static sources such as line-side equipment will be avoided through their design and the specification of noise emission requirements (for further information please see Volume 5: Appendix SV-001-000).

11.5.9 Noise insulation measures will be offered for qualifying buildings as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996[92] (the Regulations). The assessment reported in this section provides an estimate of the buildings that are likely to qualify under the Regulations. Qualification for noise insulation under the Regulations will be identified and noise insulation offered at the time that the Proposed Scheme becomes operational.

11.5.10 Where required, as well as improvements to noise insulation of windows facing the railway, ventilation will be provided so that windows can be kept closed to protect internal sound levels. Following Government's emerging National Planning Practice Guidance[93], where the noise from the use of the Proposed Scheme measured outside a dwelling exceeds the Interim Target defined by the WHO Night Noise Guidelines for Europe[94], residents are considered to be significantly affected by the resulting noise inside their dwelling. The effect on people at night due to the maximum sound level as each train passes has also been assessed[95]. The Interim Target is a lower level of noise exposure than the Regulations trigger threshold for night noise. In these particular circumstances, where night-time noise levels for the use of new or additional railways authorised by the Bill are predicted following the methodology set out in the

[92] The Noise Insulation (Railways and Other Guided Transport Systems) Regulations, London. Her Majesty's Stationery Office (1996).
[93] National Planning Practice Guidance – Noise http://planningguidance.planningportal.gov.uk
[94] World Health Organization, Night-time Noise Guidelines for Europe, 2010.
[95] During the night (2300-0700) a significant effect is also identified where the Proposed Scheme results in a maximum sound level at the façade of a building at or above: 85dB L_{pAFmax} (where the number of train pass-bys exceeding this value is less than or equal to 20); or 80dB L_{pAFmax} (where the number of train pass-bys exceeding this value is greater than 20).

Regulations to exceed 55dB[96], or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion[95], noise insulation will be offered for these additional buildings.

Ground-borne noise and vibration

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

Assessment of impacts and effects

Residential receptors: direct effects – individual dwellings

11.5.12 Taking account of the avoidance and mitigation measures incorporated into the Proposed Scheme, the assessment has identified approximately six residential dwellings close to the Proposed Scheme at: Crossroads Farm, Woodlands Barn, Woodlands Farmhouse, and Woodlands Lodge near Quainton; and at Upper Greatmoor Farm and Lower Greatmoor Farm near Edgcott, where noise would exceed the daytime trigger threshold set in the Regulations. It is therefore estimated that these buildings are likely to qualify for noise insulation under the Regulations. These dwellings are indicated in Map Series SV-05 (Volume 2, CFA12 Map Book).

11.5.13 The assessment has identified two additional residential buildings close to the Proposed Scheme: at 1 and 2 Woodlands Farm Cottages near Quainton, where the daytime forecast noise level does not exceed the threshold set in the Regulations but the forecast night-time noise level would exceed the World Health Organization's Interim Target of 55dB[97], or the maximum noise level (dependent on the number of train passes) as a train passes exceeds the criterion. It is estimated that these buildings will also be offered noise insulation as described previously in the Avoidance and mitigation measures section. These buildings are indicated in Map Series SV-05 (Volume 2, CFA12 Map Book).

11.5.14 The mitigation measures including noise insulation will reduce noise inside all dwellings such that it will not reach a level where it would significantly affect residents.

Residential receptors: direct effects – communities

11.5.15 The mitigation measures in this area will avoid significant airborne noise effects on the majority of receptors, and at the following communities:

- Waddesdon;
- Quainton; and
- Edgcott.

11.5.16 Taking account of the envisaged mitigation, Map Series SV-05 (Volume 2, CFA12 Map Book) shows the long term 40dB[98] night-time sound level contour from the operation of trains on the Proposed Scheme. The extent of the 40dB night-time sound level

[96] Equivalent continuous level, $L_{pAeq,23:00-07:00}$ measured without reflection from the front of buildings.
[97] Equivalent continuous level, $L_{pAeq,23:00-07:00}$ measured without reflection from the front of buildings.
[98] Defined as the equivalent continuous sound level from 23:00 to 07:00 or $L_{pAeq,night}$).

contour is equivalent to, or slightly larger than, the 50dB daytime contour[99]. In general, below these levels adverse effects are not expected.

11.5.17 Above 40dB during the night and 50dB during the day the effect of noise is dependent on the baseline sound levels in that area and the change in sound level (magnitude of effect) brought about by the Proposed Scheme. The airborne noise impacts and effects forecast for the operation of the scheme are presented in Map Series SV-05 (Volume 2, CFA12 Map Book).

11.5.18 The changes in noise levels are likely to affect the acoustic character of the area such that there is a perceived change in the quality of life and are considered to be significant when assessed on a community basis[100] taking account of the local context[101].

11.5.19 In this study area, the assessment indicates that none of the direct adverse effects[87] on the areas of residential communities in the Waddesdon and Quainton area are considered to be significant.

Residential receptors: indirect effects

11.5.20 The assessment of operational noise and vibration indicates that significant indirect effects on residential receptors are unlikely to occur in this area.

11.5.21 Non-residential receptors: direct effects

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

11.5.23 Non-residential receptors: indirect effects

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

Summary of likely significant residual effects

11.5.25 The mitigation measures reduce noise inside all dwellings such that it does not reach a level where it would significantly affect[87] residents.

11.5.26 The avoidance and mitigation measures in this area will avoid noise and vibration adverse effects[87] on the majority of receptors and communities including shared open areas.

11.5.27 Taking account of the avoidance and mitigation measures and the local context, none of the residual permanent noise effects[87]on the acoustic character of communities in this area are considered significant.

[99] With the train flows described in the assumptions section of this CFA Report, the daytime sound level (defined as the equivalent continuous sound level from 07:00 to 23:00 or $L_{pAeq,day}$) from the Proposed Scheme would be approximately 10dB higher than the night-time sound level. The 40dB contour therefore indicates the distance from the Proposed Scheme at which the daytime sound level would be 50dB.
[100] Further information is contained in Volume 1.
[101] Further information is provided in Volume 5: Appendix SV-001-000 and SV-004-012.

12 Traffic and transport

12.1 Introduction

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

12.1.2 With regards to traffic and transport, the main issues as a result of the Proposed Scheme are traffic generated during construction, traffic generated during operation of the Calvert IMD (located in CFA13) the closures of PRoW and roads, either temporarily or in some cases permanently, with associated diversions or realignments and the loss of overflow car parking at the Buckinghamshire Railway Centre near Quainton.

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

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

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

12.1.6 Engagement has been undertaken with the relevant highway authority, Buckinghamshire County Council.

12.2 Scope, assumptions and limitations

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

12.2.2 The study area includes the A41 Aylesbury Road, Akeman Road, High Street (Waddesdon), and Bicester Road, together with local roads that are affected by the Proposed Scheme.

12.2.3 The baseline forecast traffic flows for the future years of assessment have been derived using the Department for Transport's traffic forecasting tool, Trip End Model Presentation Program (TEMPRO). The assessment covers the morning (08:00-09:00) and evening (17:00-18:00) peak hours for an average weekday.

12.2.4 It has been assumed that bus services for the future years of assessment will be the same as those currently operating, since it is not possible to forecast how services may change in the future.

12.2.5 Forecast future year traffic flows with and without the Proposed Scheme have been based on an approach that does not take account of wider effects, such as redistribution and reassignment of traffic, modal shift and peak spreading. As a consequence, local transport effects may be over-estimated.

12.3 Environmental baseline

Existing baseline

12.3.1 Existing conditions in the Waddesdon and Quainton area have been determined through site visits, specially commissioned transport surveys, liaison with relevant transport authorities and stakeholders to source traffic data, information on public transport, PRoW and accident data.

12.3.2 Traffic surveys were undertaken to establish current traffic flows on the road network subject to assessment during September 2012 and February 2013. The surveys comprised of automatic traffic counts, junction turning counts and queue surveys. This was supplemented by traffic and transport data obtained from other sources where available, including from Buckinghamshire County Council.

12.3.3 PRoW surveys were undertaken in August and September 2012, to establish the nature of the PRoW and their usage by pedestrians, cyclists and equestrians (non-motorised users). The surveys included all PRoW and roads that will cross the Proposed Scheme, and any additional PRoW that will be affected by the Proposed Scheme. The surveys indicated that all of the PRoW that will cross the route are used by no more than 10 people per day. The Proposed Scheme affects 16 PRoW within the Waddesdon and Quainton area, excluding roads, and crosses 13 of these. In addition to the 13 PRoW, the Proposed Scheme crosses five roads with potential for use by non-motorised users.

12.3.4 The main strategic roads and local roads affected by the Proposed Scheme are the A41 Aylesbury Road/Akeman Road/High Street (Waddesdon)/Bicester Road, Blackgrove Road, Station Road, Quainton Road, Perry Hill, Buckingham Road, Grendon Road, Fiddlers Field Road (also known as Snake Lane), Lee Road, Edgcott Road (also known as Shipton Lee Road), The Broadway and Lawn Hill.

12.3.5 Relevant accident data for the road network subject to assessment has been obtained from Buckinghamshire County Council for the three year period of 2009 to 2011. This has been assessed and any identified clusters have been examined. No accident clusters have been identified in the area.

12.3.6 The following three public bus services operate along roads that were subject to traffic and transport assessment:

- Route 16 – connecting Aylesbury to Steeple Claydon serving Waddesdon, Quainton, Grendon Underwood, Edgcott and Calvert;
- Route 18 – connecting Buckingham to Aylesbury serving Waddesdon, Grendon Underwood, Edgcott, Calvert, Steeple Claydon, as well as Twyford, Marsh Gobbon, Launton and Bicester; and
- Route 613 – connecting Haddenham to Waddesdon serving Hartwell and Aylesbury.

12.3.7 Three of these services operate along the A41 High Street through Waddesdon, with a combined peak frequency of up to three buses an hour. Route 16 also operates along

Quainton Road/Station Road with a weekday peak frequency of up to one bus an hour.

12.3.8 There is a rail station at Quainton Road on the Aylesbury Link railway line. Although no scheduled passenger trains pass through Quainton Road, the station remains connected to the railway network. Special event trains call at the station for organised events at the Buckinghamshire Railway Centre, which take place on most weekends during summer months and on a less frequent basis during the rest of the year. Freight trains use the line at a frequency of approximately up to four a day, some of which also use the Bicester to Bletchley Line.

12.3.9 There are no navigable waterways affected by the Proposed Scheme in this area and consequently these are not considered further in this assessment.

Future baseline

12.3.10 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. The baseline traffic volumes also take specific account of the consented changes to the Greatmoor EfW facility. These include the provision of direct road access to the facility from the A41 Bicester Road via a disused railway.

12.3.11 The proposed future East West Rail Link will provide a strategic railway connection between East Anglia and Central, Southern and Western England. It is expected to be fully operational by 2019. East West Rail Link passenger services between Milton Keynes and Aylesbury are expected to commence operation on the upgraded Aylesbury Link railway line alongside the Proposed Scheme from December 2017 with a service frequency of one tph in each direction. Future operations at the Calvert Landfill site and potentially the Greatmoor Energy from Waste facility, may also result in an increase in freight trains using this section of line of up to six trains per day. Some of these may arrive and depart via the Bicester to Bletchley Line to north in the Calvert, Steeple Claydon, Twyford and Chetwold area (CFA 13).No other changes to the traffic and transport baseline are anticipated in the Waddesdon and Quainton area.

Construction

12.3.12 Construction activities have been assessed against 2021 baseline traffic flows, irrespective of when they occur during the construction period. Future baseline traffic volumes in the peak hours in this area are forecast to grow by between around 14% and 19% by 2021 compared to 2012, depending on road type.

Operation (2026)

12.3.13 Future baseline traffic volumes in the peak hours in this area are forecast to grow by between around 24% and 32% by 2026 compared to 2012, depending on road type.

Operation (2041)

12.3.14 Future baseline traffic volumes in the peak hours in this area are forecast to grow by between around 48% and 66% by 2041 compared to 2012, depending on road type.

12.4 Effects arising during construction

Avoidance and mitigation measures

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

- transporting construction materials and equipment along haul roads adjacent to the route of the Proposed Scheme where reasonably practicable to reduce lorry movements on the public highway;
- the majority of roads crossing the Proposed Scheme will be kept open during construction resulting in reduced diversions of traffic onto alternative routes;
- provision of temporary alternative routes and/or building structures early to maintain connectivity for PRoW closed during construction to reduce loss of amenity;
- HGV routeing as far as reasonably practicable along the strategic road network, and using designated access roads, as shown in Volume 5: Map TR-03-056 (Volume 5, Traffic and transport Map Book); and
- providing on-site accommodation and welfare facilities in adjacent CFA to reduce daily travel by site workers.

12.4.2 The draft CoCP (see Volume 5: Appendix CT-003-000) includes measures which seek to reduce the impacts and effects of deliveries of construction materials and equipment, including construction lorry trips during peak background traffic periods. The draft CoCP includes HGV management and control measures.

12.4.3 Where reasonably practicable, the number of private car trips to and from the site (both workforce and visitors) will be reduced by encouraging alternative modes of transport or vehicle sharing. This will be supported through an over-arching framework travel plan[102] that will require travel plans to be used, along with a range of potential measures to mitigate the impacts of traffic and transport movements associated with construction of the Proposed Scheme. As part of this a construction workforce travel plan will be put into operation with the aim of reducing workforce commuting by private car, especially sole occupancy car travel. Where reasonably practicable this will encourage the use of sustainable modes of transport or vehicle sharing.

12.4.4 The measures in the draft CoCP (Section 14.2) will include clear controls on vehicle types, hours of site operation, and routes for heavy goods vehicles, to reduce the impact of road based construction traffic. In order to achieve this, generic and site specific management measures will be implemented during construction of the

[102] Construction and operational travel plans will promote the use of sustainable transport modes as appropriate to the location and types of trip. They will include measures such as: provision of information on and promotion of public transport services; provision of good cycle and pedestrian facilities; liaison with public transport operators; promotion of car sharing; and the appointment of a travel plan coordinator to ensure suitable measures are in place and are effective.

Proposed Scheme on or adjacent to public roads, bridleways, footpaths and other PRoW affected by the Proposed Scheme as necessary.

12.4.5 Specific measures will include:

- core site operating hours will be 08:00-18:00 on weekdays and 08:00-13:00 on Saturdays and site staff and workers will therefore generally arrive before the morning peak hour and depart after the evening peak hour (although the assessment has assumed that some work journeys to the construction sites take place within the morning and evening peak hours to reflect a reasonable worst case scenario) (draft CoCP Section 5); and
- excavated material will be reused where reasonably practicable along the alignment of the Proposed Scheme which will reduce the effects of construction vehicles on the public highway (draft CoCP, Section 15.2).

Assessment of impacts and effects

Temporary effects

12.4.6 The following section considers the impacts on traffic and transport and the consequential effects resulting from construction of the Proposed Scheme.

12.4.7 The temporary traffic and transport impacts within the area will be:

- construction vehicle movements to/from the construction site compounds; and
- PRoW closures and diversions.

12.4.8 Construction vehicle movements required to construct the Proposed Scheme include the delivery of plant and materials, movement of excavated materials, and site worker trips.

12.4.9 Details of construction compounds along with planned construction routes are provided in Section 2. The duration of when there will be busy transport activity at each site is shown in Table 15. This represents the periods when the construction traffic flows will be greater than 50% of the peak flows. Also shown is the estimated number of daily vehicle trips during the peak month. The lower end of the range shows the average number of trips in the busy period and the upper end shows the average during the peak month.

Table 15: Typical vehicle trip generation for construction site compounds in this area

Compound Type	Location	Access to/from compound	Indicative start/set up date	Estimated duration of use (years)	Estimated duration with busy vehicle movements (months)	Average daily combined two-way vehicle trips during busy period and within peak month of activity	
						Cars/ LGV	HGV
Satellite	A41 Bicester Road overbridge	A41 Bicester Road	2017	Two years and nine months	16 months	10-20	370-380
Satellite	Station Road overbridge	Station Road, A41 Bicester Road and Station Road, A4146, A418, A41 Bicester Road	2017	Two years and nine months	16 month	150-200	10-20
Satellite	Woodlands Cutting/Quainton auto-transformer feeder station	A41 Bicester Road, The Broadway, Edgcott Road, Grendon Road, Buckingham Road, Lawn Hill/Edgcott Road and A421, Gawcott Road, Buckingham road, Hillesden Road, Perry Hill, Lawn Hill/Edgcott Road. For indivisible abnormal loads, Hillesden Road, Gawcott Road from the A421 and Radclive Road	2017	Seven years	13 months	130-200	30-60

12.4.10 Information on the indicative construction programme and methodology is provided in Section 2 which illustrates how the phasing of activities at different compounds will generally be staggered and that construction activities at individual compounds may not occur over the whole duration presented in Table 15. Consequently the peak traffic movements will not generally occur at the same time, although in some instances there may be some overlap.

12.4.11 Where construction routes serve more than one construction compound, the combined vehicle movements have been assessed.

12.4.12 Construction of the Proposed Scheme is expected to result in changes in daily traffic flows due to works and construction vehicles accessing worksites and also temporary road closures and diversions.

12.4.13 It is proposed that the M40 and A41 will provide the primary HGV assess routes.

12.4.14 There will be permanent effects due to permanent closures as follows, and these are reported in Section 12.5. These will include permanent closure of Station Road that will require a traffic diversion of approximately 2.5km via Station Road overbridge; and the permanent closure of Waddesdon Hill as a result of the realignment of the A41 Bicester Road that will require a traffic diversion of approximately 2.5km via the realigned A41 Bicester Road. The impact of these road closures is taken into account in considering changes in traffic flow during construction.

12.4.15 The changes in traffic flows will lead to a significant increase in delays to vehicle users and congestion[103] at the following junctions:

- A41 Akeman Road with Station Road (major adverse effect);
- A41 Bicester Road with Blackgrove Road and Waddesdon Hill (major adverse effect);
- A41 Aylesbury Road with The Broadway (major adverse effect);
- Grendon Road with Edgcott Road and Marsh Gibbon Road (moderate adverse effect);
- Edgcott Road with Main Street and The Broadway (moderate adverse effect); and
- Perry Hill with Buckingham Road and Lawn Hill (moderate adverse effect).

12.4.16 Construction of the Proposed Scheme will result in substantial increases in daily traffic flows (i.e. more than 30% for HGV or all vehicles) and these will cause a significant increase in traffic related severance[104] for non-motorised users in the following locations:

- The Broadway (major adverse effect) due to an increase in HGV flow as well as all traffic flow;
- Buckingham Road/Grendon Road/Edgcott Road (major adverse effect) due to an increase in HGV flow as well as all traffic flow;
- A41 Aylesbury Road/Akeman Road/High Street (Waddesdon), Bicester Road, east of The Broadway (major adverse effect) due to an increase in HGV flow;

[103] In assessing significant effects of traffic changes on congestion and delays, a major adverse effect occurs where traffic flows at a junction will be beyond or very close to capacity with the Proposed Scheme and the increases in traffic due to the Proposed Scheme will be such as to substantially increase queues and delays on a routine basis at peak times. A moderate adverse effect will occur when traffic flows at a junction will be approaching or at capacity with the Proposed Scheme and modest increases in traffic will increase the frequency of queues and more substantial delays. A minor adverse effect occurs when traffic flows at a junction are not generally exceeding capacity with the Proposed Scheme but the increase in flows will result in occasional queues and delays or small increases in existing delays.

[104] In the context of this traffic and transport section, Severance is used to relate to a change in ease of non-motorised users due to, for example, a change in travel distance or travel time or a change in traffic levels on a route that makes it harder for non-motorised users to cross. A reference to severance does not imply a route is closed to access.

- Lawn Hill/Buckingham Road (moderate adverse effect) due to an increase in HGV flow as well as all traffic flow;
- Fidlers Field Road (also known as Snake Lane) (moderate adverse effect) due to an increase in HGV flow; and
- Lee Road, between Lawn Hill and Fidlers Field Road (moderate adverse effect) due to an increase in HGV flow.

12.4.17 These traffic flow increases will not result in increases in congestion and significant delays except those identified above.

12.4.18 Utilities works, including diversions, have been assessed in detail where they are major works and where the traffic and transport impacts from the works separately, or in combination with other works, will be greater than other construction activities arising within the area. Minor utilities works are expected to result in only localised traffic and pedestrian diversions, which will be of short duration. No additional significant effects are expected due to utilities works.

12.4.19 The construction of the Proposed Scheme will require land currently used as an overflow car park for the Buckinghamshire Railway Centre near Quainton, which is regularly used at weekends, especially during the summer months. This will potentially result in the loss of approximately 600 overflow parking spaces[105] which will have a major adverse effect.

12.4.20 The effect on accident and safety risk will not be significant as there are no locations where there are both existing clusters of accidents and increases in traffic during construction.

12.4.21 The construction of the Proposed Scheme will require temporary rail possessions in the area which will affect some users of passenger services stopping at Quainton Road during special events at Buckinghamshire Railway Centre. The possessions will be short-term and generally take place during mid-week nights or weekends. Therefore the effects of these possessions on rail users in this area will not be significant.

12.4.22 Apart from general congestion, there will be no effect on bus services, or disruption at stations or interchanges that will result from construction of the Proposed Scheme in this area.

12.4.23 There will be minor adverse effects on non-motorised users due to temporary PRoW diversions increasing travel distances at Footpath WAD/4A/1 and Bridleway WAD/4/2, with the diversions being approximately 100 metres in length. There will be minor adverse effects on non-motorised users due to temporary PRoW diversions increasing travel distances at Footpath WAD/4A/1 and Bridleway WAD/4/2, with the diversions being approximately 100m in length. There will be a moderate adverse effect at Bridleway QUA/36/2, Bridleway QUA/28A/2, Footpaths GUN/25/2 and GUN/28/1.

[105] Based upon an assumed 25m^2 per space and an the area of field used for over flow car parking being approximately 25,000m^2.

Cumulative effects

12.4.24 The assessment includes the cumulative effects of planned development during construction by taking this into account within the background traffic growth.

12.4.25 The assessment also includes in-combination effects by taking into account traffic and transport impacts of works being undertaken in neighbouring areas. Worker trips associated with the construction and operation of the Infrastructure Maintenance Depot (IMD) located at Calvert in CFA13 is the main element of this. Consequently, from the adjacent area to the north, Calvert, Steeple Claydon, Twyford and Chetwode (CFA13), cumulative average construction traffic flows of approximately 470 cars/LGV per day (two-way) and 20 HGV per day (two-way) have been included in the assessment for this area.

12.4.26 From the adjacent area to the south, Stoke Mandeville and Aylesbury (CFA11), cumulative average construction traffic flows of approximately 310 cars/LGV per day (two-way) and 20 HGV per day (two-way) have been included in the assessment for this area.

Permanent effects

12.4.27 Any permanent effects of construction have been considered in the operations phase for traffic and transport in Section 12.5. This is because the impact and effects of ongoing increases in travel demand and the wider effects of the operations phase need to be considered together.

Other mitigation measures

12.4.28 The implementation of the draft CoCP (see Volume 5: Appendix CT-003-000) in combination with the framework travel plan and the construction workforce travel plan will, to some degree, mitigate the transport related effects during construction of the Proposed Scheme. The reductions in effects arising from the travel plan measures have not been included in the assessment which will mean the adverse effects may be over-stated.

12.4.29 Rail replacement bus services will also be provided where necessary when rail possessions are in place on the Aylesbury Link railway line. Where reasonably practicable rail possessions will be scheduled to coincide with other planned rail possessions for engineering and maintenance works on the same line to minimise additional disruption to rail users.

12.4.30 No further traffic and transport mitigation measures during construction of the Proposed Scheme are considered necessary based on the outcomes of this assessment. Section 5 provides further information with regard to the Buckinghamshire Railway Centre.

Summary of likely significant residual effects

12.4.31 Increased traffic during the most intensive periods of construction, particularly HGV traffic, will affect non-motorised users crossing and using: The Broadway; Buckingham Road; Grendon Road; Edgcott Road; the A41 Aylesbury Road/Akeman Road/High Street (Waddesdon)/Bicester Road, east of The Broadway; Lawn

Hill/Buckingham Road; Fiddlers Field Road (also known as Snake Lane); and Lee Road, between Lawn Hill and Fiddlers Field Road.

12.4.32 Increased traffic during the most intensive periods of construction will also cause additional intermittent traffic congestion and delay at a number of junctions in the area, including: A41 Aylesbury Road with The Broadway; Grendon Road with Edgcott Road and Marsh Gibbon Road; Edgcott Road with Main Street and The Broadway; Perry Hill with Buckingham Road and Lawn Hill; A41 Akeman Road with Station Road; and A41 Bicester Road with Blackgrove Road and Waddesdon Hill.

12.4.33 The expected loss of overflow parking capacity at the Buckinghamshire Railway Centre will have a significant effect on visitors travelling by car.

12.4.34 Temporary closure of six PRoW (WAD/4A/1, WAD/4/2, QUA/36/2, QUA/28A/2, GUN/25/2 and GUN/28/1) during construction will increase travel distances.

12.4.35 The significant effects that result from construction of the Proposed Scheme are shown on Map Series TR-03-056 (Volume 5 Transport and transport Map Book).

12.5 Effects arising from operation

Avoidance and mitigation measures

12.5.1 The following measures have been included as part of the design of the Proposed Scheme and will avoid or reduce impacts on transport users, these include:

- retaining the majority of roads that will be crossed by the Proposed Scheme in, or very close to, their current location resulting in no substantial diversions of traffic onto alternative routes; and
- retaining PRoW that will be crossed by the Proposed Scheme, with localised realignments kept to a minimum length where reasonably practicable.

Assessment of impacts and effects

12.5.2 The following section considers the impacts on traffic and transport and the consequential effects resulting from the operational phase of the Proposed Scheme (as described in Section 2.4).

12.5.3 The operational traffic and transport impacts within this area will be:

- increase in off-peak traffic flows from workers commuting to and from the Calvert IMD (located in CFA13);
- permanent road closures and the associated realignment;
- permanent relocation of bus stops; and
- PRoW closures and associated realignments.

12.5.4 Occasional traffic may access areas of the Proposed Scheme for maintenance purposes. However, these infrequent vehicle movements are expected to be very low and will not have a significant effect.

12.5.5 The following effects on vehicle occupants will arise from diversions:

- permanent closure of Station Road will require a traffic diversion of approximately 2.5km via the realigned Station Road overbridge, resulting in a moderate adverse effect; and
- permanent closure of Waddesdon Hill will require a traffic diversion of approximately 2.5km via the realigned A41 Bicester, resulting in a moderate adverse effect.

12.5.6 Workers commuting to and from the Calvert IMD (located in CFA13) are expected to result in increases in off-peak (21:00-22:00) traffic flows (i.e. more than 30% in all traffic) associated with shift working at the Calvert IMD in CFA13, which will cause a significant increase in traffic related severance, for non-motorised users, in the following locations:

- The Broadway, Grendon Underwood (minor adverse effect); and
- Buckingham Road/Grendon Road/Edgcott Road (minor adverse effect).

12.5.7 Operation of the Proposed Scheme will require land currently used as an overflow car park for the Buckinghamshire Railway Centre, which is regularly used at weekends, especially during the summer months. This will potentially result in the loss of approximately 400 overflow parking spaces, albeit less than during construction, which will have a major adverse effect on motorised users.

12.5.8 The effect on accident and safety risks will not be significant as there are no locations where there are both clusters of accidents and increases in traffic due to the operation of the Proposed Scheme.

12.5.9 The realignment of the A41 Bicester Road will result in a moderate adverse effect on interchange, resulting from the relocation of the Fleet Marston bus stops outside Cranwell Gate to replacement bus stops 500 metres to the west at the new junction of Waddesdon Hill with the realigned A41 Bicester Road.

12.5.10 It is not expected that the operation of the Proposed Scheme will require bus route diversions, and there will be no impacts on bus services in the area. Consequently there will be no other effects on public transport users during operation of the Proposed Scheme.

12.5.11 There will be minor adverse effects on the relatively few non-motorised users as a result of severance from increased travel distance due to permanent PRoW and road realignments. These include Footpaths GUN/28/1, GUN/31/1, QUA/35/1, Edgcott Road, Footpath QUA/26, Footpath QUA/24A/1, where the realignments are between 100 and 200 metres in length. In addition there is a 450 metre realignment at Footpath WAD/3/4, a 500 metre realignment at Footpath QUA/31/3, a 700 metre realignment at Station Road and an 800 metre realignment at the A41 Bicester Road.

12.5.12 The impacts and consequential effects of the operation of the Proposed Scheme in 2041 will be the same as described for 2026, having taken account of the increased background traffic growth.

Cumulative effects

12.5.13 The assessment includes cumulative effects of planned development during operation by taking into account background traffic growth.

12.5.14 The assessment considers in-combination effects by taking into account transport impacts as a result of the Proposed Scheme in neighbouring areas. However, there will be no additional traffic in this area resulting from the operation of the Proposed Scheme in neighbouring areas.

Other mitigation measures

12.5.15 No other mitigation measures during operation of the Proposed Scheme are considered necessary based on the outcome of this assessment. Section 5 provides further information with regard to the Buckinghamshire Railway Centre.

Summary of likely significant residual effects

12.5.16 Increased traffic generated by workers commuting to and from the Calvert IMD (see Volume 2, Report 13) will affect non-motorised users crossing and using The Broadway; Buckingham Road; Grendon Road; and Edgcott Road.

12.5.17 Road users will be affected by additional travel distance caused by the stopping-up of Station Road and Waddesdon Hill.

12.5.18 Permanent relocation of Fleet Marston bus stops, from outside Cranwell Gate to the new junction of Waddesdon Hill with the realigned Bicester Road will have an effect on bus passengers using these bus stops.

12.5.19 The loss of overflow parking capacity at the Buckinghamshire Railway Centre will have a significant effect on visitors travelling by car.

12.5.20 Permanent realignment of 11 PRoW, including roads, during operation will result in increased travel distances, but affect relatively few non-motorised users.

12.5.21 The significant effects that result from the Proposed Scheme in 2026 and 2041 are shown on Map TR-04-067 (Volume 5, Traffic and Transport Map Book).

13 Water resources and flood risk assessment

13.1 Introduction

13.1.1 This section provides a description of the current baseline for water resources including surface water, groundwater and flood risk. It then reports on the likely impacts and significant effects on these aspects as a result of the construction and operation of the Proposed Scheme.

13.1.2 The main environmental features of relevance to water resources and flood risk include:

- tributaries of the Fleet Marston Brook (a tributary of the River Thame);
- the River Ray and its tributaries: Tetchwick Brook, Doddershall Brook, and Muxwell Brook;
- three SSSI: Finemere Wood SSSI, Sheephouse Wood SSSI, and Grendon and Doddershall Woods SSSI;
- the Grendon and Doddershall Meadows LWS; and
- superficial deposits comprising Alluvium and Head which may contain shallow groundwater.

13.1.3 Key environmental issues relating to water resources and flood risk include:

- construction in close proximity to the old landfill site boundary of the Calvert Landfill site at the northern boundary of the Waddesdon and Quainton area;
- the potential impacts of culvert crossings;
- track drainage discharging to surface water features, or draining shallow groundwater;
- the diversion of several drains including the drain at Cross Roads Farm, Doddershall Brook and Muxwell Brook (see Map WR-01-017 in Volume 5, Water Resources and Flood Risk Assessment Map Book);
- restriction of groundwater flow by sub-surface structures, affecting superficial deposits and, possibly, features in SSSI which are dependent on shallow groundwater; and
- potential impacts on the risk of surface water flooding.

13.1.4 Volume 5: Appendix WR-001-000 contains a report on the route-wide effects including:

- generic assessments on a route-wide basis;
- stakeholder engagement;
- in combination effects;

- a draft operation and maintenance plan for water resources and flood risk;
- a Water Framework Directive[106] (WFD) compliance assessment; and
- a route-wide Flood Risk Assessment (FRA).

13.1.5 Detailed reports on water resources and flood risk within this area are also contained in the Volume 5 appendices. These include:

- Appendix WR-002-012 – Water Resources Assessment report; and
- Appendix WR-003-012 – Flood Risk Assessment.

13.1.6 Map Series WR-01 to WR-04 showing details referred to in this report and those in Volume 5 are all contained in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

13.1.7 Where there is a residual impact to water resources and following mitigation there is a consequent effect on ecology, this is discussed further in Section 7 of this report.

13.1.8 Discussions have been undertaken with the Environment Agency, Fomento de Construcciones y Contratas (FCC) Environment Ltd (operators of the Calvert Landfill) and private holders of groundwater abstraction licences.

13.2 Scope, assumptions and limitations

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

13.2.2 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the centre line of the route, except where there is clearly no hydraulic connectivity. For surface water features in urban areas, the extent was reduced to 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at stations and depots, professional judgement has been used in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this spatial scope is defined as the study area.

13.2.3 Site visits have been carried out for the following locations along the route:

- the proposed crossings of the River Ray; and
- the proposed crossings of the Muxwell Brook.

13.2.4 Water Framework Directive (WFD) classification data has been made available by the Environment Agency. For surface water bodies that do not have a WFD status class shown in the relevant River Basin Management Plan (RBMP), the status class has been taken as the status class for the first downstream water body for which a status class is

[106] Water Framework Directive – Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, Strasbourg, European Parliament and European Council.

reported. Where groundwater does not have a WFD status class shown in the relevant RBMP, these are referred to as 'not assessed by the Environment Agency' in the geology and hydrogeology tables of Volume 2 (Table 16 and Table 17) and Volume 5: Appendix WR-002-012.

13.2.5 There are no data available with regard to groundwater levels. No monitoring of groundwater levels has been undertaken as part of this assessment, but there is not anticipated to be any significant groundwater within the bedrock geology crossed by the route. Any groundwater levels and flow directions within superficial deposits have been inferred from topography and potential connectivity to surface watercourses that pass through the superficial deposits.

13.2.6 There is little data available regarding existing groundwater quality, although the assessment for this area considers any degradation in water quality rather than absolute water chemistry conditions.

13.2.7 No specific hydraulic modelling has been undertaken within the study area for any source of flood risk. The limitations associated with flood risk within this study area are described in detail in the flood risk assessment in Volume 5: Appendix WR-003-012.

13.3 Environmental baseline

Existing baseline – surface water resources

Surface water features

13.3.1 Water bodies in the study area to the east of Waddesdon fall within the Thame and South Chilterns sub-catchment of the Thames River Basin District (RBD) as set out within the RBMP[107].

13.3.2 Water bodies to the west of Waddesdon fall within the Cherwell sub-catchment of the Thames RBD.

13.3.3 The current surface water baseline is shown on Maps WR-01-016 and WR-01-017 (Volume 5, Water Resources and Flood Risk Assessment Map Book) and all surface water features within the study area are assessed within Volume 5: Appendix WR-002-012. Table 16 includes features potentially affected by the Proposed Scheme.

[107] Environment Agency (2009), Thames River Basin District Management Plan.

Table 16: Surface water features potentially affected by the Proposed Scheme

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book)	Watercourse classification[108]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[109]
Tributary of Fleet Marston Brook	Near Lower Blackgrove Farm north of the route	Ordinary watercourse	No status class shown in RBMP – assumed status Poor	No status class shown in RBMP – assumed status Good	Moderate
Unnamed pond	North of Wayside Farm (SWC-CFA12-13)	Not applicable	Not applicable	Not applicable	Low
Unnamed pond	North of Glebe Farm (SWC-CFA12-14)	Not applicable	Not applicable	Not applicable	Low
Headwater of Fleet Marston Brook	Crossed by the route north of Little Manor Holding (SWC-CFA12-01)	Main river	No status class shown in RBMP– assumed status Poor	No status class shown in RBMP– assumed status Good	Moderate
Headwaters of the Tetchwick Brook and tributaries	Crossed by the route twice west of Buckinghamshire Railway Centre (SWC-CFA12-02 and SWC-CFA12-03). Will also be crossed by three highway crossings (SWC-CFA12-15, SWC-CFA12-16 and SWC-CFA12-17)	Ordinary watercourse	No status class shown in RBMP – assumed status Poor	No status class shown in RBMP – assumed status Good	Moderate
Unnamed pond	On the route east of Upper South Farm (part of a group of six ponds) (SWC-CFA12-18).	Not applicable	Not applicable	Not applicable	Low
Unnamed drain	Crossed by the route north of Upper South Farm (SWC-CFA12-04)	Not applicable	Not applicable	Not applicable	Low
Unnamed drains	Crossed by the route five times north and north-east of Doddershall House and ultimately flowing into Tetchwick Brook (SWC-CFA12-05, SWC-CFA12-06, SWC-CFA12-07,SWC-CFA12-08 and SWC-CFA12-19)	Ordinary watercourse	No status class shown in RBMP – assumed status Poor	No status class shown in RBMP – assumed status Good	Moderate

[108] Water-feature classifications: Section 113 of the Water Resources Act 1991 defines a main river as a watercourse that is shown as such on a main river map. Section 72 of the Land Drainage Act 1991 defines an ordinary watercourse as 'a watercourse that is not part of a main river'. Section 221 of the Water Resources Act 1991 defines a watercourse as including 'all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows'. Main rivers are larger rivers and streams designated by Defra on the main river map and are regulated by the Environment Agency.

[109] For examples of receptor value see Table 43 in the SMR Addendum (Volume 5, Appendix CT-001-000/2).

Water feature	Location description (Volume 5, Water Resources and Flood Risk Assessment Map Book)	Watercourse classification[108]	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value[109]
River Ray	Crossed by the route near Woodlands Farm (SWC-CFA12-09)	Main river	Ray and tributaries north-east of Grendon Underwood GB106039030100 Moderate	Good	High
Unnamed pond	Near Woodlands Farm (SWC-CFA12-20)	Not applicable	Not applicable	Not applicable	Low
Tributary of the River Ray (Finemere Wood)	West of Finemere Wood (SWC-CFA12-10)	Ordinary watercourse	No status class shown in RBMP – assumed status Moderate	No status class shown in RBMP – assumed status Good	Moderate
Unnamed lake (Finemere Wood)	South-west of Finemere Wood	Not applicable	Not applicable	Not applicable	Moderate
Unnamed drain	South of Sheephouse Wood; joins Muxwell Brook downstream of the crossing (SWC-CFA12-11)	Ordinary watercourse	No status class shown in RBMP – assumed status Moderate	No status class shown in RBMP – assumed status Good	Moderate
Muxwell Brook	South of Sheephouse Wood (SWC-CFA12-12)	Main river	No status class shown in RBMP – assumed status Moderate	No status class shown in RBMP – assumed status Good	Moderate
Unnamed lakes at landfill site	Disused clay pits south-west of Sheephouse Wood	Not applicable	Not applicable	Not applicable	Low
Numerous unnamed ponds within 1km radius of the Proposed Scheme	Various locations (see Volume 5: Appendix WR-002-012 for further details)	Not applicable	Not applicable	Not applicable	Low

Water Framework Directive status

13.3.4 There is one WFD water body that will be crossed by the route: the 'River Ray and tributaries north-east of Grendon Underwood'. The current overall status of this water body is Moderate. The study area also contains small tributaries of two other WFD water bodies – the Fleet Marston Brook and the Tetchwick Brook – both of which have a current overall status of Poor. The Environment Agency predicts that by 2027 all three WFD water bodies will be of Good status.

Abstractions and permitted discharges

13.3.5 According to Environment Agency records, there are no licensed surface water abstractions. There is the potential for further unlicensed abstractions to exist, as a

licence is not required for abstraction volumes below 20 cubic metres per day. Details are presented in Volume 5: Appendix WR-002-012. The abstractions are classified as high value receptors.

13.3.6 According to Environment Agency records, there are 10 current consented surface water discharges within 1km of the route in the study area. All consents are associated with sewerage discharges (for further information see Volume 5: Appendix WR-002-012).

Existing baseline – groundwater resources

Geology and hydrogeology

13.3.7 The geological formations within this area are described further in Section 8 and with a schematic geological cross-section in Volume 5: Appendix WR-002-012.

13.3.8 The location of private abstractions, geological formations and indicative groundwater levels are shown on Map WR-02-012 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.9 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 17. Unless otherwise stated, the geological groups listed are all crossed by the route.

Table 17: Summary of geology and hydrogeology in the study area

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Superficial deposits						
Alluvium	Present along watercourses. Very limited laterally within the study area.	Clay, silt, sand and gravel	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Head Deposits	Very limited extent in the east of the study area. Partly crossed by the route.	Sands, gravels and silts	Secondary A	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate
Bedrock						
Kimmeridge Clay Formation (Ancholme Group)	Small outcrop to south west of route near Waddesdon (not crossed by route)	Mudstones comprising thin siltstone and cement stone beds with local sands and silts	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low
Ampthill Clay Formation (Ancholme Group)	Eastern part of CFA12	Mudstone, slightly silty with limestone nodules	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low
West Walton Formation	Eastern part of CFA12, west of	Mudstone with some silt, sand	Unproductive	Not assessed by	Not assessed by	Low

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
(Ancholme Group)	Ampthill Clay Formation	and gravel		Environment Agency	Environment Agency	
Weymouth Member, Upper Oxford Clay (Ancholme Group)	Eastern part of CFA12, west of West Walton Formation	Mudstone, slightly silty with limestone nodules	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low
Stewartby Member, Middle Oxford Clay (Ancholme Group)	Western part of CFA12, west of Weymouth Member	Mudstone with some silt, sand and gravel	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low
Peterborough Member, Lower Oxford Clay (Ancholme Group)	Western part of CFA12	Mudstone with some silt, sand and gravel	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low

Superficial deposits

13.3.10 Superficial drift deposits are absent from the majority of the area, with the exception of Alluvium (consisting of clay, silt, sand and gravel) associated with watercourses and an area of Head deposits (consisting of clay, silt, sand and gravel) to the north of Waddesdon.

13.3.11 Both the Alluvium and the Head deposits are classified as Secondary A aquifers.

Bedrock aquifers

13.3.12 The surface bedrock geology in the Waddesdon and Quainton area consists of the Ancholme Group which is composed of a succession of different mudstones from approximately 30 to 100m thick.

13.3.13 From east to west along the route, the Ancholme Group comprises the Ampthill Clay Formation, West Walton Formation, Weymouth Member (Upper Oxford Clay), Stewartby Member (Middle Oxford Clay) and Peterborough Member (Lower Oxford Clay), as shown on Map WR-02-012 (Volume 5, Water Resources and Flood Risk Assessment Map Book). Also within the Ancholme Group is the Kimmeridge Clay which comprise small outcrops that will not be crossed by the route.

13.3.14 All these formations are classified as Unproductive strata and do not have any meaningful quantities of groundwater in them.

Water Framework Directive status

13.3.15 No WFD classification has been given to the superficial deposits or the Ancholme Group.

Abstraction and permitted discharges

13.3.16 According to Environment Agency records, there are no licensed abstractions, either for potable water supplies or other purposes, in the study area although there is one abstraction outside the study area within 1.7km from the centre line of the route (for further details, see Volume 5: Appendix WR-002-012). The route does not pass through any Source Protection Zones (SPZ). There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20 cubic metres per day. Details are presented in Volume 5: Appendix WR-002-012. The abstractions are classified as high value receptors.

Surface water/groundwater interaction

13.3.17 There are no springs or issues shown on Ordnance Survey maps in the area.

13.3.18 The Superficial deposits, comprising Alluvium and Head, may contain shallow groundwater, and are present in the valleys of the Fleet Marston Brook, Doddershall Brook and River Ray. In these locations the Superficial deposits are likely to be in hydraulic connectivity with the local watercourses and are likely to only contain limited groundwater within them.

Water dependent habitats

13.3.19 In addition to the watercourses identified in Table 16, there are a number of potentially water dependent ecological sites within 1km of the route in the Waddesdon and Quainton area. These include:

- Finemere Wood SSSI (see Map EC-01-026, C5 to E2, in Volume 5, Ecology Map Book);
- Grendon and Doddershall Woods SSSI (see Map EC-01-026, A10 to B10) – the River Ray and one of its tributaries run through Grendon Wood;
- Sheephouse Wood SSSI (see Map EC-01-027, E6 to G4); and
- Grendon and Doddershall Meadows LWS (see Map EC-01-026, F7 to H5).

13.3.20 Details of the ecological receptors at each of these sites are given in Section 7 of this report.

Existing baseline – flood risk

River flooding

13.3.21 The agreed data set for river flooding is the Environment Agency Flood Zone Mapping, as shown on Maps WR-01-016 and WR-01-017 (Volume 5, Water Resources and Flood Risk Assessment Map Book).

13.3.22 The Proposed Scheme will cross the floodplains of the River Ray and the Muxwell Brook.

13.3.23 Upstream of the crossing with the route (see Map WR-01-017 SWC-CFA12-09, Volume 5, Water Resources and Flood Risk Assessment Map Book) the River Ray has a catchment size of approximately 5km^2. The route will cross approximately 2,600m^2 of Flood Zone 3 and 2,900m^2 of Flood Zone 2. The land use in the floodplain around the Proposed Scheme location is largely made up of arable farm land and pasture.

No properties are at risk but the access road to Woodlands Farm is crossed by the flood zones.

13.3.24 The Muxwell Brook (SWC-CFA12-11 and SWC-CFA12-12, Map WR-01-017 in Volume 5, Water Resources and Flood Risk Assessment Map Book) has a catchment size of approximately 4km^2 at the intersection with the Proposed Scheme. The Muxwell Brook is conveyed beneath the existing Aylesbury Link railway line by two culverts. During the site visit to the area, out-of-channel flow was observed along the base of the natural valley, discharging via the existing underbridge and adjacent culvert. Although the site visit was undertaken during the winter months, there had been no exceptional rainfall events in the preceding days, and it is unlikely that flows in the watercourse will have been significantly elevated above normal levels. It is possible that the existing infrastructure has insufficient capacity to convey the flow due to blockage. A more detailed description of the hydrology of the Muxwell Brook is contained within the Flood Risk Assessment (Volume 5: Appendix WR-003-012). Downstream of the crossing is the Calvert Landfill. No properties are at risk but the access road to Upper Greatmoor Farm and Lower Greatmoor Farm is crossed by the flood zones and are, therefore at risk of flooding.

Surface water flooding

13.3.25 The agreed data set for surface water flooding is the Environment Agency Flood Map for Surface Water (FMfSW)[110].

13.3.26 The Proposed Scheme will cross the Fleet Marston Brook (SWC-CFA12-01) and a tributary north of Waddesdon, the Tetchwick Brook and a tributary the near the Buckinghamshire Railway Centre (SWC-CFA12-02 and SWC-CFA12-03), the Doddershall Brook (SWC-CFA12-06) and its tributaries (SWC-CFA12-04, SWC-CFA12-05, SWC-CFA12-07, and SWC-CFA12-08), and a tributary of the Muxwell Brook (SWC-CFA12-10) near Finemere Wood. These crossings are shown on Map WR-01-017 (Volume 5, Water Resources and Flood Risk Assessment Map Book). All of these watercourses have an associated surface water floodplain as shown on the Environment Agency FMfSW.

13.3.27 The Environment Agency FMfSW shows areas to be at risk of surface water flooding for the 1 in 200 years return period (0.5% annual probability) rainfall events associated with dry valleys in the upper reaches of the Fleet Marston Brook (see Map WR-01-017, Volume 5, Water Resources and Flood Risk Assessment Map Book).

Sewer flooding

13.3.28 The agreed data set for sewer flooding is the Buckinghamshire Preliminary Flood Risk Assessment[111] (PFRA), however, the route will not cross any urbanised areas in the study area.

Artificial water bodies

13.3.29 Flooding from artificial systems may occur from failure of a retaining structure which impounds water. No artificial water bodies were identified in the Waddesdon and Quainton area or areas associated with any reservoir inundation.

[110] The Environment Agency (2009), *Areas Susceptible to Surface Water Flooding*.
[111] Jacobs and Buckinghamshire County Council (2011), *Buckinghamshire County Council Preliminary Flood Risk Assessment*.

Groundwater flooding

13.3.30 The agreed data set for groundwater flooding is the Aylesbury Vale Strategic Flood Risk Assessment[112] (SFRA) and the Buckinghamshire PFRA.

13.3.31 The Aylesbury Vale SFRA implies there is generally a low risk of groundwater flooding in the district. This is confirmed in the Buckinghamshire PFRA where it is reported that less than 25% of the study area is at risk of groundwater flooding.

Future baseline

13.3.32 Section 2.1 and Appendix CT-004-000 identify developments with planning permission or sites allocated in adopted development plans, on or close to the Proposed Scheme. These are termed 'committed developments' and will form part of the baseline for the operation of the Proposed Scheme. The potential cumulative effects arising from committed developments in relation to water resources and flood risk have been considered as part of this assessment of the construction and operation of the Proposed Scheme.

13.3.33 All developments are required to comply with the National Planning Policy Framework (NPPF)[113], development plans and other legislation and guidance. As such committed developments should have a neutral effect on the water resources and flood risk baseline.

Climate change

13.3.34 Current projections to the 2080s indicate that climate change may affect the future baseline against which the impacts of the Proposed Scheme on surface water and groundwater resources have been assessed. There may be changes in the flow and water quality characteristics of surface water and groundwater bodies as a result of changes in climate. However, except for flood flows described below, these changes are not considered to result in the reported effects from the Proposed Scheme changing in significance.

13.3.35 Current projections indicate that there will be more frequent, higher intensity rainfall events in the future. The probability and severity of surface water flooding could therefore increase as surface water drainage systems fail to cope with more frequent, higher intensity storms. Peak river flows during flood events are expected to increase, potentially causing greater depths and extents of flooding.

13.3.36 When considering the influence that climate change may have on the future baseline, against which the impacts from the Proposed Scheme on flood risk have been evaluated, the assessment has used the recommended precautionary sensitivity ranges of key parameters, as given in Table 5 in the technical guidance to the NPPF. The sensitivity testing undertaken allows for variations in climate change factors included in other national guidance.

13.3.37 Further information on the potential additional impacts of climate change for water resources and flood risk is provided in Sections 7 and 8 of Volume 1 and Table 13 of Volume 5: Appendix CT-009-000.

[112] Royal Haskoning and AVDC (2007), *Aylesbury Vale SFRA – Level 1 Report*.
[113] Department for Communities and Local Government (2012), *National Planning Policy Framework Technical Guidance*.

13.4 Effects arising during construction

Avoidance and mitigation measures

13.4.1 The general approach to mitigation is set out in Volume 1, Section 9.

13.4.2 Avoidance and mitigation measures will be utilised to reduce any potentially significant adverse effects on water resources and flood risk to levels that will not be significant. Further details are given in Volume 5: Appendix WR-002-012 and WR-003-012.

13.4.3 Consideration will be given in the design to the objectives of the WFD as described in the River Basin Management Plan. This may include the use of soft engineering solutions for bank design, and the inclusion of natural forms such as berms or incorporation of a two-stage channel, riffles and pools and marginal planting, where reasonably practicable. The following surface water crossings and associated diversions will be dealt with in this way, as discussed further in Volume 5: Appendix WR-002-012 (see Maps WR-01-016 and WR-01-017 in Volume 5, Water Resources and Flood Risk Assessment Map Book):

- the Fleet Marston Brook (SWC-CFA12-01);
- the tributaries of the Tetchwick Brook which will have five crossings (SWC-CFA12-02, SWC-CFA12-03, SWC-CFA12-13, SWC-CFA12-14 and SWC-CFA12-15) including those for highways access;
- the Doddershall Brook north-east of Doddershall House (SWC-CFA12-06) and four tributaries will have four crossings (SWC-CFA12-04 and SWC-CFA12-05, SWC-CFA12-07 and SWC-CFA12-08);
- the River Ray (SWC-CFA12-09);
- the unnamed watercourse at Finemere Wood (tributary of Muxwell Brook) (SWC-CFA12-10); and
- the Muxwell Brook (SWC-CFA12-11 and SWC-CFA12-12).

13.4.4 Drainage on the Proposed Scheme has been designed to control the rate and volume of run-off from the railway and prevent an increase in flood risk. Associated access roads and hard-standings will be designed to match peak run-off rates to existing rates through use of sustainable drainage system (SuDS) techniques. The SuDS balancing ponds provided in the current design are shown on Maps CT-06-047 to CT-06-053 (Volume 2, CFA12 Map Book), and will be designed where practicable to discharge at existing run-off rates and will accommodate for events up to and including the 1 in 100 annual probability (1%) including an allowance for climate change.

13.4.5 Where realignments of existing roads are required, for example the A41 Bicester Road (also known as Aylesbury Road) near Waddesdon, appropriate mitigation will be provided to address the risks to the receiving watercourses for both flow and water quality through the detailed design of the Proposed Scheme using the Design Manual

for Roads and Bridges[114] and CIRIA guidance[115]. Run-off rates and water quality will be controlled in accordance with the necessary approvals. For the A41 realignment a detailed assessment will be made during detailed design of the Proposed Scheme to inform the final discharge and treatment arrangements.

13.4.6 No works associated with the construction of cuttings, embankments, culverts, the two auto-transformer substations or the National Grid feeder station will be required below the mudstones of the Ancholme Group. As a result, there is no potential for impact from these works on any groundwater present below the mudstones of the Ancholme Group.

13.4.7 Replacement floodplain storage will be provided at the crossings of the River Ray and the Muxwell Brook to mitigate for any potential increase in the risk of flooding at these river crossings. Replacement floodplain storage areas will mitigate for temporary loss of floodplain storage resulting from the construction works in the floodplain. The replacement floodplain storage areas provided in the current design are shown on Maps CT-06-047 to CT-06-053 (Volume 2, CFA12 Map Book). All replacement floodplain storage will be provided prior to the construction of built structures within the floodplain.

13.4.8 To reduce potential adverse effects on flood risk all culverts (such as at Doddershall and at the crossing of the Tetchwick Brook tributaries) will be designed to convey the 1 in 100 year annual probability (1%) flow including an allowance for climate change, and the diverted watercourses will be designed with at least equal capacity to the existing system to ensure no loss of conveyance. This has ensured that flow is not cut off and continues to be conveyed to the downstream catchment, whilst ensuring downstream flood risk is not increased.

13.4.9 At the dry valley near Briar Hill Farm east of Waddesdon (Map WR-01-016 in Volume 5, Water Resources and Flood Risk Assessment Map Book), the Proposed Scheme will be in deep cutting (Waddesdon south cutting) through the area at risk of surface water flooding. Ground level information suggests that Briar Hill Farm is situated on watershed between two catchments and the catchment area for this dry valley is approximately 0.1km^2. Run-off volumes will be relatively low and overland flows will be collected into the crest drainage network. The crest drainage will be designed to carry the 1 in 100 years return period (1% annual probability) rainfall event, including an allowance for climate change.

13.4.10 The draft CoCP sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme (see Volume 5: Appendix CT-003-000/1). It will provide effective management and control of the impacts during the construction period.

13.4.11 Method statements for all crossings and diversions such as the River Ray will be agreed in consultation with the Environment Agency to ensure that any temporary impacts on water quality, flow and ecology are acceptable. These will include details of suitable construction sequencing, channel stabilisation, methods for managing potential pollution events and methods to be used for managing sediment.

[114] http://www.dft.gov.uk/ha/standards/dmrb/vol4/section2.htm
[115] Murname, E., Heap, A. and Swain, A. (2006) *C648 Control of Water Pollution from Linear Construction Sites*, CIRIA, London, UK.

13.4.12 The land quality section of this report (Section 8) sets out the assessment of potential impacts from construction in contaminated areas of the Calvert Landfill site, which is located on the boundary of CFA12 and CFA13.Implementation of the measures within the draft CoCP (Section 11) will provide effective management and control during construction, starting with pre-construction ground investigation and subsequent risk assessment. If the pre-construction ground investigation and risk assessment confirms a potential risk of leachate release, in accordance with the draft CoCP, Section 16, monitoring will be undertaken in consultation with the Environment Agency prior to, during and post-construction, if required, to establish baseline conditions for surface and groundwater and to confirm the effectiveness of agreed temporary and permanent mitigation measures. Further information can be found in Volume 2, CFA 13 Report, Sections 8 and 13.

13.4.13 Superficial deposits, comprising Alluvium and Head deposits, which may contain shallow groundwater, are present in the catchments of the tributaries of the Fleet Marston Brook, Doddershall Brook and River Ray. The superficial deposits are likely to be in hydraulic connectivity with the local watercourses. In all cases, the watercourses will be crossed by culverts. The foundations for the culverts will be constructed using good practice as described in Section 16 of the draft CoCP which will ensure no contamination occurs to groundwater.

13.4.14 Site specific flood risk management plans will be prepared prior to construction, as stated in Section 16 of the draft CoCP. In accordance with Section 16 of the draft CoCP, excavated material storage will be located outside of the flood zones to avoid having an impact on the risk of flooding.

Assessment of impacts and effects

13.4.15 This section describes the significant effects following the implementation of avoidance and mitigation measures.

13.4.16 Further details of the potential impacts that will not have significant effects are provided in the Water Resources Assessment report in Volume 5: Appendix WR-002-012 and Flood Risk Assessment in Appendix WR-003-012.

13.4.17 An assessment of the impact on the WFD status is detailed within the WFD Compliance Assessment, contained within the route-wide Water Resources appendix (Volume 5: Appendix WR-001-000).

13.4.18 It is not considered that projected climate change effects, combined with the effects from the construction of the Proposed Scheme, will alter the significance of any of the reported effects on surface water and groundwater resources (see Volume 3: Route-wide Effects Assessment for further information).

Temporary effects

Surface water

13.4.19 The assessment shows that there will be no significant temporary adverse effects on surface water resources during the construction period.

Groundwater

13.4.20 The assessment shows that there will be no significant temporary adverse effects on groundwater resources or water dependent habitats during the construction period.

Flood risk

13.4.21 The assessment has identified no significant increase in risks resulting from all sources of flooding during the construction process and therefore no significant temporary adverse effects.

Cumulative effects

13.4.22 There are no committed developments that have been identified which will result in significant cumulative temporary effects.

Permanent effects

Surface water

13.4.23 The assessment shows that there will be no permanent significant adverse effects on surface water resources.

Groundwater

13.4.24 The assessment shows that there will be no permanent significant adverse effects on groundwater resources or water dependent habitats.

Flood risk

13.4.25 The assessment shows there will be no significant permanent adverse effects on flood risk from all sources.

Cumulative effects

13.4.26 There are no committed developments that have been identified which will result in significant cumulative permanent effects.

Other mitigation measures

13.4.27 There are considered to be no other mitigation measures required.

Summary of likely significant residual effects

13.4.28 Following mitigation no significant residual adverse effects have been identified within the assessment.

13.5 Effects arising from operation

Avoidance and mitigation measures

13.5.1 Generic examples of design measures that will mitigate impacts so that there will be no significant adverse effects on the quality and flow characteristics of surface water courses and groundwater bodies during operation and management of the Proposed Scheme are described in Volume 1, Section 9.

13.5.2 Site specific examples of design measures that will mitigate impacts include the drainage arrangements for the Proposed Scheme in the study area. This comprises 12 balancing ponds for either railway (seven) or highway (five) drainage and six land

drainage areas. These ponds and their associated access tracks are shown in Maps CT-06-047 to CT-06-053 (Volume 2, CFA12 Map Book).

13.5.3 Generic examples of management measures during operation and management of the Proposed Scheme that will mitigate impacts so that there are no significant adverse effects on the quality and flow characteristics of surface water courses and groundwater bodies are described in Volume 1, Section 9 and in the draft operation and maintenance plan for water resources and flood risk included in Volume 5: Appendix WR-001-000.

13.5.4 Operation and management of the Proposed Scheme is not likely to have a significant adverse effect on flood risk anywhere in the catchments through which it passes. Generic examples of management measures that may mitigate flood risk are described in Volume 1, Section 9.

Assessment of impacts and effects

13.5.5 There are considered to be no significant adverse effects to surface water, groundwater or flood risk arising from operation of the Proposed Scheme.

Other mitigation measures

13.5.6 There are considered to be no further mitigation measures required to mitigate adverse effects on surface water resources, groundwater resources or flood risk.

14 References

Aylesbury Vale District Council (2007), *Aylesbury Vale District Local Plan* (Written Statement 2004, Saved Policies).

Aylesbury Vale District Council (2013), *Vale of Aylesbury Plan Strategy 2011 – 2031* (Submission August 2013).

Aylesbury Vale District Council (2007), *Aylesbury Vale District Local Plan* (Saved Policies).

Aylesbury and District Ramblers; *The Aylesbury Ring*; www.aylesbury-ramblers.org.uk/the-aylesbury-ring. Accessed: 3 July 2013.

British Standards Institution (2011), BS 10175:2011, *Code of practice for investigation of potentially contaminated sites*.

Buckinghamshire and Milton Keynes Environmental Records Centre (2009), *Criteria for the Selection of Local Wildlife Site in Berkshire, Buckinghamshire and Oxfordshire*.

Buckinghamshire County Council (2012), Minerals and Waste Core Strategy Development Plan Document.

Buckinghamshire County Council (2001), *Landscape Plan for Buckinghamshire Part 1: Landscape Character Assessment*.

Buckinghamshire County Council (1991), *Buckinghamshire Structure Plan 1991-2011* (Saved Policies).

Buckinghamshire County Council, *Aylesbury Ring*; www.buckscc.gov.uk/assets/content/bcc/docs/row/promoted_routes/aylesburyring.pdf. Accessed: 3 July 2013.

Buckinghamshire County Council, *Bernwood Jubilee Way Guidebook*, www.buckscc.gov.uk/sites/bcc/bernwood/Bernwood_Jubilee_Way_Guidebook.page. Accessed: 3 July 2013.

Buckinghamshire County Council, *Claydon Woods Walk,* www.buckscc.gov.uk/assets/content/bcc/docs/row/promoted_routes/claydonwood.pdf. Accessed: 3 July 2013.

Buckinghamshire County Council, *Doddershall Circular Walk*, www.buckscc.gov.uk/assets/content/bcc/docs/row/promoted_routes/Doddershall.pdf. Accessed: 3 July 2013.

Buckinghamshire County Council, *North Bucks Way*, www.buckscc.gov.uk/assets/content/bcc/docs/row/promoted_routes/North_Bucks_Way_Leaflet.pdf.
Accessed: 3 July 2013.

Buckinghamshire County Council, *The Tramway Trail*, www.buckscc.gov.uk/assets/content/bcc/docs/row/promoted_routes/tramway.pdf. Accessed: 3 July 2013.

Buckinghamshire Railway Centre, www.bucksrailcentre.org. Accessed: 14 August 2013.

CL:AIRE (2007) *Climate change, pollutant linkage and brownfield regeneration*. Subr:im bulletin 3.

Communities and Local Government, Indices of Multiple Deprivation 2010, https://www.gov.uk/government/publications/english-indices-of-deprivation-2010. Accessed: 16 August 2013.

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

Department for Environment, Food and Rural Affairs (2011), *The Natural Choice: securing the value of nature*.

Department for Environment, Food and Rural Affairs (2010) *Based Background Maps for NOx, NO2, PM10 and PM2.5,* http://laqm.defra.gov.uk/maps/maps2010.html. Accessed: 5 July 2013.

Department for Environment, Food and Rural Affairs (2009), *UK Climate Projections 2009*.

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

Department for Environment, Food and Rural Affairs (2009), *Soil Strategy for England*.

Department for Environment, Food and Rural Affairs (2005), *Likelihood of Best and Most Versatile Agricultural Land*.

European Commission (2000), *EU Water Framework Directive: Directive 200/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.* Strasbourg, European Parliament and European Council.

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

Equine Ramblers, *Midshires Way,* http://www.equineramblersuk.co.uk/horse-riding-stories.php; Accessed: 3 July 2013.

Institute of Air Quality Management (2011), *Guidance on the assessment of the impacts of construction on air quality and the determination of their significance*.

Jacobs (2008), *Aylesbury Vale Landscape Character Assessment*, prepared for Buckinghamshire County Council and Aylesbury Vale District Council.

Jacobs (2008), *Aylesbury Vale: Areas of Attractive Landscapes*, prepared for Aylesbury Vale District Council and Buckinghamshire County Council.

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

Natural Environment and Rural Communities Act 2006 (2006), Natural England.

Office for National Statistics (ONS), Census 2011; http://www.ons.gov.uk/ons/guide-method/census/2011/index.html. Accessed: 1 February 2013.

ONS (2012), *Business Register and Employment Survey 2011*.

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

South East Regional Assembly (2009), *The South East Plan, Regional Spatial Strategy for the South East*.

South East England Biodiversity Forum (2009), *South East Biodiversity Strategy*.

Sustainable Remediation Forum UK (2010), *A Framework for Assessing the Sustainability of Soil and Groundwater Remediation*.

The Conservation of Habitats and Species Regulations (SI 2010, No.490, as amended) London, Her Majesty's Stationery Office.

The Hedgerows Regulations 1997 (1997, No. 1160), London, Her Majesty's Stationery Office.

The National Bridleroute Network; *The Midshires Way*, www.ride-uk.org.uk/extent/natreg/midshire.htm. Accessed: 3 July 2013.

The National Byway, *Welcome to the National Byway*, www.thenationalbyway.org/welcome.asp. Accessed 3 July 2013.

The Rothschild Foundation, *Waddesdon Manor*, www.therothschildfoundation.com/areas-of-interest/waddesdon-manor. Accessed: 3 July 2013.

The Wildlife and Countryside Act 1981 (1981, as amended).