

A417 Missing Link  
TR010056

6.2 Environmental Statement  
Chapter 2 The Project

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and Procedure) Regulations 2009**

**A417 Missing Link**

Development Consent Order 202[x]

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**6.2 Environmental Statement  
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## 2 The project

### 2.1 Introduction

2.1.1 This chapter of the Environmental Statement (ES) provides an overview of the scheme location and context together with a detailed description of the scheme. It also outlines details of the embedded environmental mitigation measures (section 2.8 Environmental mitigation design measures), the construction, operation and long-term management (section 2.9 Construction, operation and long-term management), and the decommissioning of the scheme (section 2.11 Decommissioning). The scheme is illustrated in the General Arrangement and Section Plans (Document Reference 2.6).

### 2.2 Need for the scheme

2.2.1 Together, the A417 and A419 make up one of the south-west's most important road corridors. They link the M5 at Gloucester (Junction 11A) to the M4 at Swindon (Junction 15). They help south-west businesses connect with markets and opportunities in the Midlands and North, and they attract investment for Gloucestershire and its neighbours by linking them to London and the south east.

2.2.2 Most of the A417/A419 route is dual-carriageway, but the section between the Brockworth bypass and Cowley roundabout is single carriageway. This restricts the flow of traffic causing pollution and congestion. Delays of 20 minutes or more are not unusual, which results in some motorists diverting onto local roads to avoid tailbacks, causing difficulties for neighbouring communities. Poor visibility and challenging gradients also mean that a disproportionately high number of collisions are seen along this stretch of road.

2.2.3 Upgrading this section of A417 to dual-carriageway would help improve safety, support the economy, ease congestion and reduce pollution. On this stretch of road alone, there were 42 personal injury collisions between July 2014 and June 2019, nine of which were fatal. It would also support the predicted growth in jobs and housing in the Gloucestershire area by improving this key road connection. This would bring significant benefits for road users, local communities and businesses.

#### Client Scheme Requirements

2.2.4 A set of Client Scheme Requirements (CSRs) were developed by Highways England. The CSRs for the scheme are to:

- **Transport and safety:** to reduce delays, create a free-flowing road network and improve safety along this stretch of the A417
- **Environment and heritage:** to reduce the impact on the landscape, natural and historic environment of the Cotswolds and, where possible, enhance the surrounding environment
- **Community and access:** to reduce queuing traffic and pollution, improve access for local people to the strategic road network, and support residents and visitors' enjoyment to the countryside
- **Economic growth:** to help boost growth and prosperity by making journeys more reliable and improving connectivity

2.2.5 The scheme vision and objectives cascade down from the CSRs.

## 2.3 Scheme objectives

- 2.3.1 The Cotswolds Area of Outstanding Natural Beauty (AONB) is the largest of 38 AONBs in England and Wales. In view of its special landscape character, there is a clear need to balance economic and social benefits of an improved road against potentially negative environmental impacts.
- 2.3.2 The upgrading of this section of the A417 to dual-carriageway must be carried out in a way that is sensitive to the surrounding Cotswolds AONB.
- 2.3.3 The integrated project team for the scheme has worked closely with key stakeholders including Gloucestershire County Council (GCC), Cotswolds Conservation Board (also known as Cotswold National Landscape but referred in this ES as CCB), National Trust (NT), Gloucestershire Local Nature Partnership (GLNP) and Gloucestershire Wildlife Trust (GWT) to develop a scheme specific vision statement, four scheme specific objectives and a number of sub-objectives.
- 2.3.4 The Cotswolds Area of Outstanding Natural Beauty (AONB) is managed and looked after by CCB.
- 2.3.5 The scheme vision, design principles, four scheme specific objectives and associated sub-objectives are identified in Table 2-1.

**Table 2-1 Scheme vision, design principles, objectives and sub-objectives**

Scheme vision			
<p><i>A landscape-led highways improvement scheme that will deliver a safe and resilient free-flowing road whilst conserving and enhancing the special character of the Cotswolds AONB; reconnecting landscape and ecology; bringing about landscape, wildlife and heritage benefits, including enhanced visitors' enjoyment of the area; improving local communities' quality of life; and contributing to the health of the economy and local businesses.</i></p>			
Scheme design principles			
<p>Any solution involving a new road must ensure that the scheme is designed to meet the character of the landscape, not the other way around.</p> <p>Any scheme should bring about substantial benefits for the Cotswolds landscape and environment as well as people's enjoyment of the area.</p> <p>Any scheme must have substantially more benefits than negative impacts for the Cotswolds AONB.</p>			
Scheme objectives			
<p><b>Safe, resilient and efficient network:</b> to create a high-quality resilient route that helps to resolve traffic problems and achieves reliable journey times between the Thames Valley and West Midlands as well as providing appropriate connections to the local road network.</p>	<p><b>Improving the natural environment and heritage:</b> to maximise opportunities for landscape, historic and natural environment enhancement within the Cotswolds AONB and to reduce negative impacts of the scheme on the surrounding environment.</p>	<p><b>Community and access:</b> to enhance the quality of life for local residents and visitors by reducing traffic intrusion and pollution, discouraging rat-running through villages and substantially improving public access for the enjoyment of the countryside.</p>	<p><b>Supporting economic growth:</b> to facilitate economic growth, benefit local businesses and improve prosperity by the provision of a free-flowing road giving people more reliable local and strategic journeys.</p>

Scheme sub-objectives				
1	Road safety would be improved by designing to current standards and better separating strategic and local traffic.	The scheme would have an identity which reflects, conserves and enhances the character of the local landscape.	The scheme would enhance community cohesion by improving local connectivity and accessibility by helping to separate strategic and local traffic.	The scheme would contribute towards national transport policies that support economic growth.
2	The scheme would be designed to provide greater road traffic capacity, improved network resilience and better journey time reliability for strategic and local journeys.	The scheme would improve landscape and ecological connectivity through landscape and habitat restoration and creation.	The scheme would reduce rat-running on local roads through provision of a more reliable strategic route with improved capacity, thereby enhancing the amenity of local settlements.	The scheme would complement Development Plans published by local authorities in the region to support regional and local economic growth and prosperity.
3	The scheme would enhance operational efficiency, improve maintenance safety and support best value whole-life cost benefits.	The horizontal and vertical alignments of the scheme would pay due regard to the nature of the local landform.	The scheme would contribute towards community and recreational opportunities through improved provision for motorised and non-motorised users.	The scheme would contribute to the health of the local visitor economy through improved access and visitor experience of the Cotswolds AONB.
4	The scheme would consider appropriate relaxations or departures from highways standards to reduce the environmental impact of the road without compromising safety.	The siting and form of structures, cuttings, embankments and landscape mounding would reflect local topography and landform.	The scheme would reduce road noise by applying sensitive noise mitigation measures where required.	The scheme would reduce disruption to local economic interests and businesses during both construction and operation.
5		The design of structures would be of lasting architectural quality.	The scheme would reduce light pollution through sensitive structural, junction, and lighting design and sign illumination.	The scheme would restore redundant highways land to agricultural, public access, community or nature benefit uses where appropriate.
6		The scheme would avoid significant interruption to groundwater flows or negative impacts on the aquifer, springs and watercourses.	The scheme would improve air quality by reducing pollution from traffic congestion.	The scheme would support the development and employment of local skills in its construction.
7		The scheme would avoid or, where absolutely necessary, reduce the direct loss of National Trust land, other areas owned and managed for conservation, open access land and country parks and at the same	The scheme would improve continuity of access to the Public Rights of Way network, the Cotswold Way National Trail and the Gloucestershire Way long distance footpath.	The scheme would seek sustainable opportunities to use locally sourced construction materials to support the local economy.

Scheme sub-objectives			
		time reduce intrusion upon such land.	
8		The scheme would enable enhanced preservation of heritage assets and their settings and adopt designs that reflect and enhance the historic character of the area.	

2.3.6 The development of the scheme has considered the feedback received during the 2019 and 2020 statutory consultations and ongoing assessments to produce a scheme design which has been used as the basis of the DCO Application. The scheme design, and the assessment of its likely significant environmental effects, are presented in this ES.

## 2.4 Project location

- 2.4.1 The preferred route for the scheme was announced by the Secretary of State on the 14 March 2018 (the Preferred Route Announcement). The A417/A419 is located along a strategic route between Gloucester and Swindon that provides an important link between the Midlands and south of England. The route is an alternative to the M5/M4 route via Bristol. The section of the A417 near Birdlip, known as the 'Missing Link', forms the only section of single carriageway along the route and is in the Cotswolds AONB. The location of the scheme is shown in ES Figure 1.1 Location plan (Document Reference 6.3).
- 2.4.2 The surrounding area of the Existing A417 route contains a mix of agricultural land, woodland and Special Category Land. The nearest village is Birdlip, situated approximately midway between Cowley roundabout to the east and Brockworth bypass to the west. Cowley village is located east of the scheme, between Cockleford and Coberley. Crickley Hill Country Park is situated immediately west of the Air Balloon roundabout.
- 2.4.3 The scheme involves undertaking works on a Country Park, Open Access Land and registered Common Land. This land is located in the areas surrounding Crickley Hill Country Park and Barrow Wake. This is detailed further in Part 5 of the Book of Reference (Document Reference 4.3) and is shown on the Special Category Land Plans (Document Reference 2.3).
- 2.4.4 The land likely to be required temporarily or permanently for the construction, operation and maintenance of the scheme is within the DCO Boundary shown on the Land Plans (Document Reference 2.2).

## 2.5 Baseline and future baseline scenario

- 2.5.1 This section provides a description of the baseline scenario and the future baseline scenario.
- 2.5.2 For each environmental factor, as defined in ES Chapter 18 Glossary (Document Reference 6.2), the existing baseline scenario and future baseline scenario for the relevant environmental receptors and resources must be defined. These descriptions are outlined in ES Chapters 5 to 14 (Document Reference 6.2) and a high-level summary of the conditions under each scenario is provided below.

### **Baseline scenario**

- 2.5.3 The baseline scenario is the current state of the environment without implementation of the scheme. The Existing A417 operates as single carriageway between the Brockworth bypass and Cowley roundabout.
- 2.5.4 Key environmental constraints include but are not limited to:
- The Existing A417 is situated entirely within the Cotswolds AONB. Refer to ES Figure 1.4 Cotswolds AONB (Document Reference 6.3). The Cotswolds AONB is characterised by the presence of low-lying vales, steep escarpment, high wold and valleys. The escarpment also provides the setting for the Cotswold National Trail.
  - Crickley Hill and Barrow Wake Special Site of Scientific Interest (SSSI) is located adjacent to the Existing A417, on the slopes of the escarpment. Part of the SSSI is designated Common Land.
  - Cotswold Beechwoods Special Area of Conservation (SAC) lies south-west of the Existing A417.
  - Emma's Grove , a scheduled monument lies adjacent to the Existing A417. Refer to ES Figure 6.1 Designated heritage assets within one kilometre of the scheme (Document Reference 6.3) and Heritage Designation Plans (Document Reference 2.12).
  - Further south on the High Wold is Bushley Muzzard SSSI at Brimpsfield.
- 2.5.5 These environmental constraints are illustrated on ES Figure 1.3 Environmental constraints plan (Document Reference 6.4) and Environmental Features– Statutory or Non-Statutory Sites or Features of Nature Conservation (Document Reference 2.9).
- 2.5.6 Further details of the existing baseline conditions have been defined individually for each environmental factor in the relevant topic chapters (ES Chapters 5-14 (Document Reference 6.2)).

### **Future baseline scenario**

- 2.5.7 The future baseline is the likely evolution of the current state of the environment without implementation of the scheme, taking account natural changes and readily available information such as the Local Development Plan and climate change scenario data. There are two future baseline years:
- Opening year - when the scheme is to become operational, i.e. open to traffic is 2026.
  - Design year - a future year scenario 15 years after the opening year when mitigation measures are likely to have achieved their desired outcome. For this scheme it is 2041.
- 2.5.8 Potential changes to landscape in the future would not be noticeable i.e. tree and vegetation growth would not be extensive. Landscape pattern or topography is unlikely to change.
- 2.5.9 Given the relatively short period of time between the baseline scenario and 2026 (opening year) and 2041 (15 years after opening), the features and characteristics of the landscape would remain. There would likely be no perceivable change to the landform, land cover, field pattern and vegetation presence during this time. Hence the future baseline for ecological and heritage assets which contribute to the character of the landscape would remain the same as set out in the existing baseline.



2.5.10 Based on the current land use, the future baseline in the absence of the scheme is unlikely to change significantly by 2041. Subtle changes are expected due to climate change, such as some movements of certain species and local population changes; however, the overall habitats and species composition in the study area (as defined in ES Chapter 4 Environmental Assessment Methodology (Document Reference 6.2)) are expected to be broadly similar to that of the existing baseline. Therefore, the future baseline would remain the same as set out in the existing baseline.

## 2.6 Project description

2.6.1 The scheme would provide 3.4 miles (5.5 kilometres) of new, rural all-purpose dual carriageway for the A417. The new dual carriageway would connect the Existing A417 Brockworth bypass with the existing dual carriageway A417 south of Cowley. The new dual carriageway would be completed in-line with current trunk road design standards. The section to the west of the existing Air Balloon roundabout would follow the Existing A417 corridor, but to the south and east of the Air Balloon roundabout, the corridor would be offline, away from the existing road corridor.

2.6.2 The scheme has been designed so that it is sympathetic to the AONB character. It is described briefly below in three route sections:

- Climbing the escarpment (online section) – Brockworth bypass to existing Air Balloon roundabout
- Existing Air Balloon roundabout to Cowley junction (offline section) – existing Air Balloon roundabout to new Cowley junction
- Repurposing the Existing A417

2.6.3 All distances, directions, areas and lengths referred to in this document are approximate.

2.6.4 The term 'chainage' (Ch) is used to refer to the distance measured in metres along the centre line of the scheme. The chainages referred to in the text are indicated on the General Arrangement and Section Plans (Document Reference 2.6).

### **Climbing the escarpment (online section)**

#### Mainline

2.6.5 The scheme would start (from the west) on the Existing A417 to the east of the existing Witcombe Court underbridge (at Ch 0+000) and head east along the Existing A417 corridor towards the existing Air Balloon roundabout (at Ch 2+000). This is shown on General Arrangement and Section Plans (Document Reference 2.6).

2.6.6 The scheme would have three lanes climbing the escarpment (which includes a climbing lane for heavy vehicles), and two lanes descending.

2.6.7 The route would closely follow the existing road alignment south of Crickley Hill Country Park, with widening proposed on the southern side. The gradient of the existing road is variable, with one section as steep as 10%. The proposed alignment would have a consistent gradient of 8% between Ch 0+555 and Ch 1+733. This is shown on General Arrangement and Section Plans (Document Reference 2.6).

- 2.6.8 Between Ch 0+900 and Ch 1+700, the route would start to deviate from the Existing A417 road level, with the proposed road higher than the existing road level, before transitioning into cutting at approximately Ch 1+700. Earth bunding and planting would be provided along the southern side of the alignment to screen the road from the surrounding area.
- 2.6.9 The road would continue in cutting until tying into the Existing A417 levels at the location of the existing Air Balloon roundabout. The maximum depth of cut is 17 metres measured at Ch 1+800, just past the end of the 8% uphill gradient. This cutting is similar to the existing cutting at this location, although the mainline corridor would be wider. The alignment would start its horizontal deviation from the Existing A417 corridor at approximately Ch 2+000.

#### Side roads

- 2.6.10 Cold Slad Lane currently serves a number of properties to the north of the Existing A417 on the western side of Crickley Hill Country Park. It is currently connected to the Existing A417 by means of a T-junction at Ch 1+550. This junction would be removed, and a new connection created that would run parallel to the mainline and join the new Ullenwood junction.
- 2.6.11 An access to the Cricket Club would be provided via Cold Slad Lane adjacent to the new Ullenwood junction. Access and parking provision would also be provided for the Air Balloon Cottages.
- 2.6.12 Dog Lane is situated to the north of the Existing A417. It runs parallel to the A417 from Witcombe Court underbridge to Ch 0+900 where a connection is provided to continue the existing lane that runs north-south. This would maintain access between Witcombe Court underbridge and several private residences north of the A417.
- 2.6.13 Vehicular access between Dog Lane and Cold Slad Lane would be restricted and a new section of bridleway would be provided, forming an east-west Public Right of Way connection north of the A417.

#### Structures

- 2.6.14 A new bat underpass would be provided at approximately Ch 1+100 and is referred to as the Crickley Hill bat underpass.
- 2.6.15 The scheme would provide a new access to Grove Farm, replacing the existing at grade junction with an access connecting to Cold Slad Lane via an underbridge at Ch 1+680.
- 2.6.16 The scheme would include a new crossing near Emma's Grove for walkers, cyclists and horse riders including disabled users, which would accommodate the Cotswold Way National Trail. The structure would be referred to as the Cotswold Way crossing. The crossing would be provided at Ch 2+000.

### **Existing Air Balloon roundabout to Cowley junction (offline section)**

#### Mainline

- 2.6.17 At Ch 2+000 the alignment follows a right-hand curve passing in cut between the existing Air Balloon roundabout and Emma's Grove, before continuing eastbound and passing Ullen Wood on the northern side. The alignment then continues its offline path, passing between Rushwood Kennels and Birdlip Radio Station towards the new Shab Hill junction positioned in the existing valley at Shab Hill. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).

- 2.6.18 Termination of the climbing lane occurs within the Shab Hill junction extents at approximately Ch 3+200. The remainder of the scheme has two lanes in both directions.
- 2.6.19 Between Ch 3+600 and Ch 5+000 the route would continue in a south-east direction to the east of Stockwell Farm and would be at a similar level to the existing ground or in cut (up to six metres). The alignment would tie into the Existing A417 west of the existing underbridge at Ch 5+500. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).

#### Junctions

- 2.6.20 The Ullenwood junction would be a four-arm roundabout located north of the existing Air Balloon roundabout, connecting the existing A436 and Leckhampton Hill with the new A436 link road and Cold Slad Lane.
- 2.6.21 A new junction would be incorporated at Shab Hill at Ch 3+200, providing a link from the A417 to the A436 (towards the A40 and Oxford via Ullenwood junction), and to the B4070 (for Birdlip and other local destinations). The junction would be located in the existing valley and utilises a compact 'half-cloverleaf' arrangement to reduce the impact on the surrounding landscape, visual impact and adjacent properties of Rushwood Kennels and Birdlip Radio Station. Each side of the junction would be connected via a link road beneath the A417 by means of an open aspect underbridge, referred to as Shab Hill junction underbridge. Roundabouts at each end of the link would provide connection between the mainline slip roads and the local road network. Access to Birdlip village would be provided via the western roundabout and the B4070 whilst the A436 and other properties including Rushwood Kennels and surrounding farmland would be via the eastern roundabout. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).
- 2.6.22 From Ch 5+000 to Ch 5+470, the proposed Cowley junction would provide a free flow "local grade separated" junction consisting of a left in and left out arrangement on either side of the A417 mainline. This junction would serve the local road network providing links to Stockwell and other local settlements including Caudle Green, Nettleton Bottom and Brimpsfield. The junction would make use of the existing Cowley Wood Lane underbridge to allow for all directions of travel to be made. The junction would generally be in cut (up to five metres) and have landscape earthworks on the eastbound side of the junction. On either side of the eastbound junction link road, mitigation bunds would be provided to reduce the visual impact. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).
- 2.6.23 A roundabout would connect the westbound slip roads to the Existing A417 and local road network. The roundabout would also enable traffic flows to be managed during phasing of the construction works. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).
- 2.6.24 Cowley Wood Lane would be realigned east where the Cowley junction onslip/offlip ties into the existing lane. Cowley Wood Lane would be a private means of access serving properties to the north. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).

## Side Roads

### *A436 link road*

- 2.6.25 A new single carriageway is proposed to connect the existing A436, just east of the existing Air Balloon roundabout, to the new Shab Hill junction. It would run parallel to the mainline between Ch 2+150 and Ch 3+150. At its northern end it would tie into the new Ullenwood junction providing access to Cheltenham via Leckhampton Hill or the existing A436. At its southern end it would tie into the new Shab Hill junction. This would provide direct access onto the A417 mainline and the B4070 Birdlip link road to the west. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).
- 2.6.26 The proposed A436 link road would climb up to 8% from the existing A436. As such, a 3.5 metre wide climbing lane and a one metre hardstrip is proposed to accommodate slower moving vehicles travelling from the new Ullenwood junction to Shab Hill junction.

### *B4070*

- 2.6.27 A link between the Shab Hill junction and Birdlip would be provided via the realigned B4070. The link between Shab Hill junction and Barrow Wake would be a single carriageway with a segregated walkers, cyclists and horse riders (WCH) route running parallel for much of its length before diverging, prior to the Existing A417 underbridge, to connect to the Air Balloon Way (as defined in section 2.6.35). The road between Shab Hill and Barrow Wake would comprise a 6.8 metre carriageway with a 2.5 metre verge on the northern edge. On the southern side, a 3 metre WCH route is proposed with a 1.8 metre separation to the road and one metre verge. The B4070 would provide access to Birdlip Radio Station as well as Shab Hill Barn and Farm using an at-grade, staggered cross road junction arrangement. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).

### *Barrow Wake roundabout*

- 2.6.28 A new roundabout would be located at the junction between the B4070 and the entrance of the existing Barrow Wake car park. It would connect the B4070 from the new Shab Hill junction to the existing road between Birdlip and Barrow Wake and utilise the existing pavement extents where possible. The road from Barrow Wake to Birdlip would comprise a 6 metre wide carriageway with a 1.5 metre verge on its eastern side which would narrow to approximately one metre, 120 metres south of Barrow Wake to preserve mature trees in this verge. The western verge would generally be 2.5 metres and accommodate a pedestrian/cycle route. This is shown the General Arrangement and Section Plans (Document Reference 2.6).

### *Local access provisions*

- 2.6.29 A new access would be provided via the eastern roundabout of Shab Hill junction. This would enable access to Rushwood Kennels, Cuckoopen Farm and other residential dwellings via an access track designated as an unclassified road which would be 3.5 metres wide, with one metre verges on either side. This road would also be used as a WCH route connecting Cowley Footpath 1 and Footpath 15 to a proposed WCH route over the Gloucestershire Way crossing. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).
- 2.6.30 The existing Cowley Lane between Stockwell Farm and Cowley is severed by the proposed A417 mainline. The lane is reconnected by the Cowley overbridge at Ch

4+050. Cowley Lane would consist of a 3.5 metre wide carriageway, widened to four metres across the overbridge. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).

- 2.6.31 The existing Stockwell Farm access lane is also severed by the proposed A417 mainline. The lane is reconnected by the Stockwell overbridge at Ch 4+725. This is shown on the General Arrangement and Section Plans (Document Reference 2.6).

### Structures

- 2.6.32 The Gloucestershire Way crossing would be provided at Ch 2+690 as shown on the General Arrangement and Section Plans (Document Reference 2.6). The crossing would be a new 37 metre wide multi-purpose crossing to provide essential mitigation for bats and an enhancement opportunity for ecology and landscape integration. The public would also further benefit as the crossing would accommodate the Gloucestershire Way long distance footpath and provide an improved visitor experience compared to the existing situation which currently is partially along the highway.

### Repurposing the Existing A417

- 2.6.33 The current A417 between the existing Air Balloon roundabout and Cowley roundabout would be detrunked.
- 2.6.34 The Existing A417 would be retained between the new Cowley junction and the existing Stockwell Farm/A417 junction, to maintain local access for residents and businesses. Here, the Existing A417 would be narrowed and retained as a lower-class public road give the significant reduction in traffic and opportunity to provide pedestrian connections to and from the new Cowley junction area where several rights of way and local routes connect.
- 2.6.35 Between the Stockwell Farm junction and the Cotswold Way crossing, a five metre wide corridor along approximately 1.68 miles (2.7 kilometres) of the current A417 would be converted into a 'purpose built' restricted byway route for WCH including disabled users and carriages (referred to hereafter as 'Air Balloon Way'). For the Air Balloon Way extents, the majority of the remaining existing road would be broken out and planted with species-rich calcareous grassland and native hedgerow and trees to enhance the existing verges. This would enhance the landscape and better connect wildlife corridors. As part of the five metre Air Balloon Way corridor, three metres of paved surface would be retained with another two metres of soft surface to be installed, to help accommodate different users.
- 2.6.36 Engagement with stakeholders including GCC's Public Rights of Way Officer and Local Access Forum is ongoing around the proposal to designate a restricted byway between the Stockwell Farm / A417 junction and Cold Slad Lane, including across the proposed Cotswold Way crossing. This designation would allow WCH users access along the Air Balloon Way and over the Cotswold Way crossing and beyond, via the detrunked A417 and existing local roads.
- 2.6.37 Five disabled car parking bays would be provided near the Stockwell Farm / A417 junction. Further parking provision for car and horseboxes would be provided in the vicinity of the Golden Heart Inn. This would provide parking for users of the Air Balloon Way and help address recreational pressure on other areas such as at Barrow Wake and the Crickley Hill Country Park.

- 2.6.38 Three horseboxes and ten car parking spaces would be provided at the Golden Heart Inn with a pedestrian link to the Air Balloon Way, improving the provision and recreational experience for visitors to the AONB.
- 2.6.39 A section of the Existing A417 road would be demolished and landscaped to provide replacement Special Category Land (Common Land). This would be adjacent to the area of Common Land at Barrow Wake and would be of at least the same quality when compared to the Common Land to be acquired. This is shown on ES Figure 12.4 Open Access Land (Document Reference 6.3) and detailed in the Special Category Land Plan (Document reference 2.3). The replacement Common Land would be adjacent but separate to the Air Balloon Way and would have similar habitats to the common land being deregistered as part of the scheme.
- 2.6.40 The details of surfacing, signage and other arrangements would be determined with GCC at detailed design.
- 2.6.41 Access would be granted for the maintenance of existing utilities and other assets within the current A417 corridor. An easement would be agreed with the relevant utility companies (see section 2.9). It is yet to be confirmed if a maintenance bay is required or would be provided. This would be confirmed at the detailed design stage.

#### **Limits of deviation**

- 2.6.42 The assessments included within this ES are based on: the design of the scheme described within this chapter, the General Arrangement and Section Plans (Document Reference 2.6), the works described in Schedule 1 of the draft DCO (Document Reference 3.1) indicated principally on the Work Plans (Document Reference 2.4); and the maximum area of land anticipated as likely to be required, taking into account the proposed Limits of Deviation (LoD) for the scheme.
- 2.6.43 LoD have been incorporated within the DCO Boundary to allow minor modifications to be made to the scheme during the detailed design and construction stages. Such flexibility is required, for example, to enable the construction contractor to alter their working procedures or make minor adjustments to the position of certain infrastructure in response (for example) to unforeseen ground conditions.
- 2.6.44 The lateral and vertical LoD set out in article 8 of the draft DCO (Document Reference 3.1) and described below have been determined based on the design, construction and buildability factors associated with the scheme, and have been taken into consideration as part of the EIA as reported in this ES.
- 2.6.45 The lateral LoD is set out in the Works Plans (Document Reference 2.4). The lateral LoD in respect of the earthworks associated with Work Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 only is 2.0 meters except between the points outlined in Table 2-2 where they shall deviate a maximum distance outlined in the table. In respect of any other work, the lateral LoD is the DCO Boundary.

**Table 2-2 Lateral LoD**

<b>Work No. (Refer to Works Plans (Document Reference 2.4))</b>	<b>Description</b>	<b>Lateral LoD</b>
1	A417 mainline	1.0m between points A and B on sheet 1 of the Works Plans
		0m between points C and D on sheet 1 of the Works Plans
		0m between points G and H on sheet 2 of the Works Plans
1k	Cold Slad Lane	5.3m between points E and F on sheet 2 of the Works Plans
5	Gloucestershire Way crossing	1.0m between points I and J on sheet 2 of the Works Plans
6	B4070	0m between points K and L on sheet 3 of the Works Plans
		1.0m between points M and N on sheet 3 of the Works Plans
		0m between points O and P on sheet 3 of the Works Plans
10	Cowley junction	0m between points Q and R on sheet 6 of the Works Plans

2.6.46 The vertical LoD from the levels of the authorised development shown on the General Arrangement and Section Plans (Document Reference 2.6) is 0.5 metres upwards or downwards except for Work No. 4d (A436 link road) between points A1 (Chainage 0+390 as shown on sheet 2 of the Works Plans) and point B1 (Chainage 0+900 as shown on sheet 4 of the Works Plans) where it shall deviate a maximum of 0.5 metres upwards or 2.0m downwards.

2.6.47 The environmental assessment conclusions regarding likely significant effects as presented within this ES relate to the scheme as detailed in General Arrangement and Section Plans (Document Reference 2.6), and have taken into account and assessed the LoD as set out in the Works Plans (Document Reference 2.4) and article 8 of the draft DCO (Document Reference 3.1).

2.6.48 The scheme would not deviate beyond the limits identified above unless it can be demonstrated by the undertaker to the Secretary of State's satisfaction, following consultation with the relevant local planning authority and the local highway authority, that a deviation in excess of these limits would not give rise to any materially new or materially worse adverse environmental effects in comparison with those reported in the environmental statement.

2.6.49 In no case would the scheme extend beyond the defined DCO Boundary.

### **Earthworks and landscape**

2.6.50 Cut and embankment slope proposals vary along the length of the scheme. Refer to ES Figure 7.11 Environmental masterplan (Document Reference 6.3).

2.6.51 The landscape proposals include earth banks or bunds of approximately two to three metres in height, known as 'false cuttings'. These would be included along

sections of the scheme and would help reduce views of the traffic on the scheme as well as reduce noise levels to the surrounding area.

#### Crickley Hill escarpment (Online section) to Shab Hill junction

- 2.6.52 There would be a landscape bund along Crickley Hill to help screen views of the road from Barrow Wake viewpoint, the Cotswold Way National Trail along with the surrounding areas. The maximum cutting is 17 metres deep at Ch 1+800 along Crickley Hill.
- 2.6.53 The cutting slopes would typically have an overall slope angle of 35 degrees to the horizontal and may locally be steepened up to 60 degrees with intermediate benches at five metre height intervals (achieving an overall slope angle of 35 degrees), subject to ground conditions. Cut slopes would be left unfinished with rock exposures with benching to allow for natural weathering of the slope angle to replicate the existing landscape, while eliminating the need for hard engineered solutions. Rock exposures would provide opportunities for rare and protected flora and fauna communities.

#### Shab Hill junction to Cowley junction

- 2.6.54 Landscape bunds are proposed from Shab Hill junction east to Cowley junction. The bunds would be at the top of the cut slopes and the shoulders of some embankments (including local roads and on and off slips over this chainage extent). The maximum fill embankment is 20 metres high at Shab Hill junction (approximately at Ch 3+200).
- 2.6.55 The general principle for bunds is as follows:
- In areas of cutting, bunds would be two to three metres above existing ground level, located at the top of the cutting.
  - In areas of embankment, bunds would be two to three metres above proposed road level, at the top of the embankment.
  - The landscape bunds front slopes (carriageway side) would typically have a gradient of 50%, and the back slopes designed sensitively to integrate sympathetically with the surrounding landscape.

### **Structures**

- 2.6.56 Ten new structures would be provided for the scheme. Preliminary details are listed in Table 2-3.

**Table 2-3 Proposed structures**

Chainage	Structure name	Cross Section	Length
Ch 1+100	Crickley Hill bat underpass	3m (h) x 3m (w)	55m
Ch 1+725	Grove Farm underpass	4m (h) x 8m (w)	32m
Ch 2+000	Cotswold Way crossing	5m (w)	56m span and 58m ramp
Ch 2+690	Gloucestershire Way crossing	37m (w)	66m
Ch 3+200	Shab Hill junction underbridge	19m (w)	62m
Ch 4+040	Cowley overbridge	11m (w)	42m
Ch 4+735	Stockwell overbridge	11m (w)	36m

- 2.6.57 Further details about the proposed structures are in the following sub-sections.



### Crickley Hill bat underpass - Ch 1+100

- 2.6.58 Bat surveys in this area identified several species of bats crossing the Existing A417 along a section of existing woodland bordering either side of the road. The bat flight paths would be impacted by the scheme therefore a bat underpass is required as embedded mitigation.
- 2.6.59 The underpass would be a precast concrete box of three metres by three metres. Access through the underpass would be restricted with grills at either end.

### Grove Farm underpass – Ch 1+725

- 2.6.60 Grove Farm underpass would provide a link under the A417 between Cold Slad Lane and Grove Farm. It would provide connectivity for WCH, including disabled users, via the diversion of Badgeworth Bridleway 87. The underpass would also provide access from Cold Slad Lane for existing telecommunications masts located south of the A417.
- 2.6.61 Grove Farm underpass would be a prestressed beam solution. The structure would have a width of eight metres with a headroom of four metres to allow passage for emergency and refuse vehicles as well as horse riders. This would include a 3.5 metre wide carriageway which is considered typical for an accommodation access track. The remaining width would accommodate WCH including disabled users, drainage and utilities.
- 2.6.62 Low lux, directional, demand sensitive lighting would be required. The demand sensitive lighting would be available between half an hour after dawn and until half an hour before sunset between 1st April and 31st October. From 1st November – 31 March, the demand sensitive lighting would be available 24-hours a day.

### Cotswold Way crossing – Ch 2+000

- 2.6.63 The new crossing would provide mitigation for the severance of the Cotswold Way National Trail, for walkers, cyclists and horse riders including disabled users. The crossing would accommodate a five metre wide path. This would act as a continuation of the Air Balloon Way.
- 2.6.64 The crossing is located adjacent to Emma's Grove, a scheduled monument consisting of a group of three round barrows. The crossing would land between the new A417 mainline and Cold Slad Lane, to the west of Ullenwood junction.
- 2.6.65 The structure would be a single span crossing approximately 65 metres long with an approach ramp with a gradient of approximately 5% to allow access for all users.

### Gloucestershire Way crossing - Ch 2+690

- 2.6.66 The Gloucestershire Way crossing provides essential mitigation for bats and an enhancement opportunity for ecology and landscape integration.
- 2.6.67 The crossing contributes to the delivery of the scheme vision by seeking to conserve and enhance the special character of the Cotswolds AONB, providing safe recreational access away from the busy road and providing landscape and habitat connectivity. The crossing reconnects the Gloucestershire Way long distance footpath (which would usually have been directed through the Shab Hill junction via an underpass) and link key landscape features in the areas, including Ullen Wood, Emma's Grove and the Air Balloon Way.

- 2.6.68 It would improve access to places of historical interest, such as Emma's Grove and Barrow Wake, thereby providing cultural heritage benefits.
- 2.6.69 The crossing would provide habitat connectivity between areas of woodland and grassland and forms part of the overall strategy to provide landscape mitigation and permeability for biodiversity and people across the proposed A417.
- 2.6.70 The location for this crossing has been selected due to landscape and ecological data to address severance of the landscape, field pattern and field boundary features and with regard to protected species, principally to the network of bat roosts, commuting routes and feeding areas that would be severed and fragmented by the scheme. The crossing provides landscape integration and would ensure bats and other wildlife (such as badgers and barn owls) can travel between Ullenwood and existing feeding and resting locations on the other side of the proposed highway.
- 2.6.71 The structure would be a two span steel composite beam structure approximately 70 metres long. The crossing would be integral with the abutments and piers. The crossing would be wide enough to accommodate and separate wildlife and people and would be 37 metres wide, to include the following:
- 3.5 metres provision for walkers, cyclists, and horse riders, including disabled users
  - 25 metres wildlife area comprising calcareous grassland (as essential mitigation and enhancement for biodiversity and landscape)
  - 1.5 metres maintenance strip (health and safety requirement)
  - 2 x 3 metres native species-rich hedgerows (essential mitigation for bats and to separate wildlife from the WCH route)
  - 2 x 0.5 metre parapet beams

#### Shab Hill junction underbridge – Ch 3+200

- 2.6.72 Shab Hill junction underbridge would carry the A417 mainline over the B4070. The structure would be a single span, integral precast prestressed concrete beam solution with a cast in situ concrete deck. The clear span would be approximately 19 metres long and the deck 62 metres wide, carrying the A417 dual carriageway, a central reserve, two single carriageway slip roads and four verges / hard shoulders.
- 2.6.73 The precast beams would be U-shaped beams, with a structural depth of one metre. The span would be connected integrally to the full height reinforced concrete abutment to the north and the part-height abutment to the south. The abutments would be founded on piled foundations.

#### Cowley overbridge – Ch 4+040

- 2.6.74 Cowley overbridge would span the proposed A417 at a skew of 17 degrees relative to the carriageway. The crossing would provide connectivity to the local road network and includes the planting of a continuous native species-rich hedgerow, to provide continuity from the tree lines already proposed leading up to the bridge, which replace the existing treeline features in the landscape. The hedgerow provides essential mitigation for bats and landscape integration.
- 2.6.75 The structure would be a single span, integral composite steel girder and concrete deck highway overbridge. The bridge deck would be 11 metres wide in total, carrying a single lane four metre wide carriageway with a three metre wide verge either side of the carriageway and two edge beams. The deck would be square to the abutments with a clear span of 48 metres.

- 2.6.76 The steel girders would have variable depth along the span, reducing towards midspan. The span is connected integrally to the part-height reinforced concrete abutments and founded on piled foundations.

Stockwell overbridge – Ch 4+735

- 2.6.77 Stockwell overbridge would span the proposed A417 at a skew of 11 degrees relative to the carriageway. The crossing would provide a private means of access with two verges consisting of continuous native species-rich hedgerows, to provide continuity from the tree lines already proposed leading up to the bridge, which replace the existing treeline features in the landscape. The hedgerows provide essential mitigation for bats and landscape integration
- 2.6.78 The structure would be a single span, integral composite steel girder and concrete deck highway overbridge. The bridge deck would be 11 metres wide in total, carrying a single lane 3.5 metre wide gravel track carriageway with a two metre wide verge either side of the carriageway and two edge beams. The road would be widened across the crossing to four metres with three metre verges. The deck would be square to the abutments with a clear span of 48 metres.
- 2.6.79 The steel girders would have variable depth along the span, reducing towards midspan. The span is connected integrally to the part-height reinforced concrete abutments and founded on piled foundations.

Mammal culverts – Ch 3+200, Ch 3+410 and Ch 4+780

- 2.6.80 Mammal culverts are required for badgers, one under the B4070 (at Ch 3+200 along B4070) and two under the A417 mainline (at Ch 3+410 and Ch 4+780). These would provide safe crossing points. Further details can be found in ES Chapter 8 Biodiversity, section 8.9 Design, mitigation and enhancement measures (Document Reference 6.2).

**Laybys**

- 2.6.81 Four laybys are proposed, two on the eastbound carriageway and two on the westbound carriageway. The location of the laybys shown on General Arrangement and Section Plans (Document Reference 2.6) which are labelled as follows:
- EB1 Ch0+000 to Ch 0+375
  - EB2 Ch4+285 to Ch4+660
  - WB1 Ch0+000 to Ch0+375
  - WB2 Ch4+115 to 4+490

**Ground stabilisation measures**

- 2.6.82 The northern slopes of Crickley Hill are susceptible to ongoing slope movements and instability which have the potential to impact users of both the mainline highway and Cold Slad Lane. Refer to ES Figure 13.17 Groundwater conceptual model locations (Document Reference 6.3) for the general arrangement at the location and sections C-C' and D-D' in ES Figure 13.10 Groundwater conceptual model cross section (Document Reference 6.3) for the hydrogeological conceptualisation.
- 2.6.83 Mitigation or stabilisation measures are considered to be required to manage this risk. The installation of inclined horizontal drains has been proposed to control

groundwater pressures within the slopes and mitigate the risk of potential slope instability. These would be located approximately between:

- CH0+680 to CH1+730, northern side of the A417
- CH0+820 to CH1+050, southern side of the A417

2.6.84 The horizontal drains would comprise shallow inclined perforated drainage pipes which would be installed by drilling into the slope from the highway verge. All intercepted groundwater would be carried from the horizontal drains into the road drainage network to a surface water discharge point, within the same receiving water that the groundwater would naturally have discharged to. The drains would be up to 50 metre long. It is not proposed that any slope drainage be installed beneath the existing residential properties up Crickley Hill, including Halfacres and Fernbank.

2.6.85 Further details of both the slope stability assessments undertaken and the design of the horizontal drains are outlined in ES Appendix 9.2 Preliminary Ground Investigation Report (Document Reference 6.4). For the purposes of the ES it is a complete and robust baseline.

### **Flood risk**

2.6.86 All sources of flood risk to and from the scheme, including the impact of a changing climate on flood risk, have been assessed as part of ES Appendix 13.3 Flood Risk Assessment (Document Reference 6.4) and are reported in ES Chapter 13 Road Drainage and the Water Environment (Document Reference 6.2).

### **Drainage design overview**

2.6.87 The scheme drainage design has been developed in accordance with the Design Manual for Roads and Bridges (DMRB) CG 501 Design of highway drainage systems and LA 113 Road drainage and the water environment. The requirements of the National Policy Statement for National Networks (NPSNN) and the National Planning Policy Framework (NPPF) have also been considered in the design process, alongside advice from environmental practitioners responsible for undertaking water related assessments reported in ES Chapter 13 Road Drainage and the Water Environment (Document Reference 6.2).

2.6.88 Carriageway run off would be collected and attenuated via drainage basins connecting via outfalls into local watercourses. The location of drainage basins is illustrated on ES Figure 7.11 Environmental Masterplans (Document Reference 6.3). Details of the drainage proposals can be found in ES Appendix 13.10 Drainage Report (Document Reference 6.4). Existing discharge rates would be maintained to all existing outfalls and discharge rates to new outfalls would be reduced to existing greenfield runoff rates.

2.6.89 Details of the proposed drainage have been developed in discussion with the Lead Local Flood Authority (LLFA) and Environment Agency.

2.6.90 The drainage design includes an allowance for the effects of climate change. Attenuation has been provided for up to and including 100 years plus 40% climate change allowance, through sustainable urban drainage system (SuDs) features.

### **Tributary of Norman's Brook**

2.6.91 The tributary of Norman's Brook, as shown on General Arrangement and Section Plans (Document Reference 2.6), is the principal watercourse receiving flows from the western part of the scheme. The widening and change in alignment of

the A417 up Crickley Hill would impact this watercourse directly. The new embankment formed as part of the landscape earthworks would require the realignment of the watercourse on the south side of the new A417 embankment, between Grove Farm and the existing culvert near Crickley Hill Farm (Flyup 417 Bike Park). It also requires an existing culvert to be modified and extended in the vicinity of Dog Lane and Crickley Hill Farm (Flyup 417 Bike Park).

2.6.92 The scheme would seek to open up existing sections of culverted watercourse and minimise the introduction of new culverted sections of watercourse wherever possible. Further details on the design are report in ES Appendix 13.10 Drainage Report (Document Reference 6.4).

2.6.93 The scheme would maintain the existing character and geomorphology of the existing stream by replicating existing features such as cascades, weirs, pools and irregular meanders. The detail of this would be developed at the detail design stage.

### **Public Rights of Way**

2.6.94 A network of Public Rights of Way (PRoW) crosses the A417 corridor. The network comprises primarily of footpaths in addition to a small number of bridleways and restricted byways. Safe crossing points are limited where these routes interface with the Existing A417. A key feature of the PRoW network in the area is the Cotswold Way, a National Trail. There is also the Gloucestershire Way long distance footpath.

2.6.95 The scheme aims to ensure that existing routes remain accessible where possible for the local community and visitors to the area. Necessary mitigation and opportunities for enhancement of the WCH network have been explored with stakeholders.

2.6.96 The scheme would provide several new and safe PRoW crossings across both the online and offline sections of proposed A417 through the construction of overbridges and underpasses.

2.6.97 The details are presented in Annex F Public Rights of Way Management Plan of ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4) and in ES Chapter 12 Population and Human Health (Document Reference 6.2).

### **Lighting**

2.6.98 Given the AONB context, and the environmental sensitivity of the scheme, avoiding and minimising light pollution is a key consideration.

2.6.99 In line with the *Cotswolds Dark Skies & Artificial Light Position Statement* published by CCB, there would be no permanent road lighting associated with the scheme.

2.6.100 Existing road lighting affected by the scheme would be removed. This includes lighting at Cowely junction and the Air Balloon roundabout. Temporary construction lighting would be intermittently used throughout the construction phase for select operations in isolated locations only.

### **Fencing, walling and other boundary treatments**

2.6.101 Boundary treatment would be provided to demarcate the extent of highways authority ownership. The boundary treatment may comprise of timber post and four rail fencing, stockproof fencing, mammal proof fencing or other landscape-led proposals such as hedgerows and dry-stone walling. Fencing, walls and hedges would also be provided within the DCO Boundary and vary in form and function.

Materials for the boundary treatment would be determined at detailed design unless otherwise specified. Details can be found on the ES Figure 7.11 Environmental Masterplan (Document Reference 6.3).

- 2.6.102 Where a timber post and four rail fence demarcate the highways ownership boundary, the adjacent landowner would maintain the fence from their side, while the highways authority maintain from the road side. Where a mammal fence or wall demarcates the boundary, a maintenance strip would be acquired for the highway authority to maintain from the landowner side.

### Technology

- 2.6.103 The scheme would include limited technology to support the maintenance and operation of the scheme.
- 2.6.104 The following equipment would be proposed on the scheme and can be found on the General Arrangement and Section Plans (Document Reference 2.6):
- 5 CCTV cameras (3 on Crickley Hill, 1 at Shab Hill junction, 1 at Cowley junction)
  - 1 weather station at Shab Hill junction
  - 4 emergency roadside telephones, located in each of the public lay-bys
  - 3 traffic counters (2 arrays per site)
  - 4 automatic number plate recognition cameras

### Off site works

- 2.6.105 No off site works are identified. Details of any off-site works required to facilitate the development (delivered by Highways England or other parties) would be considered at detailed design where applicable.

## 2.7 Environmental management plan (EMP)

- 2.7.1 An EMP has been developed and is presented in ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4). This forms the EMP (design). The EMP includes scheme specific actions identified through the EIA process for all environmental factors and includes a Register of Environmental Actions and Commitments.
- 2.7.2 The EMP sets out the measures for control of environmental effects through all lifecycle stages from the design stage in accordance with Table 2-4.

**Table 2-4 Delivery schedule and updates of the EMP**

Project stage	EMP iteration	Produced/refined
Design	First iteration of EMP (formerly outline EMP) produced during the design stage for the preferred option.	Produced
Construction (refined for the consented project)	Second iteration of EMP (formerly construction EMP) refined during the construction stage for the consented project, in advance of construction.	Refined
End of construction	Third iteration of EMP (formerly handover EMP) building on the construction EMP refined at the end of the construction stage to support future management and operation.	Refined

- 2.7.3 Prior to the commencement of the construction, the EMP would be refined by the contractor, in line with DMRB *LA 120 Environmental management plans*<sup>1</sup>. This would form the EMP (construction).

- 2.7.4 Upon completion of construction of the scheme the EMP (construction) must be converted into the EMP (end of construction).

## 2.8 Embedded environmental mitigation

2.8.1 The scheme design has emerged as part of an iterative process between the Applicant's engineering, environmental design and assessment teams, and through active engagement with statutory consultees, key stakeholders and the wider public. Throughout the iterative design process, interventions have been made and integrated into the scheme with the primary purpose of avoiding or reducing adverse effects at source and to make the scheme fit better into its landscape setting. These measures are considered integral to the scheme and are termed "embedded mitigation".

2.8.2 Essential mitigation and any enhancement measures are reported in each environmental factor chapter (ES Chapters 5-14 (Document Reference 6.2)). Further details on the approach to mitigation of impacts can be found in ES Chapter 4 Environmental assessment methodology (Document Reference 6.2).

2.8.3 The Environmental Masterplans presented in ES Figure 7.11 Environmental Masterplans (Document Reference 6.3) shows both embedded and essential mitigation measures.

2.8.4 The environmental design incorporates mitigation and enhancements to create a coordinated coherent scheme. These are identified on ES Figure 7.11 Environmental Masterplans (Document Reference 6.3).

### Embedded mitigation

2.8.5 The following section identifies design and construction measures which are integrated into the scheme to avoid, prevent or reduce adverse environmental effects both during construction and operation of the scheme.

2.8.6 A construction stage EMP, (referred to as EMP (construction)) will be prepared and used to manage environmental impacts to air, land and water from construction operations. This will include a commitment to follow appropriate industry best practice and published guidelines to reduce pollutant and sediment movement. An EMP (design) is provided in ES Appendix 2.1 EMP (Document Reference 6.4) and the measures contained would be implemented during the construction phase of the scheme.

2.8.7 A Construction Traffic Management Plan will be prepared to secure appropriate routing and management of construction traffic. An outline Construction Traffic Management Plan is provided as Annex B of Appendix 2.1 EMP (Document Reference 6.4).

### Air quality

2.8.8 The scheme design moves traffic away from local sensitive receptors, in particular those receptors in the existing Birdlip Air Quality Management Areas. By moving traffic away from receptors, it allows a greater distance over which pollutants can disperse.

2.8.9 Best practice mitigation measures to reduce effects from construction dust are included in ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4).

### Cultural heritage

- 2.8.10 A construction compound was originally to be located next to Cowley junction. This has been relocated as a result of the geophysical survey results, to avoid potential physical impacts to buried assets, including the known Roman village (see ES Chapter 6 Cultural Heritage (Document Reference 6.2)). This has avoided potential physical impacts arising.

### Landscape and visual

- 2.8.11 Landscape character has been considered throughout the design process forming a key driver in shaping the engineered design form and location of other scheme features. The landscape design is set out on ES Figure 7.11 Environmental Masterplans (Document Reference 6.3) and includes a large number of measures to avoid landscape impacts.
- 2.8.12 The proposed gradient along the Crickley Hill section (Ch 1+000 to 1+400) has been reduced from 25 metres to 17 metres as the design has evolved in order to reduce the depth and width of the cutting. This helps avoid the need for large engineered retaining structures, reduces the scheme's footprint and effect on the character of the escarpment landscape character area.
- 2.8.13 The vertical alignment of the mainline has been adjusted to sit below the existing ground level to help set the scheme into the high wold landscape character area, with the addition of landscape and acoustic bunding to better integrate the scheme into the undulating character of the landscape, reducing visual and acoustic effects.
- 2.8.14 Compounds and other construction facilities have been sited sympathetically within the landscape, via a comprehensive site selection process, and located on arable fields where possible to aid restoration post construction.

### *Trees and woodland*

- 2.8.15 Every effort has been made to avoid, protect and retain existing trees (including ancient woodland and veteran trees) where practicable and in accordance with BS5837:2012. The potential loss of ancient woodland at Ullenwood has been avoided by altering the location of the Ullenwood roundabout and associated linking roads.
- 2.8.16 The proposed gradient along the Crickley Hill section (Ch 1+000 to 1+400) has been reduced from 25 metres to 17 metres as the design has evolved in order to reduce the depth and width of the cutting. This has enabled a reduction in the potential loss of woodland at Emma's Grove, adjacent to the Existing A417.
- 2.8.17 The landscape character and sensitive landscape features have been protected by re-locating the crusher and material stockpile compound on the south side of the new alignment of the A417 between Ch 2+300 and Ch 2+600. This has moved it from species rich grassland to within arable fields. This has also avoided impact on Ullenwood ancient woodland during construction.
- 2.8.18 Woodland planting has been used to integrate the attenuation basins at Ullenwood junction, within the grounds of National Star College and screen the new junction from sensitive users of the college. Proposed woodland provides visual and physical connectivity with Ullenwood ancient woodland.

### *Cowley and Shab Hill junctions*

- 2.8.19 Cowley and Shab Hill junctions have been designed to integrate them in the landscape using a combination of woodland planting with landscape earthworks



to help visually screen the road infrastructure. The vertical and horizontal alignment changes between Shab Hill junction and Cowley junction have been designed to better match the existing topography and create cuttings to minimise impact on the landscape.

- 2.8.20 The visual prominence and landscape effect of Shab Hill junction has been refined to reduce the footprint and height of the junction reducing the effect on the high wold valley and high wold landscape and to reduce its visual presence for sensitive receptor groups, mainly users of the Gloucestershire Way long distance footpath and the community of Shab Hill (Rushwood Kennels). This has avoided the need for a highly visible engineered structure (viaduct or long span overbridge) at Coldwell Bottom dry valley by filling in the head of the valley, altering the landform and providing mitigation planting. The footprint of the Shab Hill junction has also been reduced with the inclusion of WCH access via Gloucestershire Way Crossing.
- 2.8.21 Drainage basins would be located within Shab Hill junction (Ch 3+200) to reduce the overall footprint of the scheme, reducing its landscape and visual effect.
- 2.8.22 Cowley junction (Ch 5+000 to Ch 5+470) would be enclosed by landscape bunding to integrate it into the local landscape, reducing its landscape and visual effects.

#### *Earthworks*

- 2.8.23 Earthworks and false cuttings are a sympathetic design to the AONB character using gently engineered slopes to tie into existing topography, sustainably constructed from excavated materials. Embankments have been graded out to slopes which reflect the surrounding topography. This would integrate the scheme with the existing landform and allows the adjacent land to be returned to agricultural use.
- 2.8.24 The cutting slopes would typically have an overall slope angle of 35 degrees to the horizontal and may locally be steepened up to 60 degrees with intermediate benches at five metre height intervals (achieving an overall slope angle of 35 degrees), subject to ground conditions. This would reduce the width and footprint of the cutting and so reduce the associated landscape and visual effects.
- 2.8.25 Cut slopes would be left unfinished with rock exposures with benching to allow for natural weathering of the slope angle to replicate the existing landscape, while eliminating the need for hard engineered solutions. Rock exposures would provide opportunities for rare and protected flora and fauna communities.
- 2.8.26 Earthworks at Shab Hill junction (Ch 3+200) fill in the head of the valley, setting the infrastructure into the landscape, reducing its scale and prominence helping to tie it into the local topography.

#### *Drainage*

- 2.8.27 Attenuation basins and drainage features have been integrated into the landscape by designing the shape of each basin to reflect the surrounding topography. The attenuation basins have been enclosed by new woodland planting to further reduce the landscape and visual effects. They have also been located away from existing woodland to limit the amount of woodland lost.

#### *Structures*

- 2.8.28 The scheme has avoided potential visual impacts arising through design changes (refer to ES Chapter 3 Assessment of Alternatives (Document Reference 6.2)) by

removing and reducing retaining walls through the escarpment. The depth of cutting through the escarpment has reduced as the design of the scheme has evolved from 25 metres to 17 metres. These changes have removed the need for long and tall retaining walls through the cut section.

- 2.8.29 Bridges and structures would be of high architectural quality (further details provided in Design Document (Document Reference 7.7)), finished in locally sourced material and other materials which complement the local vernacular. This would be considered as part of the detailed design.
- 2.8.30 Careful placement of structures within the landscape has been considered to reduce their effect on topography and character of the area, while meeting their access and biodiversity purposes. Bridges and structures would be of high architectural quality, finished in locally sourced material and other materials which complement the local vernacular.
- 2.8.31 Cowley (Ch 4+040) and Stockwell (Ch 4+725) overbridges would be positioned low in the landscape, reducing their visual effect, and helping to integrate them into the surrounding landform when combined with the proposed landscape bunds. This is possible because of the carefully designed vertical alignment of the scheme set below the existing ground level.

#### *Air Balloon Way*

- 2.8.32 As described in section 2.6 Project description of this chapter, the Air Balloon Way would be provided along the repurposed A417 to provide a 5m wide 'purpose-built' route for WCH with a restricted byway designation. Hardstanding (combination of tarmac and crushed stone) would be retained and improved for cyclists and wheelchair users, with a soft margin for horse riders. The remaining width of the repurposed A417 would be overlain with subsoil and topsoil for planting new trees and hedgerow with species rich seed mixes to enhance this new and planting.
- 2.8.33 The Air Balloon Way has been extended along the repurposed A417, which would avoid the need for an additional access to the Barrow Wake car park and reduce the risk of people accessing the Crickley Hill and Barrow Wake SSSI from the Air Balloon Way.
- 2.8.34 The creation of calcareous grassland by changing the land use from arable to pasture, and the inclusion of grassland along the Air Balloon Way and highway verge would contribute to the special qualities of the AONB.

#### *B4070*

- 2.8.35 The provision of a new roundabout and making use of the existing rural lane and underpass at Barrow Wake to reconnect into the historic A417 utilises the existing carriageway footprint. This avoids subdividing fields and disrupting historic field patterns.

#### *Barrow Wake*

- 2.8.36 The entrance to Barrow Wake has been improved by creating an opportunity for natural surveillance which should discourage and reduce antisocial behaviour in the area and make the area more user and family friendly.
- 2.8.37 Further improvement works to Barrow Wake car park include resurfacing, drainage and reconfigured parking spaces and some tree planting.

*Highway alignment*

- 2.8.38 Topographical levels along sections of the old A417 alignment would be reinstated to restore land to original levels, infilling sections using site won excavated materials, likely from the cutting through the escarpment. This process would help achieve a cut and fill balance across the scheme.

*PRoW*

- 2.8.39 Within the AONB there would be improvements to PRoW and recreational routes for walkers, cyclists and horse riders, including disabled users, which would enhance the area's special qualities. There would be traffic free crossings of the A417 at the Cotswold Way crossing and Gloucestershire Way crossing, with further grade separated crossings at Grove Farm underpass, Cowley overbridge and Stockwell overbridge. Further improvements to the scheme design include linking up Dog Lane with Cold Slad Lane with a new bridleway, providing safe connections to Cowley junction and across the realigned B4070, and the provision of the traffic free Air Balloon Way WCH route along the repurposed A417.
- 2.8.40 Further details are provided in Annex F PRoW Management Plan (ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4)).

Biodiversity

- 2.8.41 The design of the scheme aims to primarily avoid or reduce the impacts of habitat loss, habitat degradation, habitat fragmentation and species mortality.

*Habitat loss and degradation*

- 2.8.42 The potential loss of ancient woodland at Ullenwood has been avoided by altering the location of the roundabout and associated linking roads. The loss of other priority habitats including broadleaved deciduous woodland at Shab Hill and Emma's Grove, has also been reduced where possible due to alteration of junction alignments and design although it was not possible to avoid these locations completely. The landscape design results in an increase in area of native species-rich hedgerows, broadleaved woodland and calcareous grassland compared to the area lost due to construction.
- 2.8.43 The proposed location of the material crushing compound has been moved south of the mainline of the scheme to be over 200 metres away from the Ullenwood ancient woodland. This has avoided potential habitat degradation due to dust deposition.
- 2.8.44 A footpath (Badgeworth footpath 89) has been diverted to avoid cutting through SSSI woodland and calcareous grassland so as not to incur further loss or degradation of the SSSI habitat.
- 2.8.45 Retaining walls have been designed to include niches and ledges within the rock faces to maximise opportunity for biodiversity allowing natural colonisation of vegetation and provide habitat for invertebrates. The total area of this proposed habitat is approximately 2 hectares.
- 2.8.46 Attenuation basins would serve to protect habitat adjacent to the road scheme from surface water run-off and pollution events hence reducing the risk of habitat degradation.

*Habitat fragmentation and species mortality*

- 2.8.47 Habitat creation would be designed to create new wildlife corridors and link existing but isolated areas of habitat such as small woodlands. All habitat planting and species selection would consider the potential effects of future climate change to ensure establishment and resilience in the longer term and take into account the requirement for mobility of species throughout the landscape.
- 2.8.48 Habitat fragmentation is being mitigated where possible, with the locations of structures determined by ecological survey data. The Gloucestershire Way crossing would be a multi-purpose crossing to the north of Shab Hill that would be 37 metres wide and would provide essential mitigation for bats. The crossing would also provide a WCH route to continue the Gloucestershire Way long distance path. The bridge deck would include 25 metres of calcareous grassland and two native species-rich hedgerows three metres wide, which would connect to woodland, hedgerows with tree and calcareous grassland planting either side of the crossing.
- 2.8.49 The woodland planting either side of the Gloucestershire Way crossing has been designed to link the existing woodlands of Ullenwood and Emma's Grove, providing a green corridor for bats and other wildlife such as badgers, barn owl, fox and deer to enable their movement across the scheme. Hedgerows on the crossing would be planted on hedge-banks that would be constructed to provide essential mitigation for bats.
- 2.8.50 The bridleway on the Gloucestershire Way crossing would be segregated from the habitat proposed for use by wildlife by a thick hedgerow to avoid disturbance to the wildlife and degradation of the habitat.
- 2.8.51 The construction of the Gloucestershire Way crossing would require a satellite compound which would be situated in adjacent arable pasture to the west of the crossing. The compound and construction footprint for the crossing would avoid the loss of priority woodland, calcareous grassland habitat and irreplaceable habitat such as veteran trees.
- 2.8.52 Two overbridges are provided to maintain existing minor roads and farm tracks at Cowley Lane (Ch 4+040) and Stockwell Lane (Ch 4+725). Cowley overbridge has been designed to include a minimum three metre wide soft verge to include native species-rich hedgerow on one side and Stockwell overbridge includes a three metre soft verge for hedgerows on both sides of the crossing in order to maintain habitat connectivity across the new road for many species.
- 2.8.53 The Existing A417 between the Stockwell Farm junction and the Cotswold Way crossing would be converted into a 'purpose built' restricted byway route. Existing verges would be improved to provide wider calcareous grassland verges with hedges and trees which would restore habitat connectivity in an east to west and north to south direction for wildlife, providing foraging and commuting habitat for bats, barn owls and other bird species, reptiles, badgers and invertebrates.
- 2.8.54 The scheme is in cutting for much of its length which reduces the risk of mortality of birds and bats that may fly over the new road corridor. In addition, the provision of false cuttings, typically two metres or more in height, for landscape and noise purposes also act as mitigation to reduce the risk of mortality by encouraging birds and bats to fly above the height of most vehicles.
- 2.8.55 Culverts/mammal tunnels and underbridges are proposed as wildlife crossings within the scheme to maintain connectivity for animal dispersal across the

landscape and reduce wildlife use of the road, thus reducing animal fatalities and the effects of habitat fragmentation. Locations for such crossings are based on baseline data indicating the requirement for a wildlife crossing.

- 2.8.56 Underpasses designed specifically for use by wildlife would not be lit, to prevent disturbance to the target species which are nocturnal.
- 2.8.57 A summary of the culverts/mammal tunnels and underpasses can be found in Table 2-5. It should be noted that although the structures are designed for target species based on baseline information, the dimensions and design may be suitable for other species to use these crossings such as reptiles, amphibians, invertebrates and other birds and mammals.

**Table 2-5 Wildlife culverts and underpasses**

Target Species	Structure	Location	Chainage	Dimension	Length
Badger	Culvert	Shab Hill side road (B4070)	0+390	600 mm	37 m
Bats	Underpass	East of Flyup 417 Bike Park	1+100	3 m (h) x 3 m (w)	55m
Badger	Culvert	Shab Hill junction south	3+460	750 mm +	112 m
Badger	Culvert	South of Stockwell overbridge	4+800	600 mm +	58 m

#### *Bats*

- 2.8.58 An underpass specifically designed for bats would be constructed under the A417 at Ch 1+100 in order to address fragmentation impacts. This location was chosen based on the radio-tracking data of several Annex II species crossing the road in this area. The underpass would be a minimum of three metres by three metres and approximately 50 metres long. Landscape planting and height management of existing trees around the entrances to the underpass would ensure that bats are guided into the underpass rather than being encouraged up embankment slopes towards the road. Landscape planting would also be designed to provide a buffer between lit working areas during construction, and light spill from headlights at night during operation of the scheme.
- 2.8.59 As mentioned above, the Gloucestershire Way crossing would be a multi-purpose crossing to the north of Shab Hill that would be in the region of 37 metres wide incorporating 25 metres of calcareous grassland and two native species rich hedgerows which would provide essential mitigation for bats.
- 2.8.60 The overall scheme and especially any underpasses designed specifically for use by wildlife would not be lit, to prevent disturbance to the target species which are nocturnal and which reduces potential impact to foraging and commuting bats and potential disturbance to roosting bats due to lighting. Low lux, directional, demand sensitive lighting might be required at Grove Farm underpass. The demand sensitive lighting would be available between half an hour after dawn and until half an hour before sunset between 01 April and 31 October. From 01 November – 31 March, the demand sensitive lighting would be available 24-hours a day. The scheme is assessed in ES Chapter 8 Biodiversity (Document Reference 6.2) on this basis.

#### *Badgers*

- 2.8.61 Badgers were found to be highly active throughout the scheme. Three mammal culverts, as shown in Table 2-3, have been positioned within existing badger territories, as identified during badger surveys, which would be severed by the scheme. All would be a minimum of 600 millimetres in diameter and all designed

so that the tunnel and approach to the tunnel would be dry at all times with suitable approach gradients. The opportunities for location of mammal tunnels were limited due to the road design much of which is in steep cuttings, but all are within an appropriate distance of existing badger routes and setts.

- 2.8.62 Wildlife fencing for badgers has been included in the scheme design throughout the majority of the length of the scheme due to the complexity of some of the junction layouts. The fencing is designed to funnel badgers and potentially other species through the wildlife crossings and overbridges and away from potential entry onto the road network, for example via side roads or property access roads to reduce the risk of mortality from road traffic collisions. One-way gates would be provided where this is considered to be a risk, so that badgers can exit the road network. Badger fencing is in most cases synonymous with the highways fencing location and is shown on ES Figure 7.11 Environmental Masterplan (Document Reference 6.3).

#### *Terrestrial invertebrates*

- 2.8.63 Woodland at Crickley Hill is of national importance for invertebrates specifically saproxylic beetles. Changes to the scheme have resulted in impacts to the Crickley Hill woodland being avoided.

#### Geology and soils

- 2.8.64 The depth of cutting through the escarpment has reduced from 25 metres to 17 metres as the design has evolved. The raising of the alignment up Crickley Hill has avoided the need to intercept the underlying Lias Clay, a vulnerable formation with deep-seated failures.
- 2.8.65 The existing geological exposures at Crickley Hill have been avoided to reduce impacts on the designated geological features at Crickley Hill and Barrow Wake SSSI.
- 2.8.66 The scheme footprint has been reduced and designed to avoid best and most versatile land and to reduce impacts on soil resources.

#### Material assets and waste

- 2.8.67 The depth of cutting through the escarpment has reduced from 25 metres to 17 metres as the design has evolved, considerably reducing the amount of excess excavated material. This is positive because it reduces the number of associated traffic movements to remove the material off-site and avoids the possibility of any impact on waste infrastructure in the area.
- 2.8.68 The earthworks strategy and scheme design allows for the materials which would be excavated on-site, to be re-used at areas of the DCO Boundary where materials are required, for example, to blend new highway embankments into the existing topography. This avoids and reduces the amount of material that is required from off-site sources in some cases.

#### Noise and vibration

- 2.8.69 A lower noise road surface would be incorporated throughout the scheme.
- 2.8.70 Mitigation measures designed into the scheme to reduce impacts, including noise during operation are achieved through careful design of the horizontal and vertical alignment of the road. The proposed alignment of the road results in the creation of cuttings, and roadside landscaping and screening in the form of earthworks bunds. This has resulted in the number of people adversely affected by noise across the scheme being reduced. The approach is in line with the aim of

government noise policy to minimise, as far as is sustainable, adverse impact on health and quality of life.

- 2.8.71 The horizontal and vertical alignment of the scheme, as part of the engineering design, has resulted in larger distances between the dwellings and the proposed new A417 in some locations (principally Birdlip), or increased screening (from cuttings). This would result in reduced noise exposures which are identified in ES Chapter 11 Noise and vibration (Document Reference 6.2).
- 2.8.72 In particular, the engineering design has addressed, where practicable, dwellings currently in very close proximity to the existing road which are exposed to high noise levels. For example, the Air Balloon Cottages where the alignment of the scheme has moved further south.
- 2.8.73 The noise reductions in Noise Important Areas respond to the requirement stated in the revised 2019 National Planning Policy Framework (described in ES Chapter 11 Noise and Vibration (Document Reference 6.2)) that ‘development should, wherever possible, help to improve local environmental conditions...’, and hence provide enhancement where sustainable to do so.
- 2.8.74 With regard to expansion joints for bridges, the scheme design assumes integral bridges (with no bearings and no expansion joints). Hence, there would be no movement gaps which could potentially give rise to groundborne noise or vibration, or airborne noise as tyres impact the edges of any such joint. Best Practicable Means (BPM) is assumed as embedded mitigation to control construction noise in the form of low noise emission plant and processes (as specified in BS 5228 Annex B - Noise sources, remedies and their effectiveness).
- 2.8.75 BPM would include noise and vibration control - for example:
- The selection of quiet and low vibration equipment.
  - Review of construction programme and methodology to consider quieter methods (including non-vibratory compaction plant, where required).
  - Sensitive location of equipment on site, control of working hours, to be set out and controlled through a Section 61 agreement, described in ES Appendix 2.1 EMP (Document Reference 6.4).
  - The provision of acoustic enclosures where feasible and the use of less intrusive alarms, such as broadband vehicle reversing warnings.
  - Screening where practicable - for example local screening of equipment, perimeter hoarding or the use of temporary stockpiles.
  - Training of site personnel
  - Provision of information to the public

#### Population and human health

- 2.8.76 The scheme and its junctions have been designed to appropriate standards (DMRB), to allow safe access to existing properties, land, businesses, facilities and services. For example, existing crossings and access arrangements interacting with the Existing A417 would largely be provided with appropriate diversions or replacement infrastructure as part of the scheme.
- 2.8.77 The proposals for PRoW are described in the section ‘PRoW’ (paragraph 2.8.39).
- 2.8.78 The location for the replacement Common Land is described in the section ‘Repurposing the Existing A417’ (paragraphs 2.6.33-2.6.41). This is shown on ES Figure 12.4 Open Access Land (Document Reference 6.3). For more information, refer to the Special Category Land Plans that support the DCO Application (Document Reference 2.3). This land is connected to the existing Common Land

at Barrow Wake and the replacement Common Land would be landscaped as part of the scheme (see ES Chapter 7 Landscape and visual effects (Document Reference 6.2) and ES Chapter 12 Population and human health (Document Reference 6.2) for further details). The replacement Common Land would be accessible given the proposed separate but adjacent Air Balloon Way and the proposal would reinstate Common Land that was previously de-registered for the construction of the current A417.

#### Road drainage and the water environment

- 2.8.79 The depth of cutting through the escarpment has reduced from 25 metres to 17 metres as the design has evolved. The raising of the alignment up Crickley Hill has avoided the interception of sensitive groundwater zones.
- 2.8.80 Flow volume and quality control measures are incorporated into the scheme design to provide SuDS.
- 2.8.81 The carriageway drainage would consist of a multi-stage treatment train to collect, store, convey and treat routine runoff, which could potentially include grassed swales (dry), catch-pits and detention basins to remove and retain soluble and suspended pollutants to ensure discharges to groundwater or local watercourses are at acceptable levels.
- 2.8.82 The drainage design will incorporate measures to control and contain spillages, where required. Any spillages on the scheme following road accidents would be routinely managed by Highways England, which is responsible for the maintenance of trunk road assets.
- 2.8.83 Attenuation/infiltration basins would be designed to ensure that groundwater levels would not impede their performance. In addition, where embankments are to be constructed above key groundwater/surface water interactions (springs), culverts or drainage blankets would be incorporated into the design to maintain the existing flow regime and to ensure the sub-surface flows do not compromise the integrity of the earthworks. Specific drainage solutions would be designed to maintain springs recharge into and flows within the realigned tributary of Norman's Brook. Opportunities would be sought to promote calcium carbonate precipitation in the realigned stream to enhance the potential for tufa formation. These would be considered at the detailed design stage.
- 2.8.84 Design of drainage cuttings would incorporate drainage media allowing seepages of groundwater from the exposed rock faces to be collected separately from the highway drainage and to allow recharge to the underlying aquifers maintaining the existing recharge mechanisms. The recharge would occur either through the highway drainage or attenuation/infiltration basins. Where underlying geology prevents infiltration, collected groundwater would be discharged into the nearest surface watercourse, which, under baseline conditions, would be recharged by groundwater and thus maintaining the overall water balance within the catchments.
- 2.8.85 The design of the road drainage would consider necessary measures and treatment to provide appropriate protection to the karst aquifer from potential water quality deterioration. These mitigation measures would be developed at detailed design.
- 2.8.86 Best practice mitigation measures to reduce effects from construction on ground and surface water are included in Annex G Ground and surface water



management plan of ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4).

### Climate

- 2.8.87 The crossings have been refined as part of the evolution of the scheme, which has resulted in a reduction in embodied greenhouse gas (GHG) emissions due to fewer materials and associated construction works emissions.
- 2.8.88 The depth of cutting through the escarpment has reduced from 25 metres to 17 metres as the design has evolved. This has removed the requirement for a number of retaining walls and their associated embedded carbon emissions. This would also reduce the required earthworks and excess material, reducing the corresponding construction process emissions and emissions associated with waste management activities (transport, processing and final disposal).
- 2.8.89 The scheme has been designed to minimise the requirement for energy consuming operational equipment such as street lighting or intelligent transport systems wherever possible. Where lighting may be potentially required, for example at Grove Farm underpass, low lux demand sensitive lighting is proposed to reduce GHG emissions associated with operating the scheme.

## **2.9 Construction, operation and long-term management**

### **Construction activities**

- 2.9.1 The approach to construction described below is indicative and subject to change during detailed design but it is representative of the likely approach to be adopted and has been defined taking advice from the appointed buildability advisors for the scheme.
- 2.9.2 The construction activities for the scheme would be typical of a major highway scheme and consist of the following:
- Preparatory works comprising archaeological investigation and ground investigation works including trial pits, remedial work in respect of any contamination or other adverse ground conditions, ecological surveys and mitigation works, site set up works (including the erection of temporary fencing and provision of access points), top-soil stripping and stockpiling for access points and compounds.
  - Establishment of site compounds, laydown areas and facilities.
  - Vegetation clearance.
  - Statutory utility diversions.
  - Bulk earthworks.
  - Drainage works.
  - Construction of bridge structures including piling.
  - Road pavements works.
  - Landscape and planting works.
- 2.9.3 It is anticipated that works to the online and offline sections would occur at the same time so that material movements between areas of cut and fill can take place simultaneously, thereby minimising stockpile requirements.
- 2.9.4 For the online section along Crickley Hill, it is likely the contractor would construct the works in 2 stages: first the westbound widening works; and, after completion, switch to the eastbound construction works, with traffic running on the new westbound lanes in contraflow.

- 2.9.5 Construction of the new Ullenwood junction would require detailed phasing to ensure continued traffic movements both of A417 and A436 traffic. The excavation of the new alignment, where it crosses the Existing A417 at Air Balloon roundabout could only occur once traffic has been diverted along the new A436 link road and through the new Shab Hill junction onto the new A417 in single lane running, with the new B4070 having been constructed.
- 2.9.6 It is proposed that the new Cowley junction is completed off-line as much as possible, whilst traffic continues to utilise the Existing A417 road and roundabout.
- 2.9.7 Further information regarding the scheme management, phasing of works and night-time working can be found in Annex B Construction Traffic Management Plan of ES Appendix 2.1 EMP (Document Reference 6.4).
- 2.9.8 Working hours would be restricted to 07:30–18:00 on Mondays to Fridays and 08:00–13:00 on Saturdays, Sundays and public holidays except for —
- Night-time closures for bridge demolition and installation
  - Any oversize deliveries or deliveries where daytime working would be excessively disruptive to normal traffic operation
  - Junction tie-in works
  - Removal of overhead power lines
  - Overnight traffic management measures
  - Cases of emergency
  - Any works for which different working hours have been agreed with parties who will or may be affected by those works and recorded in the approved EMP (construction), in which case the EMP (construction) must require adherence to those working hours
  - As otherwise agreed by the relevant planning authority in advance
- 2.9.9 The total number of working nights is currently expected to be fewer than 35 throughout the 42-month construction period. Works undertaken during these nights would be divided between Crickley Hill, Ullenwood junction, Shab Hill junction and Cowley junction.

#### Public Rights of Way

- 2.9.10 PRow that interface with the scheme and are therefore affected by works are shown in ES Figure 12.2 Public Rights of Way and Local Routes (Document Reference 6.3).
- 2.9.11 In total, the scheme has the potential to affect the following PRow:
- 1 National Trail (the ‘Cotswold Way’)
  - 1 Long-Distance Path (the ‘Gloucestershire Way’)
  - 16 Footpaths (including those comprising the Gloucestershire Way);
  - 4 Bridleways
  - 3 Restricted Byways
- 2.9.12 Information regarding the management and diversion of public rights of way can be found in Annex F PRow Management Plan (ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4)).

#### Temporary works

- 2.9.13 Full details of the temporary works including the temporary compounds and topsoil storage areas are considered and in the environmental topic chapters (ES Chapter 5 – 14) (Document Reference 6.2)), where relevant.

- 2.9.14 Construction of the scheme would require excavation in places to form cuttings for the highway and this material would then be used to form embankments. The design aims to balance these 'cut and fill' requirements as far as practicable. As such no borrow pits would be required.
- 2.9.15 Where possible, the permanent earthworks drainage would be installed before the start of the main construction programme, with cut-off ditches and filter drains, and these would manage the surface water run-off towards and within the DCO Boundary and discharge it into the existing watercourses via the temporary/permanent basins as required.
- 2.9.16 The contractor would also need to obtain temporary discharge consents from the Environment Agency. Temporary settlement basins/tanks would be used to ensure any site surface water discharge to the adjacent watercourses is of the required quality, with any suspended solids given the opportunity to settle out.
- 2.9.17 At watercourse crossings, during the construction of the permanent culverts, it is assumed that multiple temporary smaller pipes (same cross-sectional area as the existing) would be used adjacent to the new crossing with the watercourses locally temporarily realigned to suit.
- 2.9.18 The DCO Boundary on the General Arrangement and Section Plans (Document Reference 2.6) allows for temporary traffic management areas, temporary working and storage areas, material stockpiles, haul roads, and provision for site compounds to be used during the construction of the scheme.

### **Construction programme**

- 2.9.19 If the DCO is granted, construction is expected to start in early 2023 and the scheme is expected to be open to traffic in 2026, however, Highways England may be in a position to commence preparatory works in late 2022, subject to the consents and approvals set out in the Consents and Agreements Position Statement (Document Reference 7.2) having been obtained.
- 2.9.20 The construction programme would be finalised by the contractor in advance of the works. The duration of the construction works is currently estimated to be at least 33 months, commencing nine months after the start of environmental preparatory works, giving an overall construction period of 42 months. The scheme is anticipated to be open for traffic in 2026.
- 2.9.21 The preparatory works delivered under the DCO would consist of:
- Archaeological investigation and ground investigation works including trial pits.
  - Remedial work in respect of any contamination or other adverse ground conditions.
  - Ecological surveys and mitigation works.
  - Site set up works (including the erection of temporary fencing and provision of access points), top-soil stripping and stockpiling for access points and compounds. The spatial extent of these site set up works would be limited to those areas identified as construction compounds on the General Arrangement Plans (Document Reference 2.6a), and access points to those compounds from the public highway.
- 2.9.22 The preparatory works will progress in accordance with the controls set by the EMP at Appendix 2.1 (Document Reference 6.4). Implementation of the measures described in the EMP will ensure that there are no significant environmental effects resulting from preparatory works taking place.

## Construction compounds, access and vehicle movements

2.9.23 Construction of the scheme would require a large quantity of plant and equipment. The high volume of material to be moved would require large excavators, articulated dump trucks, dozers, compactors plus graders, bowsers and stabilising plant. To construct the structures, large piling rigs and heavy-duty cranes would also be required. Exact plant numbers and type would be determined by the construction methodology and the volume of material to be handled on site.

### *Compounds*

2.9.24 It is currently proposed to include two main compounds and a crusher/material stockpile compound. The main compounds are proposed to be located at:

- Ch 0+000, located in the adjacent fields to the west bound carriageway.
- Ch 5+500, located in the adjacent fields to the proposed Cowley junction on the eastbound carriageway.

2.9.25 Operations at the two main compounds would include office and welfare accommodation, training and induction facilities, emergency recovery and safe refuge facilities, material storage, waste segregation areas, plant lay down area, fuel storage and car/minibus parking for staff and operatives. The two main compounds would also act as holding points for oversized deliveries until they are able to access the required area on site.

2.9.26 A crusher and material stockpile compound would be located in fields on the south side of the new alignment of the A417 between Ch 2+300 and Ch 2+600. To facilitate movement of material to and from this compound, a temporary Bailey bridge crossing over the Existing A417 would be required at Ch 2+100.

2.9.27 In addition to the crusher, bulk stone and topsoil storage, a small office and welfare facility would be maintained at this location for staff and workforce engaged with material handling.

2.9.28 Satellite compounds for specific junction, side road, overbridges and underbridge construction can be found on General Arrangement and Section Plans (Document Reference 2.6) and would be located at the following locations:

- Crickley Hill bat underpass
- Grove Farm underpass
- Cotswold Way crossing
- Shab Hill junction
- Cowley overbridge
- Stockwell overbridge and
- Barrow Wake car park

2.9.29 These small satellite compounds would comprise of a small office and welfare facility together with limited storage facilities for materials.

### *Vehicle movements*

2.9.30 Indicative haul routes are shown ES Figure 2.1 Indicative Haul Routes (Document Reference 6.3).

2.9.31 Average movements per day of 420 are estimated over the duration of the construction works, however there would be variations from day to day in the numbers of vehicles arriving or leaving site. Further details are provided in Table 2-6.

**Table 2-6 Estimated vehicle movements**

Vehicle type	Estimated vehicle movements per day (accounts for trips both to and from site)	Location
HGVs per day	40	On the network
6m <sup>3</sup> concrete trucks per day	10	On the network
20t load lorry (bulk deliveries or removal of material assets and waste)	120	On the network
44t load lorry	250	On the site haul roads*
<b>TOTAL VEHICLE MOVEMENTS</b>	<b>420</b>	

\*The average travel distance on the haul roads would be in the region of 0.93 miles (1.5 kilometres).

2.9.32 The Traffic Management Plan (Annex B Construction Traffic Management Plan of ES Appendix 2.1 EMP (Document Reference 6.4)) sets out that one weekend closure and 29 individual weeknight closures of the main carriageway are anticipated over the duration of the construction works.

### **Statutory utilities**

2.9.33 Construction of the scheme would require the diversion, relocation or protection of several existing utility assets including water, wastewater, electricity and telecommunications. The required diversions would be planned in detail by the contractor as part of the construction works.

2.9.34 Four statutory undertakers (SUs) with apparatus would be impacted as a result of the scheme:

- BT Openreach
- Western Power Distribution
- Severn Trent Water
- Gigaclear

2.9.35 The SUs' plant is predominately located in Crickley Hill and alongside roads. The main exceptions are high voltage electricity cables and water mains which run through fields.

2.9.36 The main utilities work required for the construction of the scheme would include:

#### BT Openreach

- Cowley Lane roundabout - Existing underground cables including junction boxes affected by the temporary road alignment during construction of the new junction and location and level of new roundabout, realignment of major cable route required.
- Shab Hill junction - The scheme would affect cables between Birdlip Radio Station and Shab Hill Farm together with Birdlip Radio Station and Rushwood Kennels. Diversions would be required Shab Hill junction. A new cable would be laid along the realigned B4070 to connect with the existing cables at Barrow Wake. A new cable would also be laid along the new A436 link road connecting Air Balloon area to Shab Hill junction to replace cables along the Existing A417.
- Crickley Hill - Supply to Flyup 417 Bike Park would need to be maintained. A temporary above ground diversion between Ch 1+200 and Ch 1+650 would be required to allow embankment construction. The permanent diversion would

be positioned in the verge of the Cirencester bound carriageway of the new A417 between Ch 0+900 and Ch 1+550. The existing service in Cold Slad Lane would require diverting to the northern side of the road at its junction with the Existing A417.

#### Western Power Distribution

- 11KV Overheads Ch 0+400 - existing pole to be moved circa three metres. Additional poles to be adjusted to avoid the alignment of the new access road to Flyup 417 Bike Park.
- Low Voltage (LV) underground crossing Ch 0+500 - divert along new western verge of the new A417 and abandon existing underground crossing and pole.
- High Voltage (HV) Overhead crossing at Ch 1+100 - Install twin 110mm diameter ducts under the alignment of the new road (includes installing ducts under the Existing A417) together with two new poles and stays and divert cables through ducts.
- Grove Farm and 2no. Telecommunication Masts; New pole and stays required at termination of O/H. New underground cable would follow the realigned tributary of Normans Brook Ch 1+100 to Ch 1+500 to feed the existing telecommunications masts.
- HV Crossing at Ch 2+200 - New poles to be installed, existing cables can span new cutting for A436 link road and A417 150 metre span without need for diversion.
- B4070 - HV underground cable to be diverted to suit new road alignment.
- Ch 4+000 Cowley Overbridge - Overhead cables to be diverted to avoid new bridge structure embankments.

#### Severn Trent Water

- Cold Slad - existing 125mm main is to be abandoned and a length of new 125 main to be laid together with temporary bypass facilities at connection into existing main.
- Air Balloon roundabout - Abandonment of a 63mm main at Air Balloon roundabout.
- Shab Hill junction - The existing access road to Rushwood Kennels is severed by the new A417. To maintain supply, a new 90mm supply would be installed through a 150mm duct (installed by the main contractor) under the new cutting and A417. Once installed the existing 3-inch supply would be abandoned.
- Cowley junction - Existing 90mm main to private fields would be abandoned and new 90mm PE main to be laid alongside Climperwell Road and Cowley Wood Lane. This supply would also act as a temporary supply to the main construction compound / offices.

#### Gigaclear

- Stockwell Farm - New fibre cable would be installed over new Cowley overbridge, abandon and recover old cable.
- Birdlip Radio Station – New fibre cable diversion through Shab Hill junction required.

#### **Permanent and temporary land-take**

2.9.37 The extent of land use requirements during construction and operation are defined by permanent and temporary land-take requirements. These are shown within the DCO Boundary on the General Arrangement and Section Plans

(Document Reference 2.6). These are set out and justified in the Statement of Reasons (Document Reference 4.1) accompanying the DCO Application.

- 2.9.38 Permanent land-take is required to construct, operate and maintain the scheme and includes the footprint of all the proposed highway infrastructure, earthworks and drainage works, also includes the areas for environmental mitigation, such as landscape planting and areas of habitat replacement. Further details on the essential landscaping areas are shown on the ES Figure 7.11 Environmental Masterplans (Document Reference 6.3).
- 2.9.39 Temporary land-take is required to assist the contractor in the construction of the scheme, including working areas, site compounds and topsoil storage areas, and can also be required for the construction of part of the works with a permanent easement right acquired for operation and maintenance.

### **Demolition**

- 2.9.40 The scheme would require the demolition of two residential properties on Crickley Hill (Woodside House and Pinewood) and two commercial properties (The Air Balloon public house and Crickley Hill Tractors). The existing Air Balloon roundabout will also be demolished.
- 2.9.41 Approximately 1.68 miles (2.7 kilometres) of the Existing A417 between Air Balloon roundabout and the A417/Stockwell junction would be repurposed as part of the scheme.

## **2.10 Maintenance**

- 2.10.1 A Maintenance and Repair Statement has been prepared for the scheme, which identifies maintenance proposals for assets and how these would be maintained during operation. The maintenance proposals have been developed with engagement with Highways England's Maintenance and Operation team.
- 2.10.2 In summary, the overall operational approach would be that which is normal for a dual carriageway. Thus, maintenance operations would be normal routine activities which need to be performed on a cyclical or regular basis and non-routine activities for repair and renewal which require less predictable access to the highway.
- 2.10.3 Maintenance lay-bys have been located to provide safe access to maintain the structures and the drainage network, as well as undertake landscaping works. Access for maintenance would be mainly from the local road network. Maintenance operations that would require access to the verge or central reserve only, would be undertaken using temporary traffic management for lane closures. Some verge maintenance activities and inspection visits may be able to be undertaken without lane closures where the work is a sufficient distance from the live carriageway.
- 2.10.4 Maintenance activities would be as authorised under the DCO. As required by the EMP, industry standard control measures would be applied and encapsulated in the third iteration of the EMP, the EMP (end of construction). With the implementation of these measures no significant effects are considered likely.

## **2.11 Decommissioning**

- 2.11.1 The traffic and economic assessment demonstrate the proposed improvements would operate adequately for the first 15 years of opening to the design year (2026 to 2041). Typically, highway schemes are designed to have a material life-

span of between 20 and 40 years before major maintenance and upgrading is required dependant on material properties, maintenance and usage. Elements including structural concrete and steelwork have extended design lives of up to 120 years.

- 2.11.2 It is considered highly unlikely that the scheme would be decommissioned as the road is likely to have become an integral part of the infrastructure in the area. Decommissioning would not be either feasible or desirable and is therefore not considered further within this ES.

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<sup>1</sup> Available at:

<https://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/LA%20120%20Environmental%20management%20plans-web.pdf>