

# A417 Missing Link

## Preliminary Environmental Information Report

Chapter 2 The Project

28 September 2020

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## 2 Project description

### 2.1 Introduction

2.1.1 This chapter of the Preliminary Environmental Impact (PEI) Report provides an overview of the site location and context together with a detailed description of the scheme and outline details of the incorporated environmental mitigation measures (Section 2.7), the construction, operation and long-term management (Section 2.8), and the demolition of the scheme (Section 2.10). The scheme is illustrated in the General Arrangement drawings (Figure 2.1).

### 2.2 Need for the project

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 49 personal injury collisions between 2013 and April 2018, ten 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.

### 2.3 Project objectives

2.3.1 The Cotswolds Area of Outstanding Natural Beauty (AONB) is the largest of 38 AONBs in England and Wales, and the second largest protected landscape in England after the Lake District National Park. 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 have worked closely with key stakeholders including Gloucestershire County Council (GCC), Cotswolds Conservation Board (CCB), National Trust (NT), Gloucestershire Local Nature Partnership (GLNP), Gloucestershire Wildlife Trust (GWT) and G-First LEP to develop a scheme specific vision statement, four scheme specific objectives and a number of sub-objectives.

2.3.4 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**

<b>Scheme vision</b>			
<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>			
<b>Scheme design principles</b>			
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.			
Any scheme should bring about substantial benefits for the Cotswolds landscape and environment as well as people's enjoyment of the area.			
Any scheme must have substantially more benefits than negative impacts for the Cotswolds AONB.			
<b>A417 scheme objectives</b>			
<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.	<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.	<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.	<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.

<b>A417 scheme sub-objectives</b>				
<b>1</b>	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.
<b>2</b>	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.
<b>3</b>	The scheme would enhance operational efficiency, improve maintenance safety and support best	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	The scheme would contribute to the health of the local visitor economy through improved access and

<b>A417 scheme sub-objectives</b>				
	value whole-life cost benefits.		improved provision for motorised and non-motorised users.	visitor experience of the Cotswolds AONB.
<b>4</b>	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.
<b>5</b>		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.
<b>6</b>		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.
<b>7</b>		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 time reduce intrusion upon such land.	The scheme would improve continuity of access to the Public Rights of Way network, the Cotswold Way National Trail and the Gloucestershire Way.	The scheme would seek sustainable opportunities to use locally sourced construction materials to support the local economy.
<b>8</b>		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.		

2.3.5 The development of the proposed scheme has considered the feedback received during the 2019 statutory consultation and ongoing assessments. The preliminary design, and the assessment of its likely significant environmental effects, are presented in this PEI report.

## 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 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 Figure 1.1.

- 2.4.2 The surrounding area of the existing A417 route contains a mix of agricultural land, woodland and common 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 land likely to be required temporarily or permanently for the construction, operation and maintenance of the scheme is within the scheme boundary shown in Figure 2.1. It is important to note that the land required may reduce due to the design and construction methodology development. The maximum area of land likely to be required has therefore been assessed.

## 2.5 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 the existing baseline scenario and future baseline scenario for the relevant environmental receptors and resources must be defined. These descriptions are outlined in Chapters 5 to 14 of this PEI report.

### Baseline scenario

- 2.5.3 The baseline scenario is the current state of the environment without implementation of the scheme.
- 2.5.4 The proposed scheme is situated entirely within the Cotswolds AONB. A small part to the west of the study area is not within the AONB. 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.
- 2.5.5 There are also ecological and heritage assets which contribute to the character of the landscape. Adjacent to the existing A417, on the slopes of the escarpment is Crickley Hill and Barrow Wake Special Site of Scientific Interest (SSSI). South-west of the study area is Cotswold Commons and Beechwood Special Area of Conservation (SAC). Further south on the High Wold is Bushley Muzzard SSSI at Brimpsfield and to the east is Cowley Manor, a Grade II\* Registered Park and Garden (RPG). Several scheduled monuments are dotted throughout the three-kilometre study area including Crickley Hill Camp, Emma's Grove, Brimpsfield Castle and mound, Coberley Long Barrow, Coberley Roman Villa, Cotswold Beechwoods, Bowl Barrow and Great Witcombe Roman Villa.
- 2.5.6 These designations reflect the conservation value of the region, and its rich heritage of human settlement.

### Future baseline scenario

- 2.5.7 The future baseline is an outline of the likely evolution of the current state of the environment without implementation of the project, taking account natural changes and readily available information such as the Local Development Framework and climate change scenario data.

- 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 2025 (opening year) and 2040 (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, 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 proposed scheme is unlikely to change significantly by 2040. 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 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

### Detailed description of the preliminary design

- 2.6.1 The scheme would provide 3.4 miles (5.5km) 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 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.
- Climbing the escarpment (online section)
- 2.6.4 West of the existing Air Balloon roundabout, two lanes in each direction would be provided with an additional climbing lane for heavy vehicles climbing the escarpment.
- 2.6.5 The route would closely follow the existing road alignment, with widening proposed on the southern side. The gradient would be reduced from the existing 10% to 8%.
- 2.6.6 The term 'chainage' (Ch) is used to refer to the distance measured in metres along the centre line of the proposed scheme. The chainages referred to in the text are indicated on the General Arrangement drawings in Figure 2.1.



- 2.6.7 Between Ch 0+900 and Ch 1+700, the route would start to deviate from the existing A417 alignment vertically, with the road higher than the existing, before transitioning into cutting at approximately Ch 1+700.
- 2.6.8 Between Ch 1+700 and Ch 3+000 the road would continue in cutting. The maximum depth of cut is 17 metres measured at Ch 1+800, just past the end of the 8% uphill grade. The alignment would start its deviation from the existing A417 alignment at approximately Ch 2+000.
- Cold Slad Lane (side road)*
- 2.6.9 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. This junction would be removed, and a new connection created to the proposed Ullenwood junction.
- 2.6.10 An access to the Cricket Club would also 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.
- 2.6.11 A new bat underpass would be provided at approximately Ch 1+100.
- 2.6.12 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 underpass at Ch 1+680.
- 2.6.13 The new Cotswold Way crossing at Ch 2+100 near Emma's Grove would be provided for walkers, cyclists and horse riders including disabled users, which would accommodate the Cotswold Way National Trail.
- Existing Air Balloon roundabout to Cowley junction (offline section)
- 2.6.14 At Ch 2+000 the alignment follows a right-hand curve between the existing Air Balloon roundabout and Emma's Grove, before continuing eastbound.
- 2.6.15 The new Gloucestershire Way crossing at Ch 2+690 would be provided as a new multi-purpose crossing in the region of 25 metres wide to provide essential mitigation for bats and for landscape integration. It would also further benefit from accommodating the Gloucestershire Way and provide an improved visitor experience.
- 2.6.16 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).
- 2.6.17 Between Ch 3+600 and Ch 5+000 the route would continue in a south-east direction and would generally be at grade or in cut (up to 6 metres).
- 2.6.18 Two new overbridges are proposed along this section to provide connectivity to the local road network and provide habitat connectivity (via Cowley overbridge at Ch 4+040) and private means of access (via Stockwell overbridge at Ch 4+725).
- 2.6.19 A new junction would be provided at the eastern end of the scheme, replacing the existing Cowley roundabout, and making use of the existing underbridge to provide access to local destinations such as Nettleton Bottom and Brimpsfield. The use of the existing underbridge would allow for all directions of travel to be made.



### *A436 Link Road*

- 2.6.20 A new single carriageway is proposed to connect the existing A436, just east of the existing Air Balloon roundabout, to the proposed 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 proposed Ullenwood junction providing access to Cheltenham via Leckhampton Hill or the existing A436. At its southern end it would tie into the proposed Shab Hill junction. This would provide direct access onto the A417 mainline and the B4070 Birdlip link to the west.
- 2.6.21 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 1 metre hardstrip is proposed to accommodate slower moving vehicles travelling from the new Ullenwood junction to Shab Hill junction.

### *Ullenwood Junction*

- 2.6.22 The Ullenwood junction would be a four-arm roundabout connecting the existing A436 and Leckhampton Hill with the new A436 Link Road and Cold Slad Lane.
- 2.6.23 Along the realigned section of Leckhampton Hill road, three accesses would be provided serving the realigned access to Crickley Hill Country Park and proposed attenuation basins.

### *Shab Hill Junction*

- 2.6.24 The junction utilises a compact 'half clover-leaf' arrangement to reduce the impact on the surrounding landscape and adjacent properties of Rushwood Kennels and Birdlip Radio Station.
- 2.6.25 The junction would be located in the existing valley to reduce visual impact.
- 2.6.26 Each side of the junction would be connected via a link road beneath the A417 by means of an open aspect underbridge. Roundabouts at each end of the link would provide connection between the mainline slip roads and the local road network.
- 2.6.27 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.
- 2.6.28 The mainline A417 would be on embankment approximately 7.3 metres at its highest point through the junction. The junction slip roads would tie into the roundabouts at a lower level.
- 2.6.29 The earthworks slopes would be generally 1:3 throughout the junction.

### *Rushwood Kennels, Cuckoopen Farm and residential properties at Ch 3+175*

- 2.6.30 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 metre wide, with 1 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 proposed Gloucestershire Way crossing.

### *B4070 connection to Birdlip*

- 2.6.31 Access to Birdlip would be provided from the proposed Shab Hill junction via a new link that would utilise the existing lane, underbridge and junction on the existing Barrow Wake access road, to the B4070.

- 2.6.32 The link between Shab Hill junction and Barrow Wake would be a single carriageway with a segregated WCH route running parallel for much of its length before diverging, prior to the existing A417 underbridge, to connect to the proposed new Air Balloon Way. 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 westbound side, a 3 metre WCH route is proposed with a 0.5 metre separation to the road and 1 metre verge on the southern edge.
- 2.6.33 The road from Barrow Wake to the existing B4070 junction would comprise a 6 metre wide carriageway with a 1.5 metre verge on its eastern side which would narrow to approximately 1 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.
- 2.6.34 The B4070 would also provide access to Birdlip Radio Station as well as Shab Hill Barn and Farm using an at-grade, staggered cross road junction arrangement.
- Barrow Wake roundabout – Ch 3+180*
- 2.6.35 Barrow Wake roundabout would be located at the junction between the B4070 link roads and the entrance of the existing Barrow Wake viewpoint car park. It would connect the proposed B4070 from Shab Hill to the existing road between Birdlip and Barrow Wake and utilise the existing pavement extents where possible.
- Cowley Lane - Ch 4+050*
- 2.6.36 The existing Cowley Lane between Stockwell Farm and Cowley is severed by the proposed A417 mainline. The lane is reconnected by the proposed Cowley overbridge at Ch 4+050. Cowley Lane has a design speed of 50km/h and would consist of a 3.5 metre wide carriageway, widened to 4 metres across the overbridge. Cowley overbridge also provides habitat connectivity via a vegetated southern verge.
- Stockwell Farm Overbridge - Ch 4+725*
- 2.6.37 The existing Stockwell Farm access lane between Stockwell Farm and Cowley is also severed by the proposed A417 mainline. The lane is reconnected by the proposed Stockwell overbridge at Ch 4+725. Stockwell Overbridge also provides habitat connectivity via vegetated verge on both sides of the track.
- Cowley Junction – Ch 5+200*
- 2.6.38 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 link road underbridge. There is a proposed private means of access running parallel to the offslip that would serve as access to properties along Cowley Lane.
- 2.6.39 The junction would generally be in cut (up to 5 metres) and have landscape earthworks on the eastbound side of the junction. The road would tie into the existing A417 just before the existing overbridge.
- 2.6.40 On either side of the eastbound junction link road, mitigation bunds would be provided to reduce the visual impact. The height of these bunds would be up to 4.5 metres above existing ground level.

- 2.6.41 A roundabout is proposed to 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.
- Repurposing the existing A417
- 2.6.42 The repurposed A417 between the existing Air Balloon roundabout and Cowley roundabout would be detrunked for its entire length.
- 2.6.43 Approximately 2.7 kilometres of the existing A417 between the Golden Heart Inn interchange with Stockwell Lane and the Birdlip Link Road near Barrow Wake would be converted into a 'purpose built' route for non-motorised users including WCH (referred to hereafter as 'Air Balloon Way').
- 2.6.44 The remaining 1 kilometre of the existing A417 between Birdlip Link Road near Barrow Wake and the existing Air Balloon roundabout (which would be demolished as part of the scheme) would be landscaped, with a connection maintaining local access for residents.
- 2.6.45 The existing A417 adjacent to Barrow Wake would be demolished and replaced with Common Land designation. This would be adjacent to the area of Common Land at Barrow Wake, forming a connection and extension of this current designation. Refer to Figure 12.4 Open Access Land.
- 2.6.46 Engagement with stakeholders including GCC's Public Rights of Way Officer and Local Access Forum is ongoing, with a view to designating:
- part of the route between the Golden Heart Inn interchange with Stockwell Lane and the Birdlip Link Road near Barrow Wake, a restricted byway; and
  - the section from thereon to the Cotswold Way crossing and beyond via a bridleway.
- 2.6.47 This designation would allow WCH users access along the detrunked section of the existing A417 and over the proposed Cotswold Way crossing and beyond, via the detrunked A417 and existing local roads.
- 2.6.48 The WCH connection between the Air Balloon Way and the Cotswold Way crossing would be via Barrow Wake car park, avoiding the section of existing A417 identified as replacement Common Land.
- 2.6.49 The majority of the 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.
- 2.6.50 In order to assist to remove vehicles and parking using the Crickley Hill Country Park and Barrow Wake, provision for car parking in the vicinity of the Golden Heart Inn would help support this by facilitating use of the recreational route in this location. In addition to this, there would be proposed disabled and horsebox parking near the where the Roman road meets the existing A417.
- 2.6.51 The details of surfacing, signage and other arrangements as appropriate would be agreed where possible through the Statement of Common Ground with GCC in addition to or instead within the Statement of Common Ground with the WCH technical working group members.
- 2.6.52 Access would be granted for the maintenance of existing utilities within the existing A417 corridor. An easement would be agreed with the relevant utility companies. 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.

## Earthworks and landscape

2.6.53 Cut and embankment slope proposals vary along the length of the scheme. The maximum cutting is 17 metres deep at Crickley Hill, while the maximum fill embankment is 20 metres high at the Shab Hill junction.

2.6.54 The current landscape proposals include the following:

- Earth banks or bunds of approximately 2m – 3m in height, known as ‘false cuttings’, would be included along sections of the scheme.
- The height of the bunds above existing ground or proposed road level would vary throughout depending on cut depth or embankment height.
- In areas of cutting, bunds would be 2m – 3m above existing ground level, located at the top of the cutting.
- In areas of embankment bunds would be 2m – 3m above proposed road level, at the top of the embankment.
- These would be associated with the regrading of the embankments and would help reduce views of the traffic on the scheme as well as reduce noise levels to the surrounding area.
- Earth bunds and embankment back slopes would be designed sensitively to integrate with the surrounding landscape.
- 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 5m height intervals (achieving an overall slope angle of 35 degrees), subject to ground conditions.
- East of Shab Hill until the end of the scheme, landscape bunds would be proposed at the top of cut slopes and the shoulders of some embankments (including local roads and on and off slips over this chainage extent). On embankments, the landscape bunds would be an average of 2 metres above proposed carriageway level with front slopes (carriageway side) typically being 1 in 2 and the back slopes varying to tie into the surrounding landscape sympathetically.

## Structures

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

**Table 2-2 Proposed structures**

Chainage	Structure name	Purpose	Target species	Dimension	Length
Ch 1+100	Bat underpass	Underpass to provide safe crossing for bats and link habitats on either side of the A417.	Bats	3m x 3m	50m
Ch 1+680	Grove Farm underbridge	Underbridge under the A417 would provide a link between Cold Slad Lane and Grove Farm, and provide connectivity for walkers, cyclists and horse riders (WCH) and telecommunications.	No target species	5.7m (h) x 4.4m (w)	
Ch 2+100	Cotswold Way crossing	Bridge over A417 near Emma's Grove for walkers, cyclists and horse riders including disabled	No target species		

Chainage	Structure name	Purpose	Target species	Dimension	Length
		users, which would accommodate the Cotswold Way National Trail.			
Ch 2+690	Gloucestershire Way crossing	Bridge over A417 to provide essential mitigation for bats and for landscape integration. It will also further benefit from accommodating the Gloucestershire Way and provide improved visitor experience.	Bats, barn owl, badger	In region of 25m wide	70m
Ch 3+200	B4070 mammal culvert	Culvert to provide safe crossing under the B4070 (at Ch0+390) for badgers.	Badger	0.6m +	37m
Ch 3+200	Shab Hill Junction underbridge	Underbridge carrying the proposed A417 over the link road at Shab Hill Junction. The junction connects the A436 and the B4070 to the A417.	No target species		
Ch 3+410	Shab Hill Junction mammal culvert	Culvert under the A417 to provide safe crossing of the A417 mainline for badgers.	Badgers	0.75m +	112m
Ch 4+040	Cowley overbridge	Bridge over the A417 to provide connectivity to the local road network (Cowley village) and includes the planting of a continuous native species-rich hedgerow to follow on and provide continuity from the tree lines already proposed leading up the bridge which replace the existing treeline features in the landscape. The hedgerow provides essential mitigation for bats and landscape connectivity.	Bats	11m wide	48m
Ch 4+725	Stockwell overbridge	Overbridge to provide a private means of access (Stockwell Farm) with two verges now consisting of continuous native species-rich hedgerows to follow on and provide continuity from the tree lines already proposed leading up the bridge which replace the existing treeline features in the landscape. The hedgerows provide essential mitigation for bats and landscape connectivity.	Bats	11m wide	48m
Ch 4+780	Mammal culvert south of Stockwell overbridge	Culvert under the A417 to provide safe crossing of the A417 mainline for badgers.	Badger	0.6m +	58m

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

Grove Farm Underpass

2.6.57 Grove Farm underpass would provide a link between Cold Slad Lane and Grove Farm. It provides connectivity for walkers, cyclists and horse riders (WCH) including disabled users; and the telecommunications masts.

2.6.58 Grove Farm Underpass would be a prestressed beam solution with clear opening of 4m high x 8m wide.

Cotswold Way crossing – Ch 2+100

2.6.59 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 bridge would accommodate a 5 metre wide path. This would act as a continuation of Air Balloon Way.

2.6.60 The bridge is located adjacent to Emma's Grove, a scheduled monument consisting of a group of three round barrows. The bridge would land between the new A417 mainline and the existing A417, to the west of the new Air Balloon roundabout.

2.6.61 The structure would be a single span bridge approximately 65 metres long with an approach ramp.

Gloucestershire Way crossing Ch 2+690

2.6.62 The Gloucestershire Way 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 would reconnect the Gloucestershire Way and link key landscape features in the areas, including Ullen Wood, Emma's Grove and the new Air Ballown Way.

2.6.63 It would improve access to places of historical interest, such as Emma's Grove and Barrow Wake, thereby providing cultural heritage benefits, as well as increasing the number of visitors in the area.

2.6.64 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.

2.6.65 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 give regard to protected species; particularly bats, badgers and barn owls; and 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 wildlife can travel between Ullenwood and existing feeding and roosting locations on the other side of the proposed highway.

2.6.66 The structure would be a two-span bridge, approximately 65 metres long. The bridge would be integral with the abutments and piers. The bridge would be wide enough to accommodate and separate wildlife and people and would be in the region of 25 metres wide.

Bat underpass east of Fly Up - Ch 1+100

- 2.6.67 The bat underpass would provide essential flight path mitigation. The underpass would be a precast concrete box of 3m x 3m. Access through the underpass would be restricted with grills at either end.

Shab Hill Junction underbridge – Ch 3+200

- 2.6.68 Shab Hill Junction underbridge would span the proposed link road at the junction, carrying the A417 mainline. 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.
- 2.6.69 The precast beams would be U-shaped beams, with a structural depth of 1 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

- 2.6.70 Cowley overbridge would span the proposed A417 at a skew of 17 degrees relative to the carriageway. The bridge 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.
- 2.6.71 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 4 metre wide carriageway with a 3 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.
- 2.6.72 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+725

- 2.6.73 Stockwell overbridge would span the proposed A417 at a skew of 11 degrees relative to the carriageway. The bridge 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.
- 2.6.74 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 2 metre wide verge either side of the carriageway and two edge beams. The road would be widened across the bridge to 4 metres with 3 metre verges. The deck would be square to the abutments with a clear span of 48 metres.
- 2.6.75 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.



## **Flood risk and drainage design**

### Flood risk

- 2.6.76 All sources of flood risk to and from the scheme, including the impact of a changing climate on flood risk, are being assessed as part of a Flood Risk Assessment (to be accompany the ES) and Chapter 11 Road Drainage and the Water Environment of this PEI report.
- 2.6.77 The proposed scheme would be designed to manage a 1 in 100-year return period event plus an allowance of 40% for climate change. It would ensure that there is no surface water flooding for a one in five-year return period event.

### Drainage strategy and design

- 2.6.78 The highway drainage design is designed in accordance to the Design Manual for Roads and Bridges (DMRB) CG 501 Design of highway drainage systems and LA 113 Road drainage and the water environment.
- 2.6.79 The A417 mainline and slip road drainage systems would be adopted and maintained by Highways England. The side road drainage systems would be adopted and maintained by GCC. The road drainage for the scheme would be managed using a series of attenuation basins, which are assumed to remain dry most of the time.
- 2.6.80 The Highways England and GCC drainage systems would be kept separate, wherever possible.
- 2.6.81 Drainage collection and conveyance methods will be designed sustainably where possible. In areas of constraints, traditional collection systems such as gullies and concrete channels may be required.

### Highway Drainage – A417 (Highways England)

- 2.6.82 Pavement edge drainage details for the A417 would be selected in line with the recommended solutions in CG 501 Design of highway drainage systems. Where practicable vegetative systems are preferred over conventional. Likely solutions are outlined below.
- 2.6.83 In cuttings, the preferred verge solution would be grass lined surface water channels and filter drains located in the verge.
- 2.6.84 On embankments, the preferred verge solution would be surface water channels.
- 2.6.85 The preferred central reserve detail for super elevated carriageways is a surface water channel.
- 2.6.86 In sections with steep longitudinal gradients or where space in the verge or central reserve is restricted, the grassed surface water channels may need to be replaced with concrete or employ special details to counter erosion issues.
- 2.6.87 Where kerbs are required, the surface water runoff would be drained via gully outlets or combined kerb and drainage units.
- 2.6.88 Cut-off ditches at the top of cuttings and the bottom of embankments would intercept natural run-off from adjacent land. Where necessary for reasons of slope stability the ditches at the top of cuttings may be lined. If the natural topography falls away from the road alignment, cut off ditches would not generally be provided other than to mitigate local flooding risk, or for slope stability reasons.
- 2.6.89 When the highway is in deeper cutting, the verge filter drains would also drain the subsurface of the pavement along with the surface water runoff from the adjacent

slopes. They may also serve a function lowering groundwater to ensure slope stability.

- 2.6.90 Fin drains would be used to drain the road pavement where this isn't already provided for by a filter drain.
- 2.6.91 Wherever practicable, systems draining trafficked paved road surfaces would be kept separate from those intercepting groundwater and run-off from earthworks slopes.
- 2.6.92 Slip lanes at Shab Hill Junction and Cowley junction would be maintained by HE. Where the slip roads are in cutting, filter drains would be used to drain the carriageway and cutting slopes. On embankments, over the edge or gullies would be used, depending on whether kerbs are present.

#### Highway Drainage – Gloucester County Council

- 2.6.93 For local roads adoptable by Gloucestershire County Council the highway drainage in cuttings would typically comprise combined filter drains and grassed surface water channels. On shallow embankments with no kerbs the default would be over the edge drainage with swales or ditches.

#### Cross drainage & watercourses

- 2.6.94 Several watercourses/streams/dry valleys would cross the route of the scheme. The flows in these watercourses/dry valleys would be maintained within their catchment through culverts wherever possible.
- 2.6.95 Dry valleys are natural features which may give rise to surface water flows in certain circumstances (e.g. during periods of exceptional rainfall and in the event of melting snow).
- 2.6.96 No EA designated main river crossings are required for the scheme.
- 2.6.97 The proposed cross drainage culverts would be designed to convey the 100 year event plus a 40% allowance for climate change.
- 2.6.98 Table 2-3 indicates the proposed principal cross drainage features under the A417 mainline. Culvert sizes and form would be refined at detailed design.

**Table 2-3 A417 cross drainage features**

Approximate chainage	Location	Type	Size/diameter (m)
Ch 0+530	Crickley Hill Stream culvert	Watercourse	0.6 (=existing)
Ch 3+200	Shab Hill culvert	Dry valley	1.2
Ch 4+775	Stockwell culvert	Dry valley	1.2

- 2.6.99 In addition to the culverts in Table 2-3, there would be a number of culverts managing land drainage or minor watercourses under side roads adjacent to the scheme, and numerous smaller culverts conveying flows from the cut-off ditches under tracks, Public Right of Way (PRoW) and private accesses.

#### **Crickley Hill Stream (Norman's Brook)**

##### Existing Crickley Hill Stream

- 2.6.100 Crickley Hill Stream (a tributary of Norman's Brook) is the principal watercourse receiving flows from the western part of the scheme.

- 2.6.101 The stream is a distinguishable feature and is a continuously flowing watercourse fed by land drainage systems and springs on the south and east of Grove Farm and the A417 highway drainage system to the north.
- 2.6.102 Between its source and the A417 culvert the existing stream has an irregular and steep course interrupted by short culverts and other features such as informal dams and cascades.
- 2.6.103 Most public data sources including the Digital River Network<sup>1</sup> still report that Crickley Hill Stream connects to the Horsbere Brook catchment.
- 2.6.104 A tracer test confirmed that the watercourse is in fact a tributary of Normans Brook and crosses under the existing A417 mainline via a 0.6 metre diameter culvert located across from the Fly Up Bike Park.
- 2.6.105 The stream enters a culvert just east of the Fly Up Bike Park. This culvert cranks north west and crosses diagonally under the existing A417 Mainline and then continues along Dog Lane and Bentham Lane before discharging to an open ditch just north of Bentham County Club on the western side of Bentham Lane. The total length of culvert is 1000 metres including the section under the A417 mainline.

#### Watercourse realignment

- 2.6.106 The widening of the A417 up Crickley Hill impacts Norman's Brook directly. This requires the existing culvert at Fly Up Bike Park to be extended. It also requires the realignment of the stream on the south side of the new A417 embankment, between Grove Farm and the existing culvert near Crickley Hill Farm (Fly Up Bike Park).
- 2.6.107 Along Crickley Hill the watercourse and associated land drainage would be realigned to the bottom of the proposed embankment.
- 2.6.108 The scheme would seek to deculvert existing sections of culverted watercourse and minimise the introduction of new culverted sections of the watercourse where possible.

#### **Public Rights of Way**

- 2.6.109 A network of PRoW crosses the A417 corridor. The network comprises primarily of footpaths in addition to a small number of bridleways and restricted byways, however 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.
- 2.6.110 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.
- 2.6.111 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.
- 2.6.112 The details are presented in the Public Rights of Way Management Plan (Appendix 12.2) and in Chapter 12 Population and Human Health.

## Lighting

- 2.6.113 A lighting assessment has been undertaken which concluded that road lighting was not essential.
- 2.6.114 Given the AONB context, and the environmental sensitivity of the scheme, avoiding and minimising light pollution is a key consideration.
- 2.6.115 In line with the “Cotswolds Dark Skies & Artificial Light Position Statement” published by Cotswolds Conservation board, there would be no permanent road lighting associated with the scheme.
- 2.6.116 Temporary construction lighting would be intermittently used throughout the construction phase for select operations in isolated locations only.

## Fencing, walling and other boundary treatments

- 2.6.117 Boundary fencing is proposed along the highway boundary and at other locations. The fencing 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. Details can be found on the Environmental Masterplan Figure 7.9.

## Technology

- 2.6.118 The preliminary scheme design includes limited technology to support the maintenance and operation of the new road and has been developed in agreement with the Highways England Maintenance, Operations and Technology teams.

### Intelligent transport system

- 2.6.119 The following equipment is being proposed on the scheme:
- 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 laybys
  - 3 traffic counters (2 arrays per site)
  - 4 automatic number plate recognition (ANPR) cameras.

## Temporary works

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

### Construction compounds and storage areas

- 2.6.121 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.
- 2.6.122 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.

2.6.123 A crusher and material stockpile compound is 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.

2.6.124 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.

2.6.125 Satellite compounds for the junction and side road overbridges and underbridge construction are located at the following locations:

- Grove Farm underpass;
- Gloucestershire Way Crossing;
- Shab Hill junction;
- Stockwell overbridge; and
- Cowley overbridge.

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

#### Borrow pits

2.6.127 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.

#### Temporary drainage

2.6.128 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 site and discharge it into the existing watercourses via the temporary/permanent basins as required.

2.6.129 The contractor would also need to obtain temporary discharge consents from GCC and 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.

2.6.130 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.

#### Access arrangements

2.6.131 Appropriate traffic management measure would be employed to ensure that traffic flow on the existing A417 and other roads as well as access to property is safely maintained.

2.6.132 The existing A417 is not identified as an abnormal load route.

### **Scale of development**

2.6.133 The draft DCO will allow for the proposed scheme to be constructed anywhere within the maximum extent of the defined limits within which the draft DCO will authorise. These are known as the limits of deviation. Further details on limits of deviation are provided in Chapter 4 Environmental Assessment Methodology. These will be detailed in the ES and in the draft DCO.

### **Off site works**

2.6.134 Confirmation of any off-site works required to facilitate the development (delivered by Highways England or other parties); will be detailed in the ES.

## **2.7 Environmental mitigation design measures**

2.7.1 The proposed scheme design has emerged as part of an iterative process between the engineering and 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 proposed scheme with the primary purpose of avoiding or reducing adverse effects at source and to make the proposed scheme fit better into its landscape setting. These measures are considered integral to the proposed scheme and are termed as “embedded mitigation”.

2.7.2 DMRB LA 104 defines embedded mitigation as “project design principles adopted to avoid or prevent adverse environmental effects.” Embedded mitigation is reported as part of the scheme description and not repeated in each environmental factor assessment.

2.7.3 The environmental design incorporates landscape, biodiversity and cultural heritage mitigation and enhancements, to create a coordinated coherent scheme. These are identified on Figure 7.9 Environmental Masterplans.

### **Embedded mitigation**

#### Air quality

2.7.4 The preliminary scheme design moves traffic away from local sensitive receptors, in particular those receptors in the existing Birdlip Air Quality Management Areas (AQMA). By moving traffic away from receptors, it allows a greater distance over which pollutants can disperse. The design requires the removal of one receptor which would result in a net reduction in receptors exposed to pollutants. No other design specific mitigation has been incorporated for air quality.

#### Cultural heritage

2.7.5 Measures to avoid potential physical impacts arising from the proposed scheme on buried archaeological remains include:

- The construction compound at Cowley has been relocated as a result of the geophysical survey results, to avoid buried assets.
- Attenuation basins have been moved and redesigned to reduce the impact on buried assets, identified during the geophysical survey.

#### Landscape and visual

2.7.6 Landscape character has been considered throughout the design process forming a key driver in shaping the engineered design form and location of other proposed scheme features. The preliminary landscape design is set out on Figure 7.9

Environmental Masterplans and includes a large number of measures to avoid landscape impacts.

#### *Trees and woodland*

- 2.7.7 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 risk of loss of the veteran tree in the Air Balloon pub garden has been reduced, although further work on the detailed landscape design for the drainage basins is required to realise this opportunity. The potential loss of ancient woodland at Ullenwood has been avoided by altering the location of the roundabout and associated linking roads.
- 2.7.8 There has been a reduction in the potential loss of woodland at Emma's Grove, adjacent to the existing A417.
- 2.7.9 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.
- 2.7.10 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 connective with Ullenwood ancient woodland.

#### *Cowley and Shab Hill junctions*

- 2.7.11 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.
- 2.7.12 The visual prominence and landscape effect of Shab Hill junction has been reduced by removing 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.

#### *Earthworks*

- 2.7.13 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 allow the adjacent land to be returned to agricultural use.

#### *Drainage*

- 2.7.14 Attenuation basins and drainage features have been integrated into the landscape by designing the shape of each basin to reflect the surrounding topography and enclose the basins within new woodland planting. They also been located to away from existing woodland to limit the amount of woodland lost.



### *Structures*

- 2.7.15 Retaining structures are designed to be sympathetic to the character of the Cotswolds AONB, using suitable facing materials such as local sourced materials to fit existing vernacular and exposed rock faces. Facings could also include areas for colonisation with local species to visually break up the surfaces.
- 2.7.16 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.
- 2.7.17 Three of the A417 crossings are planned to provide mitigation for bats and to better integrate the proposed scheme into the landscape. These include the Gloucestershire Way crossing, Stockwell overbridge and Cowley overbridge. Further details are provided under the Biodiversity heading of section 2.7 Environmental mitigation design measures of this chapter and in Chapter 8 Biodiversity.

### *Air Balloon Way*

- 2.7.18 As described in section 2.6 of this chapter, the Air Balloon Way would be narrowed to a 'purpose-designed' width and suitably resurfaced for footpath, bridleway and cycle access. Resurfacing would be locally appropriate toppings, such as crushed stone. The broken-up sections of road would be removed and where possible reused for construction material within the scheme. The remaining width would be overlain with subsoil and topsoil for planting new trees and hedgerow with species rich seed mixes to enhance this new and planting.
- 2.7.19 The Air Balloon Way WCH route has been realigned to connect to Barrow Wake to the repurposed A417, to avoid cutting across Barrow Wake SSSI.
- 2.7.20 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.

### *Barrow Wake*

- 2.7.21 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. It also improves the entrance to Barrow Wake 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.
- 2.7.22 Further improvement works to Barrow Wake car park including resurfacing and reconfigured parking spaces and some tree planting. The proposals also include the provision of a Cotswold stone wall to run along the car park edge to reduce the visual prominence of cars parked on the escarpment during both day and night, while maintaining access and views.

### *Boundaries*

- 2.7.23 Field boundaries would be a combination of new Cotswold drystone walling and hedgerows. A significant amount of additional Cotswold stone walling would be used to define the edge of the highway, create new field boundaries and provide additional screen on top of landscape and acoustic bunding, complimenting the special qualities and character of the AONB.

- 2.7.24 Historic field boundaries would be strengthened with proposed hedgerow planting and Cotswold stone walling to match existing, particularly on the escarpment dip slopes, south of Crickley Hill, and across the high wold enhancing the special qualities of the AONB.

*Highway alignment*

- 2.7.25 The depth of cutting through the escarpment has reduced from 25 metres (previous 2019 scheme iteration) to 17 metres for the proposed scheme, significantly reducing the amount of excavated material and number of associated traffic movements to remove the material off-site during the construction phase. These changes have removed the need for long and tall retaining walls through the cut section.
- 2.7.26 The levels of the old A417 alignment would be rationalised in places through infilling using excavated materials to restore land to original grades.
- 2.7.27 The visual prominence of the proposed scheme within its sensitive context has been reduced through changes to the horizontal and vertical highway alignment, by inclusion of landscape and acoustic bunds tailored to replicate the surrounding topography, and through extensive areas of woodland planting and carefully located Cotswold stone walling to sit the proposed scheme into the landscape. Specific examples include bunding adjacent to the proposed scheme south of Crickley Hill, with woodland planting to screen the road from sensitive receptor viewpoints along the Cotswold Way National Trail and Barrow Wake. 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.

*Cultural Heritage*

- 2.7.28 An improved setting to Emma's Grove scheduled monument would be provided by removing overgrown scrub and tree cover to expose the monument and provide visual connectivity with the wider landscape including to Crickley Hill, Barrow Wake and the vale of Gloucestershire.

*PROW*

- 2.7.29 Within the AONB there have been improvements to PRow and recreational routes for walkers, cyclists and horse riders, including disabled users which enhance the area's special qualities. There is now the provision of two traffic free crossings over the A417 at the Cotswold Way crossing and Gloucestershire Way crossing. Further improvements include linking up Dog Lane with Cold Slad Lane, providing safe crossing points at Ullenwood junction and the provision of the Air Balloon Way along much of the repurposed A417.

Biodiversity

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

*Habitat loss and degradation*

- 2.7.31 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.

- 2.7.32 The original location of a material crushing compound within the previous iteration of the proposed scheme was adjacent to Ullenwood and may have resulted in habitat degradation due to dust deposition. The proposed location of this compound has been moved south of the mainline of the proposed scheme to be over 200 metres away from the ancient woodland.
- 2.7.33 The location of a footpath from Air Balloon Way was originally designed to cut through SSSI woodland and calcareous grassland on the embankment to join Barrow Wake car park. The footpath has been re-positioned to avoid the designated habitat including notable plant species such as musk orchid known to be present at that location. Further PRoW that were proposed to run through Barrow Wake SSSI in the previous 2019 scheme iteration have also been re-routed so as not to incur further loss or degradation of SSSI habitat.
- 2.7.34 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.
- 2.7.35 A total of eleven attenuation basin areas (some containing more than one basin) are proposed throughout the proposed scheme for road drainage purposes. Although these basins are designed not to be permanently wet due to the landscape character of the Cotswolds and underlying geology, any marginal or seasonally wet areas would be beneficial to wildlife providing additional foraging habitat for bats, birds, invertebrates and other wildlife. Wildlife would be discouraged from basins within junction arrangements with habitat management but attracted to other features set back from the road alignment with additional landscaping and planting design to benefit biodiversity.
- 2.7.36 Attenuation basins would also serve to protect habitat adjacent to the road proposed scheme from surface water run-off and pollution events hence reducing the risk of habitat degradation.

*Habitat fragmentation and species mortality*

- 2.7.37 Habitat creation would be designed to create new wildlife corridors and link existing but isolated areas of habitat such as small areas of woodland. 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.
- 2.7.38 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 in the region of 25 metres wide and would provide essential mitigation for bats. The crossing would also provide a Walking Cycling Horseriding route to continue the Gloucestershire Way long distance path. The bridge deck would include species-rich grassland, scrub and two native species-rich hedgerows, which would connect to woodland and hedgerow planting either side of the bridge.
- 2.7.39 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 proposed scheme. Hedgerows on the bridge would be planted on hedge-banks that would be constructed to provide suitable habitat for reptiles and invertebrates. The provision of boulder piles would further enhance the bridge habitat for these species.

- 2.7.40 The WCH path on the Gloucestershire Way crossing would be segregated from the habitat proposed for use by wildlife to avoid disturbance and degradation of the habitat.
- 2.7.41 The construction of the bridge would require a satellite compound which would be situated in adjacent arable pasture to the west of the bridge. Unlike the previous 2019 scheme iteration, the compound and construction footprint for the bridge would not require the loss of priority woodland or calcareous grassland habitat or irreplaceable habitat such as veteran trees.
- 2.7.42 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 3 metre wide soft verge to include hedgerow on one side and Stockwell overbridge includes a 3 metre soft verge for hedgerows on both sides of the bridge in order to maintain habitat connectivity across the new road for many species.
- 2.7.43 The existing A417 would be de-trunked and would not be open to public vehicles, although would be accessible by maintenance and utilities if required. Existing verges would be enhanced 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.
- 2.7.44 The proposed 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 2 metre 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.
- 2.7.45 Culverts/mammal tunnels and underbridges are proposed as wildlife crossings within the proposed 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.
- 2.7.46 Underpasses designed specifically for use by wildlife would not be lit, to prevent disturbance to the target species which are nocturnal.
- 2.7.47 A summary of the culverts/mammal tunnels, underpasses and overbridges can be found in Table 2-2 Proposed structures. 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.

### *Bats*

- 2.7.48 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 3 metres x 3 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.

- 2.7.49 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 25 metres wide and would provide essential mitigation for bats.
- 2.7.50 The overall proposed 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 proposed scheme is assessed in the Biodiversity Chapter 8 on this basis.

### *Badgers*

- 2.7.51 Badgers were found to be highly active throughout the proposed scheme. Three mammal culverts, as shown in the table above, have been positioned within existing badger territories, as identified during badger surveys, which would be severed by the proposed 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 250 metres of existing badger routes and setts<sup>2</sup>. Landscape planting has been designed to direct badgers to new wildlife culverts and Stockwell and Cowley overbridges which provide a crossing route for badgers. The overbridges have been further enhanced to include hedgerows which would provide cover to facilitate mammals crossing these structures.
- 2.7.52 Subject to detailed design, badgers and other wildlife could also use the underpass designed for bats at the western end of the proposed scheme at chainage 1+085. Badger surveys showed a territory to span both sides of the existing A417 in this location, however badgers are thought to use the existing Witcombe road underbridge and therefore the bat underpass at CH 1+100 would provide a safer method of crossing within the existing territory. A further underpass (Grove Farm underpass) is proposed nearer to the Air Balloon roundabout, as a safer access route for Grove Farm which would cross under the A417 from Cold Slad Lane. This underpass would be suitable to be used by species such as bats, badger, fox and deer. Badger fencing would tie in with this structure to encourage its use and prevent access of animals to the highway.
- 2.7.53 Wildlife fencing for badgers has been included in the proposed scheme design throughout the entire length of the proposed 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 the Environmental Masterplan (Figure 7.9).

#### *Terrestrial invertebrates*

- 2.7.54 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

- 2.7.55 Opportunities have been taken during proposed scheme design to avoid geology and soils receptors. 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.
- 2.7.56 The proposed scheme footprint has been reduced and designed to avoid best and most versatile (BMV) land and to reduce impacts on soil resources.
- 2.7.57 To inform the assessment on geology and soils receptors the proposed scheme design is being developed in accordance with CD 622 Managing Geotechnical Risk<sup>3</sup>, which describes best practice in relation to managing the risk associated with the ground. This includes best practice on characterising a site, including geology, geomorphology, hydrogeology and contaminated land amongst other things.
- 2.7.58 Further investigations would be undertaken prior to construction in the Crickley Hill escarpment area to locate potential voids associated with gulls/fissures in the limestone formations or faults, and to investigate potential connectivity with the wider hydrogeological setting. The results would inform detailed design, particularly of any voids treatment or grouting works, if/where required. This additional information would also enable further consideration of risks from possible contaminated areas and the potential for migration of possible contaminants. Where risks are deemed significant, remediation options and strategies would be developed accordingly.
- 2.7.59 The proposed scheme design would also include assessment of ground aggressivity and selection of appropriate concrete class, pile design for the site-specific ground conditions and structural loading.

#### Materials

- 2.7.60 The previous 2019 scheme iteration generated a large excess of material, up to 1Mm<sup>3</sup>. The scheme has been modified as part of the EIA process to avoid this and remove any impact on waste infrastructure.
- 2.7.61 The earthworks process allows for the materials which would be excavated on-site, to be re-used at areas of the site where materials are required. This reduces the amount of material that is required from off-site sources.
- 2.7.62 The preliminary design re-uses excavated material on-site to blend the new highway embankments into the existing topography and so reduce the landscape impacts of the new alignment. This removes the need to transport surplus material on the highway network to off-site disposal facilities. This would avoid the adverse environmental effects on people and communities living along the routes to the off-site disposal facilities.

### Noise and vibration

- 2.7.63 A low noise road surface would be incorporated throughout the proposed scheme.
- 2.7.64 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.
- 2.7.65 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, or increased screening (from cuttings). This would result in reduced noise exposures which are identified in Chapter 11 Noise and vibration.
- 2.7.66 In particular, this engineering design has addressed, where practicable, dwellings currently in very close proximity to the existing road which are exposed to high noise levels. These noise reductions in Noise Important Areas respond to the requirement stated in the revised National Planning Policy Framework (described in Chapter 11 Noise and Vibration) that ‘development should, wherever possible, help to improve local environmental conditions...’, and hence provide enhancement where sustainable to do so.

### Population and human health

- 2.7.67 The scheme and its junctions have been designed to appropriate standards (DMRB), to allow safe access to existing 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. This includes new junctions and overbridges. The preliminary scheme design would continue to develop based on the outcome of supplementary public consultation. Once the scheme is consented, the detailed design would be undertaken.
- 2.7.68 The preferred location for the replacement Common Land is within a section of the re-purposed A417. This land is connected to the existing Common and would be re-landscaped as part of the scheme (see Chapter 7 Landscape and visual effects and Chapter 12 Population and human health for further details). The land would be fully accessible given the proposed Restricted Byway and the proposal would bring back Common Land that was previously de-registered for the construction of the current A417.

### Road drainage and the water environment

- 2.7.69 Flow volume and quality control measures are incorporated into the preliminary scheme design to provide a sustainable drainage system (SuDS) and are not considered to comprise additional mitigation.
- 2.7.70 The carriageway drainage would consist of a multi-stage treatment train which could potentially include vegetative systems such as 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.



- 2.7.71 Attenuation/infiltration basins would be designed to ensure that groundwater levels would not impede their performance.
- 2.7.72 Design of retaining walls or other structures within cuttings would incorporate drainage features 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.
- 2.7.73 In addition, where embankments are to be constructed above key groundwater/surface water interactions (springs), culverts or drainage blankets will 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 will be designed to maintain spring recharge into, and flows within, the realigned Norman's Brook. These will be considered at the detailed design stage.
- 2.7.74 Design of retaining walls or other structures within cuttings will 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 in baseline conditions would be recharged by that groundwater and thus maintaining the overall water balance within the catchments.
- 2.7.75 The design of the road drainage network will consider necessary measures and treatment to provide appropriate protection to the karst aquifer from potential water quality deterioration. Where there is potential interaction with groundwater levels than these are appropriately assessed based upon the groundwater monitoring network.
- 2.7.76 These mitigation measures will be updated through the detailed design of the proposed scheme's drainage.
- 2.7.77 The detailed design of underground structures, such as piled foundations, will consider designs to reduce impacts on groundwater flow. For example, deeper and wider spaced piling to reduce flow barrier effects and allow a similar groundwater flow path and incorporating appropriate drainage solutions. A site-specific Foundation Works Risk Assessment (FWRA) will be undertaken to identify appropriate piling methodology. The FWRA will be made available for review by the EA during the detailed design period as per their request and will be recorded in the Statement of Common Ground.
- 2.7.78 The geotechnical design may require localised dig and replacement of soils, the location of which is currently unknown and will be confirmed at a detailed design stage. The design will take due consideration to minimising potential impacts on local hydrogeology. This will specify adequate physical properties and compaction requirements to ensure that the hydraulic properties of the engineering fill would not result in significant adverse impact on groundwater flows.
- 2.7.79 Norman's Brook would be realigned to the toe of the proposed A417 embankment along Crickley Hill. The scheme would seek to deculvert existing sections of culverted watercourse and minimise the introduction of new culverted sections of the watercourse where possible.

2.7.80 The proposals aim to maintain the existing character and geomorphology of the existing stream by replicating existing features such as cascades and irregular meanders.

#### Climate change

2.7.81 The current gradient of Crickley Hill is up to 10% in places, which results in problems caused by slow-moving vehicles. To address this, the scheme would reduce the gradient and provide two lanes in each direction, with a climbing lane for slow-moving vehicles from Brockworth heading eastwards towards Cowley. This would assist in reducing the operational carbon footprint from road users due to free-flowing traffic and shallower gradients.

2.7.82 The scheme has been designed to eliminate the requirement for energy consuming operational equipment such as street lighting, reducing the operational carbon impact to negligible.

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

### **Construction activities**

2.8.1 The construction activities for the scheme would be typical of a major highway scheme and consist of the following:

- advance works comprising advanced ecology mitigation (for example, moving of badger setts and vegetation clearance) and archaeological investigation;
- 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
- auxiliary works including side roads, WCH routes and ecology structures; and
- landscape and planting works.

### **Construction programme**

2.8.2 The start date for the construction phase would depend upon several factors including the grant of a DCO. It is currently anticipated that the construction activities would commence in 2023 and the scheme open to traffic in 2025.

2.8.3 The construction programme would be finalised by the contractor in advance of the works. An outline construction programme, including the duration, anticipated phasing, working hours and any requirement for night time working will be detailed in the ES.

### **Construction access and vehicle movements**

2.8.4 The construction of the scheme would use typical construction techniques associated with major infrastructure projects.

2.8.5 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.

- 2.8.6 It is currently assumed that a haul road strip 10 meters wide would be required parallel to the embankment/structures with access gained via upgrading existing farm tracks.

### Excavated Materials

- 2.8.7 It is estimated that 86,099 cubic metres of surplus material would remain after the required cut and fill construction operations, (cut 1,434,780 cubic metres and fill 1,348,750 cubic metres). The earthworks strategy, including management of excess material, is to be developed further as part of the Environmental Impact Assessment. This would examine further options for re-using the material on-site to achieve an earthworks cut/fill balance and ensure waste would not be disposed outside of the region.
- 2.8.8 It is assumed that the excavated material (limestone) would be suitable for processing and re-use in certain areas of the highway construction such as various drainage classifications, Class 1, Class 6A, Class 6F and Class 6P, however, from current ground investigation information it is thought that the material would be unsuitable for use as a granular Type 1 material or capping within 0.5 metres of the road surface, which would need to be imported from an external source. The exact capabilities of the excavated material would not be known until the results of the full required Ground Investigation are known and the Geotechnical Design Report completed. At present, based on the information currently available, it is thought that the extremely weak to weak limestone material found up to a depth of around 6 metres would not be suitable for processing. The moderately strong to strong limestone material thought to be present below 6 metres should however be suitable for processing.
- 2.8.9 To minimise haul distance, a crusher would be positioned close to the deep cut area and Shab Hill Junction (around Ch 2+700).
- 2.8.10 Table 2-4 indicates the cut, fill and surplus quantities which arise from bulk earthworks for each zone

**Table 2-4 Earthwork quantities**

Segment	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )	Net (m <sup>3</sup> )
(CH 0 + 500)	22,621	782	21,839
(CH 500 + 1800)	55,396	331,781	-276,385
(CH 1800 + 2200)	153,841	8,932	144,909
(CH 2200 + 4000)	848,052	790,363	57,689
(CH 4000 + 5150)	307,458	165,208	142,250
(CH 5150 + 5759)	47,482	51,685	-4,203
<b>Total</b>	<b>1,434,850</b>	<b>1,348,751</b>	<b>86,099</b>

### Statutory utilities

- 2.8.11 Construction of the scheme would likely 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.

2.8.12 Four statutory undertakers (SU's) with apparatus would be impacted as a result of the scheme:

- BT Openreach;
- Western Power Distribution;
- Severn Trent Water; and
- Gigaclear.

2.8.13 The SU's 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.

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

2.8.14 The extent of land use requirements during construction and operation are defined by permanent and temporary land-take requirements. These are shown within the scheme boundary line on the General Arrangement drawings in Figure 2.1. These would be set out and justified in the Statement of Reasons to accompany the DCO application.

2.8.15 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 Environmental Masterplans (Figure 7.9).

2.8.16 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**

2.8.17 The scheme would not require the demolition of any existing major structures, although 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) would be necessary.

2.8.18 Approximately 1 kilometre of the existing A417 between Birdlip Link Road near Barrow Wake and the existing Air Balloon roundabout would be repurposed as part of the scheme.

### **Environmental management plan**

2.8.19 An Environmental Management Plan (EMP) is being developed. The EMP will summarise scheme specific actions identified through the EIA process for all environmental factors and will be presented in the form of a Register of Environmental Actions and Commitments (REAC) within the ES.

2.8.20 Prior to the commencement of the construction works, the EMP would be refined by the contractor, in line with DMRB standard LA 120.

## **2.9 Maintenance**

2.9.1 A Maintenance and Repair Strategy Statement would be prepared for the scheme, which would identify maintenance proposals for assets and how these would be maintained during operation.

- 2.9.2 The maintenance proposals would be developed with engagement with Highways England's Maintenance and Operation team.
- 2.9.3 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 Environmental Management Plan (EMP) for the end of construction. With the implementation of these measures no significant effects are considered likely.

## **2.10 Decommissioning**

- 2.10.1 The traffic and economic assessment demonstrate the proposed improvements would operate adequately for the first 15 years of opening to the Design Year of 2040. 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.
- 2.10.2 It is considered highly unlikely that the proposed 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 PEI Report.

## End Notes & References

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<sup>1</sup> UK Government, CEH digital river network of Great Britain (1:50,000), 2020. Available at: <https://data.gov.uk/dataset/5ecb0e8c-a4b9-4afb-bb4b-ebc34474f9df/ceh-digital-river-network-of-great-britain-1-50-000>

<sup>2</sup> George E Pearce (2011) Badger behaviour conservation and rehabilitation.

<sup>3</sup> Highways England (Aug 2019) CD 622 Managing Geotechnical Risk.

<http://www.standardsforhighways.co.uk/ha/standards/dmr/vol4/section1/CD%20622%20Managing%20geotechnical%20risk-web.pdf>