ENVIRONMENTAL ASSESSMENT REPORT – BIODIVERSITY CHAPTER

Notice

This document is the Biodiversity chapter from the Environmental Assessment Report (EAR) for Project Control Framework (PCF) Stage 2 of the A27 Arundel Bypass Scheme ('the Scheme'), completed in May 2018. Three design options for the Scheme (Option 1, Option 3 and Option 5A) were being considered at this time.

Following a Preferred Route Announcement for the Scheme in May 2018, Highways England announced a further non-statutory public consultation to be undertaken in 2019. This resulted in the scheme returning to PCF Stage 2. New documents will be completed as a part of this Stage that will consider design developments and any other evidence available.

8 BIODIVERSITY

8.1 INTRODUCTION

8.1.1 This biodiversity chapter provides an ecological impact assessment of the A27 Arundel Bypass upon designated sites, habitats and species. Likely significant effects associated with each Scheme Option (Option 1, Option 3 and Option 5A) are assessed and discussed. A comparison of the three Scheme Options against one another, in respect of relative magnitude of ecological impact, is presented. This analysis is required by Highway England to inform selection of a preferred route option.

8.1.2 The ecological impact assessment considers Important Ecological Features within appropriate study areas measured from the edge of the preliminary footprint of each of the three Scheme Options. Study areas have been selected with respect to the features considered to allow possible direct and indirect impacts to be fully accounted for, and are described in Section 8.2.

8.1.3 The assessment is based on desk study and field survey information presented in the PCF Stage 1 Environmental Study Report. In addition, it includes desk study information gathered in 2017 provided by the Mid-Arun Valley Environmental Survey based on their surveys undertaken between 2015 and 2017.

8.1.4 A range of habitat, protected and notable species surveys are being undertaken by Highways England between February 2017 and August 2018. Appendix E summarises methods for ecological surveys being undertaken in 2017/2018 and key preliminary findings. Detailed survey findings from 2017/2018 surveys will be presented at PCF Stage 3, however, preliminary findings have been incorporated into this assessment.

8.1.5 The Ordnance Survey 1:25,000 series map has been used to reference individual place names in this chapter (for example, Paine's Wood, Barn's Copse, Tortington Common etc.). Where place names need to be referenced that do not correspond to those published by the Ordnance Survey, the location name given is accompanied by a National Grid reference (e.g. Sandy Hole Pond, National Grid reference SU9819106947). An eight or ten figure grid reference is provided where the ecological feature may be pin-pointed precisely; a six figure grid reference is provided where the feature is a broader area. Place names commonly referred to in the text are also mapped in Figure 8-1.

8.2 LEGISLATIVE AND POLICY FRAMEWORK

EU DIRECTIVES AND INTERNATIONAL CONVENTIONS

WILD BIRDS DIRECTIVE 2009/147/EC

8.2.1 This directive creates a comprehensive scheme of protection for all wild bird species naturally occurring in the European Union. The Directive places great emphasis on the protection of habitats for endangered as well as migratory species, especially through the establishment of a coherent network of Special Protection Areas.

HABITATS DIRECTIVE 92/43/EEC

8.2.2 Together with the Birds Directive, this Directive forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: network of protected sites and system of strict species protection. This directive provides for the establishment of a network of Special Areas for Conservation.

WATER FRAMEWORK DIRECTIVE 2000/60/EC

8.2.3 The Directive establishes a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater.

ENVIRONMENTAL IMPACT ASSESSMENT DIRECTIVE 2011/92/EU

8.2.4 The Directive requires Environmental Impact Assessment to be undertaken in relation to a wide range of defined public and private projects, which are defined in Annexes I and II.

UK AND ENGLISH LEGISLATION FRAMEWORK

8.2.5 A number of statutes exist to ensure direct and indirect protection of England's habitats and species. Those with direct relevance are summarised in this section

THE CONSERVATION OF HABITATS AND SPECIES REGULATIONS 2017

8.2.6 The Regulations which implement the Habitats Directive (EC Directive 92/43/EEC) in the United Kingdom require those consenting a development (in the case of the Scheme, the competent authority is the Secretary of State for Transport) to decide whether or not a plan or project can proceed having undertaken the an 'appropriate assessment' which:

- Determines whether a project may have a significant effect on a European site[1];
- If required, undertake an appropriate assessment of the project; and
- Decide whether there may be an adverse effect on the integrity of the European site in light of the appropriate assessment.

8.2.7 The Regulations also require those proposing a development that may negatively impact a European Protected Species of plant or animal (those listed on Schedule 2 of the Regulations/Annex IV of the EC Habitats Directive) to pass three licensing tests which are regulated by Natural England:

- The impact is necessary for imperative reasons of overriding public interest including those of a social or economic nature (Regulation 55, Section 2e);
- There is no satisfactory alternative to the proposed development (Regulation 55, Section 9a); and
- That the development will not be detrimental to the maintenance of the species concerned at a favourable conservation status in their natural range (Regulation 55, Section 9b).

8.2.8 All species of bat, hazel dormouse (*Muscardinus avellenarius*), great crested newt (*Triturus cristatus*), lesser whirlpool ram's-horn snail (*Anisus vorticulus*), otter (*Lutra lutra*) and white clawed crayfish (*Austropotamobius pallipes*) are all examples of European Protected Species which are considered in this assessment. Hazel dormouse and numerous species of bat have been confirmed as present in the Field Survey Area (see Section 8.4 Baseline).

WILDLIFE AND COUNTRYSIDE ACT 1981

8.2.9 This is the primary legislation in Great Britain for the protection of flora, fauna and the countryside. This legislation covers four areas:

[1] European sites include: Special Areas of Conservation, Special Protection Areas, sites of Community importance (SCIs), and candidate SACs. As a matter of Government policy, potential Special Protection Areas and Ramsar sites are also treated as European sites.

- Wildlife protection, including protection of wild birds, their eggs and nests, protection of other animal and protection of plants;
- Nature Conservation, Countryside & National Parks;
- Public Rights of Way; and
- Miscellaneous provisions.

THE COUNTRYSIDE AND RIGHTS OF WAY ACT 2000

8.2.10 The Act places a duty on Government Departments and the National Assembly for Wales to have regard for the conservation of biodiversity and maintain lists of species and habitats for which conservation steps should be taken or promoted, in accordance with the Convention on Biological Diversity.

8.2.11 Schedule 9 of the Act amends SSSI provisions of the Wildlife and Countryside Act 1981, including provisions to change SSSIs and providing increased powers for their protection and management.

8.2.12 Schedule 12 of the Act amends the species provisions of the Wildlife and Countryside Act 1981, strengthening the legal protection for threatened species.

THE NATURAL ENVIRONMENT AND RURAL COMMUNITIES ACT 2006

8.2.13 The Act was designed to help achieve a rich and diverse natural environment and thriving rural communities through modernised and simplified arrangements for delivering Government policy. The Act established a new independent body - Natural England - responsible for conserving, enhancing, and managing England's natural environment for the benefit of current and future generations. The Act made amendments to both the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way (CROW) Act 2000.

8.2.14 Section 40 of the Act imposes a duty on public authorities, including Highways England, which is that: "*In exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity."*

8.2.15 Section 41 of the Act requires the Secretary of State to: *"publish a list of the living organisms and types of habitat which in the Secretary of State's opinion are of principal importance for the purpose of conserving biodiversity."* These are alternative referred to as Habitats/Species of Principal Importance.

THE NATIONAL PARKS AND ACCESS TO THE COUNTRYSIDE ACT 1949

8.2.16 In England and Wales National Parks and Areas of Outstanding Natural Beauty are designated under the National Parks and Access to the Countryside Act 1949. The purposes of designation for National Parks are to:

- Conserve and enhance their natural beauty, wildlife and cultural heritage and
- Promote public understanding and enjoyment of their special qualities.

8.2.17 All the national parks in England, Wales and Scotland have an aim and purpose to promote understanding and enjoyment of the 'special qualities' of their area. The special qualities of the South Downs National Park include the following relating to nature conservation: *"A rich variety of wildlife and habitats including rare and internationally important species"*[2]*.* For the purpose to this

[2] South Downs National Park Authority [on-line] South Downs National Park – Special Qualities. https://www.southdowns.gov.uk/wp-content/uploads/2015/03/SDNP-Special-Qualities.pdf (accessed November 2017).

assessment, this is interpreted to mean internationally, nationally and locally designated and protected habitats and species and issues surrounding connectivity of wildlife habitat across the park.

THE PROTECTION OF BADGERS ACT 1992

8.2.18 The Act applies to England and Wales making it an offence to kill, injure or take a badger, or to damage or interfere with a set unless a license is obtained from a statutory authority allowing the badgers to be carefully excluded, making them move elsewhere in their territory. Badgers are protected and so are the setts (burrows) they live in.

THE HEDGEROW REGULATIONS 1997

8.2.19 These regulations are designed to protect important hedgerows in England and Wales. The regulations cover hedgerows that have a continuous length of at least 20 metres, or if less than 20 metres, meets another hedgerow at each end. The regulations also cover hedgerows that grow in, or adjacent to any common land, local nature reserve, Site of Special Scientific Interest (SSSI), or land used for agriculture, forestry of the breeding or keeping of horses, ponies of donkeys. Anyone proposing to remove a hedgerow, or part of a hedgerow, covered by these regulations, must first notify the local planning authority by submitting a Hedgerow Removal Notice.

RELEVANT PLANNING POLICY FRAMEWORK

NATIONAL PLANNING POLICY FRAMEWORK

8.2.20 The National Planning Policy Framework (NPPF) adopted in 2012 sets out the Government's planning policies for England and how these are expected to be applied. The NPPF contains the following statements which are of relevance to the Scheme (not an exhaustive list, but including those of highest relevance):

- Section 11, paragraph 109 states that the planning system should contribute to and enhance the natural and local environment by: *"minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures";*
- Section 11, paragraph 115 states that – *"Great weight should be given to conserving landscape and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty, which have the highest status of protection in relation to landscape and scenic beauty. The conservation of wildlife and cultural heritage are important considerations in all these areas, and should be given great weight in National Parks and the Broads".*
- Section 11, paragraph 116 states that – *"Planning permission should be refused for major developments in these designated areas except in exceptional circumstances and where it can be demonstrated they are in the public interest. Consideration of such applications should include an assessment of: the need for the development, including in terms of any national considerations, and the impact of permitting it, or refusing it, upon the local economy; the cost of, and scope for, developing elsewhere outside the designated, area, or meeting the need for it in some other way; and any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated."*
- Section 11, paragraph 117 states that - *"To minimise impacts on biodiversity and geodiversity, planning policies [local authorities] should: plan for biodiversity at a landscape-scale across local authority boundaries; identify and map components of the local ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation; promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority*

species populations, linked to national and local targets, and identify suitable indicators for monitoring biodiversity in the plan"; and

- Section 11, paragraph 118 states that: *"When determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by applying the following principles: if significant harm resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused". It also states that: "planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss".*

NATIONAL NETWORKS NATIONAL POLICY STATEMENT (NNNPS);

8.2.21 The NNNPS sets out the need for, and Government's policy to deliver development of nationally significant infrastructure projects (NSIPs) on the national road and rail network in England. The Planning Act 2008 requires the Examining Authority and the Secretary of State to use the NNNPS to make decisions on applications for development consent for nationally significant infrastructure projects on the road and rail networks and strategic rail freight interchanges for England.

8.2.22 The NN NPS contains the following statements which are of key relevance:

- "*Prior to granting a Development Consent Order, the Secretary of State must, under the Habitats Regulations, consider whether it is possible that the project could have a significant effect on the objectives of a European site* (paragraph 4.22)".
- "*If a proposed national network development makes it impossible to rule out an adverse effect on the integrity of a European site, it is possible to apply for derogation from the Habitats Directive, subject to the proposal meeting three tests. These tests are that no feasible, less-damaging alternatives should exist, that there are imperative reasons of overriding public interest for the proposal going ahead, and that adequate and timely compensation measures will be put in place to ensure the overall coherence of the network of protected sites is maintained* (paragraph 4.25)".
- "*As a general principle, and subject to the specific policies below, development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives.…Where significant harm cannot be avoided or mitigated, as a last resort, appropriate compensation measures should be sought*" (paragraph 5.25, page 52).
- "*Where a proposed development on land within or outside a SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), development consent should not normally be granted. Where an adverse effect on the site's notified special interest features is likely, an exception should be made only where the benefits of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest, and any broader impacts on the national network of SSSIs*" (paragraph 5.29, page 53).
- "*Sites of regional and local biodiversity and geological interest (which include Local Geological Sites, Local Nature Reserves and Local Wildlife Sites and Nature Improvement Areas) have a fundamental role to play in meeting overall national biodiversity targets, in contributing to the quality of life and the well-being of the community, and in supporting research and education. The Secretary of State should give due consideration to such regional or local designations*" (paragraph 5.31, page 53).
- "*Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales and therefore requiring conservation action. The Secretary of State should ensure that applicants have taken measures to ensure these species and habitats are protected from the adverse effects of development. Where appropriate, requirements or planning obligations may be used in order to deliver this protection. The Secretary of State should refuse consent where harm to the habitats or*

species and their habitats would result, unless the benefits of the development (including need) clearly outweigh that harm" (paragraph 5.35, page 54).

- The NN NPS at paragraph 5.32 states the following regarding Ancient Woodland and 'aged or veteran trees'. The formal terms Ancient Tree and Veteran Tree are used in this assessment or Ancient/Veteran tree collectively (it is noted that the NN NPS uses the term 'aged tree' which isn't a formal ecological term).
- "*Ancient woodland is a valuable biodiversity resource both for its diversity of species and for its longevity as woodland. Once lost it cannot be recreated. The Secretary of State should not grant development consent for any development that would result in the loss or deterioration of irreplaceable habitats including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the national need for and benefits of the development, in that location, clearly outweigh the loss. Aged or veteran trees found outside ancient woodland are also particularly valuable for biodiversity and their loss should be avoided. Where such trees would be affected by development proposals, the applicant should set out proposals for their conservation or, where their loss is unavoidable, the reasons for this*" (page 54).

OUR GREEN FUTURE: A 25 YEAR PLAN TO IMPROVE THE ENVIRONMENT

8.2.23 DEFRA's 25 year environment plan contains the following targets:

- "Restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term;
- Creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats as part of a wider set of land management changes providing extensive benefits;
- Taking action to recover threatened, iconic or economically important species of animals, plants and fungi, and where possible to prevent human induced extinction or loss of known threatened species in England and the Overseas Territories; and
- Increasing woodland in England in line with our aspiration of 12% cover by 2060: this would involve planting 180,000 hectares by end of 2042".

LOCAL PLANNING POLICY

ARUN DISTRICT COUNCIL PLANNING POLICIES

8.2.24 Relevant policies relating to biodiversity in the adopted Arun District Local Plan 2003 include saved policies GEN23 (Water Environment), GEN25 (Water Resource), GEN29 (Nature Conservation Across the District), AREA13 (Sites of International Importance for Nature Conservation), AREA14 (Sites of National Importance for Nature Conservation), AREA15 (Sites of Local Importance for Nature Conservation). This current local plan is in the process of being updated.

8.2.25 The Council produced a series of modifications to the Arun Local Plan 2011 – 2031 which is undergoing public consultation to end of 23rd February 2018. Arun Local Plan 2011 – 2031 Consultation on the Main Modifications[3] sets out the Council's vision for the development of Arun up to 2031. Relevant draft Local Plan policies include SD SP1 (Sustainable development), ENV SP1 (Natural Environment), ENV DM1 (Designated Sites of biodiversity or geological importance), ENV DM3 (Biodiversity Opportunity Areas), ENV DM4 (Protection of Trees), ENV DM5 (Development and biodiversity).

[3] Arun District Council (2014) *Arun Local Plan 2011 – 2031* [online] https://www.arun.gov.uk/download.cfm?doc=docm93jijm4n11682.pdf&ver=11665

SOUTH DOWNS NATIONAL PARK PLANNING POLICIES

8.2.26 The part of the South Downs National Park affected by the Scheme is covered by the saved policies of 11 inherited Local Plans and 5 adopted joint core strategies. The South Downs National Park Authority is currently preparing its Local Plan, once adopted the policies in the South Downs Local Plan will replace all existing planning policies across the National Park. A pre-submission consultation on the Local Plan concluded in November 2017 and is due to be submitted to the Government for examination in spring 2018.

8.2.27 Relevant draft Local Plan policies include core policies SD1 (Sustainable development) and SD2 (Ecosystem Services), strategic policies SD10 (International Sites, SD11 (Trees, Woodland and Hedgerows), SD17 (Protection of the Water Environment).

OTHER RELEVANT DOCUMENTS

8.2.28 Department of Environment Food and Rural Affairs (2011). Biodiversity 2020: A strategy for England's wildlife and ecosystem services.

8.2.29 This Strategy builds on the Natural Environment White Paper and sets out the strategic direction for biodiversity policy for the next decade on land (including rivers and lakes) and at sea, providing a comprehensive picture of how we are implementing our international and EU commitments.

NATURAL ENVIRONMENT WHITE PAPER (2011)

8.2.30 The White Paper sets out a clear framework for protecting and enhancing the natural environment, backed up with practical action. It details how it will take forward the Biodiversity Challenge to halt the loss of UK and International species and habitats. It details how to "mainstream the value of nature across our society"; "promote an ambitious, integrated approach, creating a resilient ecological network across England" and "move from net biodiversity loss to net gain".

THE UK POST-2010 BIODIVERSITY FRAMEWORK 2012

8.2.31 The UK Post-2010 Biodiversity Framework was published on 17 July 2012. It was produced by JNCC and Defra, on behalf of the Four Countries' Biodiversity Group (4CBG), through which the environment departments of all four governments in the UK work together.

8.2.32 The Framework covers the period from 2011 to 2020, and was developed in response to two main drivers: the Convention on Biological Diversity's (CBD's) Strategic Plan for Biodiversity 2011-2020 and its 5 strategic goals and 20 'Aichi Biodiversity Targets', published in October 2010; and the EU Biodiversity Strategy, released in May 2011.

8.2.33 The Framework shows how the work of the four UK countries joins up with work at a UK level to achieve the 'Aichi Biodiversity Targets' and the aims of the EU biodiversity strategy. It identifies the activities required to complement the country biodiversity strategies, and where work in the country strategies contributes to international obligations.

BIODIVERSITY 2020: A STRATEGY FOR ENGLAND'S WILDLIFE AND ECOSYSTEM SERVICES

8.2.34 This document sets out the strategic direction for biodiversity policy up to 2020 based around four thematic areas: a more integrated large-scale approach to conservation on land and at sea; putting people at the heart of biodiversity policy; reducing environmental pressures; and improving scientific knowledge.

THE SUSSEX BIODIVERSITY ACTION PLAN

8.2.35 The Sussex Biodiversity Action Plan sets out the actions needed for protecting and enhancing wildlife in Sussex. It provides a framework for conserving and enhancing the species and spaces of Sussex including a list of Sussex priority species and habitats.

SUSSEX BIODIVERSITY OPPORTUNITY AREAS

8.2.36 The Survey Area includes parts of two Sussex Biodiversity Partnership Biodiversity Opportunity Areas (BOAs):

- BOA 19 - Climping to Houghton – which targets (among other objectives) wetland habitat management, restoration and creation, woodland management and restoration, conservation of farmland birds and woodland butterflies and floodplain restoration and reconnection; and
- BOA 20 Arundel Park – which targets chalk grassland management, restoration and creation, woodland management and restoration and conservation of woodland butterflies.

SOUTH DOWNS NATIONAL PARK AUTHORITY POLICY

8.2.37 The Survey Area lies partly inside the South Downs National Park boundary which includes most of Paine's Wood, Binsted Wood and Tortington Common. The South Downs National Park has a range of nature conservation objectives including:

- To conserve and enhance the cultural heritage and large areas of high-quality and well-managed habitat to form a network supporting wildlife throughout the landscape.

8.2.38 The South Downs National Park Authority has produced a biodiversity opportunity map which defines key locations considered to be suitable for the creation and restoration of priority habitats. This supports a key South Downs National Park priority to restore an ecologically functional network of semi-natural habitats across the South Downs. Work is underway to define the extent of the biodiversity opportunity areas that fall within the Survey Area and will be reported at PCF Stage 3.

SOUTH DOWNS NATURE IMPROVEMENT AREA

8.2.39 The 'South Downs Way Ahead' Nature Improvement Area is approximately 4.0 kilometres north and 4.0 kilometres east of the Survey Area. Nature Improvement Areas are a landscape scale approach to nature conservation introduced by the Government as part of the Natural Environment White Paper. The South Downs Way Ahead Nature Improvement Area objectives include:

- Walk the Chalk - To broaden the South Downs Way National Trail as a semi-natural corridor and improve the natural qualities of the route;
- Linking the Fragments - To achieve real improvements to the conservation and management of chalk grassland at the heart of the matrix of downland habitats; and
- Valuing the Chalk - To attribute environmental, economic and social values to the benefits and services provided by chalk downland.

HIGHWAYS ENGLAND BIODIVERSITY STRATEGY

8.2.40 Highways England's biodiversity strategy document: 'Our plan to protect and increase biodiversity' states that: "by 2020, the company must deliver no net loss of biodiversity, and that by 2040 it must deliver a net gain in biodiversity" (page 9).

8.2.41 The Scheme has adopted the Department for Environment, Food and Rural Affairs' biodiversity metric to calculate baseline biodiversity units which are present in the footprint of each of the three Scheme Options. This information will be used as a basis for evaluating progress towards Highways England's national target of achieving net gain/no net loss of biodiversity. Biodiversity unit calculation information will influence the ecological impact assessment by quantifying the relative impact magnitude of different Scheme Options and by providing a quantitative benchmark to inform the size and type of habitat compensation which may be required. Ancient Woodland, ancient and veteran trees and Wood Pasture and Parkland HPI are defined as irreplaceable habitats and, following Department for Environment Food and Rural Affairs guidance, they has been excluded from this biodiversity unit calculation. The findings of the biodiversity unit calculation will be presented at PCF Stage 3.

NATURAL ENGLAND STANDING ADVICE AND OTHER GUIDANCE

8.2.42 Natural England has identified a Woods and Parks Landscape Scale Project area (also known as the Ebernoe Focus Area) which spans from the Chichester coast to west of Horsham, including the entire Desk Study Area. This area is design to promote conservation measures, such as woodland and parkland habitat management and creation, to benefit rare bat species such as Bechstein's bat (*Myotis bechsteinii*) and the barbastelle (*Barbastella barbastellus*).

8.2.43 Natural England's standing advice on Ancient Woodland and veteran trees states that (note that there are two different types of Ancient Woodland which discussed in Section 8.4) Ancient semi-natural woodland and plantations on ancient woodland sites have equal protection under the National Planning Policy Framework. The standing advice provides strong direction that options to avoid impacts on Ancient Woodland must be exhausted in the first instance. The standing advice also proposes a range of measures to ensure Ancient Woodland is protected from direct or indirect impacts arising from development, including ensuring a sufficient buffer zone is left between development and Ancient Woodland to ensure protection from direct impacts.

8.3 STUDY AREA

8.3.1 Both the Desk Study Area and Field Survey Area were defined to include land likely to be at risk from possible direct and indirect impacts that might arise from each of the Scheme Options (together termed the Zone of Influence). Definition of the Desk and Field Survey Areas follow available guidance provided in the Design Manual for Roads and Bridges[4] [5] and other sources of survey best practice referenced in Appendix E.

DESK STUDY

8.3.2 The following Desk Study Areas were used. Distances are measured from the outer edge of the provisional Scheme footprint:

- International statutory designated sites – 10 kilometres extending to 30 kilometres for Special Areas for Conservation (SACs) designated for bats;
- National statutory and non-statutory designated sites – 2 kilometres; and
- Protected and notable species – 2 kilometres.

[4] Design Manual for Bridges and Roads (1993). Volume 11, Section 3, Part 4 Ecology & nature Conservation
[5] Design Manual for Bridges and Roads (various dates). Volume 10, Section 4 Nature Conservation

8.3.3 In addition to the above, any international designated site or SSSI within 0.2 kilometres of the 'the affected road network'[6] was included in the desk study in order to consider the possibility of air quality impacts. 0.2 kilometre from the affected road network is the distance for consideration of air quality impacts recommended in the Design Manual for Roads and Bridges air quality assessment guidance. The affected road network was identified from traffic modelling (refer to the traffic modelling study which is document HE551523-WSP-GEN-A27A-PCF2-RP-TR-ComMA).

FIELD SURVEY

8.3.4 A 50 metres Field Survey Area from each of the Scheme Options was used for collection of Extended Phase 1 Habitat Survey data in 2016 at PCF Stage 1. The findings of 2016 survey work are reported in the PCF Stage 1 Environmental Study Report.

8.3.5 Between May 2017 and autumn 2018, additional habitat survey work will be undertaken including Phase 1 Habitat Survey, National Vegetation Classification survey, other botanical survey work and a range of survey work targeting protected and notable species. These surveys have been undertaken in an area extending up to 1.5 kilometres from the boundary of the provisional footprint for each Scheme Option. Appendix E contains a list of all habitat survey work being progressed in 2017 and 2018, the methods being used and preliminary findings. The preliminary findings of the 2017 and 2018 surveys have been included in the description of baseline conditions in this report.

8.4 BASELINE CONDITIONS

8.4.1 The following section sets out baseline information on designated sites, habitats and species used to inform the assessment of ecological impacts.

8.4.2 Methods for desk study and field survey data collection are outlined first. The findings of the desk study and field survey information are then discussed alongside each other for each designated site, habitat type and species/species group.

8.4.3 Each designated site, habitat type and species/species group is valued according to the Chartered Institute for Ecology and Environmental Management Ecological Impact Assessment method[7] and guidance provided in Highways England's Interim Advice Note 130/10[8]. Further explanation is provided in Section 8.5.

DESK STUDY METHODS

8.4.4 The PCF Stage 1 Environmental Study Report presented the findings of a desk study which obtained and reviewed records of protected and notable species, habitats and designated nature conservation sites within the Desk Study Areas. This information is reviewed again in this assessment along with additional desk study information provided in 2017 by the Mid-Arun Valley Environmental Survey.

8.4.5 The following types of protected or notable designated sites and habitats were included in the desk study:

- United National Education, Scientific and Cultural Organisation (UNESCO) Biosphere Reserves;

[6] The affected road network is the part of the road network linking to the A27 that could be affected by changes to traffic patterns during either the construction or operational phase of the Scheme.
[7] Chartered Institute for Ecology and Environmental Management (2016). Guidelines for ecological impact assessment in the UK and Ireland Terrestrial, Freshwater and Coastal. CIEEM. Winchester
[8] Highways England (2010). Interim Advice Note 130/10 - Ecology and Nature Conservation: Criteria for Impact Assessment Interim Advice Note 130/10. Highway England.

- SAC/candidate SAC;
- Special Protection Area (SPA)/proposed SPA;
- Ramsar site;
- Sites of Special Scientific Interest (SSSI) including proposed SSSIs;
- National Nature Reserve (NNR);
- Local Nature Reserve (LNR);
- Local Wildlife Site (LWS);
- Notable Road Verge;
- Ancient Woodland Inventory site;
- Land listed on Natural England's Priority Habitat Inventory;
- Habitats of Principal Importance (HPI) in England included on Section 41 of the Natural Environment and Rural Communities Act 2006;
- Important Hedgerows as defined by The Hedgerows Regulations 1997; and
- Habitats on the Sussex Biodiversity Action Plan (BAP).

8.4.6 Species were considered to be protected or notable if they were included on any of the following pieces of statute or conservation registers; and were included in the desk study:

- Annex 1,Annex 2 and Annex 4 of the Habitats Directive (Council Directive 92/43/EEC);
- Annex 1 of the Birds Directive (Council Directive 2009/147/EC);
- Schedules 1, 5 or 8 of the Wildlife and Countryside Act, 1981;
- Species of Principal Importance (SPI) in England included on Section 41 of the Natural Environment and Rural Communities Act 2006;
- Birds of Conservation Concern Red List or Amber List[9];
- Joint Nature Conservation Committee Conservation Designations for UK Taxa spreadsheet[10] containing details of species listed on the UK or England Red Data Book and National Notable, Nationally Rare or Nationally Scarce species;
- Species or habitats on the Sussex Biodiversity Action Plan (BAP); and
- Species included on the Sussex Rare Species Inventory (provided by Sussex Biodiversity Records Centre).

8.4.7 The following desk study sources were used, contacted and/or reviewed. Records of protected and notable species were only considered relevant if from the period 2007 to 2017:

- Ordnance Survey mapping;
- A data search provided by Sussex Biodiversity Records Centre provided in 2016 and updated in 2017;
- The Government's Multi Agency Geographic Information for the Countryside website[11];

[9] Eaton, M et al. (2015). Birds of *British Birds* Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man.. 108: 708 – 746.
[10] Joint Nature Conservation Committee (undated). Conservation Designations for UK Taxa. [on-line] http://jncc.defra.gov.uk/page-3408 (accessed November 2017).
[11] Multi-Agency Geographic Information System for the Countryside [on-line] http://www.magic.gov.uk/ (access November 2017).

- Natural England's Ancient Woodland Inventory and Priority Habitat maps;
- The Woodland Trust's Ancient Tree Hunt map for the UK;
- Publicly available aerial imagery; and
- Ecological survey work undertaken by the Mid-Arun Valley Environmental Survey and published in 2017[12] [13].

FIELD SURVEY METHODS

HABITATS

8.4.8 A Phase 1 Habitat Survey was undertaken by two suitably experienced ecologists between 12 and 14 January 2016. This information was provided with the PCF Stage 1 Environmental Study Report. The Survey Area extended to an approximate distance of 50 metres from the centre line of each of the three Scheme Options. Access was only available to approximately 20% of the Field Survey Area because of land access restrictions (see Section 8.6 below).

8.4.9 The Phase 1 Habitat Survey followed the Joint Nature Conservation Committee method[14]. This method is a standardised technique for rapidly obtaining baseline habitat information over a large area of land. Habitats present in the Field Survey Area were identified and dominant plant species recorded in accordance with standard botanical nomenclature[15].

8.4.10 Between May 2017 and August 2018, additional habitat survey work will be undertaken including Phase 1 Habitat Survey, National Vegetation Classification Survey and other botanical survey work. The preliminary findings of habitat survey work which is being progressed in 2017 and 2018 have been included in this baseline. Appendix E contains a list of all habitat survey work being progressed in 2017 and 2018, methods being adopted in each instance and a review of preliminary survey findings which has inform this assessment.

8.4.11 The Phase 1 Habitat Survey map presented in the PCF Stage 1 Environmental Study Report has been updated for this assessment with preliminary findings of 2017 Phase 1 Habitat Survey information and information provided by the Mid-Arun Valley Environmental Survey.

SPECIES

8.4.12 In accordance with best practice[16], the Phase 1 Habitat Survey undertaken to inform the PCF Stage 1 Environmental Study Report was extended to consider and include consideration of habitat suitability to support, protected or notable species. The findings of this survey work are presented with the PCF Stage 1 Environmental Study Report.

8.4.13 Protected and notable species records collated during the desk study and habitat assessments undertaken to inform the PCF Stage 1 Environmental Study Report were reviewed and updated for this assessment with the addition of new desk study information received in 2017 from Sussex Biodiversity Records Centre and the Mid-Arun Valley Environmental Survey.

[12] Thompson, J. (March, 2017). An ecological survey of the Mid-Arun Valley. Wildlife Splash on behalf of the Mid-Arun Environmental Survey.
[13] Thompson, J. (October, 2017). *The Mid-Arun Valley 2015 – 2017; A27 Arundel Bypass Road Options 1, 3 and 5A; Ecological Impact Report.* Wildlife Splash on behalf of the Mid-Arun Environmental Survey.
[14] Joint Nature Conservation Committee (2010). Phase 1 Habitat Survey: A technique for environmental audit. JNCC. Peterborough.
[15] Stace, C. (2010). New Flora of the British Isles – 3rd Edition. CUP. Cambridge
[16] Institute of Environmental Assessment (1995). *Guidelines for Baseline Ecological Assessment*. E & FN Spon. London.

8.4.14 The preliminary findings of on-going species survey work to date are also included. Appendix E contains a list of all survey work being progressed in 2017 and 2018, methods being adopted in each instance and a review of preliminary survey findings which has been used to inform this assessment.

8.4.15 A species baseline has been built-up by consideration of broad habitat suitability for different species. In instances where habitats could not be visited because of land access restrictions, and where 2017 /2018 survey data is not yet complete, a precautionary approach has been adopted. Where the presence of a species in suitable habitat remains uncertain, it has been assumed that the species concerned is likely to be present.

8.4.16 Further species surveys may be required at PCF Stage 3 to enable ecological impact assessment and inform the need for, extent and scope of mitigation or other measures.

DESIGNATED SITES

8.4.17 Table 8.1 lists each of the designated sites in the Desk Study Area including their proximity to the three Scheme Options. The Survey Area is not part of a UNESCO Biosphere Reserve. The nearest such reserve is the Brighton and Lewes Downs Biosphere Reserve which is over 10 kilometres away. Baseline information on designated sites presented in this section is based entirely on data provided by the Joint Nature Conservation Committee, Natural England or Sussex Biodiversity Records Centre. Valuations of designated sites are based on interpretation of this baseline information.

Table 8.1 Statutory and Non-Statutory Designated Site

Site Designation	Statutory / Non - Statutory	Site Name	Approximate Distance (kilometres) and Direction From Scheme Options			Key Habitat Type
			1	3	5A	
SAC	Statutory	Singleton and Cocking Tunnels	14.1 north-west	13 north-west	12.4 north-west	Man-made structure
SAC	Statutory	The Mens	14.5 north	14.5 north	15.4 north	Woodland / wood pasture
SAC	Statutory	Ebernoe Common	18.1 north	18 north	18.3 north	Woodland / wood pasture
Ramsar site, SAC & SPA	Statutory	Arun Valley	6.4 Kilometres north	6.6 Kilometres north	7.3 Kilometres north	Inland water bodies, wetland and humid grassland.
SAC	Statutory	Duncton to Bignor Escarpment	5.8 north	5.8 north	5.8 north	Broadleaved woodland on calcareous soils.
SSSI	Statutory	Arundel Park	0.4 north	1.4 south	1.4 south	Chalk grassland and variety of woodland.
SSSI	Statutory	Fairmile Bottom	2 north west	1.5 north	1.5 north	Yew woodland, yew scrub and chalk grassland.
LWS	Non-Statutory	Binsted Wood Complex	The northern edge of this LWS crossed by Option 1	Crossed by this Option	The southern edge of this LWS is crossed by Option 5A	Mixture of Ancient Woodland and recent woodland.
LWS	Non-Statutory	Poling Copse	0.6 east	0.6 east	0.6 east	A large block of Ancient Woodland.
LWS	Non-Statutory	Warning camp Hill and New Down	1.8 north east	1.8 north east	1.8 north east	Herb-rich chalk grassland and a small area of ancient, semi-natural woodland.
LWS	Non-Statutory	Rewell Wood Complex	The southern edge of this LWS is in Option 1	Immediately adjacent to Option 3	The southern edge of the LWS is in Option 5A	Diversity of habitats including ancient semi-natural woodland, worked Sweet Chestnut coppice, confer plantation, beech plantation and species-rich chalk grassland.
LWS	Non-Statutory	Arun Valley, Watersfield to Arundel (includes Arundel Wetland Centre)	0.4 north east	0.4 north	0.4 north	Extensive tract of wetland, wet grassland, network of ditches and unimproved meadows.
LWS	Non-Statutory	Slindon Bottom	>3	> 3	1.85 west	An area of Ancient Woodland with a rich higher plant flora.
Notable Road Verge	Non-statutory	A27 Avisford 'site A' A27 Avisford 'site B' A27 Avisford 'site C'	0.3 east	The east edge of the road verge is in the Option 3 footprint	The west of the road verge is in the Option 5A footprint	No citation information provided by Sussex Biodiversity Records Centre – assumed to be a species-rich neutral or calcareous grassland

8.4.18 The following biological SSSIs are within 0.2 kilometres of a road which may be subject to chances in traffic flows as a result of the Scheme operation. Only Fairmile Bottom SSSI is also within 2 kilometres from the boundary of the footprint of a Scheme Option, the other SSSIs are greater than 2 kilometres from the Scheme Options:

- Adur Estuary SSSI which is 13 metres from an affected road;
- Amberley Mount to Sullington Hill SSSI which is 170 metres which is 13 metres from an affected road;
- Arundel Park SSSI is 90 metres from an affected road;
- Beeding Hill to Newtimber Hill SSSI which is 72 metres from an affected road;
- Chantry Mill SSSI which is 50 metres from an affected road;
- Fairmile Bottom SSSI which is directly adjacent to an affected road; and
- Sullington Warren SSSI which is 114 metres from an affected road.

DESCRIPTION OF STATUTORY DESIGNATED SITES

8.4.19 Statutory designated sites are mapped in Figure 8.2.

SINGLETON AND COCKING TUNNELS SAC, THE MENS SAC AND EBERNOE COMMON SAC

8.4.20 Three SACs designated for bats were identified within 30 kilometres of the Survey Area. These are: Ebernoe Common SAC which is located approximately 19 kilometres north of the nearest of the three Scheme Options; The Mens SAC which is located approximately 15 kilometres north of the nearest of the three Scheme Options; and Singleton and Cocking Tunnels SAC which is located approximately 14 kilometres north-west of the nearest of the three Scheme Options. Two bat species, barbastelle (*Barbastelle barbastellus*) and Bechstein's bat (*Myotis bechsteini*) were identified as primary reasons for the selection of these SACs. These SACs are all of international importance.

ARUN VALLEY SAC, ARUN VALLEY SPA AND ARUN VALLEY RAMSAR SITE

8.4.21 The Arun Valley SAC, SPA and Ramsar site is located approximately 6.8 kilometres to the north of the three Scheme Options, upstream along the River Arun. The Arun Valley SAC, SPA and Ramsar site share part of the same boundary with each other. They all consist of low-lying grazing marsh habitat with a rich flora and fauna assemblage. The southern parts of the SAC, SPA and Ramsar site is fed by calcareous springs, while to the north, the underlying geology is greensand and the water is more acidic. The plant communities present include drier fields dominated by meadow grasses (*Poa* sp.), crested dog's-tail (*Cynosurus cristatus*) and perennial rye-grass (*Lolium perenne*). In wetter areas, rushes, sedges and tufted hair-grass (*Deschampsia cespitosa*) are more frequent. Ungrazed fields have developed into fen, scrub or woodland. Fen areas consist of common reed (*Phragmites australis*), reed sweet-grass (*Glyceria maxima*) and greater tussock-sedge (*Carex paniculata*), often with scattered elder and sallow scrub. On less permanently water logged ground, alder (*Alnus glutinosa*), and willow (*Salix sp.*) woodland is present. Birch (*Betula sp.*), oak (*Quercus sp*), and hazel (*Corylus avellana*) woodland is present on the driest ground. The ditches and margins between grazing marsh fields have a very rich aquatic flora and invertebrate fauna. The Arun Valley SAC/SPA/Ramsar site supports important numbers of wintering waterbirds, which feed in the wetter, low-lying fields and along ditches.

8.4.22 The Arun Valley SPA qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting internationally important populations of Bewick's swan (*Cygnus columbianus bewickii*) which is listed on Annex I of the Bird Directive. In addition, the SPA qualifies under Article 4.2 of the same directive by regularly supporting over 20,000 waterfowl (a range of different species).

8.4.23 The Arun Valley Ramsar site is designated for its presence of British Red Data Book threatened (and endangered) invertebrate species, nationally rare and scarce plant species, diverse flora within ditches across the site, assemblages of waterfowl of international importance and presence of the northern pintail (*Anas acuta*) at levels of national importance.

8.4.24 The Arun Valley SAC is primarily designated for the presence of ramshorn snail (*Anisus vorticulus*). The site comprises one of the largest populations of this species in the UK.

DUNCTON TO BIGNOR ESCARPMENT SAC

8.4.25 The Duncton to Bignor Escarpment SAC is 5.8 kilometres north of all Scheme Options and predominantly consists of mature beech woodland situated on the steep scarp face of the South Downs, with occasional parcels of ash woodland, scrub and grassland. The site comprises a diverse mollusc assemblage and rich floral community with rare plant species present including white helleborine (*Cephalanthera damasonium*), yellow bird's-nest (*Monotropa hypopitys*), green hellebore (*Helleborus viridis*) and limestone fern (*Gymnpcarpium robertium*). This SAC is primarily designated for the presence of the Habitats Directive Annex I habitat type Asperulo-Fagetum beech forests. This SAC is of international importance.

ARUNDEL PARK SSSI

8.4.26 Arundel Park SSSI is within 2 kilometres of all Scheme Options; the nearest being Option 1 which is approximately 0.5 kilometres north. Arundel Park SSSI is also Arundel Park SSSI is 90 metres from London Road in Arundel and is within 0.2 kilometres of the A234 in two places due south of the A234 road junction with the B2139 road. Arundel Park SSSI is renowned as one of the most important sites in the country for invertebrates including a number of protected / notable species. Fifteen species present here have been classified as endangered and under threat of extinction, including the rare field cricket (*Gryllus campestris*) and the beetle (*Laemophloeus monilis*). The site also supports a diverse breeding bird community, particularly over-wintering wildfowl such as gadwall (*Anas strepera*) and pochard (*Aythya ferina*). The site comprises a mosaic of species-rich chalk grassland, marsh grassland, scrub and semi-natural broadleaved and mixed woodland. A rich floral community has also been recorded at Swanbourne Lake towards the south of the site. The site also supports at least 25 breeding butterfly species including the duke of Burgundy, brown argus (*Aricia agestis*) and chalk hill blue (*Lysandra coridon*). A rare mollusc (*Pseudamnicola confusa*) has also been recorded in the reedbeds within the site. This SSSI is of national importance.

FAIRMILE BOTTOM SSSI

8.4.27 Fairmile Bottom SSSI is closest to Option 3 which is 1.45 kilometres to the south. This SSSI is designated for beech woodland, yew woodland and oak woodland with areas of species-rich chalk grassland and notable invertebrate communities. Fairmile Bottom is also directly adjacent to the A29 road near Madehurst which would be affected by altered traffic flows should any of the Scheme Options become operational. This SSSI is of national importance.

ADUR ESTUARY SSSI

8.4.28 The Adur Estuary SSSI is 13 metres from the A27 road to the north of Shoreham-by-Sea which would be subject to altered traffic flows should any of the Scheme Options become operational. This SSSI is designated as one of two significant areas of saltmarsh between Chichester Harbour and Pagham Harbour. It supports a diverse assemblage of saltmarsh and coastal plant species.

AMBERLEY MOUNT TO SULLINGTON HILL SSSI

8.4.29 The Amberley Mount to Sullington Hill SSSI is 0.17 kilometres from the B2139 road south of Amberley which will be subject to altered traffic flows should any of the Scheme Options become operational. This SSSI is designated for species-rich unimproved calcareous grassland, juniper scrub and a rich assemblage of butterflies and moths.

BEEDING HILL TO NEWTIMBER HILL SSSI

8.4.30 The Beeding Hill to Newtimber Hill SSSI is 72 metres from the A283 road south of Upper Beeding which would be subject to altered traffic flows should any of the Scheme Options become operational. This SSSI is designate for unimproved chalk grassland, juniper scrub and calcareous pedunculated oak-ash-beech woodland. The site supports a rich community of invertebrates, especially harvestmen and has some uncommon butterflies and moths. A nationally uncommon plant also occurs. Devil's Dyke is the best known example of a dry chalk valley.

CHANTRY MILL SSSI

8.4.31 The Chantry Mill SSSI is 50 metres from the A283 road through Storrington which will be subject to altered traffic flows as a result of the Scheme. This SSSI is designated for geological reasons.

SULLINGTON WARREN SSSI

8.4.32 The Sullington Warren SSSI is 114 metres from the A283 road through Storrington which will be subject to altered traffic flows as a result of the Scheme.

8.4.33 This SSSI lies over Sandgate Beds and Lower Greensand, supports a range of heathland habitats including both wet and dry heath, grassland, scrub and woodland. The woodland carries a rich community of breeding birds.

DESCRIPTION OF NON-STATUTORY DESIGNATED SITES

8.4.34 Six non-statutory designated sites were identified within 2 kilometres of Options 1, 3 and 5A. A summary of the features underpinning the designation of these LWS is provided in Table 8-2. Information on non-statutory sites in this section was provided by Sussex Biodiversity Records Centre unless otherwise stated. Non-statutory designated sites are mapped in Figure 8.3.

BINSTED WOOD COMPLEX LWS

8.4.35 Binsted Wood Complex LWS comprises a mixture of semi-natural Ancient Woodland, recent woodland, conifer plantation, species rich grassland and old tracks.

8.4.36 The mix of habitats and geology gives rise to a diverse flora. The western half and east end of the LWS is largely semi-natural Ancient Woodland (ASNW) in Binsted Wood, Steward's Copse and Barn's Copse (among other woods). The central part of the LWS is largely a plantation on an Ancient Woodland site (PAWS) in Tortington Common, Pinewoods and Paine's Wood. The southernmost part of this LWS is an area of Wood Pasture and Parkland HPI in an area called Binsted Park (Wood Pasture and Parkland HPI and Ancient Woodland habitats partly overlap in this location).

8.4.37 Binsted Park is a location with frequent Ancient/Veteran Trees which have been recorded by the Mid-Arun Valley Environmental Survey[17]. The paths and rides are especially species rich and Scotland Lane supports a species-rich, wet, grassland flora that includes at least 11 species of sedge including long-stalked yellow-sedge (*Carex lepidocarpa*). Sussex Biodiversity Records Centre states that this sedge is a county rarity at its only recorded West Sussex location.

8.4.38 The Mid-Arun Valley Environmental Survey states that this LWS is the largest block of ancient semi-natural woodland south of the South Downs on the Sussex coastal plain.

8.4.39 Oak and hazel woodland is the predominant habitat type of this complex. Oak dominates the canopy with birch and sweet chestnut (*Castanea sativa*) and an irregular understory of hazel. Sweet chestnut coppice dominates in some areas. The ground flora is mostly bracken (*Pteridium aquilinum*) and bramble (*Rubus fruticosus*) with carpets of bluebell (*Hyacinthoides non-scripta*) and wood anemone (*Anemone nemorosa*). Early-purple orchids (*Orchis mascula*) occur in abundance and have been counted in thousands in Ash Piece. The rare adder's-tongue fern (*Ophioglossum vulgare*) has also been recorded here.

[17] Thompson, J (March, 2017). *An ecological survey of the Mid-Arun Valley*. Wildlife Splash. East Sussex.

8.4.40 A diverse range of butterflies have been recorded in this LWS including the ringlet (*Aphantopus hyperantus*), silver-washed fritillary (*Argynnis paphia*), white admiral (*Limenitis camilla*) and purple emperor (*Apatura iris*). Freshwater cockles and glow-worms (*Lampyris noctiluca*) have also been recorded.

8.4.41 LWSs are of county importance as they are designated according to county specific criteria. However, Binsted Park Complex LWS is considered to be of national importance based on the following reasons:

- Guidance in Highways England Interim Advice Note 130/10 - Ecology and Nature Conservation: Criteria for Impact Assessment which recommends that Ancient Woodland is of national importance;
- The weight given to protection of Ancient Woodland and Ancient/Veteran trees in national planning policy (i.e. the National Networks National Policy Statement and the National Planning Policy Framework);
- Consultation responses received from at PCF Stage 1 from Natural England and West Sussex County Council which consider Ancient Woodland in the Field Survey Area to be of national importance;
- Binsted Wood Complex LWS is thought by Sussex Biodiversity Records Centre and the Mid-Arun Valley Environmental Survey to be the largest block of Ancient Woodland south of the South Downs in Sussex/largest block of woodland on the Sussex coastal plain. Such large, continuous areas of Ancient Woodland are scarce in a national context; and
- Binsted Park Complex LWS contains Parkland and Wood Pasture HPI and numerous Ancient/Veteran trees both of which are uncommon in a national context.

REWELL WOOD COMPLEX LWS

8.4.42 The southern edge of Rewell Wood Complex LWS is crossed by Option 1 and Option 5A and is immediately adjacent to Option 3. This LWS is variously contains sweet chestnut coppice, conifer plantation, beech plantation and species-rich chalk grassland. Wide rides and glades support a rich flora and butterfly fauna. The disused gravel pits are of entomological importance.

8.4.43 The semi-natural woodland comprises predominantly oak, beech, ash (*Fraxinus Excelsior*), field maple (*Acer campestre*) and hazel. The woodlands comprise dense carpets of bluebells with wood spurge (*Euphorbia amygdaloides*), honeysuckle (*Lonicera periclymenum*), pignut (*Conopodium majus*), bugle (*Ajuga reptans*) and early-purple orchid. Many of the wide rides and woodland glades support species-rich chalk grassland including the white mullein (*Verbascum lychnitis*) which is considered rare in Sussex.

8.4.44 The LWS is recognised for supporting a diverse butterfly fauna including dingy skipper (*Erynnis tages*), grizzled skipper (*Pyrgus malvae*), green hairstreak (*Callophrys rubi*), duke of Burgundy (*Hamearis lucina*), pearl-bordered fritillary (*Boloria euphrosyne*), white admiral and purple emperor and a rare species of moth called the drab looper (*Minoa murinata*).

8.4.45 Rewell Wood also supports a large population of hazel dormice (*Muscardinus avellanarius*) and approximately six pairs of nightjar (*Caprimulgus europaeus*) which breed annually.

8.4.46 Rewell Wood Complex LWS is considered to be of national importance for the same reasons as Binsted Wood Complex LWS. Binsted Wood Complex LWS and Rewell Wood Complex LWS are adjacent to one another (separated only by the existing A27 road). Collectively they form a very large area of Ancient Woodland habitat.

ARUN VALLEY – WATERSFIELD TO ARUNDEL LWS

8.4.47 All Scheme Options are approximately 0.4 kilometres south of the Arun Valley - Watersfield to Arundel LWS which encompassed the Arundel Wildfowl and Wetlands Trust Reserve. This LWS comprises the River Arun and its floodplain to the north of the existing A27 road, which includes largely wetland grassland habitat and land mapped by Natural England as Good Quality Semi-improved Grassland and Coastal and Floodplain Grazing Marsh HPI. A dense network of ditches is present in this LWS.

8.4.48 The LWS is considered to be of high botanical interest containing a large number of protected and notable plant species including marsh-mallow (*Althaea officinalis*), cut-grass (*Leersia oryzoides*), sharp-leaved pondweed (*Potamogeton acutifolius*), small water-pepper (*Polygonum minus*), common meadow-rue (*Thalictrum flavum*), mare's-tail (*Hippuris vulgaris*), fan-leaved water-crowfoot (*Ranunculus circinatus*), frogbit (*Hydrocharis morsus-ranae*), arrowhead (*Sagittaria sagittifolia*), tubular water-dropwort (*Oenanthe fistulosa*), pink water-speedwell (*Veronica catenata*), ivy-leaved duckweed (*Lemna trisulca*) and fat duckweed (*Lemna gibba*), fox sedge (*Carex vulpina*), narrow-leaved water-dropwort (*Oenanthe silaifolia*) and black Poplar (*Populus nigra*) trees.

8.4.49 The Arun Valley - Watersfield to Arundel LWS is also considered to be of ornithological interest as it supports a number of wetland bird species including breeding redshank (*Tringa totanus*), lapwing (*Vanellus vanellus*), snipe (*Gallinago gallinago*) and yellow wagtail (*Motacilla flava*), and in winter attracts large numbers of waders and wildfowl, including snipe, teal (*Anas crecca*) and Bewick's swan. The grasslands are considered particularly important feeding grounds for whimbrel (*Numenius phaeopus*) on spring passage. The reedbeds along the River Arun and ditches are also a major stronghold of breeding reed warblers (*Acrocephalus scirpaceus*). The LWS also supports a number of notable invertebrate species including a water snail (*Pseudamnicola confuse*), hairy dragonfly (*Brachytron pratense*), and the marsh-mallow colonies support a rare weevil (*Apion sorror*).

8.4.50 The Arun Valley - Watersfield to Arundel LWS meets criteria for designation as a LWS and is of county importance.

POLLING COPSE LWS

8.4.51 All Scheme Options are approximately 0.6 kilometres west of Poling Copse LWS. This LWS is a large block of broadleaved Ancient Woodland consisting predominantly of oak and hazel over slightly acid soils. It meets criteria for designation as a LWS but following guidance provided in Highways England Interim Advice Note 130/10, all Ancient Woodland is of national importance.

WARNING CAMP HILL AND NEW DOWN LWS

8.4.52 All Scheme Options are approximately 1.8 kilometres east of Warningcamp Hill and New Down LWS. This LWS is an area of herb rich chalk grassland with extensive patches of burnet rose (*Rosa pimpinellifolia*) which is an uncommon plant in West Sussex and a large population of the small flowered buttercup (*Ranunculus parviflorus*). The site also contains Ancient Woodland. This site meets criteria for designation as a LWS but following guidance provided in Highways England Interim Advice Note 130/10, all Ancient Woodland is taken to be of national importance.

SLINDON BOTTOM LWS

8.4.53 Slindon Bottom LWS is 1.85 kilometres east of Option 5A but is greater than 3 kilometres from Option 1 and Option 3. It is an Ancient Woodland that lies at the junction of two geological types, namely Valley Gravel and Upper Chalk and has a varied flora. This site meets criteria for designation as a LWS but following guidance provided in Highways England Interim Advice Note 130/10, all Ancient Woodland is taken to be national importance.

AVISFORD A27 AVISFORD 'SITE A', A27 AVISFORD 'SITE B' AND A27 AVISFORD 'SITE C' – NOTABLE ROAD VERGE

8.4.54 These Notable Road Verge forms one continuous strip of habitat extending along the existing A27 road on both sides of the carriageway from the Yapton Lane junction at approximate National Grid reference SU9744706865 to National Grid reference SU9958407415. The western end of Option 5A is in the Notable Road Verge, Option 3 is directly adjacent to the east end of the Notable Road Verge and Option 1 is about 0.8 kilometres east of the Notable Road Verge.

8.4.55 Sussex Biodiversity Records Centre has confirmed that the verges are designated as they support notable plant species including bee orchid *(Ophrys apifera*) and southern marsh orchid (*Dactylorhiza praetermissa*) and a diverse population of invertebrates. It is likely that the verge habitat is unimproved neutral or calcareous grassland given that both neutral and chalk geology are present in the near vicinity. As a precaution it is assumed that the grassland present would qualify as a HPI (Lowland Meadow HPI or Lowland Calcareous Grassland HPI) and it is assumed to be of up to county importance. Botanical survey work in 2018 will include this road verge if safe survey access can be obtained.

HABITATS

SUMMARY OF HABITATS IN THE SURVEY AREA

8.4.56 Nineteen different habitat types have been identified in the Desk Study Area which are either mapped on Natural England's Ancient Woodland Inventory or Priority Habitat Inventory; those which have been identified by the Mid-Arun Environmental Survey; those identified by the Woodland Trust; and/or those which were identified by habitat survey work undertaken by Highways England between 2015 and 2017. They are listed in Table 8-2.

8.4.57 Figure 8.4 shows Ancient Woodland mapped by Natural England's Ancient Woodland Inventory. Figure 8.5 shows the habitats identified on Natural England's Priority Habitat Inventory. Figure 8.6 shows Phase 1 Habitat types identified by Highways England's habitat surveys with additional information provided by the Mid-Arun Valley Environmental Survey. Table 8-2 details how Natural England's Priority Habitat Inventory and their Ancient Woodland Inventory correspond to Phase 1 Habitat types.

Table 8.2 Phase 1 Habitat Types within Each Scheme Option (✓ = Habitat Present)

PHASE 1 HABITAT TYPE	CORRESPONDING HPI TYPE	SCHEME OPTION		
		1	3	5A
WOODLAND				
Semi-natural Broadleaved Woodland (not Ancient Woodland)	Lowland Mixed Deciduous Woodland HPI (partly) Wet Woodland HPI (partly)	✓	✓ (includes wet woodland)	✓ (includes wet woodland)
Semi-natural Broadleaved Woodland (Ancient Semi-Natural Woodland)	Lowland Mixed Deciduous Woodland HPI	✓	✓	✓
Mixed Plantation Woodland (Plantation on an Ancient Woodland Site)	None.	x	✓	x
Scattered Broadleaved Trees (Ancient/Veteran Trees)	Wood Pasture and Parkland HPI (partly)	✓	✓	✓
Scattered Broadleaved Trees (younger trees)	None.	✓	✓	✓

WETLAND				
Swamp	Lowland Fen HPI (partly) Reebed HPI (partly) Coastal and Floodplain Grazing Marsh HPI (partly)	✓	✓	✓
Flood Plain Mire	Lowland Fen HPI	x	x (but some is present downstream of the Field Survey Area)	x (but some is present downstream of the Field Survey Area)
Standing Water	Pond HPI (partly)	✓	✓	✓
Running Water	River HPI (partly)	✓	✓	✓
Saltmarsh – Scattered Plants	Saltmarsh HPI	x	✓	✓
GRASSLAND				
Unimproved neutral grassland	Lowland Meadow HPI	x	x	x
Poor Semi-improved Grassland	Coastal and Floodplain Grazing Marsh HPI (partly)	✓	✓	✓
Semi-improved neutral grassland	Coastal and Floodplain Grazing Marsh HPI (partly)	✓	✓	✓

Marshy grassland	Coastal and Floodplain Grazing Marsh HPI (partly)	x	x	x (but some is present downstream of the Field Survey Area)
OTHER				
Dry dwarf shrub heath (Lowland Heathland HPI)	Lowland Heath HPI	x	✓ (part of Binsted Wood Complex LWS)	x
Dense Continuous Scrub / Scattered Scrub	None.	✓	✓	✓
Intact species-poor hedge, defunct species-poor hedge and species-poor hedge and trees	Hedgerow HPI (mostly)	✓	✓	✓
Arable	Arable Field Margin HPI (part)	x	✓	✓
Buildings and hard-standing	None.	✓	✓	✓

WOODLAND HABITATS

ANCIENT WOODLAND

8.4.58 Natural England's Ancient Woodland Inventory sub-divides Ancient Woodland into two different types: Ancient Semi-Natural Woodland[18]; or Plantation on an Ancient Woodland Site[19].

8.4.59 Preliminary findings of Highways England 2017 habitat survey work in Tortington Common, Pinewoods and Paine's Wood, suggest that this habitat is likely to be mixed plantation woodland as the tree canopy comprised between 25 – 75% coniferous species (mainly Scot's pine (*Pinus sylvestris)* and Hybrid larch (*Larix* × *marschlinsii*)) and broad-leaved species including sweet chestnut (Castanea sativa) which is abundant. The PCF Stage 1 Environmental Study Report mapped this habitat as Broadleaved Plantation Woodland or Coniferous Plantation Woodland.

8.4.60 Ancient Woodland is identified on Figure 8.4 and is variously mapped as Broadleaved Semi-natural Woodland or Mixed Plantation Woodland on the Phase 1 Habitat Survey map (Figure 8.5), depending on the dominant tree species which are present (whether conifer or broadleaved). The preliminary findings of 2017 habitat survey work are consistent with mapped information on Natural England's Ancient Woodland Inventory.

8.4.61 Large areas of Ancient Woodland are present in the Binsted Wood Complex LWS and Rewell Wood Complex LWS. Some of this Ancient Woodland is considered to be Plantation on an Ancient Woodland Site (e.g. Tortington Common, Pine Wood, Paine's Wood and Goblestubbs Copse) but large areas of Ancient Semi-Natural Woodland are also present (e.g. in Binsted Wood, Binsted Park, Barn's Copse and Steward's Copse among other woodlands).

8.4.62 Ancient Woodland (comprising both Ancient Semi-Natural Woodland and Plantation on an Ancient Woodland Site) is also present North West of Arundel in an area called the Waterwoods (which is within the Rewell Wood Complex LWS).

8.4.63 Ancient Woodland is traversed by all Scheme Options. Of the three Scheme Options, Option 3 traverses the largest area of Ancient Woodland which is mainly Plantation on an Ancient Woodland Site. Option 1 or Option 5A mainly traverse Ancient Semi-Natural Woodland. The Waterwoods is traversed by Option 1 only.

8.4.64 Ancient Woodland in the Desk Study Area is considered to be of national importance for the reasons outlined in the Designated Sites section in relation to Binsted Park Complex LWS and Rewell Wood Complex LWS.

WOOD PASTURE AND PARKLAND HPI

8.4.65 Wood Pasture and Parkland HPI is broadly characterised as a habitat supporting open growth trees, many of which may be Ancient/Veteran trees, over pasture or other types of grassland[20].

[18] Ancient Semi-natural Woodland is composed predominantly of trees and shrubs native to the site that do not obviously originate from planting. They include stands that may have been managed by coppicing or pollarding in the past, as well as those where the tree and shrub layer has grown up by natural regeneration.

[19] Plantations on Ancient Woodland Sites (also called Ancient replanted woodland sites) are areas of Ancient Woodland where the original native tree cover has been felled and replaced by planted stock most commonly of a species not native to the site, for example conifers such as Norway spruce (*Picea abies*) or Corsican pine (*Pinus nigra* var. *maritima*), but also broadleaves such as sycamore (*Acer pseudoplatanus*) or sweet chestnut.

[20] Maddock, A (Ed). (2008). *UK Biodiversity Action Plan; Priority Habitat Descriptions*. Biodiversity Reporting and information Group. Joint Nature Conservation Committee.

8.4.66 Two areas of this habitat are present in the Desk Study Area. The first is at Binsted Park which is approximately equidistant between the villages of Binsted and Tortington, inside the Binsted Wood Complex LWS. Binsted Park is directly traversed by Option 5A but is 0.6 kilometres from Option 3 and 1.4 kilometres from Option 1. The northern part Binsted Park is also mapped as Ancient Woodland and Lowland Mixed Deciduous Woodland HPI as well as Wood Pasture and Parkland HPI (the three habitat types overlap in this location).

8.4.67 Phase 1 Habitat Survey information for Binsted Park indicates that it is partly an area of Broadleaved Semi-Natural Woodland, this is not inconsistent with the Natural England Priority Habitat Inventory and can occur where grazing or grassland management has ceased and, over a long period of time, areas of open grown trees become woodland. Arboricultural survey work is being undertaken in 2017 to confirm the location and condition of Ancient/Veteran trees in Binsted Park. For the purposes of this assessment Binsted Park is assumed to be a good quality example of Wood Pasture and Parkland HPI.

8.4.68 The second area of Wood Pasture and Parkland HPI identified by Natural England is due west of where Binsted Lane meets the A27 road at approximate National Grid reference TQ001071. This area of habitat is approximately 50 metres from Option 1 and is over 0.3 kilometres from the other Scheme Options. It is also in the Binsted Wood Complex LWS.

8.4.69 On the basis of desk study information, Wood Pasture and Parkland HPI in the Desk Study Area is likely to be of national importance because it is an integral part of the Binsted Park Complex LWS (see valuation rationale given for that LWS) and because it contains aggregations of Ancient/Veteran tress which are an irreplaceable habitat.

SCATTERED TREES (ANCIENT/VETERAN AND YOUNG)

8.4.70 Together, the Woodland Trust's Ancient Tree Hunt Interactive Map[21], the Mid-Arun Valley Environmental Survey[22] and Sussex Biodiversity Records Centre have identified over 100 Ancient/Veteran Trees in the Desk Study Area. Detailed survey work in 2017 and 2018 will aim to verify this desk study information and will document the location of Ancient/Veteran trees in the Field Survey Area. Precise tree locations will be provided in the PCF Stage 3 assessment. As part of a precautionary approach, informed by desk study data and the preliminary findings of tree survey work, Ancient/Veteran trees are assumed to be relatively frequent and clustered in three key locations:

- Binsted Park;
- Within Binsted Wood Complex LWS; and
- Either side of the Arun Valley Railway, near Priory Farm as approximate National Grid reference TQ023062.

8.4.71 In general, individual Ancient/Veteran trees are considered to be of high importance on the basis they are an irreplaceable habitat. The importance attributed to clusters of Ancient Trees (such as may be present in Binsted Park Wood Pasture and Parkland HPI) is of up to national importance because aggregations of these trees are nationally scarce and, when frequent and in close proximity to each other, provide sufficient habitat support to populations of rare invertebrates, fungi and lichen species which specialise on dead wood. Individual Ancient/Veteran Trees isolated from a habitat complex containing other Ancient/Veteran trees are less likely to be of such high importance.

[21] Woodland Trust (2017). Ancient tree hunt - Interactive map. [on-line] http://www.ancient-tree-hunt.org.uk/discoveries/interactivemap/ (accessed September 2017).
[22] Thompson, J (March, 2017). *An ecological survey of the Mid-Arun Valley*. Wildlife Splash. East Sussex.

8.4.72 Highways England's Phase 1 Habitat surveys have identified Scattered Broadleaved Trees which are young trees at various places in the Field Survey Area. Young trees are common and widely distributed in the Desk Study Area and are of no more than local importance.

LOWLAND MIXED DECIDUOUS WOODLAND HPI

8.4.73 Lowland Mixed Deciduous Woodland HPI is broadleaved woodland of semi-natural origin, whether Ancient Woodland, recent woodland and sometimes broadleaved plantation woodland[23].

8.4.74 All Semi-Natural Ancient Woodland is also mapped by Natural England as Lowland Mixed Deciduous Woodland HPI. Large parts of Binsted Wood Complex LWS are mapped as Lowland Mixed Deciduous Woodland.

8.4.75 There are also areas of Lowland Mixed Deciduous Woodland HPI in the Desk Survey Area which are not mapped by Natural England as Semi-Natural Ancient Woodland. They are near Old Scotland Lane, part of Binsted Park, part of Barn's Copse, Ash Piece, Singer's Piece and recent woodland (highways landscaping) directly adjacent to the existing A27 road.

8.4.76 The preliminary findings from 2017 habitat survey work, and information provided by the Mid-Arun Valley Environmental Survey, indicate that non-Ancient Woodland in the Field Survey Area near Old Scotland Lane, Ash Piece and in Singer's Piece, has similar characteristics to Ancient Woodland although not formally mapped by Natural England as such.

8.4.77 Phase 1 Habitat Survey information identifies all Lowland Mixed Deciduous Woodland HPI in the Field Survey Area as Broadleaved Semi-Natural Woodland (Figure 8.5) which is consistent with Natural England's Ancient Woodland Inventory and Priority Habitat Inventory data.

8.4.78 On the basis of desk study information, Lowland Mixed Deciduous Woodland HPI in Binsted Wood Complex LWS (including Ancient Woodland and non-Ancient Woodland) is likely to be of national importance for the same reasons as were provided for valuing the LWS.

8.4.79 Areas of young Lowland Mixed Deciduous Woodland HPI, such as along the existing A27 road, are likely to be of low botanical diversity, support only occasional Ancient Woodland plant species and are a commonplace habitat in Sussex which is of no more than local importance.

WET WOODLAND HPI

8.4.80 The preliminary findings 2017 National Vegetation Classification surveys undertaken by Highways England and the Mid-Arun Valley Environmental Survey information has identified three locations where Wet Woodland HPI may be present. The first is a downy birch (*Betula pubescens*) and purple-moor grass (*Molinia caerulea*) wet woodland between Paine's Wood and Pinewood's which is likely to be adjacent or within Option 3 (at approximate National Grid reference SU992071). The second area of Wet Woodland HPI is an alder (*Alnus glutinosa*) and ash woodland associated with springs in an area called Hundred House Copse or Little Danes Wood (approximate National Grid reference SU976068 which is due west of Barn's Copse). This wet woodland would be traversed by Option 5A only and to date has only been identified by Mid-Arun Environmental Survey data. The third are of possible Wet Woodland HPI is a willow woodland (including grey willow *Salix cinerea*) at Lake Copse and potentially also in adjacent woodlands called The Shaw (at National Grid reference SU9897305950) and The Lag (at National Grid reference SU9936805955), these woodlands would be crossed by Option 5A only.

[23] Maddock, A (Ed). (2008). *UK Biodiversity Action Plan; Priority Habitat Descriptions*. Biodiversity Reporting and information Group. Joint Nature Conservation Committee.

8.4.81 All Wet Woodland HPI is a component part of Binsted Wood Complex LWS and is valued as part of this site in this assessment.

WETLAND HABITATS

COASTAL AND FLOODPLAIN GRAZING MARSH HPI

8.4.82 Coastal and Floodplain Grazing Marsh HPI is defined as periodically inundated pasture/meadow and freshwater or brackish ditches and it is often recognised for its importance for aquatic plants, aquatic invertebrates and/or wetland birds and other fauna as well as for plant habitats[24]. Coastal and Floodplain Grazing Marsh HPI often contains other wetland HPI types (e.g. Reedbed HPI, Lowland Fen HPI, Pond HPI and River HPI) – see discussion of these habitats below.

8.4.83 Relatively large areas of Coastal and Floodplain Grazing Marsh have been mapped by Natural England on both the west and east floodplains of the River Arun to the south of Arundel. This includes land in the Arun Valley – Watersfield to Arundel LWS (previously described); land between the Arun Valley Railway and Ford Road; and land present either side of two small watercourses called Binsted Rife and Tortington Rife[25] (Figure 8.1).

8.4.84 Coastal and Floodplain Grazing Marsh HPI is best considered as a wetland ecosystem type made up of several different habitat types rather than a single habitat type. Highways England's Phase 1 Habitat Survey data for areas mapped by Natural England as Coastal and Floodplain Grazing Marsh HPI support this assessment. Coastal and Floodplain Grazing Marsh HPI is variously mapped as Improved Grassland, Poor Semi-Improved Grassland, Running Water, Marshy Grassland, Swamp and other Phase 1 Habitats types (Figure 8.1).

8.4.85 Preliminary findings from 2017 habitat survey work indicate that Coastal and Floodplain Grazing Marsh HPI on the River Arun Floodplain is mainly Improved Grassland (precautionary considered to be Semi-Improved Neutral Grassland as part of the PCF Stage 1 Environmental Study Report). However, some of the ditches present on the River Arun Floodplain may support a moderate diversity of aquatic plant species including at least one ditch that supports opposite-leaved pondweed (*Groenlandia densa*) which is an England Red Data Book Vulnerable species[26].

8.4.86 The Mid-Arun-Valley Environmental Survey surveyed the valley of Binsted Rife between 2015 and 2017 downstream of the Field Survey Area. They found to the valley of the Binsted Rife to contain a mosaic of swamp and marshy grassland communities and judged these to qualify as Lowland Fen HPI. A number of wetland plant species listed on the Sussex Rare Species Inventory were recorded by the Mid-Arun Valley Environmental Survey in close proximity to Binsted Rife. The Mid-Arun Valley Environmental Survey aquatic invertebrate survey work in 2016 recorded a diverse community of aquatic invertebrates in Binsted Rife.

8.4.87 The Mid-Arun-Valley Environmental Survey has also surveyed the valley of Tortington Rife between 2015 and 2017 including sections at the southern edge of the Field Survey Area. They identified a field west of this watercourse which supported a moderate diversity of damp grassland species along with reedbed, swamp communities and sedge communities. Frogbit, which is an England Red Data Book Vulnerable Species and a Sussex Rare Species Inventory aquatic plant species, was found in Tortington Rife.

[24] Maddock, A (Ed). (2008). *UK Biodiversity Action Plan; Priority Habitat Descriptions*. Biodiversity Reporting and information Group. Joint Nature Conservation Committee.
[25] Maddock, A (Ed). (2008). *UK Biodiversity Action Plan; Priority Habitat Descriptions*. Biodiversity Reporting and information Group. Joint Nature Conservation Committee.
[26] Stroh, P.A., *el al.* (2014). *A Vascular Plant Red List for England.* Botanical Society for Britain and Ireland.

8.4.88 The condition of plant and invertebrate habitats in Binsted Rife and Tortington Rife will be verified by further ecology survey work in 2018. However, for the purpose of this assessment, they are assumed to be as described by the Mid-Arun Valley Environmental Survey.

8.4.89 The only location where Coastal and Floodplain Grazing Marsh HPI is traversed by the Scheme Options is on the River Arun floodplain where all Scheme Options traversed this HPI. However, Option 3 traversed a number of watercourses in Tortington Wood and Pinewoods upstream of Tortington Rife valley where Coastal and Floodplain Grazing Marsh HPI has been mapped by Natural England. Option 5A traversed the valleys of both Tortington Rife and Binsted Rife upstream of where Coastal and Floodplain Grazing Marsh HPI has been mapped by Natural England.

8.4.90 Based on desk study evidence, areas of Coastal and Floodplain Grazing represent an integrated network of wetland habitats includes other HPI types (e.g. River HPI, Reedbed HPI, Lowland Fen HPI and Pond HPI) and supports uncommon plants and a diverse assemblage of aquatic invertebrates. This habitat complex is likely to be of at least county importance. It is noted that the areas of highest plant/invertebrate diversity are closely correlated with the watercourses which are present. The baseline information relating to birds (presented in this section) describes the importance of bird communities which may be present in this HPI type.

REEDBED HPI

8.4.91 Reedbed HPI includes all vegetation dominated by common reed[27]. This habitat not mapped by Natural England's Priority Habitat Inventory but is recorded in Highway England's Phase 1 Habitat Surveys (Figure 8.5). It is mapped as Wet Ditch or Swamp according to the Phase 1 Habitat Survey classification.

8.4.92 Mostly of the reedbed in the Field Survey Area occurs as thin, narrow strips of common reed alongside ditches. However, on the east bank of the River Arun (at approximate National Grid reference TQ011055 and adjacent the area of Coastal Saltmarsh HPI referred to below) a larger reedbed has been identified by 2017 habitat survey work.

8.4.93 All Scheme Options will cross areas of Reedbed HPI where they cross ditches and streams throughout the Field Survey Area, particularly on the River Arun floodplain. Option 3 and Option 5A are situated within 50 metres of the larger reedbed on the east bank of the River Arun.

8.4.94 Common reed in itself is not a notable plant species however reedbeds are valued as they support notable wetland animal species such as reedbed specialist birds. Larger reedbeds which include areas of sparse common reed over open water as well as dense reed are likely to offer sufficiently large foraging and sheltering resources to sustain populations of notable animal species.

8.4.95 In general, Reedbed HPI is not valued independently but is considered to be an intrinsic part of Coastal and Floodplain Grazing Marsh HPI as the two HPI types almost entirely overlap in the Field Survey Area. Small, isolated stands of reedbed HPI are not likely to be of high importance to wildlife and are likely to be of no more than local importance.

LOWLAND FEN HPI

8.4.96 The Mid-Arun Valley Environmental Survey consider swamp and tall wetland herb communities in the valley of Binsted Rife, and potentially reed and sedge swamp communities in a field west of Tortington Rife (at approximate National Grid reference SU9941305631) to qualify as Lowland Fen HPI. The habitat survey information provided by the Mid-Arun Valley Environmental Survey

[27] Maddock, A (Ed). (2008). *UK Biodiversity Action Plan; Priority Habitat Descriptions*. Biodiversity Reporting and information Group. Joint Nature Conservation Committee.

and aerial imagery of these areas are consistent with this classification, although field survey work being undertaken in 2017 and 2018 is required to verify this information.

8.4.97 Possible Lowland Fen HPI in Binsted Rife valley is 0.8 kilometres downstream of Option 5A. Possible Lowland Fen HPI in a field west of Tortington Rife is approximately 1.5 kilometres downstream of where Option 3 crosses a woodland stream which is connected to Tortington Rife. Option 1 is not likely to be hydrologically connected to any areas of Lowland Fen HPI as there are no direct links between it and Tortington Rife or Binsted Rife.

8.4.98 The Sussex Biodiversity Partnership state that the total area of Lowland Fen HPI in Sussex is approximately 60 hectares which would make the area of habitat present in the valley of Binsted Rife – likely to be up to 1 hectares (approximately 2% of the county resource) - of at least county importance[28]. The habitat around Binsted Rife is a component of the Coastal and Floodplain Grazing Marsh HPI which is mapped on Natural England's Priority Habitat Inventory.

WATERBODIES AND POND HPI

8.4.99 Ponds are represented as the Phase 1 Habitat type Standing Water. There are approximately 37 waterbodies within the Field Survey Area as detailed on Ordnance Survey maps. An assessment of how many overlap one of the Scheme Options is not yet available but a number are likely to be adjacent or within one of the Scheme Options. The Mid-Arun Valley Environmental Survey states that:

"*A number of ponds, particularly those that are species rich, of ancient origin or support protected species, would be classified as S41 Habitats of Principal Importance.*
Ponds, both ephemeral and permanent, throughout the area collectively support a high number of plant species. Sandy Hole Pond and ephemeral pools within Hundred House Copse and Little Danes Wood are unusual being calcareous; fed from chalk springs / seepages" (Thompson, 2017: page 42).

8.4.100 It is not possible to confirm which ponds qualify as Pond HPI without detailed floral and faunal field survey information but it is probable that a proportion of the 37 ponds do qualify (detailed surveys are being progressed in 2018). Ponds meeting Pond HPI criteria would be considered of up to county importance as they are likely to support notable or protected species. Ponds failing to meet Pond HPI criteria are considered to be of local importance because they enrich local biodiversity by providing habitats for wetland species.

RIVER HPI

8.4.101 The Mid-Arun Valley Environmental Survey has identified Binsted Rife and a second stream originating from above Sandy Hole Pond (National Grid reference SU9819106947) as 'chalk streams' on the basis that they are likely to originate from the chalk aquifer under the South Downs; and that both watercourses support plant species associated with water that is rich in calcium carbonate (e.g. frogbit and water soldier (*Stratiotes aloides*). The Joint Nature Conservation Committee consider Chalk Rivers to be part of River HPI[29]. To qualify as River HPI a river must meet a number of criteria which indicate that it is in a 'near natural' state. On account of the diversity of wetland habitats indicated by desk study information; the likely value of these watercourses to wetland animal species; and both Binsted Rife and the Sandy Hole Pond Stream appear to be unpolluted headwater streams - they are likely to qualify as River HPI. Tortington Rife is also likely to qualify for the same reasons (although it may not originate from chalk geology).

[28] Sussex Biodiversity Partnership (undated). Lowland Fen. [on-line] https://www.biodiversitysussex.org.uk/habitats/fens (accessed November 2017).
[29] Maddock, A (Ed). (2008). *UK Biodiversity Action Plan; Priority Habitat Descriptions*. Biodiversity Reporting and information Group. Joint Nature Conservation Committee.

8.4.102 The River Arun is a large watercourse which is likely to qualify as River HPI, 6.4 kilometres upstream of all Scheme Options, where it flows through the River Arun SAC. However, where it flows through the Field Survey Area it is embanked by flood walls and is not in a near natural state and thus is unlikely to meet River HPI criteria (subject to verification through ongoing field survey work in 2017 and 2018).

8.4.103 On the basis that Binsted Rife, Sandy Hole Pond Stream and Tortington Rife are all likely to qualify as River HPI and that Binsted Rife and Tortington Rife are an integral part of the Coastal and Floodplain Grazing Marsh HPI in the Desk Study Area, they are considered to be of county importance. Reaches of the River Arun in the Field Survey Area are likely to be of less than county importance subject to further confirmatory field survey.

COASTAL SALTMARSH HPI

8.4.104 A single area of Coastal Saltmarsh HPI is mapped by Natural England on the east bank of the River Arun at approximate National Grid reference TQ011055. This HPI is due south of the proposed bridge over the River Arun associated with Option 3 and Option 5A but is approximately 1.1 kilometres south of Option 1.

8.4.105 The Coastal Saltmarsh HPI present in the Desk Study Area is small, fragmented and occurs opportunistically as there is little space of sediment to be deposited either side of the River Arun as a result of the concrete flood protection walls which have been constructed south of Arundel town. The presence of this HPI increases the diversity of plant communities in the Desk Study Area by allowing marine species to grow, but is of no more than local importance on account of its small size, opportunistic occurrence and highly fragmented nature.

GRASSLAND HABITATS

GOOD QUALITY SEMI-IMPROVED GRASSLAND

8.4.106 North east of Arundel, either side of the River Arun, Natural England GIS information shows a large area referred to as ‘good quality semi-improved grassland’ habitat. This habitat is a minimum of 0.4 kilometres from the closest Scheme Option (Option 1). It is unclear from the Natural England data what grassland vegetation types are present. None of this habitat is in the Field Survey Area.

8.4.107 Guidance accompanying the Natural England GIS information states that Natural England has low confidence in this data because the habitat classification is based on survey information greater than ten years in age. It is unclear what character or condition of grassland is present without further survey information to validate the Natural England mapped data. This habitat is considered to be of local importance in the context of this assessment and would require a field survey to confirm its species composition and condition. Given proximity, it is unlikely to be subjected to direct or indirect impacts and will not form a target for field survey work relating to the Scheme.

LOWLAND MEADOW HPI

8.4.108 The Mid-Arun Valley Environmental Survey has identified an area of grassland at approximate National Grid reference TQ0076006783. It contains several unimproved neutral grassland indicator species and is located 0.2 kilometres south of Option 1 (on the far side of an area of sub-urban housing from the road) and between 0.7 kilometres and 0.9 kilometres from other Scheme Options. Highways England’s Phase 1 Habitat Surveys have yet to gain access to this area of land. Lowland Meadow is a habitat which has declined markedly in the past century and is likely to be of at least county importance.

MARSHY GRASSLAND

8.4.109 The Mid-Arun Valley Environmental Survey has identified are of marshy grassland including vegetation dominated by various rush species, including the Sussex Rare Species Inventory Rush (*Juncus subnodulosus*), in the valley of Binsted Rife. Rush vegetation and vegetation including species such as brown sedge (*Carex disticha*) and common sedge (*Carex nigra*) was recorded by the Mid-Arun Valley Environmental Survey in a field west of Tortington Rife. These habitats are part of a complex of wetland habitat making up the Coastal and Floodplain Grazing Marsh HPI and are valued as part of this HPI type in this assessment.

OTHER GRASSLAND TYPES

8.4.110 Highways England's Phase 1 Habitat Survey work has identified Poor Semi-Improved Grassland types in the Field Survey Area as reported in the PCF Stage 1 Environmental Study Report. This is a commonplace and widely distributed habitat in Sussex and is of negligible botanical nature conservation importance.

8.4.111 As noted under Coastal and Floodplain Grazing Marsh HPI, preliminary findings of 2017 habitat survey work show that areas of agricultural grassland mapped as Semi-Improved Neutral Grassland in the PCF Stage 1 Environmental Study Report (as a precaution in lieu of survey access) are mainly dominated by species such as perennial rye-grass (*Lolium perenne*) and are likely to be Improved Grassland which is of negligible botanical nature conservation importance.

OTHER HABITATS

8.4.112 Five additional habitats have been reported in the Desk Study Area:

- Aquifer fed naturally fluctuating waterbody HPI – this HPI is mentioned by the Mid-Arun Valley Environmental Survey as occurring in the Field Study Area associated with Binsted Rife and other watercourses (Thompson, 2017; page 41). There is no other corroborating desk study of field survey evidence to support this statement. In addition, this habitat is not characteristic of Sussex and is much localised in distribution in the UK (mainly Norfolk and Northern Ireland). The Mid-Arun Valley Environmental Survey link this habitat with chalk streams rather than as a habitat type in its own right. The presence of this HPI type is discounted from this assessment.
- Arable Field Margin HPI – preliminary information from 2017 Highways England habitat survey work indicates that several of the arable fields between Ford Road and the west branch of Binsted Lane are likely to contain field margins managed under agri-environmental Schemes for the benefit of wildlife. These would qualify as Arable Field Margin HPI. Several arable field margins are crossed by Option 3 and 5A. Arable Field Margin HPI is a commonplace habitat where agri-environmental funding is targeted. It can typically be created relatively easily from arable land and is of up to local importance. Should arable field margins be found to support rare/notable plant species this could elevate their importance – see discussion under Plants.
- Hedgerow HPI – preliminary information from 2017 Highways England habitat survey work indicates that the majority of the hedges between Ford Road and the west branch of Binsted Lane are likely to qualify as Hedgerow HPI. The Mid-Arun Environmental Survey cite Copythorn Field West (which is believed to be at approximately SU 9831106883) to support 20 woody species, 90 herbaceous species, 12 sedges, rushes and grasses and two fern species. Hedgerow HPI is a commonplace habitat and is likely to be of local importance. However, particularly species-rich or ancient hedges may be of up to county importance.
- Lowland Heathland HPI – preliminary information from 2017 Highways England habitat survey work indicates a number of small areas with frequent heather (*Calluna vulgaris*) within woodland rides in Binsted Wood Complex LWS. These would technically qualify as Lowland Heathland HPI but for the purposes of this assessment they are considered a component part of the Ancient Woodland in Binsted Wood Complex LWS and are valued as part of this site in this assessment.

- The Mid-Arun Environmental Survey and Natural England Priority Habitat inventory information identify two areas of Traditional Orchard HPI at National Grid reference SU 98747 05803 (0.2 kilometres south west of Option 5A at its closest point); and TQ0016905199 (0.6 kilometres south of Option 5A at its closest point). Dependent on the rarity of fruit tree varieties being grown and other associated orchard wildlife, such as lichens and dead wood invertebrates, this habitat may be of up to county importance.

SPECIES

AMPHIBIANS

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.113 Great crested newt (*Triturus cristatus*) is an EPS protected under the Conservation of Habitats and Species Regulations 2010 and Schedule 5 of the Wildlife and Countryside Act 1981. Great crested newt is also an SPI and a Sussex BAP Priority Species. Common toad (*Bufo bufo*) is a Species of Principal Importance.

8.4.114 It is illegal to deliberately capture, injure or kill great crested newt, to intentionally or recklessly disturb it, or to deliberately take or destroy its eggs. It is also illegal to damage, destroy or intentionally or recklessly obstruct access to a breeding or resting place used by a great crested newt. All life stages of great crested newt are afforded the same level of protection.

DESK STUDY

8.4.115 The desk study identified multiple great crested newt records clustered around three locations in the Desk Study Area. All records also indicated evidence of breeding activity (e.g. eggs and young). The most recent records were from 2013.

8.4.116 The records were either from ditches surrounding fields near the village of Poling approximately 1.2 kilometres east of the Scheme Options or from a pond near Walberton approximately 1.0 kilometres south west of the Scheme Options. It is not possible to confirm presence or absence on the basis of this data alone.

8.4.117 Highways England has identified 37 waterbodies within 250 metres of the centre line of the three Scheme Options. These were targeted for great crested newt survey in 2017.

8.4.118 The Mid-Arun Valley Environmental Survey reports what they consider to be major common toad breeding sites (“with 1000’s of tadpoles”) at two locations:

- The Madonna Pond which at National Grid reference SU9927206159 and is 0.2 kilometres north of Option 5A at its closest point to the Scheme Options.
- Tortington Rife which is approximately 0.2 kilometres south of Option 5A at its closest point to the Scheme Options but is hydrologically connected to watercourses which are crossed by Option 5A.

8.4.119 Three other common toad populations are identified by the Mid-Arun Environmental Survey – all are within 0.2 kilometres of Option 5A:

- A woodland pond at approximately SU 99073 05830;
- A pond at approximately SU 99245 05610; and
- The Sandy Hole Pond (National Grid reference SU9819106947).

FIELD SURVEY RESULTS

8.4.120 The terrestrial habitats present throughout the Survey Area and near each of the Scheme Options, including woodland, scrub and hedgerows, provide suitable shelter, foraging and hibernating sites for great crested newt and common toad.

8.4.121 The network of waterbodies directly west of Arundel Station and waterbodies by the Water Woods are likely to be sub-optimal for use by great crested newt because of their use for commercial angling. Great crested newt in particular is highly susceptible to predation from fish when in its larval life stage.

8.4.122 Other smaller ponds, likely to be ephemeral, were recorded within woodland parcels immediately adjacent to the existing A27 carriageway, and in Winchers Copse and Barn's Copse south of the A27 carriageway. These provide suitable foraging and breeding sites for both great crested newt and common toad.

8.4.123 Preliminary findings from 2017 great crested newt presence/absence surveys did not record any evidence of this species in 21 waterbodies that were surveyed; the habitat present in a further 12 waterbodies was considered unsuitable for great crested newt; and four waterbodies could not be accessed to survey for great crested newt.

8.4.124 Further great crested newt survey work will be undertaken in 2018 targeting the remaining waterbodies that could not be accessed in 2017. From the findings of the 2017 survey work it is unlikely that great crested newt is frequently present in the Field Survey Area.

8.4.125 The status of common toad will be assessed using a habitat suitability approach rather than direct field survey. Habitat assessment information collected to inform great crested newt survey will be used for this purpose and will be fully reported at PCF Stage 3.

PROVISIONAL VALUATION

8.4.126 Following a precautionary approach, if present in the Field Survey Area a single population of great crested newt is likely to be of local importance. If a large metapopulation of great crested newts were to be found in the Field Survey Area this may be of up to county importance.

8.4.127 Further habitat assessment and presence/absence surveys for great crested newt will be undertaken in 2018 to inform this assessment.

8.4.128 Any small, isolated population of common toad is unlikely to exceed local importance. A network of interconnected waterbodies supporting a large population would be of at least local importance and may be of higher importance. Information on the county status of common toad will be sought to accurately value its likely importance in the Desk Study Area.

BADGER

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.129 Badgers are protected under the *Protection of Badgers Act 1992*. It is illegal to wilfully take, kill, injure or ill-treat a badger, or possess a dead badger or any part of a badger. Under the Act their setts are also protected against obstruction, destruction, or damage in any part.

DESK STUDY

8.4.130 The Mid-Arun Valley Environmental Survey has reported extensive evidence of badger throughout the Desk Study Area, particularly in areas of woodland. It identified at least four setts (presumed to be main setts) in the west half of the Desk Study Area, two of which are within 0.5 kilometres from the footprint of the Scheme Options. The Mid-Arun Valley Environmental Survey has presented the mapped findings of a bait marking study (detailed study findings have not been published). These findings indicate that two badger clan territories will be directly crossed by

Option 5A and that a main sett is directly in the footprint of Option 5A.

FIELD SURVEY

8.4.131 No incidental evidence of badger field signs (hairs, latrines, dung pits, snuffle holes, mammal paths or scratching posts) or setts were recorded during the 2015 Phase 1 Habitat Survey. However, this is likely the result of restricted land access in 2015. The habitats present within the Survey Area including woodland, scrub, hedgerows and grassland were considered to provide high quality foraging opportunities for badger. Woodland and hedgerow habitat throughout the Field Survey Area were considered to provide suitable sett building opportunities.

PROVISIONAL VALUATION

8.4.132 Badgers are common and widespread in West Sussex and in England and the species is not considered to be a nature conservation priority. For these reasons, the population of badger in the Field Survey Area is likely to be of up to local nature conservation importance.

8.4.133 Detailed surveys in respect of badgers will be progressed in 2017 and 2018 in order to determine their distribution in the Field Survey Area. Accurate distribution information is also required to inform mitigation design as this species is legally protected.

BATS

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.134 All UK bat species are European Protected Species protected under the *Conservation of Habitats and Species Regulations (2010)* and under the *Wildlife and Countryside Act, 1981*. Various bats species are also listed as Species of Principal Importance. It is illegal to deliberately capture, injure or kill a bat, to intentionally or recklessly disturb them, or to deliberately take a bat. It is also illegal to damage, destroy or intentionally or recklessly obstruct access to a breeding or resting place used by a bat.

DESK STUDY

8.4.135 The desk study identified 35 confirmed or likely bat roosts within the Desk Study Area. The most recent records were from 2015. Sussex Biodiversity Records Centre identified confirmed or likely bat roosts for five bat species. These were common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), brown long-eared bat (*Plecotus auritus*), serotine (*Eptesicus serotinus*) and barbastelle (*Barbastella barbastellus*).

8.4.136 Sussex Biodiversity Records Centre data showed bat roosts to be widely distributed within the Desk Study Area. The majority of bat roost records were from the area around Slindon Common and Slindon Wood approximately 1 kilometres west of the Survey Area. Common pipistrelle roosts were also present around Arundel Castle approximately 0.4 kilometres north of the Survey Area. Barbastelle roosts were recorded within Poling Copse and Slindon Common / Wood, approximately 1 kilometres east and west of the Survey Area respectively.

8.4.137 The Mid-Arun Valley Environmental Survey commissioned bat surveys in 2016 and 2017 from Animal Ecology and Wildlife Consultants[30]. These surveys identified the following list of species in the Binsted Wood Complex LWS. Those with an asterisk(*) are identified by the Mid-Arun Valley Environmental Survey to be breeding within the Field Survey Area:

[30] Whitby, D (2016 and 2017 – two reports). *Bat Survey Trapping Survey Binsted Woods*. A report by Animal Ecology and Wildlife Consultants for MAVES

- Barbastelle;
- Alcathoe bat (*Myotis alcathoe*) (*);
- Bechstein's bat (*Myotis bechsteinii*) (*);
- Brandt's bat (*Myotis brandtii*) (*);
- Daubenton's bat (*Myotis daubentonii*);
- Natterer's bat (*Myotis nattereri*) (*);
- Whiskered bat (*Myotis mystacinus*) (*);
- Brown long-eared bat (*);
- Nathusius' pipistrelle (*Pipistrellus nathusii*);
- Common pipistrelle;
- Soprano pipistrelle;
- Noctule (*Nyctalus noctula*) (*); and
- Serotine (*).

FIELD SURVEYS

8.4.138 The habitats present within the Survey Area, particularly Ancient Woodland, woodland edges, hedgerows and watercourses provide high quality foraging and commuting areas for bats.

8.4.139 Ancient Woodland in the Survey Area contains numerous mature and Ancient/Veteran trees. Preliminary findings of 2017 Highways England preliminary roost assessment surveys indicate that woodland edge and farmland in the Field Survey Area contain approximately 150 trees which are of high and moderate suitability for roosting bats. Such features may support roosts of rare tree-roosting bat species such as barbastelle and the Bechstein's bat.

8.4.140 The Mid-Arun Valley Environmental Survey bat surveys[31] confirmed maternity colonies of Bechstein's bat, Alcathoe bat and occasional roosts for a range of other bat species in Binsted Wood Complex LWS. The Mid-Arun Valley Environmental Survey surveyors recorded barbastelle roosting in the Binsted Wood Complex LWS but considered it unlikely the roost they found was a breeding roost.

8.4.141 Preliminary findings from 2017 bat trapping and radio-tracking surveys undertaken by Highway England support the general conclusions of the Mid-Arun Valley Environmental Survey studies. A total of nine bat species have been captured foraging or commuting within the Field Survey Area. Bechstein's bat, Alcathoe bat and brown long-eared bat are using roosts within the Binsted Wood Complex LWS for breeding. Barbastelle has been recorded foraging in Binsted Wood Complex LWS but no roosts have been identified to date by Highways England relating to this species.

PROVISIONAL VALUATION

8.4.142 Further detailed bat survey work and analysis will be undertaken in 2017 and 2018. Based on desk study information and findings to date from Highways England 2017 field surveys, the complex of Ancient Woodland, hedgerow and woodland edge habitats throughout the Field Survey Area represents high quality foraging, roosting and breeding habitat for a diverse assemblage of bats.

[31] Whitby, D (2016 and 2017 – two reports). *Bat Survey Trapping Survey Binsted Woods*. A report by Animal Ecology and Wildlife Consultants for the Mid-Arun Valley Environmental Survey.

8.4.143 Both Bechstein's bat and barbastelle are listed on Annex II of the Habitats directive and are also categorised as Near Threatened on the International Union for the Conservation of Nature Red List of Threatened Species[32] and are regarded as Very Rare both in Sussex and UK[33]. Alcathoe bat is listed as Data Deficient on the International Union for the Conservation of Nature Red List of Threatened Species[34] and are considered Very Rare, with distribution across the UK unknown, having only recently been recognised in the UK[35].

8.4.144 On the basis of the diversity of the bat population present and the inclusion of several rare/threatened species, it is likely that the woodland bat assemblage supported by Binsted Wood Complex LWS and other surrounding Ancient Woodland may meet some of the criteria for SSSI designation, and is therefore likely to be of up to national importance.

8.4.145 In contrast, individual small bat roosts of common non-woodland specialist bat species (e.g. common pipistrelle) if present, are likely to be of up to local importance.

BIRDS

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.146 The majority of UK bird species are protected under the Wildlife and Countryside Act (1981). It is illegal to intentionally kill, injure, or take any wild bird, or take or destroy an egg of any wild bird. It is also an offence to damage or destroy the nest of any wild bird (whilst being built, or in use). A number of bird species are also listed as Species of Principal Importance, and/or are Birds of Conservation Concern, Red List or Amber List species and Sussex Biodiversity Action Plan Priority Species.

8.4.147 Some bird species have more extensive protection and are listed in Schedule 1 of the Wildlife and Countryside Act 1981. It is illegal to intentionally or recklessly disturb a bird listed on Schedule 1 while it is nest building, or at a nest containing eggs or young, or disturb the dependent young of such a bird.

DESK STUDY

8.4.148 The desk study identified 1997 records of 28 bird species protected under the Schedule 1 of the Wildlife and Countryside Act 1981. These records included numerous Birds of Conservation Concern Red List and Amber List species. The majority of desk study records, particularly wetland and reedbed specialist species, were from the Wildfowl and Wetland Trust Arundel Wetland Centre (which forms part of Arun Valley - Watersfield to Arundel LWS).

8.4.149 Desk study records of Birds of Conservation Concern Red List farmland birds such as corn bunting (*Emberiza calandra*) and turtle dove (*Streptopelia turtur*) showed their presence in agricultural land north and south of the A27 carriageway at Arundel. Multiple desk study records of the Wildlife and Countryside Act 1981 Schedule 1 species barn owl (*Tyto alba*) occur throughout the Desk Study Area within or immediately adjacent to each of the Scheme Options.

[32] Piraccini, R. (2016). *Barbastella barbastellus*. The IUCN Red List of Threatened Species 2016: e.T2553A22029285. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2553A22029285.en. Downloaded on 13 September 2017 and Paunović, M. 2016. *Myotis bechsteinii*. The IUCN Red List of Threatened Species 2016: e.T14123A22053752. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T14123A22053752.en. Downloaded on 13 September 2017

[33] Bat Conservation trust (2010) Species Factsheet http://www.bats.org.uk/data/files/barbastelle_11.02.13.pdf and http://www.bats.org.uk/data/files/Species_Info_sheets/bechsteins.pdf

[34] Hutson, A.M. & Paunović, M. 2016. *Myotis alcathoe*. The IUCN Red List of Threatened Species 2016: e.T136680A518740. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T136680A518740.en. Downloaded on 13 September 2017.

[35] Bat Conservation trust (2010) http://www.bats.org.uk/pages/uk_bats.html#Alcathoe

8.4.150 Desk study records of woodland birds such as hawfinch (*Coccothraustes coccothraustes*) and preliminary 2017 field survey evidence the presence of lesser spotted woodpecker (*Dendrocopos minor*) (both of which are Birds of Conservation Concern Red List species) indicate their presence in Binsted Wood Complex LWS within or immediately adjacent to each of the Scheme Options.

8.4.151 The Mid-Arun Valley Environmental Survey indicates the possible presence of three bird species in the Field Survey Area: nightingale (*Luscinia megarhynchos*)[36], nightjar (*Luscinia megarhynchos*)[37] and bittern (*Botaurus stellaris*) in the Field Survey Area. However, there is no current evidence from Highways England breeding bird field surveys that these species are present. 2018 survey work and consultation with the Mid-Arun Valley Environmental Survey will seek to verify these records.

8.4.152 The Mid-Arun Valley Environmental Survey also refers to two fields located to the east and west of Ford Road respectively which support between peak counts of 200 – 300 mute swan (*Cygnus olor*) and which may also support occasional Bewick's swan (*Cygnus columbianus*) both of which are Birds of Conservation Concern Amber List species and Bewick's Swan is a Birds Directive Annex 1 species[38]. 2018 field surveys will collect data on these fields to document their use by birds.

FIELD SURVEY

8.4.153 Phase 1 Habitat types and locations with greatest suitability to support notable and protected bird species included: Ancient Woodland within Binsted Wood and Rewell Wood; and areas of Coastal and Floodplain Grazing Marsh HPI in the Field Survey Area.

8.4.154 It is possible that Coastal and Floodplain Grazing Marsh HPI may provide suitable conditions for Bewick's swan for which Arun Valley SPA is designated and other waterfowl and wading species.

8.4.155 Mature or veteran trees within areas of Ancient Woodland and scattered within fields or along field boundaries, and old buildings are suitable to support nesting barn owl.

8.4.156 Preliminary findings to date from 2017 Highway England field surveys indicate that:

- No Bewick's swan was observed using the River Arun and adjacent floodplain; and use of the River Arun floodplain in 2017 by waterfowl was generally by low numbers of common species (e.g. mallard, mute swan, black-headed gull);
- The main woodland block within the Field Survey Area (centred on the Binsted Wood Complex LWS) was found to support a number of woodland specialist bird species which are likely to use this woodland for breeding and are Birds of Conservation Concern Red List species including lesser spotted woodpecker *(Dendropos minor*), marsh tit (*Poecile palustris*), song thrush (*Turdus philomelos*) and mistle thrush (*Turdus viscivorus*);
- Farmland adjacent to the River Arun and elsewhere was found to support a number of Bird of Conservation Concern Red List species including lapwing (*Vanellus vanellus*), yellowhammer (*Emberiza citronella*) and corn bunting and linnet; and
- Wetland habitats adjacent to the River Arun support an assemblage of wetland specialist passerine species including reed bunting (*Emberiza schoeniclus*) which is a Birds of Conservation Concern Amber List species and reed warbler (*Acrocephalus scirpaceus*) and sedge warbler (*Acrocephalus schoenobaenus*) which are Birds of Conservation Concern

[36] Thompson, J. (October, 2017). *The Mid-Arun Valley 2015 – 2017 A27 Arundel bypass Road Options 1, 3 and 5A Ecological Impact Report (using current data)* Wildlife Splash on behalf of the Mid-Arun Environmental Survey – reference possible breeding nightingale on page 10.

[37] The Mid-Arun Valley Environmental Survey (2017). *Steward's Copse*. Mid-Arun Valley Environmental Survey - reference to churring nightjar on page 3.

[38] Thompson, J. (October, 2017). *The Mid-Arun Valley 2015 – 2017 A27 Arundel bypass Road Options 1, 3 and 5A Ecological Impact Report (using current data)* Wildlife Splash on behalf of the Mid-Arun Environmental Survey.

Green List species but are wetland habitat specialists characteristic of Lowland Fen HPI and Swamp habitats.

PROVISIONAL VALUATION

8.4.157 The majority of intensive farmland in the Survey Area is likely to support an assemblage of farmland birds including several notable species and barn owl which is subject to legal protection. Subject to the detailed findings of 2017 breeding bird surveys farmland in the Field Survey Area is considered to be of importance for a number of Birds of Conservation Concern Red List and Amber List species and may be of up to county importance.

8.4.158 Ancient Woodland in the Binsted Wood Complex LWS and Rewell Wood Complex LWS is likely to be of importance for a number of Birds of Conservation Concern Red List species and support a relatively intact assemblage of woodland breeding birds. It is likely to be of up to county importance.

8.4.159 Wetland and river habitats which are located partly within each of the Scheme Options may support aggregations of notable or protected bird species and may be of county importance or higher value if species linked to the Arun Valley SPA or the Arun Valley Ramsar site are present. Surveys in respect of breeding and wintering birds are ongoing in 2017 and 2018.

FISH

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.160 Bullhead and European eel are both listed under Annex II of the Habitat and Species Directive. Other species are also listed as a SPI, and/or recorded on The International Union for the Conservation of Nature Red List of Threatened Species. European eel is a Species of Principal Importance.

DESK STUDY

8.4.161 Sussex Biodiversity Records Centre desk study information contained records of three fish species within the Desk Study Area: European eel; plaice; and brown trout.

8.4.162 The Mid-Arun Valley Environmental Survey cite the presence of several fish species (based on their own desk and field study findings) within the Desk Study Area. These records were of European eel, sea trout and mullet.

FIELD SURVEY

8.4.163 Preliminary survey findings from 2017 suggest that the watercourses are only likely to support small freshwater fish, such as stickleback and minnow, as well as populations of European eel. Typically, the watercourses observed were slow flowing, silted and poorly oxygenated.

8.4.164 Aquatic scoping surveys are underway in spring and autumn 2017. Should suitable habitats for fish be identified, presence/absence surveys will be conducted to confirm if species of conservation importance are present.

PROVISIONAL VALUATION

8.4.165 Preliminary survey findings from 2017 suggest that the watercourses are only likely to support small freshwater fish, such as stickleback and minnow, as well as populations of European eel, this assemblage of fish is likely to be at least of local importance.

HAZEL DORMOUSE

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.166 Hazel dormouse is a European Protected Species which is protected under the *Conservation of* Habitats and Species Regulations 2010 and under the Wildlife and Countryside Act 1981. Hazel dormouse is listed as a Species of Principal Importance and is also recorded as a species of Least Concern on the International Union for the Conservation of Nature Red List of Threatened Species. Hazel dormouse is subject to the same legal protection as bats and great crested newt.

DESK STUDY

8.4.167 The desk study identified 488 hazel dormouse records within the Desk Study Area. The most recent records were from 2014. The majority of records were from Paines Wood, Ash Piece and Rewell Wood which form large areas of Ancient Woodland towards the western extent of the Survey Area.

8.4.168 The Mid-Arun Valley Environmental Survey reports findings from between 2014 and 2017 undertaken by volunteers as part of the National Hazel Dormouse Monitoring Programme. These surveys have identified the presence of hazel dormouse in Paine's Wood, Ash Piece, Lake Copse, Tortington Common and Hundred House Copse.

FIELD SURVEY

8.4.169 Ancient Woodland towards the western end of the Field Survey Area, north and south of the A27 carriageway including Paines Wood, Ash Piece, Binsted Wood, Stewards Copse, Tortington Common, Winchers Copse, Singers Piece, Goblestubbs Copse and Rewell Wood were considered to provide suitable breeding, foraging, shelter and hibernating sites for hazel dormice. The Field Survey Area contains an extensive hedgerow network which is likely to offer suitable foraging and possible breeding sites for hazel dormouse.

8.4.170 Preliminary findings of Highways England hazel dormouse surveys in 2017 support the findings from the Mid-Arun Valley Environmental Survey data and also extend the known distribution of hazel dormouse in the Field Survey Area by confirming presence in the Waterwoods to the north of the A27 road.

PROVISIONAL VALUATION

8.4.171 Given the large expanse of suitable habitat present, it is likely that a large population of hazel dormice occurs in the Desk Study Area.

8.4.172 Hazel dormouse is nationally rare and although relatively widespread in Sussex, the large area of suitable woodland habitat present in the Desk Study Area may represent a core population which is more resilient, than lower suitability habitats in surrounding farmland, to years with adverse weather conditions or other factors affecting hazel dormouse breeding success.

8.4.173 It is likely that the hazel dormouse population of the Field Survey Area is of up to county importance.

INVERTEBRATES (TERRESTRIAL AND AQUATIC)

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.174 Various invertebrate species are protected from killing or injury under the *Wildlife and Countryside Act 1981*. Some are also listed as Species of Principal Importance, and/or are International Union for the Conservation of Nature Red List species and Sussex Biodiversity Action Plan Priority Species. For example, the duke of Burgundy and stag beetle (*Lucanus cervus*). The lesser whirlpool ram's-horn snail (*Anisus vorticulus*) is a European Protected Species which is protected under the Conservation of Habitats and Species Regulations 2010. It is subject to the same protection as bats, great crested newt and hazel dormouse. This snail species is a Species of Principal Importance and is listed on the International Union for the Conservation of Nature Red List as Vulnerable, and is Nationally Rare in England[39].

DESK STUDY

8.4.175 The desk study identified over 1000 invertebrate records comprised of 405 species. These records included four beetle species, 122 moth species, 272 butterfly species, two true fly species and five hymenopteran species.

8.4.176 The majority of records were from Arundel Wetland Centre, Fairmile Bottom SSSI, Wykehurst Park Grounds which are all over 0.5 kilometres from the Scheme Options and from Rewell Wood Complex LWS and Binsted Wood Complex LWS which intersect or immediately border the Scheme Options.

8.4.177 Three records of invertebrate species listed under Schedule 5 of the *Wildlife and Countryside Act 1981* were within the Desk Study Area. These were brown hairstreak (*Thecla betulae*), stag beetle and pearl-bordered fritillary - a large number of records of the latter species came from within Rewell Wood Complex LWS.

8.4.178 No records of lesser whirlpool ram's-horn snail were provided by Sussex Biodiversity Records Centre.

8.4.179 Five International Union for the Conservation of Nature Red List species were recorded within the Desk Study Area, many of which were within Rewell Wood Complex LWS. These include grizzled skipper, dingy skipper, white admiral and small heath (*Coenonympha pamphilus*) butterflies, and the phantom hoverfly (*Doros profuges*).

8.4.180 The Mid-Arun Valley Environmental Survey list numerous Red Data Book invertebrates (based on its own desk study and field survey findings) which may be present in the Field Survey Area. These comprise particularly woodland butterflies, dragonflies and damselflies associated with wetland habitats, and beetles associated with woodland and hedgerow habitats. These findings are consistent with the diverse range of invertebrates identified in the data supplied by Sussex Biodiversity Records Centre.

FIELD SURVEY

8.4.181 Notable invertebrate species recorded in the desk study are likely to be associated with the following Phase 1 Habitat types: Ancient Woodland, Ancient/Veteran trees, mature species-rich in-tact hedgerows, wetland habitats which are in areas of Coastal and Floodplain Grazing Marsh HPI and running and standing water. Given that these habitats are extensive it is probable that a range of protected and notable invertebrate species occur within the Field Survey Area.

[39] JNCC (undated). Conservation Designations for UK Taxa. [on-line] http://jncc.defra.gov.uk/page-3408 (accessed September 2017).

8.4.182 Detailed terrestrial and aquatic invertebrate survey work is ongoing in 2017 and 2018 following methods outlined in Appendix E. Survey work will focus on key habitats which are likely to support protected or notable species. Detailed analysis of desk study information (including Mid-Arun Valley Environmental Survey information) will be undertaken to identify key microhabitats likely to support notable and protected species.

PROVISIONAL VALUATION

8.4.183 Following a precautionary approach, given the large number of desk study records of protected and notable invertebrate species including those in within Binsted Wood Complex LWS, Rewell Wood Complex LWS and wetland habitats which are located either within or immediately adjacent to or inside all Scheme Options; invertebrates are considered likely to be of at least county importance. Should a population of lesser whirlpool ram's-horn snail be identified in the Field Survey Area, it may exceed county importance given its national rarity.

8.4.184 The most valuable habitats for invertebrates are likely to be Ancient Woodland, ancient or veteran trees, species-rich hedgerows and wetland habitats. Those invertebrate communities which are present in arable and poor semi-improved grassland are unlikely to exceed local importance.

OTTER

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.185 Otter (*Lutra lutra*) is protected under the *Conservation of Habitats and Species Regulations 2010* and under the *Wildlife and Countryside Act 1981*. Otter is also listed as a Species of Principal Importance and a Sussex Biodiversity Action Plan Priority Species. It is subject to the same legal protection as great crested newt, bats and hazel dormouse.

DESK STUDY

8.4.186 The desk study data contained no records of otter. The Mid-Arun Valley Environmental Survey makes the following statement about otter in the Desk Study Area[40]:

"*Otter is thought to be just beginning to extend its range across the Hampshire border into Sussex and there have been unconfirmed sightings in this catchment. There are undisturbed areas that are ideal for holt construction such as around Binsted Rife and areas of wet woodland*" (page 48).

FIELD SURVEY

8.4.187 The River Arun and the network of ditches on the River Arun floodplain including a large ditch that runs parallel to the River Arun were considered to provide suitable foraging and commuting features for otter.

8.4.188 Use of the River Arun by otter may be limited due to the lack of sheltering sites – few old bankside trees, little concealing habitat and sparse vegetation cover was noted directly adjacent to the River Arun. The complex network of ditches in the River Arun floodplain and large number of waterbodies in the Desk Study Area is likely to provide extensive and high quality foraging and commuting habitat for otter.

8.4.189 Provisional findings of field survey work in 2017 has not identified any evidence of otter in the Field Survey Areas. Further otter surveys in 2017 and 2018 will be undertaken to confirm the presence or likely absence of otter in the Field Survey Area.

[40] Thompson, J. (October, 2017). *The Mid-Arun Valley 2015 – 2017 A27 Arundel bypass Road Options 1, 3 and 5A Ecological Impact Report (using current data)* Wildlife Splash on behalf of the Mid-Arun Environmental Survey.

PROVISIONAL VALUATION

8.4.190 Otter is a wide ranging species and is known to be increasing in numbers nationally, although still a relatively uncommon mammal species in Sussex according to the Mid-Arun Valley Environmental Survey.

8.4.191 The land within the Field Survey Area would only be likely to support a small number of otter territories given their wide ranging behaviour and their relatively large territory size. The assumed otter population using the Field Survey Area for foraging and commuting may be of up to local importance if the species is present. However, if one or more breeding holts were confirmed or the Survey Area the otter population could be of up to county nature conservation importance.

PLANTS

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.192 Plants listed on Schedule 5 of the Conservation of Habitats and Species Regulations 2010 and/or Schedule 8 of the Wildlife and Countryside Act 1981 are subject to strict legal protection. Plants listed on the England Red Data Book (above Least Concern status) or those which are Species of Principal Importance on Section 41 of the Natural Environment and Rural Communities Act 2006 are national conservation priorities. Certain species are not nationally rare but are uncommon in a Sussex context, they are listed on the Sussex Rare Species Inventory.

DESK STUDY

8.4.193 The following notable plant species (either England Red Data Book above Least Concern and/or Sussex Rare Species Inventory are considered likely to be present in the Desk Study Area on the basis of Mid-Arun Valley Environmental Survey and Sussex Biodiversity Records Centre data:

- Blunt-flowered rush (*Juncus subnodulosus*) in Binsted Rife valley;
- Cornflower (*Centaurea cyanus*) arable fields in the Desk Study Area;
- Divided sedge (*Carex divisia*) on the banks of the River Arun;
- Fen bedstraw (*Galium uliginosum*) in Binsted Rife valley;
- Frogbit (*Hydrocharis morsus-ranae*) in Binsted Rife and Tortington Rife valley;
- Ivy-leaved crowfoot (*Ranunculus hederaceus*) in Binsted Rife;
- Marsh-mallow (*Althaea officinalis*) on the banks of the River Arun;
- Narrow-leaved everlasting-pea (*Lathyrus sylvestris*) near Binsted village; and
- Whorl grass (*Catabrosa aquatic*) in Binsted Rife valley.

8.4.194 The following notable species have been reported in the Desk Study Area but are likely to occur as introductions or casuals in the Desk Study Area as their occurrence does not agree with the habitat types which are present *or they are outside their native range:*

- *Water-soldier (Stratiotes* aloides) in Sandy Hole Pond;
- Box (*Buxus sempervirens*) in Binsted Wood;
- Snakes-head fritillary (*Fritillaria meleagris*) near Binsted Park; and
- Royal fern (*Osmunda regalis*) near Binsted village.

FIELD SURVEY

8.4.195 Provisional findings of Highways England surveys confirm the following species to be present in the Field Survey Area: divided sedge, marsh-mallow, water-soldier, opposite-leaved pondweed, and tubular water-dropwort (*Oenanthe fistulosa*) and numerous Ancient Woodland Indicator species in Binsted Wood Complex LWS.

8.4.196 In addition, frogbit and blunt-flowered Rush has been confirmed downstream of the Field Survey Area in Binsted Rife and Tortington Rife valleys respectively.

8.4.197 Botanical Field Survey work to look for arable weed species has been progressed for arable fields between approximately the River Arun and the west end of Option 5A.

PROVISIONAL VALUATION

8.4.198 With the below listed exceptions, all of the above named species populations occur in areas of Coastal and Floodplain Grazing Marsh HPI or Ancient Woodland, are valued, and will be assessed as a component part of that habitat in this assessment.

8.4.199 Divided sedge and marsh-mallow occur in poor semi-improved grassland on the banks of the River Arun close to where Option 3 or Option 5A will cross the river. These species populations are considered to be of up to county importance.

8.4.200 Should an arable weed community be found in the Field Survey Area which includes notable species, this may be of more than local importance.

REPTILES

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.201 The four common native reptiles, grass snake (*Natrix natrix*), common lizard (*Zootoca vivipara*), slow worm (*Anguis fragilis*), and adder (*Vipera berus*), are partially protected under the *Wildlife and Countryside Act 1981*. Under this legislation it is illegal to intentionally kill or injure a reptile. These four species are also Species of Principal Importance.

8.4.202 Smooth snake (*Coronella austriaca*) and sand lizard (*Lacerta agilis*) have additional protection under the Conservation of Habitats and Species Regulations 2010 and the Wildlife & Countryside Act 1981. The known UK distribution of these species does not coincide with the Desk Study Area.

DESK STUDY

8.4.203 The desk study identified 87 reptile records within the Desk Study Area, comprising slow worm, common lizard, grass snake and adder. The most recent records were from 2014.

8.4.204 The majority of records were near the River Arun near the town of Littlehampton approximately 2 kilometres south of the Field Survey Area. The nearest records, which included all four widespread native reptile species were from Rewell Wood Complex LWS, Binsted Wood Complex LWS within or immediately adjacent to all Scheme Options.

8.4.205 Analysis provided by the Mid-Arun Valley Environmental Survey highlights Binsted Rife (due south west the Survey Area) and Tortington Rife as high quality reptile habitats on the basis that these areas provide abundant foraging, basking and sheltering habitats in close proximity to one another.

FIELD SURVEY

8.4.206 Habitats present within the Field Survey Area, including woodland and associated glades and rides, scrub, hedgerows and grassland provide suitable foraging, basking, sheltering and hibernating opportunities for reptiles. Woodland glades and rides within Binsted Wood Complex LWS, and areas of rough grassland, ditches and hedgerows bordering fields east and west of the River Arun in particular are highly likely to provide suitable habitats for reptiles.

8.4.207 Preliminary survey findings from reptile survey work in 2017 confirm the presence of adder, common lizard, grass snake and slow worm in the Field Survey Area including land adjacent to all Scheme Options. Young reptiles were observed during autumn 2017 surveys proving that breeding is occurring in the Field Survey Area. Surveys are yet to be completed, and therefore population size class estimates of these species are not yet available.

8.4.208 Further habitat assessment and presence/absence surveys for reptiles will be undertaken in 2017 and 2018 to inform this assessment.

PROVISIONAL VALUATION

8.4.209 Given the widespread presence of rough grassland, wetland and grass/scrub mosaic habitats in the Field Survey Area reptiles are likely to be widely distributed in suitable habitats close to each of the Scheme Options. Where reptiles are present at low abundance in sub-optional habitats such as narrow, rough grassland road verges or intensively managed, arable field edges/hedgerow bases these reptile populations are unlikely to exceed local importance. However, high quality woodland ride or wetland habitats that may support large reptile populations, and which may qualify as Key Reptile Sites[41], may be present at a small number of locations of up to county importance.

WATER VOLE

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.210 Water vole (*Arvicola amphibius*) is protected under the Wildlife and Countryside Act 1981, and is listed as a Species of Principal Importance and a Sussex Biodiversity Action Plan Priority Species. Water vole is also a species of Least Concern on the International Union for the Conservation of Nature List of Threatened Species but is considered rare and declining in England[42].

8.4.211 It is illegal to intentionally kill or injure water voles. It is also an offence to intentionally or recklessly damage, destroy or obstruct access to a place that water voles use for shelter or protection or disturb water voles whilst using such a place.

DESK STUDY

8.4.212 The desk study identified 1,382 water vole records within the Desk Study Area. The most recent record is from 2015. The majority of the records were from Arundel Wetland Centre approximately 1.0 kilometres north of Option 1 at its closest point to the Scheme Options. There were also several records from a variety of streams and ditches towards Poling approximately 1.5 kilometres east of the Field Survey Area.

[41] Froglife (1999) Reptile survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice Sheet 10. Froglife, Halesworth.

[42] Battersby, J (Ed). (2005). *UK Mammals: Species Status and Population Trends First Report by the Tracking Mammals Partnership*. JNCC/Tracking Mammals Partnership.

8.4.213 The Mid-Arun Valley Environmental Survey has stated that the Field Survey Area may provide sufficient habitat to support a viable population of water vole[43]. This is based on the National Water Vole Steering Group estimate that six kilometres of linear watercourse is required for long-term population viability which may be present in the Desk Study Area. They also report water vole field signs within the Field Survey Area, including feeding remains, latrines and burrows which were present in the valley of Binsted Rife, and water vole footprints at Lake Copse.

FIELD SURVEY

8.4.214 Running water and standing water habitats, including occasional ditches along many of the field boundaries and scattered ponds, were considered to provide suitable foraging and burrowing sites for water vole. Areas of Coastal and Floodplain Grazing Marsh HPI coincide with the most suitable habitats for water vole in the Field Study Area – such as the valleys of Binsted Rife, Tortington Rife and the floodplain to the east of the River Arun which contains a large number of ditches.

8.4.215 Preliminary survey findings from 2017 indicate that the ditches both west and east of the River Arun contain widespread evidence of water vole use. Water vole field signs and droppings were found in these locations. Further surveys will be conducted in 2018 to accurately determine the distribution of this species in the Field Survey Area.

PROVISIONAL VALUATION

8.4.216 Given the national rarity of this species; confirmed evidence of water vole west of the River Arun and potentially also in Lake Copse and Binsted Rife; and large areas of suitable habitat which could support a viable population – it is likely that the water vole population in the Desk Study Area is of county importance.

WHITE-CLAWED CRAYFISH

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.217 White-clawed crayfish (Austropotamobius pallipes) is protected under the Conservation of Habitats and Species Regulations 2010 and under Schedule 5 of the Wildlife and Countryside Act 1981. White clawed crayfish is a Species of Principal Importance. Little information could be found about the status of white-clawed crayfish in Sussex, however, the species is known to be less common in southern England[44] and rare in the neighbouring county of Hampshire[45].

DESK STUDY

8.4.218 No desk study records were supplied by Sussex Biological Records Centre for this species. Further desk study information from the Environment Agency has been requested in 2017.

FIELD SURVEY

8.4.219 Ditches and ponds that contain water all year round throughout the Survey Area may provide suitable foraging and breeding habitats for white-clawed crayfish. Such water bodies occur near to all Scheme Options.

[43] Thompson, J (2017). *An ecological survey of the Mid-Arun Valley*. Wildlife Splash. East Sussex.
[44] Holdich, D (2003). *Ecology of the White-clawed Crayfish. Conserving Natura 2000 Rivers Ecology Series No. 1*. English Nature, Peterborough.
[45] Adrian Hutchings (2009). Monitoring Autropotamobius pallipes (Lereboullet) in a chalk stream in southern England. *Crayfish Conservation in the British Isles*. Proceedings of a conference held on 25th March 2009 at the British Waterways Offices, Leeds, UK

8.4.220 Preliminary survey findings from 2017 suggest that the River Arun is not a suitable white-clawed crayfish habitat, being highly tidal and partly saline. In addition, some of the drainage ditches on the Arun floodplain area are slow flowing, silted and poorly oxygenated, and hence are also likely to be unsuitable for white-clawed crayfish.

8.4.221 Further aquatic surveys will be undertaken in 2017 and 2018. Should suitable habitats for white-clawed crayfish be identified, presence/absence surveys will be conducted.

PROVISIONAL VALUATION

8.4.222 Based on available evidence it is not likely that suitable habitat for white-clawed crayfish occurs in the Field Survey Area. However, should this species be present, given its likely rarity in Sussex, a viable population may be of at least county importance.

OTHER NOTABLE MAMMAL SPECIES

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.223 Hedgehog (*Erinaceus europaeus*), brown hare (*Lepus europaeus*), harvest mouse (*Micromys minutus*) are all Species of Principal Importance (SPI) and are conservation priorities in England. Brown hare is a Sussex Biodiversity Action Plan Priority Species.

DESK STUDY

8.4.224 The desk study identified multiple records of hedgehog, brown hare and harvest mouse throughout the Desk Study Area, particularly in Binsted Wood, Paines Wood and Rewells Wood within or immediately adjacent to each of the Scheme Options.

8.4.225 The Mid-Arun Valley Environmental Survey report records of harvest mouse in Binsted Woods Complex LWS, Rewell Woods Complex LWS; evidence of brown hare in arable fields to the north east of Yapton; and highly suitable habitat for hedgehog in woodland and hedgerows throughout the Desk Study Area[46]. They also identify high quality harvest mouse habitats with confirmed evidence of harvest mouse in the valleys of Binsted Rife and Tortington Rife and in woodland edge habitats along the southern edge of the Binsted Wood Complex LWS.

FIELD SURVEY

8.4.226 The habitats present within the Field Survey Area, particularly woodland and arable farmland and to some extent hedgerows and grassland provide suitable breeding shelter, foraging and commuting habitats for all of these notable mammals.

8.4.227 The status of notable mammal species will be assessed using a habitat suitability approach rather than direct field survey. Phase 1 Habitat and other botanical habitat survey information will be used for this purpose and will be fully reported at PCF Stage 3.

PROVISIONAL VALUATION

8.4.228 An accurate valuation of this species will be undertaken when habitat survey work (presently ongoing in 2017 and 2018) has been completed. Confirmed populations of these species are likely to be of at least local importance. Information on the county status of these harvest mouse, brown hare and hedgehog will be sought to accurately value their likely importance in the Desk Study Area.

[46] Thompson, J (2017). *An ecological survey of the Mid-Arun Valley*. Wildlife Splash. East Sussex.

IDENTIFICATION OF IMPORTANT ECOLOGICAL FEATURES

8.4.229 As part of the Chartered Institute for Ecology and Environmental Management assessment method:

"*One of the key challenges in Ecological Impact Assessment is to decide which ecological features (habitats, species, ecosystems and their functions/processes) are important and should be subject to detailed assessment. Such ecological features will be those that are considered to be important and potentially affected by the project. It is not necessary to carry out detailed assessment of features that are sufficiently widespread, unthreatened and resilient to project impacts and will remain viable and sustainable*[47] ."

8.4.230 Following a precautionary approach, all designated site, and habitat and species groups considered of at least local importance and above and are taken forward to the assessment stage as Importance Ecological Features for the purpose of this PCF Stage 2 ecological impact assessment.

8.5 ASSESSMENT METHODOLOGY

8.5.1 An assessment of likely ecological impacts associated with each of the three Scheme Options was undertaken following the Ecological Impact Assessment methodology published by the Chartered Institute of Ecology and Environmental Management[48] and guidance provided in Highways England's Interim Advice Note 130/10[49] which is a component part of the Design Manual for Roads and Bridges. This Chartered Institute for Ecology and Environmental Management method has three key stages: i) valuation of the importance of ecological features; ii) identification of important ecological features (i.e. all features of local importance or higher); and iii) impact assessment and identification of significant effects.

8.5.2 The importance (value) of designated sites, habitats, species assemblages and populations of species was evaluated in the baseline of this report. Importance was assessed with reference to their nature conservation status (i.e. rarity, threat status); their 'biodiversity conservation' value (which relates to the need to conserve representative areas of different habitats and the genetic diversity of species populations); and legal status. A review of the legislation, policy and the sensitivity of the ecological receptor was undertaken and the importance of the ecological feature was determined within a geographical context on the following basis:

- International;
- National (England);
- County (West Sussex);
- Local;
- Within the Field Survey Area only; and
- Negligible.

[47] Chartered Institute for Ecology and Environmental Management (2016). Guidelines for ecological impact assessment in the UK and Ireland Terrestrial, Freshwater and Coastal. CIEEM. Winchester.
[48] Chartered Institute of Ecology and Environmental Management (2016). Guidelines for ecological impact assessment in the UK and Ireland Terrestrial, Freshwater and Coastal. CIEEM. Winchester
[49] Highways England (2010). Interim Advice Note 130/10 - Ecology and Nature Conservation: Criteria for Impact Assessment Interim Advice Note 130/10. Highway England.

8.5.3 The 2016 Chartered Institute of Ecology and Environmental Management ecological impact assessment method does not prescribe how to define different geographical levels of importance but provides general guidance. Table 8-3 (broadly based on criteria proposed by Ratcliffe, 1977; and Chartered Institute for Ecology and Environmental Management, 2006) outlines the criteria to be taken into consideration for valuing designated sites, habitats and species in Section 8.3.

8.5.4 The Chartered Institute of Ecology and Environmental Management method proposes that regional importance may be used although its use if not mandated in the method. Regional importance' has not been used in this assessment, as there is no objective, unambiguous source of information for South East England that can be used to evidence what population status, level of rarity or threat would qualify a habitat type, species/species assemblage for 'regional importance'. Thus use of this level would be highly subjective, inconsistently applied to different species/habitat types and open to challenge. This decision will be reviewed at PCF Stage 3 as further information emerges from through consultation with stakeholders. It is noted that the Mid-Arun Valley Environmental Survey considers many ecological features in the Desk Study area to be of regional importance[50]. However, no criteria are presented for regional importance that can be applied in this assessment. For the purpose of Scheme Option evaluation, the decision not to adopt the 'regional' importance level is not constraining as assessment of the relative impact of the different Scheme Options has been undertaken on a clear and consistent basis and a precautionary approach to valuation has been adopted.

8.5.5 Given the current status of conceptual design information, the ongoing of ecological surveys in 2017/2018, and access restrictions, this assessment takes a precautionary approach where uncertainties exist. Ecological features have been valued on a 'reasonable worst case' basis. Where a precautionary valuation has been undertaken this is fully justified in the impact assessment. Preliminary survey findings from on-going survey work undertaken between February 2017 and the point of EAR publication have been considered in the valuation process.

8.5.6 It is impractical and inappropriate for an ecological assessment to consider every habitat and species that may be affected by the Scheme Options. Accordingly, a threshold importance level was set and all ecological features that are of 'Local' or higher importance will be subject to impact assessment. These ecological features are described as Important Ecological Features.

8.5.7 Ecological impacts have been assessed in the absence of mitigation or compensation measures. Effect significance has been assessed according to the Chartered Institute for Ecology and Environmental Management guidance:

8.5.8 "For the purpose of ecological impact assessment, 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features'…or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity).

8.5.9 Effects have been described with respect to the geographic scale at which they may be regarded as significant - from international to local. It should be noted that in line with the guidance issued by Chartered Institute of Ecology and Environmental Management, an impact which has been considered as significant in ecological terms is the same as significant in EIA terms.

[50] Thompson, J. (October, 2017). *The Mid Arun Valley 2015 – 2017 A27 Arundel bypass Road Options 1, 3 and 5A Ecological Impact Report (using current data)* Wildlife Splash on behalf of the Mid-Arun Environmental Survey.

8.5.10 Highways England Interim Advice Note 130/10[51] uses a slightly different terminology (to the Chartered Institute for Ecology and Environmental Management) to grade the significance of impacts. However, the IAN 130/10 approach is fully compatible with the Chartered Institute for Ecology and Environmental Management approach and does not alter the conclusions which have been reached in this assessment using the latter method. Table 8-3 provides a comparison of the approaches.

Table 8.3 A comparison of the approaches

CHARTERED INSTITUTE FOR ECOLOGY AND ENVIRONMENTAL MANAGEMENT CATEGORY FOR IMPACT SIGNIFICANCE	CORRESPONDING IAN 130/10 CATEGORY FOR IMPACT SIGNIFICANCE
Significant at the international, European, UK or national level	Very Large
Significant at the regional/county level	Large
Significant at the district level.	Moderate
Significant at the local level.	Slight
Not significant, effects on features below the Local level.	Neutral

8.5.11 The relative impact of each Scheme Option was undertaken by qualitatively comparing their contrasting impact magnitude on different Important Ecological Feature types.

Table 8.4 Criteria for assessing the importance ecological features

VALUE/ IMPORTANCE	CRITERIA
International (European)	Habitats An internationally designated site or candidate site (SPA, provisional SPA, SAC, candidate SAC, Ramsar Site, Biogenetic/Biosphere Reserve, World Heritage Site) or an area that would meet the published selection criteria for designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat, which are essential to maintain the viability of a larger whole. Species Any regularly occurring population of internationally important species, threatened or rare in an international context (e.g. International Union for the Conservation of Nature Red Data Book species listed above 'Least Concern'). A regularly occurring species population which exceeds the threshold for national importance as set by guidelines for designation of illogical SSSIs in the UK or similar guidance where available).
National	Habitats A nationally designated site, SSSI, NNR, Marine Nature Reserve or a discrete area, which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). A large area of a Habitat of Principle Importance, Ancient Woodland or Wood Pasture and Parkland HPI. Species Any regularly occurring/large population of a nationally important species (e.g. England Red Data Book). A large population of a species identified as a Species of Principal Importance. A species population which would qualify for SSSI designation.
County (West Sussex)	Habitats Sites recognised by local authorities, e.g. LWSs. County sites that the designating authority has determined meet the published ecological selection criteria for designation. A diverse and/or hedgerow network comprised of mostly Important Hedges. Degraded areas of HPI (excluding Wood Pasture and Parkland HPI and Ancient Woodland Lowland Mixed Deciduous Woodland HPI which is Ancient Woodland). Species Any regularly occurring, locally significant population of a SPI or a species listed in a county/district BAP (where available). A regularly occurring, locally significant population of a county/district important species. Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the

[51] Highways England (2010). Interim Advice Note 130/10 - Ecology and Nature Conservation: Criteria for Impact Assessment Interim Advice Note 130/10. Highway England.

VALUE/ IMPORTANCE	CRITERIA
	region or county, and not integral to maintaining those populations. Sites/features scarce in the county or that appreciably enrich the county habitat resource.
Local	Habitats Areas of habitat that appreciably enrich the local habitat resource (e.g. species-rich hedgerows, ponds). Sites that retain other elements of semi-natural vegetation that, due to their size, quality or the wider distribution within the local area, are not considered for the above classifications. Species Populations/assemblages of species that appreciably enrich the biodiversity resource within the local context. Sites supporting populations of county/district important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations.
Field Survey Area	Habitats Areas of heavily modified or managed vegetation of low species diversity or low value as habitat to species of nature conservation interest. Species A good example of a common or widespread species.
Negligible	Common and widespread species and habitats.

8.6 ASSESSMENT LIMITATIONS AND ASSUMPTIONS

DESK STUDY

8.6.1 Data provided by biological records centres is often subject to the spatial coverage of biodiversity recording Schemes, many of which are not carried out in a systematic way. This data frequently does not include negative survey data (data showing where surveys have occurred and species absence has been proven likely). In particular, certain areas (e.g. nature reserves) have been heavily recorded whereas other areas (e.g. private farmland) have not been well studied. For this reason, in this assessment the absence of desk study records for a particular species has not been taken to indicate species absence. In all instances, the presence or absence of desk study records has been used alongside habitat data and the known/anticipated species distributions to infer whether these species may be present. Where doubt exists a precautionary assessment has been undertaken by assuming possible presence.

8.6.2 Survey information provided by the Mid-Arun Environmental Survey relevant to the Field Survey Area has been used to supplement Sussex Biodiversity Records Centre and other desk study data.

SURVEY LIMITATIONS

8.6.3 Detailed protected and notable species surveys (Appendix E) are ongoing in 2017 and 2018. However, preliminary survey findings and have been used to inform this assessment. Extensive desk study evidence has informed the assessment with regard to locations where survey access has not been possible or in which surveys are yet to be completed. Where uncertainty occurs a precautionary approach has been taken and species/habitat presence being assumed.

8.6.4 The Extended Phase 1 Habitat Survey undertaken in 2016 was carried out during January. As such, seasonal variations could not be observed and some species that occur within the Survey Area may not have been recorded. To supplement habitat survey data a variety of additional sources of information were investigated to provide adequate coverage of all habitat and species groups such as those listed in Section 8.3. Preliminary findings of 2017 surveys, all of which were carried out in the optimal survey periods, have further informed the assessment.

8.6.5 The Phase 1 Habitat Map Figure 8.5 has been reproduced from field notes and plans. Whilst this provides a sufficient level of detail to inform an impact assessment, the map is not intended to provide exact precise locations of habitats. Furthermore, the composition and condition of habitats, and their management regimes, are likely to change over time.

8.6.6 Land access was restricted along the A27 carriageway towards the eastern and western ends of the Field Survey Area because of the limited areas of clearance between the dual carriageway and its boundary. The 2016 Extended Phase 1 Habitat Survey therefore identified and mapped habitats in this area by observation from a vehicle driving along the A27 carriageway. Recognising the deficiency in this in approach, preliminary survey findings from 2017 survey work, where full land access was obtained, as well as information provided by the Mid-Arun Valley Environmental Survey, have been used to supplement 2016 field survey data.

8.6.7 A detailed assessment of grassland and wetland habitats in the Field Survey Area is being progressed in 2018. Where doubt exists over which habitat is present, the highest quality example of the potential habitat in question is assumed to be present (e.g. semi-improved neutral grassland where there is doubt over whether a pasture is improved grassland).

8.6.8 The detailed findings of targeted surveys for faunal and floral species being progressed in 2018 will be presented with the PCF Stage 3 assessment. Where uncertainty exists over species presence/absence, a precautionary approach has been taken and presence has been assumed.

IMPACT ASSESSMENT

8.6.9 This chapter has been produced at a time approximately mid-way through an ecological field survey programme which is due to be completed in the summer of 2018. For this reason, where complete data is not available, a precautionary ecological impact assessment has been made. In the absence of detailed survey information, a viable population/good condition example of each ecological feature type is assumed to be present. Through use of detailed desk study information and by adopting this precautionary approach, it is not considered likely that any key issues have been omitted.

8.6.10 The ecological assessment assumes that all land take impacts are permanent. The assessment assumes that successful best practice construction measures would be implemented to prevent accidental spillage of construction pollutants into watercourses and that dust arising from construction activities would be controlled.

FURTHER SURVEYS

8.6.11 Further ecological survey and assessment is being progressed in 2017 and 2018 as specified in Appendix E, in order to provide the necessary level of evidence to robustly conclude on the magnitude of likely impacts. Where surveys confirm species absence this may result in possible impact being de-scoped from future assessment work.

8.7 POTENTIAL IMPACTS

8.7.1 This section presents an assessment of ecological impacts that are likely to arise during construction and operational phases, taking into consideration the following parameters: positive/negative effect, magnitude, extent, duration, reversibility and frequency and timing. Three Scheme Options are assessed: Option 1, Option 3 and Option 5A. Consideration is given to impacts that would be likely to arise from placement of Option 3 or Option 5A on an embankment or on a viaduct where they cross the floodplain of the River Arun. No viaduct Option has been proposed as a design solution for Option 1. The ecological assessment method used is explained in Section 8.5.

8.7.2 For the purpose of this PCF Stage 2 assessment, which primarily aims to evaluate different Scheme Options, construction and operational impacts are discussed alongside each other rather than in separate sections.

8.7.3 Habitat loss estimates are approximate. Accurate habitat loss calculations will be undertaken when a detailed Scheme design is available for a preferred Scheme Option at PCF Stage 3.

STATUTORY DESIGNATED SITES

8.7.4 No Scheme Option will result in a direct impact on a European site as the closest such site is Duncton to Bignor Escarpment SAC which is 6 kilometres away.

8.7.5 The air quality assessment (Chapter 5) confirms that no European site will be affected by dust or nitrogen enrichment arising from Scheme construction or operation. This includes air quality impacts relating to traffic changes affecting the wider road network around the Scheme Options. This assessment is unchanged whether the Scheme is on an embankment or a viaduct across the River Arun floodplain.

8.7.6 A Design Manual for Roads and Bridges format Habitat Regulations Screening Assessment is required for all European sites within 2 kilometres of a proposed highways Scheme; any European site designated for bats within 30 kilometres of a highways Scheme or any site with potential connectivity to a proposed highway Scheme. Six European sites meet these criteria and were considered by the Habitat Regulations Screen Assessment which is presented in Appendix E. These comprise three bats sites within 30 kilometres of the Scheme Options:

- Ebernoe Common SAC;
- The Mens SAC; and
- Singleton and Cocking Tunnel SAC;

8.7.7 In addition, three European sites are upstream, along the River Arun of the Scheme Options:

- Arun Valley SAC;
- Arun Valley SPA; and
- Arun Valley Ramsar site.

8.7.8 The findings of the Habitat Regulations Screening Assessment are summarised by European site below.

THE ARUN VALLEY SAC, THE ARUN VALLEY SPA AND THE ARUN VALLEY RAMSAR SITE

8.7.9 The Arun Valley SAC is notified as a main population centre for the ramshorn snail (*Anisus vorticulus*). Option 1 (the closest Scheme Option) is 6.8 kilometres south of the SAC. It is improbable that the Scheme will undermine the conservation objectives of this SAC as set by Natural England. Specifically, Scheme construction or operation will not alter the extent and distribution of the snail habitats, snail distribution or underlying hydrological or other processes (i.e. grazing) that maintain snail habitat in the SAC. However, until detailed design information is available for a preferred route (to follow at PCF Stage 3), evidence of whether the Scheme will require water abstraction from local watercourses or the aquifer is not available. Such evidence is needed to robustly substantiate the provisional conclusion of no likely significant effect. Embankment or viaduct designs for any Scheme Option are unlikely to alter this provisional assessment as they would not alter water abstraction requirements.

8.7.10 The Arun Valley SPA and the Arun Valley Ramsar site are immediately adjacent to the River Arun but are 6.8 kilometres upstream of where the river is crossed by a new bridge proposed as part of both Option 3 and 5A (the newly proposed bridge is at approximately National Grid reference TQ011057). The SAC, SPA and Ramsar sites are located upriver from all Scheme Options and, therefore, no indirect impacts associated with pollution run-off are anticipated.

8.7.11 Preliminary findings of nine months of winter bird surveys (February to March and September to December 2017; and January to March 2018) suggest that qualifying bird species belonging to the Arun Valley SPA and Arun Valley Ramsar site are not present in the Field Survey Area. On this basis there is little scope for obstruction of qualifying bird species' flight lines along the River Arun associated with bridge construction for Option 3 and Option 5A. In addition, the River Arun floodplain in the Field Survey Area has not been found to support qualifying bird species belonging to the SPA/Ramsar site.

EBERNOE COMMON SAC, THE MENS SAC AND SINGLETON AND COCKING TUNNELS SAC

8.7.12 These European sites are all distant from the Scheme Options. Ebernoe Common SAC is 18 kilometres from the nearest Scheme Option; The Mens SAC is 14.5 kilometres from the closest Scheme Option; and Singleton and Cocking Tunnel SAC is 12.4 kilometres from the nearest Scheme Option. Given the distance of these SACs from all proposed Scheme Options and the wide availability of suitable bat foraging, commuting, roosting and hibernating opportunities in the close vicinity of these SACs, bats using these SACs are unlikely to rely on habitat in the Field Survey Area.

8.7.13 Evidence from third party studies of bat populations using the SACs (and reported in the Habitats Regulations Screening Assessment) indicates that the majority of bat activity (roosting, breeding foraging, hibernating) occurs within or in close proximity to the SAC. There is no evidence that bats from any of these SACs include habitats in the vicinity of the Field Survey Area in their home range. Adverse impacts on any of these SACs are unlikely. This assessment remains unchanged whether the Scheme is on an embankment or a viaduct across the River Arun floodplain.

OTHER STATUTORY DESIGNATED SITES

8.7.14 The Scheme Options are not situated within or immediately adjacent to any SSSIs or NNRs, the nearest such site is Arundel Park SSSI which is approximately 0.4 kilometres north of Option 1; and approximately 1.6 kilometres north of Options 3 and Option 5A. On the basis of proximity, direct impacts and effects are not anticipated on any statutory designated site.

8.7.15 The Design Manual for Roads and Bridges does not require consideration of air quality impacts for any sites located greater than 0.2 kilometres from a proposed road Scheme. On the basis that no statutory designated site is closer than 0.4 kilometres to the Scheme Options, air quality impact arising from any Scheme Option footprint may be discounted.

8.7.16 Whilst no statutory designated site is closer than 0.4 kilometres to the Scheme Options themselves, seven SSSIs are within 0.2 kilometres of part of the wider road network connecting to the Scheme Options footprint which will be affected by altered traffic volumes. The seven SSSIs were assessed in Chapter 5 – air quality to determine susceptibility to adverse impacts arising from nitrogen deposition and ambient levels of nitrogen oxides. A summary of the assessment presented in Chapter 5 is:

Annual mean nitrogen oxides concentrations -

- For two of the seven sites - Adur Estuary SSSI; Fairmile Bottom SSSI – the EU critical level of 30 µg/m^3 is predicted to be exceeded in relation to all Scheme Options. However, this is the case even if the Scheme is not constructed at all ('the do minimum' scenario); and modelling predicts that Scheme construction would actually reduce the concentrations of nitrogen oxides in these SSSIs compared to the 'do minimum' scenario. This is because all Scheme options would improve the composition, speed and/or volume of traffic passing within 0.2 kilometres of the SSSIs resulting in lower nitrogen oxide concentrations.
- For the five other sites - Amberley Mount to Sullington Hill SSSI; Arundel Park SSSI; Beeding Hill to Newtimber Hill SSSI; Chantry Mill SSSI; and Sullington Warren SSSI – the EU critical level of 30 µg/m^3 is not exceeded for any Scheme Option (or in the 'do minimum' scenario).

Total nitrogen deposition rates -

→ Air quality modelling results indicate that nitrogen deposition rates would not increase at any of the seven SSSIs as a result of the Proposed Scheme.

8.7.17 In summary, the air quality impact of any of the Scheme Options on SSSIs is likely to result in an improvement of the existing baseline of nitrogen concentration affecting SSSIs and no change to nitrogen deposition rates. These impacts are unlikely to be significant.

8.7.18 In relation to other possible indirect impacts on SSSIs, there are no hydrological links between SSSIs and NNRs and any Scheme Option hence the likelihood of impacts on water quality or availability to a statutory designated site is remote. Further, it is anticipated that indirect construction impacts such as dust, nitrogen emissions from road traffic, noise, vibration and temporary lighting will dissipate a short distance from each of the Scheme Options and thus adverse effects on statutory designated sites are unlikely.

8.7.19 No potential indirect effects on statutory designated sites have been reported in the provisional assessments reported in; Chapter 11 – Noise and vibration; or Chapter 13 – Road Drainage and the Water Environment. This assessment will need to be reviewed and updated when detailed construction methods are available and a preferred Scheme Option is selected. Placement of the Scheme on an embankment or a viaduct across the River Arun floodplain is unlikely to alter this provisional assessment.

8.7.20 A comparison of different Scheme Options based on the provisional impact assessment of impacts on statutory designated sites is as summarised in Table 8-5.

Table 8.5 Summary of likely impacts on statutory designed sites

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR STATUTORY DESIGNATED SITES
Duncton to Bignor Escarpment SAC and all SSSI/NNR sites	
All Scheme Options (on embankment or viaduct across the River Arun floodplain)	Significant effects are unlikely.
The River Arun SAC	
All Scheme Options (on embankment or viaduct across the River Arun floodplain)	Significant effects are unlikely. Further information on water abstraction requirements is required to robustly discount significant effects.
The River Arun SPA and the River Arun Ramsar site	
1	There is a low likelihood (because of the remote proximity of the SPA and Ramsar site) that habitat which could be removed from the Scheme area may form supporting habitat to SPA/Ramsar birds.
3 (viaduct option)	As per Option 1; with the addition of possible obstruction of bird flight lines by new bridge construction over the River Arun.
5A (viaduct option)	As per Option 3 – the two Schemes Options share the same footprint across the River Arun floodplain.
Option 3 and Option 5A on an embankment	There is a low likelihood (because of the remote proximity of the SPA and Ramsar site) that habitat which could be removed from the Scheme area may form supporting habitat to SPA/Ramsar birds – a larger area/great magnitude of habitat loss than if Option 3 or 5A are constructed on embankment than on viaduct.
Ebernoe Common SAC; The Mens SAC; and Singleton and Cocking Tunnel SAC	
All Scheme Options (on embankment or viaduct across the River Arun floodplain)	Significant adverse effects are unlikely.
All SSSIs in the Desk Study Area	
All Scheme Options (on embankment or viaduct across the River Arun floodplain)	Significant adverse effects are unlikely.

NON-STATUTORY DESIGNATED SITES

8.7.21 There are six non-statutory designated sites within the Desk Study Area and three, adjacent Notable Road Verges (forming one continuous stretch of verge). Likely impacts relating to these sites are outlined in this section.

BINSTED WOOD COMPLEX LWS

8.7.22 Option 1 overlaps the north edge of the part of Binsted Wood Complex LWS which is referred to as Steward's Copse. Scheme construction would require a narrow band of Ancient Woodland (mainly all Ancient Semi-Natural Woodland) which is approximately 0.6 kilometres long (approximately 0.2 hectares based on the footprint of Option 1) to be permanently removed from the Steward's Copse (part of Binsted Wood Complex LWS).

8.7.23 Option 3 will bisect the parts of Binsted Wood Complex LWS which are named Tortington Common and Pinewoods this habitat is all Ancient Woodland (mainly all Plantation on an Ancient Woodland Site), approximately 7.6 hectares (based on Scheme footprint) would be permanently removed to allow construction. Option 3 would also remove woodland ride communities which are known to support a diverse assemblage of plants and small fragments of Lowland Heath HPI.

8.7.24 Option 5A will sever three linear woodlands known as Lake Copse, the Shaw and the Lag on the southern edge of Binsted Wood Complex LWS from the main body of the LWS. Option 5A will sever Binsted Park area of Wood Pasture and Parkland HPI from the main body of the LWS. It will also sever Barn's Copse at the western edge of the LWS into areas of woodland either side of the new road. In total approximately 4 hectares (based on Scheme footprint) of Ancient Woodland (all Ancient Semi-Natural Woodland) would be permanently removed from the LWS . In addition, approximately 0.8 hectares of Wood Pasture and Parkland HPI will be removed from Binsted Park (based on Scheme footprint).

8.7.25 It is likely that indirect 'edge effects' would permeate into Binsted Wood Complex LWS after habitat loss/severance. This is because a previously enclosed woodland environment would be exposed to additional light, wind, altered humidity and because the hydrology of any watercourses in the woodland would be altered. Beyond habitat loss alone, a further are of Ancient Woodland, adjacent to the newly created road would be degraded, likely leading to alterations in the Ancient Woodland plant community by these 'edge effects'.

8.7.26 Whilst large areas of Ancient Woodland will remain unaffected in Binsted Wood Complex LWS should any Scheme option be progressed (the LWS is 217 hectares in size), Ancient Woodland habitat is irreplaceable. The conservation status of this LWS depends on maintenance of its full designated extent which is not currently severed by built infrastructure.

8.7.27 A significant adverse effect at the national level is likely to be associated with any of the Scheme Options. However, Option 3 will generate the highest magnitude impact on this LWS. This is on the basis that extent of Ancient Woodland habitat loss far exceeds that of the other Scheme Options and that the degree of habitat severance is far greater. Option 3 is the only Scheme Option that will impact woodland ride communities include fragmentary Lowland Heath HPI.

8.7.28 Option 5A is the only Scheme Option being considered that removes Wood Pasture and Parkland HPI from the LWS. Option 5A would also directly remove Wet Woodland HPI which is present in Lake Copse and Barn's Copse. Other Scheme Options would not impact wet woodland. Option 5A is considered damaging to the conservation objectives of the Binsted Wood Complex LWS and would impact specific habitat types that the other Scheme Options would not impact.

REWELL WOOD COMPLEX LWS

8.7.29 Each of the Scheme Options is likely to remove Ancient Woodland from Rewell Wood Complex LWS. Option 1 will remove a narrow band of this habitat from the part of the LWS called The Waterwoods (approximately 0.6 hectares, based on Scheme footprint). Option 3 is likely to remove a small area of Ancient Woodland (approximately 0.1 hectares based on Scheme footprint) from the part of the LWS called Goblestubb's Copse. Option 5A is likely to remove Ancient Woodland (approximately 0.2 hectare based on Scheme footprint) from the part of the LWS called Dane's Wood. A large area of Ancient Woodland will remain unaffected in Rewell Wood Complex LWS (678 hectares in size as determined by Sussex Biodiversity Records Centre), however, Ancient Woodland is irreplaceable and the conservation status of this LWS requires maintenance of its full designated extent. A significant adverse effect at the national level is likely to be associated with any of the Scheme Options. However, Option 1 would generate the highest magnitude impact on Rewell Wood Complex LWS (on the basis of extent of habitat loss) followed by Option 5A and then Option 3 which have a similar impact magnitude on Rewell Wood Complex LWS.

OTHER NON-STATUTORY DESIGNATED SITES

8.7.30 No Scheme Option will result in direct land taken from Poling Copse LWS, Warningcamp Hill and New Down LWS and Slindon Bottom LWS. The closest point of any Scheme Option to these sites is 0.6 kilometres (Poling Copse is 0.6 kilometres from all Scheme Options). It is unlikely that there will be indirect effects on any of these three LWS sites because there is no hydrological connectivity between the A27 and these LWSs and beyond 0.2 kilometres from an air pollution source, the Design Manual for Roads and Bridges confirms that air quality impacts associated with operation traffic or construction may be discounted.

8.7.31 Arun Valley, Watersfield to Arundel LWS is 0.4 kilometres north of all Scheme Options. There will be no direct impacts and indirect air quality impacts are also unlikely at this distance. However, ditches in the LWS may be connected to the ditch network, south of the existing A27 where the Scheme will be constructed and thus there is a potential pathway for pollution or sediment laden water to enter the LWS. This impact is unlikely to result in a significant effect as pollution sources may be controlled at source by best construction practice. However, further evidence needs to be provided at the detailed design stage before this impact may be fully discounted.

NOTABLE ROAD VERGES

8.7.32 The three adjacent Notable Road Verge are approximately 0.8 kilometres from Option 1 and are adjacent to Option 3. They are unlikely to be subject to any direct impacts relating to these options. Option 5A is inside the Notable Road Verge and is likely to result in removal of approximately 0.4 kilometres (29%) of the unimproved grassland which is assumed to be present.

8.7.33 The Notable Road Verge is directly adjacent to the A27 road and changes in operational traffic movements and volumes are likely to result in increased nitrogen oxide deposition and concentrations arising from all Scheme Options given their close proximity. These impacts may further the Notable Road Verge by causing changes in plant species composition in favour of dominance by a small number of nutrient demanding grass and tall herb species.

8.7.34 The large extent of the verge loss (associated with Option 5A only) and potential air quality impacts arising from all Scheme Options is likely to compromise the integrity of the grassland present resulting in an adverse effect at up to the county level.

8.7.35 For all likely impacts on LWS's, construction of the Scheme on embankment or viaduct across the River Arun floodplain would not exacerbate impacts already discussed.

8.7.36 A comparison of different Scheme Options based on the provisional impact assessment on non-statutory designated sites is shown in Table 8-6.

Table 8.6 Summary of likely impacts on non-statutory designed sites

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR NON-STATUTORY DESIGNATED SITES
Binsted Wood Complex LWS	
1	Significant adverse impact likely arising from Ancient Woodland loss.
3 (viaduct or embankment option)	Significant adverse impact likely arising from Ancient Woodland loss.
5A (viaduct or embankment option)	Significant adverse impact likely arising from Ancient Woodland loss. Wet Woodland HPI and Wood Pasture and Parkland HPI habitat will be lost.
Rewell Wood Complex LWS	
1	Significant adverse impact likely arising from Ancient Woodland loss.
3 (viaduct or embankment option)	Significant adverse impact likely arising from Ancient Woodland loss.
5A (viaduct or embankment option)	Significant adverse impact likely arising from Ancient Woodland loss.
Poling Copse LWS, Warningcamp Hill and New Down LWS and Slindon Bottom LWS	
All Scheme Options	Significant effects are unlikely – all sites are distant from all Scheme Options.
Arun Valley, Watersfield to Arundel (includes Arundel Wetland Centre) LWS	
All Scheme Options	Hydrological pollution associate impacts are unlikely but require further investigation when detailed design information is available.

HABITATS

ANCIENT WOODLAND (SOME OF WHICH IS LOWLAND MIXED DECIDUOUS WOODLAND HPI)

8.7.37 All Scheme Options would result in the permanent loss of Ancient Woodland comprising both Ancient Semi-Natural Woodland and Plantation on an Ancient Woodland Site. These habitat losses mainly occur within the Binsted Wood Complex LWS and the Rewell Wood Complex LWS.

Ancient Woodland figures have been reviewed and revised during PCF Stage 2. The new estimated areas of Ancient Woodland loss associated with each Scheme Option are presented in Table 8-7[52]. The Table shows the approximate area (hectares) of Ancient Woodland loss for each Option footprint and a 15 meter buffer from the extent of each Option footprint. To quantify Ancient Woodland loss the Scheme Option footprint was buffered by 15 metres and a polygon incorporating each Scheme Option footprint plus a 15 metres buffer zone was overlaid on the Natural England Ancient Woodland Inventory data set. The resulting Ancient Woodland loss estimate is thus considered to provide a realistic estimate of the area of direct habitat loss which may be required to construct the Scheme (i.e. larger than the operational footprint). It is noted that this approach may underestimate indirect impacts (e.g. hydrological, air quality impacts), however, it provides a consistent basis for Scheme Option differentiation. Indirect impacts will be more fully assessed at PCF Stage 3 when a preferred route option is selected.

[52] Permanent habitat loss estimate produced by applying a 15 metres buffer zone around Scheme Option footprint to include both the operational footprint of the Scheme Options and land likely to be required for construction only.

8.7.38 The PCF Stage 2 option designs are not the final designs and are based on a number of assumptions. The design footprint will continue to change as new data is collected, and the design is refined to incorporate environmental impact mitigation measures and other design objectives. As such, the area of Ancient Woodland loss is not final and will change as the design process continues. Ancient Woodland losses will continue to be assessed and refined through the detailed design process, and the areas are likely to change during PCF Stage 3.

Table 8.7 Likely loss of ancient woodland associated with each option

Option	Approximate Area (hectares) of Ancient Woodland within Option footprint*	Approximate Area (hectares) of Ancient Woodland within the Option footprint plus 15 m buffer
1	1.02	2.96
3	7.67	12.15
5A	4.05	6.06

*Option design as at public consultation (August 2017).

8.7.39 The conservation status of Ancient Woodland is dependent on maintaining, amongst other things, its extent, species composition, connectivity to similar habitat and the range of different woodland types it supports. Such a large area of Ancient Woodland as is present in the Desk Study Area is also uncommon in England and thus maintenance of the size and extent forms part of the conservation objectives for this habitat. As Ancient Woodland is irreplaceable it cannot be directly compensated. Each of the Scheme Options would likely result in a major adverse significant effect at up to the national level on this habitat type. Option 3 would generate the highest magnitude effect, followed by Option 5A and Option 1 the lowest magnitude effect.

8.7.40 Whether the Scheme is on viaduct or embankment across the River Arun floodplain makes little difference to this assessment as there is no Ancient Woodland on the River Arun floodplain. However, were the Scheme to be on a viaduct across the floodplain of the Tortington Rife (near Binsted Park) this is likely to be less damaging than if the Scheme is placed at grade or on embankment in this location because scrub/grassland/wetland habitat can be created under the viaduct which would provide some physical connectivity between the severed fragments of Lake Copse and Binsted Wood.

8.7.41 A comparison of different Scheme Options based on the provisional impact assessment of impacts in Ancient Woodland is shown in Table 8-8.

Table 8.8 Summary of likely impacts on ancient woodland

Scheme option	Provisional impact assessment for Ancient Woodland
1	Significant adverse impact likely arising from habitat loss.
3 (viaduct or embankment option)	Significant adverse impact likely arising from Ancient Woodland loss.
5A (non-viaduct option across Tortington Rife floodplain)	Significant adverse impact likely arising from Ancient Woodland loss.
5A (viaduct option across Tortington Rife floodplain)	Significant adverse impact likely arising from Ancient Woodland loss – a viaduct is preferential to an embankment in the Binsted Park area, as a viaduct could allow physical connectivity between severed woodland fragments in Lake Copse and Binsted Wood.

WOOD PASTURE AND PARKLAND HPI AND ANCIENT/VETERAN TREES

8.7.42 Option 5A will result in the removal of approximately 0.8 hectares of the Wood Pasture and Parkland HPI (based on the Scheme Options footprint) which is assumed to be present in the Binsted Park area of the Binsted Woods Complex LWS. Construction of Option 5A would also sever the two remaining parts of Binsted Park either side of a new road. The conservation status of this habitat is dependent on the presence of ancient and veteran trees; the presence of a range of different tree age classes (so that there are young, semi-mature and mature specimens will eventually grow into ancient or veteran trees); and the close proximity of ancient/veteran trees supporting deadwood habitats to each other to allow notable invertebrate, lichen and fungi species to colonise new habitats/extend their range. Construction of Option 5A is likely to diminish the range of tree age classes and increase the distance between remaining aged/veteran trees and as a result is likely to undermine the conservation objectives for this habitat resulting in a significant effect at the national level. Were Option 5A to be placed on a viaduct in this location, this may partly ameliorate the fragmentation aspect of this impact; however, it would still remain adverse and significant at the same level.

8.7.43 Option 1 is about 80 metres from the second area of Wood Pasture and Parkland HPI in the Desk Study Area, near to where Binsted Lane meets the existing A27. However, no direct impacts will occur to this area of HPI habitat. Indirect impacts associated with air quality are unlikely at this proximity and given intervening vegetation. However, when detailed design information is available this impact will be further assessed.

8.7.44 Option 3 will not result in any direct or indirect impacts on Wood Pasture and Parkland HPI type.

8.7.45 A comparison of different Scheme Options based on the provisional impact assessment of impacts on wood pasture and parkland HPI is provided in Table 8-9.

Table 8.9 Summary of likely impacts on wood pasture and parkland HPI

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR WOOD PASTURE AND PARKLAND HPI
1	No significant effects are likely. Possible indirect air quality impacts .
3 (viaduct or embankment option)	No significant effects are likely.
5A (non-viaduct option across Tortington Rife floodplain)	Significant adverse impact likely arising from habitat loss and habitat severance.
5A (viaduct option across Tortington Rife floodplain)	Significant adverse impact likely arising from habitat loss and habitat severance. However, preferential to a non-viaduct option, as an embankment would restrict physical connectivity between severed parkland fragments in Binsted Park.

HEDGEROW

8.7.46 Each of the Scheme Options would result in the permanent loss of hedgerow habitat both bordering the A27 carriageway and forming field boundaries which are crossed by different Scheme Options. Option 5A would result in the highest length of hedgerow loss following by Option 3 and then Option 1 – this is based on the fact that Option 5A and 3 traverse a far greater length of farmland.

8.7.47 For Option 1 hedgerow loss would only occur in a single location – due west of Arundel Station and approximately two hedgerows would be affected. Option 3 would truncate approximately five hedgerows across about 2 kilometres of farmland. Option 5A would sever approximately eight hedgerows across approximately 4 kilometres of farmland.

8.7.48 Loss of hedgerow habitat associated with all Scheme Options could affect the ecological integrity and function of the hedgerow network as a wildlife corridor and, therefore, undermine its conservation objectives. However, hedgerows will remain relatively common and widespread in the surrounding landscape. The extent of hedgerow loss likely to arise from construction of Option

3 or Option 5A would probably result in a significant adverse effect at the local level. The small, relatively localised amount of hedgerow loss likely to occur as a result of Option 1 is unlikely to be a significant effect. The decision to place the Scheme on a viaduct across the River Arun floodplain would allow more successful mitigation to be implemented – hedgerow planting under the viaduct – but would not influence the likely significance of this effect (pre-mitigation).

8.7.49 A comparison of different Scheme Options based on the provisional impact assessment of impacts on hedgerow is shown in Table 8-10.

Table 8.10 Summary of likely impacts on hedgerows

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR HEDGEROW
1 (viaduct or embankment option)	No significant effects are likely.
3 (viaduct or embankment option)	Significant adverse impact likely arising from habitat loss and severance.
5A (viaduct or embankment option)	Significant adverse impact likely arising from habitat loss and severance.

COASTAL AND FLOODPLAIN GRAZING MARSH HPI INCLUDING OTHER WETLAND HABITATS

8.7.50 This assessment considers potential impacts on wetlands including watercourses, the River Arun Coastal and Floodplain Grazing Marsh HPI. Impacts on swamp, marshy grassland, Lowland Fen HPI, Reedbed HPI, River HPI are regarded as an intrinsic part of these aquatic ecosystems and are considered herein. Pond HPI and other waterbodies are considered separately in this assessment.

8.7.51 Option 1, Option 3 and Option 5A all cross a large area of Coastal and Floodplain Grazing Marsh HPI on River Arun's east floodplain between Crossbush junction and the River Arun. Option 3 and 5A also cross an area of Coastal and Floodplain Grazing Marsh HPI west of the River Arun's between the River Arun and Ford Road. Ditches are most numerous on the east River Arun floodplain. Each of the Scheme Options will remove standing water habitat, marshy grassland and small areas of swamp habitat alongside these ditches which may qualify as Reedbed HPI. All Scheme Options will also alter the hydrology of the ditch network by changing run-off, infiltration and thus discharge rates in the ditch network which could the affect water quality and the composition of aquatic plant and animal communities in these ditches. Option 1 will cross about 0.5 kilometres of this habitat affecting only the northern part of the grazing marsh. Approximately five ditches will be severed. Options 3 and Option 5A (which share the same footprint over the River Arun floodplain) will cross about 1.2 kilometres of grazing marsh habitat and will sever approximately 10 ditches.

8.7.52 Option 3 and Option 5A (but not Option 1) will also cross a number of watercourses between Ford Road and the west branch of Binsted Lane, the largest of which is Tortington Rife which extends from Binsted Park through and to the south of the Field Survey Area. The Mid-Arun Environmental Survey data suggests that moderately diverse marshy grassland may be present in the valley of Tortington Rife in addition to standing water in the rife itself which supports a diverse assemblage of aquatic plants and animals. Option 3 will not directly affect the watercourse but may alter water quantity and quality entering the network of minor woodland ditches draining into it. Option 5A will directly sever the north section of this watercourse and although it would mainly avoid direct damage to wetland habitat, there is a risk of downstream impacts on water quantity and quality affecting Tortington Rife.

8.7.53 The headwaters of Binsted Rife which are located in Barn's Copse would be directly impacted by Option 5A only. Scheme construction in Barn's Copse may affect the quality and quantity of water entering the rife and could pollute Lowland Fen HPI, marshy grassland and animal habitats which are downstream of the Scheme.

8.7.54 The conservation status of areas of Coastal and Floodplain Grazing Marsh HPI (incorporating a range of wetland habitats) is dependent on maintenance of stable water levels, clean, unpolluted and non-sediment laden water and oxygenation of the water column among other factors. The impacts outlined above and associated with all Scheme Options are likely to disrupt these conditions resulting in a significant impact at least the county level.

8.7.55 It has not been decided whether the Scheme will cross the River Arun floodplain and Tortington Rife floodplain on embankment or viaduct and it is not possible to conduct a detailed assessment of hydrological impacts on this basis. However, embankment options are likely to generate a far greater impact on the basis that they will have a much larger footprint and will permanently change floodplain topography and hydrology whereas, post construction, a viaduct may be designed to maintain existing drainage patterns.

THE RIVER ARUN

8.7.56 Options 3 and Option 5A require a new bridge to be constructed across the River Arun. The outline design for this bridge does not include any piers in the River Arun. Bridge construction is likely to lead to permanent loss of riparian vegetation and possible shading of in stream habitats. No detailed Scheme design information is available but such a bridge may also require flood protection measures both up and down steam, affecting the hydrology and morphology of the River Arun locally. The banks of the River Arun are already protected with a concrete wall – both in the Field Survey Area, and for at least several hundred metres up and down stream - to protect adjacent land from tidal flooding. Given the existing heavily embanked nature of the River Arun the impact of bridge construction on the riparian zone and in channel morphology is only likely to be significant at the local level.

8.7.57 Option 1 would cross the River Arun on an existing bridge (National Grid reference TQ014606791). The bridge is likely to require widening to allow a greater flow of traffic but permanently habitat loss of riparian habitat is likely to be confined to the vicinity of the existing bridge and it is unlikely that this would cause an adverse effect on river habitat significant above the Survey Areas level.

8.7.58 A comparison of different Scheme Options based on the provisional impact assessment of impacts on Coastal and Floodplain Grazing Marsh HPI and the River Arun is shown in Table 8-11.

Table 8.11 Summary of likely impacts on coastal and floodplain grazing marsh HPI and the river Arun

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR COASTAL AND FLOODPLAIN GRAZING MARSH HPI AND THE RIVER ARUN
Coastal and Floodplain Grazing Marsh HPI and Other Wetland Habitats	
1	Significant adverse impact likely arising from habitat loss, severance and disruption of hydrological function.
3 (embankment option)	Significant adverse impact likely arising from habitat loss, severance and disruption of hydrological.
5A (embankment option)	Significant adverse impact likely arising from habitat loss, severance and disruption of hydrological function.
3 and 5A (viaduct option)	Significant adverse as a result of habitat loss and hydrological disruption but for all Scheme Options, a lower impact magnitude then an embankment option because of reduced habitat loss and less hydrological disruption.
The River Arun	
1	Likely to be adverse at the Survey Area level. Not significant.
3	Likely to be significantly adverse at the local level.
5A	

WATERBODIES

8.7.59 Each of the Scheme Options could result in the permanent loss of ponds which may qualify as Pond HPI. It is assumed that this habitat type is of high ecological interest and, therefore, its loss associated with any Scheme Option, may compromise the conservation status of this habitat type. This impact may be significant but is only at the local level given the likely widespread nature of pond habitat in West Sussex. The magnitude of this impact may vary between Scheme Options on the basis of option length.

8.7.60 A comparison of different Scheme Options based on the provisional impact assessment of impacts on waterbodies including pond HPI is shown in Table 8-12.

Table 8.12 Summary of likely impacts on pond HPI

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR WATERBODIES
1 (viaduct or embankment option)	May be significantly adverse at the local level.
3 (viaduct or embankment option)	May be significantly adverse at the local level.
5A (viaduct or embankment option)	May be significantly adverse at the local level.

GRASSLAND

8.7.61 Each of the Scheme Options, would result in the permanent loss of species-poor grassland and improved grassland habitat predominantly recorded along the A27's existing carriageway verges and in agricultural grasslands on the River Arun floodplain. Poor semi-improved and improved grassland types are common and widespread throughout the Field Survey Area and wider surroundings. Loss of these habitat types associated with any Scheme Option is unlikely to affect the conservation status of this habitat type and is unlikely to result in an adverse impact above the Survey Area level which would be unlikely to be a significant effect.

8.7.62 The area of Lowland Meadow HPI identified by the Mid-Arun Valley Environmental Survey would not be subject to direct impacts and is unlikely to be adversely degraded by air quality impacts associated with its relatively close proximity to Option 1 (approximately 0.2 kilometres). This is because there is intervening housing and woody vegetation in between Option 1 and the area of Lowland Meadow HPI and any changed in air quality (e.g. dust, nitrogen levels) would be expected to be dissipate before being deposited on the grassland habitat.

8.7.63 A comparison of different Scheme Options based on the provisional impact assessment of impacts on grassland is shown in Table 8-13.

Table 8.13 Summary of likely impacts on grassland

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR GRASSLAND
1	No significant effects are likely.
3 (viaduct or embankment option)	
5A (viaduct or embankment option)	

OTHER HABITATS

8.7.64 Losses of all other Phase 1 Habitat types would be unlikely to lead to an adverse effect above the Field Survey Area level which would not be a significant effect. Such habitats include arable, improved grassland which are of low or negligible nature conservation interest as plant habitats and fragmentary saltmarsh communities in the River Arun corridor which are opportunistic in occurrence.

8.7.65 This assessment is subject to the outcome of ongoing botanical survey work in 2017 and 2018. For example, should populations of notable arable plants be found this could elevate the importance of arable habitats and trigger a significant effect..

ASSESSMENT OF AIR QUALITY IMPACTS ON PLANTS AND HABITATS

8.7.66 Scheme construction and operation may cause a range of indirect environmental changes that could result in ecological impacts. In relation to the Scheme Options, changes in air quality during the operational phase have the potential to generate significantly adverse ecological effects.

8.7.67 Following guidance provided in the Design Manual for Roads and Bridges air quality assessment volume, habitats within 0.2 kilometres of an operating road are most susceptible to adverse impacts arising from deposition of nitrogen oxides and increases in nitrogen oxide concentrations which can increase soil nutrient levels causing vegetation change in favour of less species-rich plant communities. Habitats most likely to be susceptible to impacts arising from air quality changes are those which rely on low nutrient levels to sustain their species diversity including Ancient Woodland and unimproved grassland which may be present in the Notable Road Verges in the Field Survey Area. These indirect impacts have been considered in the preceding impact assessment and have fully informed consideration of the differing effects of different Scheme Options.

8.7.68 In this assessment, air quality impacts have only been quantified through air quality and traffic modelling in relation to SSSIs as is required by the Design Manual for Roads and Bridges. Further air quality assessment may be undertaken at PCF Stage 3 when a preferred Scheme option is selected so that the location of air quality impacts can be more precisely defined for other designated site and habitat features and so appropriate mitigation may be designed if required.

PROTECTED AND NOTABLE SPECIES

8.7.69 Sufficient information is considered available to robustly compare the relative ecological performance of the three Scheme Options under consideration. A precautionary approach has been used to assess the magnitude of impacts often assuming species presence where there is no data to validate likely absence of a species. These assessments will be updated at PCF Stage 3 in the light of detailed field survey data collected in 2017 and 2018.

AMPHIBIANS

8.7.70 Each of the Scheme Options would be likely to result in the permanent loss of terrestrial and aquatic habitats that are suitable for use by great crested newt and common toad for breeding, foraging and hibernating. Habitats identified of highest potential importance for great crested newt include Ancient Woodland with waterbodies in the Binsted Wood Complex LWS and the Rewell Wood Complex LWS and the complex of ditches and waterbodies on the floodplain of the River Arun.

8.7.71 Preliminary survey findings have not recorded any evidence of great crested newt and indicate that great crested newt is not widespread across the Field Survey Area. In contrast, common toad is likely to be widespread in the Field Survey Area. However, should breeding ponds or critical terrestrial sheltering or foraging habitat around a breeding pond be removed or connectivity between nearby breeding ponds be severed by construction of a road, the viability of the great crested newt or common toad populations in question may be affected. Option 3 and 5A by virtue of their larger footprint in Ancient Woodland and across the River Arun floodplain, are likely to generate the highest magnitude impact on amphibians. Option 1 has the lowest risk of compromising great crested newt and common toad conservation status given its smaller extent and proximity to the existing A27 road which is likely an existing barrier to amphibian dispersal. With referenced to Option 5A, Mid-Arun Valley Environmental Survey desk study information highlights the close proximity of several common toad breeding ponds (e.g. the Madonna Pond and a pond in Lake Copse). Construction of Option 5A would introduce a barrier to toad dispersal and is likely to lead to high levels of toad mortality when animals are forced to cross the newly built road. Both impacts are likely to lead adverse impacts on of these populations.

8.7.72 The geographical extent at which such effect might be significant will depend on the number and size of great crested newt or common toad populations that are affected. Should low numbers of waterbodies be affected, the effect may be significant at the local level. If a greater number of ponds were to be damaged or a particularly large great crested newt metapopulation were to be severed this may be significant at the county level. It is unlikely that a significant effect at the county level would apply to common toad given that it is a far more common amphibian – assessment subject to ongoing desk study work to confirm its county conservation status.

8.7.73 If a design solution is progressed which adopts a viaduct to cross the River Arun floodplain, this would be far less damaging to great crested newt populations (if present) then an embankment. This is because an embankment would cause permanent fragmentation of great crested newt habitat where great crested newt movement is unlikely to be impeded by a viaduct.

8.7.74 A comparison of different Scheme Options based on the provisional impact assessment of impacts on great crested newt is as summarised in Table 8-14.

Table 8.14 Summary of likely impacts on great created newt and common toad

Scheme Option	Provisional impact assessment for Great Crested Newt and Common Toad
1	Dependent on the size of the population affected a significant adverse effect at between the local level and the county level is possible for common toad and great crested newt (not yet confirmed as present). The risk of a significant effect at the county level is low given the small extent of aquatic habitat affected and its proximity to an existing road.
3 (embankment option)	Dependent on the size of the population affected a significant adverse effect at between the local level and the county level is possible for common toad and great crested newt (not yet confirmed as present
5A (embankment option)	Dependent on the size of the population affected a significant adverse effect at between the local level and the county level is possible for common toad and great crested newt (not yet confirmed as present). The risk of a significant effect at the county level is considered higher given the larger area of aquatic habitat affected and proximity to several common toad populations reported in the desk study.
3 and 5A (viaduct option)	Impact magnitude on great crested newt and common toad conservation status may be less severe compared to the embankment option because this design solution would have a smaller footprint and is less disruptive of amphibian movement routes.

AQUATICS WILDLIFE (FISH, AQUATIC INVERTEBRATES AND WHITE-CLAWED CRAYFISH)

8.7.75 All Options cross areas of Coastal and Floodplain Grazing Marsh HPI which has potential to affect the quantity and quality of water entering the many ditches and watercourses which are present including Tortington Rife and Binsted Rife. These impacts are likely to affect aquatic animals in the Field Survey Area as well as a wider area up and downstream. All Scheme Options will cause permanent loss of open water and riparian habitat which is likely to reduce foraging and sheltering resources for fish and aquatic invertebrates. The Scheme Options may also introduce barriers to animal passage along watercourses by introducing culverts and other road drainage infrastructure. Given these impacts it is probable that the conservation status of aquatic invertebrate and fish communities and is likely to be undermined in areas of Coastal and Floodplain Grazing Marsh HPI in the Desk Study Area and this may be significant at up to the county level (subject to the findings of further surveys in 2017 and 2018 confirming the quality of those watercourses which would be affected).

8.7.76 In the case that a population of lesser whirlpool ram's-horn snail is identified in the Field Survey Area construction of any of the Scheme Options may degrade or removed swamp and water margin habitat used by this species. Option 3 or Option 5A are likely to result in the largest magnitude impact. Considering the national rarity of this species these impacts may be significant at above the county level.

8.7.77 Comparing the different Scheme Options - Option 1 mainly affects Coastal and Floodplain Grazing Marsh HPI due south of Arundel Town which is already likely to be modified to a degree by the existing A27 road. Several of the ditches in this area are already culverted under the road modifying their flow and may experience polluted runoff from the road at present. Option 3 and Option 5A affect parts for the floodplain with little existing built development including habitats in Tortington Rife. Option 5A may affect Binsted Rife which is a largely semi-natural watercourse.

8.7.78 On the basis that white-clawed crayfish are unlikely to be present the likelihood of causing a significant effect is unlikely.

8.7.79 A comparison of different Scheme Options based on the provisional impact assessment of impacts on aquatic ecology features is summarised in Table 8-15.

Table 8.15 Summary of potential impacts on aquatic wildlife

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR AQUATIC FEATURES
1	Significant adverse impact likely arising from loss and degradation of open water and riparian habitat.
3 (embankment option)	Significant adverse impact likely arising from habitat loss, severance and disruption of hydrological.
5A (embankment option)	Significant adverse impact likely arising from habitat loss, severance and disruption of hydrological function - high magnitude on the basis that Binsted Rife is also potentially affected.
3 and 5A (viaduct option)	Significant adverse impact likely arising from loss and degradation of open water and riparian habitat – lower magnitude than all options requiring an embankment.

BADGER

8.7.80 Each of the Scheme Options would be likely to result in the permanent loss of habitats that are suitable for use by badgers, potentially resulting in the damage/destruction of badger setts. Habitats identified as of highest potential importance for badgers with a high probability of setts being present include woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS. Option 3 and Option 5A both contain habitat with a high likelihood of supporting badger setts.

8.7.81 Where the operational road crosses existing badger clan territories or truncates badger paths, badgers may attempt to cross the new carriageway. This may result in high levels of badger mortality which would deplete location populations and may even lead to loss of badger populations in close proximity to the operational Scheme.

8.7.82 Badger is a widespread and relatively common species in Sussex and badger conservation status is unlikely to be affected by any Scheme Option. Construction and operation of the Field Scheme are likely to result in an adverse impact on badger populations but this is unlikely to be above the Survey Area level which would not be significant. Irrespective of effect significance, impacts on badger may be licensable (especially where sett loss would occur) as this species is protected by law and will require mitigation.

8.7.83 Selection of a viaduct design solution for the crossing of the River Arun floodplain would be beneficial from the perspective of ease of animal movement north and south across the Scheme and reduced road traffic collision mortality.

8.7.84 A comparison of different Scheme Options based on the provisional impact assessment of impacts on badger are summarised in Table 8-16.

Table 8.16 Summary of likely impacts on badger

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR BADGER
1	Non-significant adverse effect likely as a result of sett loss and disturbance. Unlikely to undermine badger conservation status above the Survey Area level.
3 (embankment option)	
5A (embankment option)	
3 and 5A (viaduct)	Impact significance on badger conservation status unlikely to change but this is preferable as it does not sever badger movement across the Field Survey Area where viaducts are proposed.

BATS

8.7.85 Loss of foraging and roosting habitat for bats associated with Option 1 is likely to be relatively small given that Option 1 will involve the lowest overall habitat loss, and lowest extent of Ancient Woodland loss. In addition, Option 1 requires removal of woodland which is adjacent to an existing road and is, therefore, already subject to some degree of disturbance from noise, vibration from vehicles and vehicle lighting (the A27 is not currently illuminated by street lighting for much of the Field Survey Area). However, there is a risk that bat flight lines crossing the existing A27 may be adversely affected by removal of vegetation, potentially such that established flight lines may no longer be used by bats, as a result of the widening of the existing A27. This will be assessed when data from radio tracking and trapping studies in 2017 and 2018 are available.

8.7.86 Progression of Option 5A would result in severance of a number of hedgerows/woodland stands between Ford Road and the western part of Binsted Lane which initial 2017 survey findings confirm are bat flight paths. In addition, Barn's Copse, Little Dane's Wood and Lake Copse would also be severed by Option 5A, removing trees of high roosting suitability. These combined impacts may affect both commuting routes and roosting habitats belonging to Bechstein's bat, barbastelle and other notable bat species which are confirmed to be present in the Survey Area. The impact could be caused not only by direct removal of foraging and roosting resources but also by increased risk of bats colliding with vehicles during the operational phase of the Scheme. The alignment of Option 5A makes it likely that an Alcathoe bat maternity roost in Barn's Copse would be lost.

8.7.87 If Option 3 is progressed this would sever bat foraging and roosting habitat along a broad front, approximately 1.4 kilometres long, through Tortington Common and Pinewoods (inside The Binsted Woods Complex LWS). Based on available evidence, the entire woodland block, including all of Binsted Woods Complex LWS, is used by populations and breeding colonies of notable woodland bats including Bechstein's bat, barbastelle and other rare species. Negative impacts on the woodland bat assemblage would arise in the same way as described for Option 5A but would be of a higher magnitude given the large extent of habitat loss and fragmentation. Such an impact would undermine the conservation status of the woodland bat assemblage, for Bechstein's bat in particular, and would be significantly adverse at up to the national level. Detailed analysis of survey data is required to determine the flight behaviour of bats in Binsted Woods Complex LWS. Initial data analysis suggests that Bechstein's bats frequently move throughout the woodland block and are likely to cross the alignment of Option 3.

8.7.88 Bats are relatively slow to reproduce, and are loyal to their flight paths and core ranges, and therefore even a low increase in mortality rate could undermine population viability. Woodland bats are particularly susceptible to vehicle-related mortality. Both Option 3 and Option 5A are likely to compromise the conservation status of the woodland bat assemblage in the Desk Study Area an effect that would be significantly adverse at up to the national level.

8.7.89 There is a mortality risk to bats associated with all Scheme Options. In all cases bats are at risk of collision with traffic on the operational road where it crosses watercourses on the River Arun floodplain. Further analysis of 2017 surveys is required to confirm the locations of bat flight lines in the Field Survey Area. Option 3 and Option 5A carry a greater risk of bat/road traffic collision on the basis that a new bridge is proposed over the River Arun whereas Option 1 would use a (modified) existing bridge.

8.7.90 Selection of a viaduct design solution for the crossing of the River Arun floodplain would be beneficial from the perspective of easing animal movement north and south across the Scheme and reducing the risk of road traffic collision as bats would be able to fly under, rather than being directed and pushed upward and over, the bypass.

8.7.91 A summary of the different Scheme Options based on the provisional impact assessment of impacts on bats is provided in Table 8-17.

Table 8.17 Summary of likely impacts on bats

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR BATS
Bats breeding in Binsted Wood Complex LWS and surrounding Ancient Woodland habitats including Bechstein's bat and Alcathoe bat which are nationally rare.	
1	Likely to be significantly adverse at up to the national level.
3 (viaduct or embankment option)	Significant adverse at up to the national level. Both Option 3 and Option 5A are likely to compromise the integrity of woodland bat population in the Desk Study Area.
5A (viaduct or embankment option)	Significant adverse at up to the national level. Both Option 3 and Option 5A are likely to compromise the integrity of woodland bat population in the Desk Study Area.
All Scheme Options (viaduct)	For all options – a lower impact magnitude as this design solution is less damaging to movement routes and is less likely to generate road collision mortality as bats can fly under the new road.
Bat roosts belonging to common and widespread species (e.g. common pipistrelle)	
1	Likely to be significantly adverse at up to the local.
3 (viaduct or embankment option)	Significant adverse at the local level.
5A (viaduct or embankment option)	
3 and 5A (viaduct)	For all options – a lower impact magnitude as this design solution is less damaging to movement routes and is less likely to generate road collision mortality as bats can fly under the new road.

BIRDS

8.7.92 Each of the Scheme Options would be likely to result in the permanent loss of habitats that are suitable for protected and notable breeding bird species. Available evidence suggests that Ancient Woodland arable farmland and wetland habitats on the River Arun floodplain are likely to be of greatest importance for notable bird species. It is possible that loss of habitat in these areas will result in a significant adverse effect on breeding bird conservation status, however, the geographical level at which such an effect would be significant will depend on what species are affected, which will be assessed when 2017 field surveys have been completed.

8.7.93 Option 3 would be likely to result in an adverse effect of higher magnitude effect than other Options, on the woodland bird assemblage. Options 3 and 5A are both likely to damage the wetland bird assemblage using the River Arun floodplain to the same degree given they share a footprint through across the River Arun floodplain. Adverse impacts would arise from loss of bird foraging, breeding and nesting habitat and by severance and exposure of birds to road traffic collisions and noise and vibration generated in the operational phase. Option 1 is likely to be least damaging to breeding bird conservation objectives, as it would result in the lowest amount of woodland and wetland habitat loss. In addition, the woodland that would be lost should Option 1 be progressed is located adjacent to the busy A27 road and thus it is already subject to disturbance by noise and vibration from vehicles.

8.7.94 Where the Scheme crosses the River Arun floodplain a viaduct option is likely to be preferable as in this case land take from wetland habitats would be less than that required for an embankment. Furthermore, wetland habitats could be recreated beneath a viaduct and thus a great proportion of the habitat lost to construction would be able to be replaced.

8.7.95 Barn owl is a low, slow flying species which is particularly susceptible to collisions with fast moving road vehicles. Where a Scheme Option severs the territory of a barn owl, potentially separating foraging areas from nest/roost locations, an increased risk of death or injury from vehicle collisions is likely. Option 5A is likely to be most harmful to barn owl as it passes through farmland for more of its length than other options. Option 1 is likely to be least harmful to barn owl as approximately half of this Scheme occurs along the line of existing A27.

8.7.96 A comparison of the different Scheme Options based on the provisional assessment of impacts on birds is presented in Table 8-18.

Table 8.18 Summary of likely impacts on birds

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR BREEDING BIRDS
Woodland Bird Assemblage	
1	Unlikely to be significantly adverse above the local level given relatively localised footprint and the existing baseline of disturbance for woodland near the A27.
3 (no viaduct is proposed through existing woodland)	An adverse impact at the county level is possible should a county notable assemblage of woodland birds be confirmed in area which would be subject to habitat loss.
5A (no viaduct is proposed through existing woodland)	Unlikely to be significantly adverse above the local level given the smaller extent of woodland to be removed with this Scheme option.
Wetland Bird Assemblage	
1	Unlikely to be significantly adverse above the local level given relatively localised footprint in wetland habitats.
3 (embankment option)	These Scheme Options share the same footprint across the River Arun floodplain; Option 5A has a greater footprint close to Tortington Rife. An impact of county level adverse significance is possible should a county notable assemblage of birds be confirmed in area which would be subject to habitat loss.
5A (embankment option)	
3 and 5A (viaduct)	Impact magnitude on bird conservation status may be less severe, compared to the embankment option, because this design solution would have a smaller footprint and is less disruptive of hydrological flows in the network of ditches which cross the floodplain.
Farmland Bird Assemblage and Barn owl	
1	Unlikely to be significantly adverse above the local level as much of this Scheme widens the existing A27 road.
3 (embankment option)	Significant adverse impact likely as this Scheme option crosses the River Arun floodplain and farmland near Tortington. Woodland is low suitability habitat for barn owl.
5A (embankment option)	Significant adverse impact likely as this Scheme option crosses the River Arun floodplain and farmland near Tortington and Binsted. Higher magnitude given large farmland land take.
3 and 5A (viaduct)	Impact magnitude on farmland birds and barn owl conservation status may be less severe, compared to the embankment option, because this design solution would have a smaller footprint and is less disruptive of hydrological flows in the network of ditches which cross the floodplain.

HAZEL DORMOUSE

8.7.97 Each of the Scheme Options would be likely to result in the permanent loss of habitats that hazel dormouse use for breeding, sheltering and hibernation. Habitats of particular importance for hazel dormouse include Ancient Woodland within Binsted Wood Complex LWS because of the diverse mixture of species which afford a variety of food sources throughout the year, continuous shrub layer and natural features including coppice stools and hollow tree stumps. Furthermore, Binsted Wood Complex LWS is connected to other woodlands in the landscape by a dense network of hedgerows. The hedgerow network throughout the Field Survey Area may provide an important dispersal route for dormice, linking neighbouring populations beyond the Field Survey Area.

8.7.98 Option 3 and Option 5A both cross Binsted Wood Complex LWS. Option 1 clips the northern edge of Binsted Wood Complex LWS and the southern edge of Rewell Wood Complex LWS. Option 1, Option 3 and Option 5A are all likely to cause permanent loss of suitable foraging and nesting habitat for hazel dormouse. Option 3 will result in the greatest loss of Ancient Woodland hazel dormouse habitat than the other Scheme Options.

8.7.99 Option 1 is not likely to sever hazel dormouse habitat, as the only woodland that would be lost is located either side of the existing A27 which is likely to be a barrier that currently limits hazel dormouse dispersal. Option 3 will sever Binsted Wood Complex LWS into two halves. Hazel dormouse is a species that occurs at low density and requires large areas of woodland for viable populations to persist. The habitat severance that would occur during construction of Option 3 would markedly reduce the available area of breeding habitat for this species and thus would be likely to reduce the population of this species in Binsted Wood Complex LWS. Option 5A would leave the majority of Ancient Woodland in Binsted Woodland Complex LWS unfragmented. This Option is likely to leave a sufficiently large area of woodland remaining for hazel dormouse to persist. However, Option 5A would sever Lake Copse, the Shaw and the Lag, as well as numerous hedges to the south of Binsted Wood Complex LWS, which would reduce the ability of hazel dormouse to migrate from Binsted Wood Complex LWS or move into Binsted Wood Complex LWS. This would be likely to isolate populations and reduce their genetic exchange between Binsted Wood Complex LWS and the wider landscape.

8.7.100 Construction of any one of the Scheme Options would result in a significantly adverse impact on this species. The effects of Options 3 and 5A are likely to be most significant, at up to the county level, while the effects of Option 1 are more likely to be significant at the local level.

8.7.101 A comparison of the different Scheme Options based on the provisional assessment of impacts on hazel dormouse is shown in Table 8-19.

Table 8.19 Summary of likely impacts on hazel dormouse

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR HAZEL DORMOUSE
1	Significant adverse impact likely at the local level arising from loss of woodland habitat supporting hazel dormouse.
3 (embankment option)	Significant adverse impact at up to the county level likely arising from loss of woodland habitat and severance of woodland supporting hazel dormouse.
5A (embankment option)	Significant adverse impact at up to the county level likely arising from loss of woodland habitat and severance of habitat south of Binsted Wood supporting hazel dormouse..
3 and 5A (viaduct)	For all Scheme Options – a significant but relatively lower impact magnitude as hazel dormouse severance would be lower than for an embankment option.

OTTER

8.7.102 Each of the Scheme Options is likely to result in the permanent loss of terrestrial and aquatic habitats which are likely to be used by otters for movement, shelter and breeding. Habitats identified as of highest potential importance to otter include wetland habitat adjacent to the River Arun and ditches on the River Arun floodplain.

8.7.103 Noise and vibration from construction of any of the Scheme Options may also disturb otters using watercourses within the Field Survey Area. Construction may also result in severance of routes used by otter to move through the wider area, in particular those associated with the River Arun where the new bridge is proposed for Option 3 and 5A or where works to the existing bridge will occur for Option 1. Given that Option 1 is for most of its length to be constructed close to the existing A27 within an urban area already subject to sources of disturbance, Option 1 is likely to have a lower impact on otter than Option 3 or Option 5A.

8.7.104 A viaduct crossing the River Arun is preferable to an embankment as this structure would not impede otter movements in this location and poses a lower risk of road mortality as otter moving across land would not attempt to cross the operational carriageway.

8.7.105 Given that English otter populations are known to be on the increase and because otter foraging and sheltering habitat is abundant in the wider Arun Valley area (identified several kilometres up and down stream of the Field Survey Area), any impact on otter is unlikely to be significantly adverse at more than the local level. This preliminary assessment is subject to the findings of on-going 2017 and 2018 surveys.

8.7.106 A summary of the preliminary assessment of impacts on otter is provided in Table 8-20.

Table 8.20 Summary of likely impacts on otter

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR OTTER
1 (embankment option)	A significant impact above the local level is unlikely given national improvements in otter conservation status in recent years and the abundance of otter alternative otter habitat in the wider Arun Valley..
3 (embankment option)	
5A (embankment option)	
3 and 5A (viaduct)	Impact magnitude on otter conservation status may be less severe compared to the embankment option because the viaduct design solution is less disruptive of otter movement routes.

PLANTS

8.7.107 Notable plants are assessed as a component part of Ancient Woodland and Coastal and Floodplain Grazing Marsh HPI where they occur in these habitats.

8.7.108 Divided sedge and marsh-mallow populations occur directly in the path of where Option 3 and Option 5A would cross the River Arun. It is likely that their populations will be depleted by habitat clearance required for bridge construction.

8.7.109 Given the relatively small footprint of the River Arun crossing and the large areas of suitable poor semi-improved grassland plant habitat along the River Arun corridor which will remain unaffected by the Project, it is unlikely that Scheme construction will reduce these plant populations below a critical level and that they will continue to persist in the Desk Study Area. However, a significantly adverse effect at the local level is probable.

8.7.110 A summary of the preliminary assessment of impacts on plants is provided in Table 8-21.

Table 8.21 Summary of likely impacts on plants

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR PLANTS
1 (embankment option)	No significant effects likely as an existing bridge will be used.
3 (embankment option)	A significant impact at the local level is likely.
5A (embankment option)	
3 and 5A (viaduct)	Impact magnitude on plant conservation status may be less severe compared to the embankment option because the viaduct design solution is likely to result in a reduce land take from adjacent to the River Arun.

REPTILES

8.7.111 Each of the Scheme Options is likely to result in the permanent loss of habitats used by reptiles for basking, commuting, foraging and hibernating. Habitats of highest importance for reptiles include large area of semi-natural grassland on either side of the River Arun and woodland edges and rides associated with Binsted Wood Complex LWS and Rewell Wood Complex LWS.

8.7.112 Each of the Scheme Options would require large losses of area of suitable reptile habitat within the River Arun floodplain. It is probable that this will result in an significantly adverse effect on reptile conservation status, however, the geographical level at which such an effect would be significant will depend on the diversity and size of the reptile populations that are affected. If large populations or populations of several reptile species are affected, this could be a significantly adverse effect at up to the county level.

8.7.113 Option 3 and Option 5A are likely to sever reptile movement routes along the River Arun riparian zone (Option 3 and Option 5A); woodland rides in Binsted Wood Complex LWS (Option 3); and in semi-natural habitat corridors at the edge of Lake Copse, the Shaw, the Lag and along Tortington Rife valley (Option 5A). Option 1 mainly affects habitats along the existing A27 road and would not sever reptile habitat other than in the northern River Arun floodplain by crossing a small number of ditches and their surrounding riparian habitat.

8.7.114 A comparison of different Scheme Options based on the provisional assessment of impacts on reptiles is provided in Table 8-22.

Table 8.22 Summary of potential impacts on reptiles

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR REPTILES
1 (embankment option)	Significantly adverse at up to the county.
3 (embankment option)	Significantly adverse at up to the county level because of grassland and wetland loss and severance – applies equally to Option 3 and Option 5A..
5A (embankment option)	
3 and 5A (viaduct option)	Lower magnitude impact for Scheme Options 3 and 5A because of the reduced footprint..

TERRESTRIAL INVERTEBRATES

8.7.115 Each of the Scheme Options would be likely to result in the permanent loss of habitats that are suitable for use by protected and notable invertebrate species. These habitats include Ancient Woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS, as well as wetland habitat such as freshwater ditches on the River Arun floodplain and in the valleys of Tortington Rife and Binsted Rife.

8.7.116 Option 1 would require relatively little loss of wetland compared to Option 3 or Option 5A. In addition, Option 1 mainly affects Ancient Woodland close to an existing road. It is unlikely that it would affect any invertebrate habitats which are unique to the Field Survey Area around Option 1 and are not found elsewhere in Binsted Wood Complex LWS, Rewell Wood Complex LWS or on the River Arun floodplain.

8.7.117 In contrast to Option 1, Option 3 would result in large scale loss and severance of Ancient Woodland and a larger extent of loss affecting the River Arun floodplain compared to Option 1. It is probable that such large-scale loss and severance of Ancient Woodland would deplete habitat that is relied on by notable invertebrate communities.

8.7.118 Construction of Option 5A would impact invertebrate communities more severely that Option 1 given it removes a larger area of Ancient Woodland and because it removes invertebrate micro-habitats which are localised in the Desk Study Area and may be of particular value in sustaining populations of notable invertebrate species such as marshy grassland, wet woodland and Wood Pasture and Parkland HPI.

8.7.119 It is difficult to discriminate Option 3 from 5A as both options cause potentially significant but different adverse impacts on invertebrate communities – Option 3 would result in large-scale loss and severance of Ancient Woodland and floodplain; Option 5A would result in a lower degree of loss and severance compared to Option 3 but it would remove key invertebrate microhabitats.

8.7.120 Relatively large areas of habitat suitable to support protected and notable invertebrates are likely to be permanently lost as a result of any of the Scheme Options. It is probable that this will result in a significantly adverse effect on invertebrate conservation status. Option 3 and Option 5A carry the highest risk of a significant effect at the county level or above, and risk permanently degrading species diversity or causing the loss of notable invertebrate populations. Option 1 is more likely to be significantly adverse at the local level.

8.7.121 A comparison of different Scheme Options based on the provisional assessment of impacts on terrestrial invertebrates is presented in Table 8-23.

Table 8.23 Summary of likely impacts on terrestrial invertebrates

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR INVERTEBRATES
1	Significantly adverse at up to the county level.
3 (embankments option)	Significantly adverse at up to the county level because of Ancient Woodland habitat loss.
5A (embankment option)	Significantly adverse at up to the county level because of Wood Pasture and Parkland HPI and Wet Woodland HPI loss.
3 and 5A (viaduct option)	No change to effect predicted for embankment option.

WATER VOLE

8.7.122 Impacts identified on wetland habitats in respect of Coastal and Floodplain Grazing Marsh HPI habitat and Aquatic Wildlife (earlier in this section) also apply to water vole.

8.7.123 Option 1, Option 3 and Option 5A would each give rise to permanent loss of suitable foraging and sheltering habitat for water vole. In addition, each of the Scheme Options risks severing potential dispersal routes connecting water vole colonies north of the existing A27 road from Coastal and Floodplain Grazing Marsh HPI and diches to the south of it. These impacts are likely to result in a significantly adverse effect on water vole conservation status. Given the rarity of water vole and long term decline in this species in England, such impacts would be likely to be significant at least at the county level for each of the Scheme Options. However, by virtue of their larger land take and the greater number of watercourses affected, Option 3 and Option 5A carry a higher risk to water vole conservation status than does Option 1. In addition Option 3 and 5A both affect ditches draining into Tortington Rife, which Option 1 does not. Option 5A is considered to pose the highest adverse risk to water vole conservation status as, in addition to impacts on the River Arun floodplain, it also severs habitat along Binsted Rife which Option 3 does not.

8.7.124 Crossing the River Arun floodplain by viaduct would be preferable as this option would require a smaller area of permanent habitat to be lost than an embankment and would not impede water vole disperse north and south across the Scheme following construction.

8.7.125 A summary of the provisional assessment of impacts on water vole is presented in Table 8-24.

Table 8.24 Summary of likely impacts on water vole

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR WATER VOLE
1	Significant adverse impact likely arising from loss of wetland habitat and severance of dispersal routes
3 (embankment option)	Significant adverse impact likely arising from loss of wetland habitat and severance of dispersal routes.
5A (embankment option)	Significant adverse impact likely arising from loss of wetland habitat and severance of dispersal routes – slightly more damaging as Binsted Rife and Tortington Rife are affected to a greater degree.
3 and 5A (viaduct)	Impact magnitude on water vole conservation status likely to be less severe compared to the embankment option because the viaduct design solution is less disruptive of water vole movement routes and requires a lower land take from wetland habitats.

OTHER NOTABLE MAMMAL SPECIES

8.7.126 Based on available desk study information provided by the Mid-Arun Valley Environmental Survey each of the Scheme Options is likely to lead to the loss of woodland habitat suitable to support hedgehog. Option 3 is likely to result in the greatest loss of habitat suitable to support hedgehog, and Option 3 and Option 5A are likely to result in severance of large areas of suitable habitat. In contrast Option 1 would lead to the lowest woodland loss and least severance.

8.7.127 Option 1 is only likely to result in the loss of small areas of reedbed, marshy grassland rough grassland habitat potentially used by harvest mouse. Option 3 and Option 5A are likely to remove harvest mouse nesting/foraging/breeding habitats in the River Arun floodplain. Option 5A is likely to remove and sever harvest mouse habitats in Tortington Rife and Binsted Rife.

8.7.128 Option 1 is unlikely to result in the loss of habitats used by brown hare given no large areas of arable farmland or open fields are affected. Option 3 and Option 5A are likely to remove foraging/sheltering/breeding habitats supporting brown hare in farmland between the River Arun and the west branch of Binsted Lane.

8.7.129 A summary of the provisional assessment of impacts on other notable mammal species is presented in Table 8-25.

Table 8.25 Summary of potential impacts on other notable mammal species

SCHEME OPTION	PROVISIONAL IMPACT ASSESSMENT FOR OTHER NOTABLE MAMMAL SPECIES
1	Significant adverse impact likely only for hedgehog – low magnitude relative to other Scheme Options.
3 (embankment option)	Significant adverse impact likely for all species – intermediate magnitude for harvest mouse and brown hare and relatively high magnitude for hedgehog.
5A (embankment option)	Significant adverse impact likely for all species – high relatively magnitude for brown hare and harvest mouse, intermediate relative magnitude for hedgehog.
3 and 5A (viaduct)	Impact magnitude on other notable mammal conservation status likely to be less severe compared to the embankment option because the viaduct design solution is less disruptive of mammal movement routes and requires a lower land take from suitable habitats.

ASSESSMENT OF INDIRECT IMPACTS ON ANIMAL SPECIES

8.7.130 Changes in noise and vibration levels and lighting during the operational phase of the Scheme may result in significantly adverse ecological effects on animal species.

8.7.131 There is no standard guidance for quantifying the impact of noise and vibration on wild animals. Noise and vibration may result in the disturbance or the displacement of animals from habitats which they might otherwise have used. A range of light intensities and lighting types have been linked to negative impacts on wildlife including bats. Negative impacts include avoidance by wildlife of highly illuminated areas or habitat fragmentation if illumination occurs along an important movement route.

8.7.132 The highest risk of adverse ecological impacts associated with noise, vibration and lighting are likely to arise where the operational Scheme Options pass near to concentrations of semi-natural habitat including:

- Where Option 3 passes through Tortington Common, Barn's Copse and other Ancient Woodland;
- Where Option 3 and Option 5A pass through Coastal and Floodplain Grazing Marsh HPI on the River Arun floodplain;
- Where Option 5A crosses ditches draining into Tortington Rife and through Binsted Park; and
- Where Option 1 crosses the River Arun floodplain, south of the existing A27 road.

8.7.133 In all cases operational noise and vibration and lighting impacts will affect faunal features that have already been subject to direct habitat loss or severance in the construction phase. Direct habitat loss and severance, therefore, form the principal sources of ecological impact on which evaluation of different Scheme Option has been based and noise and vibration and lighting impacts form secondary impacts. For example, loss of breeding bird habitat during the construction phase may be further exacerbated if birds are unable to use additional habitat retained next to the operational Scheme because of high levels of noise and vibration.

8.7.134 Additional noise and vibration, lighting and ecology assessment will be undertaken at PCF Stage 3 when a preferred Scheme option has been selected to provide increased accuracy on the location and magnitude of potential noise and vibration impacts and so that appropriate mitigation may be developed if required.

8.8 DESIGN, MITIGATION AND ENHANCEMENT MEASURES

8.8.1 This section identifies avoidance, mitigation, compensation and enhancement measures that are recommended for consideration based on the assessment of potential ecological impacts provided in Section 8.7. The aim of this section is to confirm the likely extent, complexity and feasibility of different mitigation requirements to inform preferred route selection.

8.8.2 Detailed mitigation/compensation/enhancement proposals will be produced at PCF Stage 3 when a preferred Scheme design has been selected and detailed design information is available.

AVOIDANCE OF ECOLOGICAL IMPACTS THROUGH SCHEME DESIGN

8.8.3 None of the Scheme Options is compliant with the National Networks National Planning Policy Statement or the National Planning Policy Framework. The basis for non-compliance is as follows (in order of the strength of policy wording attached to different ecological feature types):

- The loss or deterioration of irreplaceable habitats including Ancient Woodland or Ancient/Veteran trees is strongly discouraged. Currently all Scheme Options require the loss of Ancient Woodland. Option 3 and Option 5A are likely to result in the loss of Ancient/Veteran Trees; and Option 5A requires removal of Wood Pasture and Parkland HPI in Binsted Park. These habitats are irreplaceable. Each of the Scheme Options would have potential significant impacts upon legally protected species and Habitats/Species of Principal Importance.
- Each of the Scheme Options would have potential significant impacts on Local Wildlife Sites, requiring loss of habitat from either Binsted Wood Complex LWS and/or Rewell Wood Complex LWS.

8.8.4 In this context, the need to demonstrate that measures to avoid ecological impacts through design modification is strongly supported by guidance in the National Planning Policy Framework and the National Networks National Planning Policy Statement.

8.8.5 At this point in scheme design (without detailed design of impact mitigation measures) Option 1 avoids and minimises potential ecological impacts of the scheme to the greatest extent. The following modifications to the design of each Option would avoid or reduce the severity of the potential ecological impacts reported in Section 8.7

- → Option 1: minimisation of the width of the proposed footprint by using design measures such as retaining walls instead of cuttings to avoid Ancient Woodland loss from Steward's Copse and the Waterwoods.
- → Option 3: minimisation of the width of the proposed footprint by using design measures such as retaining walls instead of cuttings to minimise Ancient Woodland loss from the Pinewoods, Paine's Wood and Tortington Common.
- → Option 5A: modification of the Scheme alignment at the western tie-in to the existing A27 road to completely avoid or greatly reduce the loss of Ancient Woodland from Barn's Copse and disruption of the headwaters of Binsted Rife. Modification of the Scheme alignment to minimise the loss of Ancient/Veteran trees from Binsted Park.

8.8.6 The above Scheme modifications should be confirmed prior to confirmation of a preferred route option.

CONSTRUCTION PHASE MITIGATION

DESIGNATED SITES

BINSTED WOOD COMPLEX LWS AND REWELL WOOD COMPLEX LWS (INCORPORATING ANCIENT WOODLAND, WOOD PASTURE AND PARKLAND HPI AND ANCIENT/VETERAN TREES

8.8.7 It is likely that each of the Scheme Options would result in significant adverse effect on Binsted Wood Complex LWS and Rewell Wood Complex LWS. These impacts would arise from the permanent loss of Ancient Woodland and Ancient and Veteran trees which are present in both LWSs. Significant adverse impacts on Wood Pasture and Parkland HPI are associated only with Option 5A as this habitat is located in Binsted Park which would not be affected by Option 1 and Option 3.

8.8.8 Only once all avoidance measures have been considered should mitigation and compensation options be pursued. It is not practicable to compensate for Ancient Woodland or Ancient/Veteran trees within the life cycle of the Scheme and therefore these resources are considered irreplaceable. However, the loss of Ancient Woodland can be partially compensated for through a combination of measures which may be agreed in advance with Natural England and the Forestry Commission, consistent with their standing advice on Ancient Woodland[53]. The type and extent of compensation measures required would be related to the type and extent of habitat lost.

[53] Natural England and Forestry Commission (2015) *Guidance - Ancient woodland and veteran trees: protecting them from development* [on-line] https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences (accessed September 2017).

8.8.9 To partly compensate for impacts on Ancient Woodland, Ancient Woodland soils, dead wood and coppice stools should be salvaged and translocated to new broad-leaved woodland creation areas. Whilst not replicating the Ancient Woodland that would be lost, the creation of new woodland should aim to result in an overall increase in size of the surrounding woodland network and hence increase connectivity within the wider landscape by linking isolated and fragmented woodland parcels and thus benefit woodland species. Other measures to enhance existing Ancient Woodland; such as the removal of invasive species (e.g. Rhododendron) from Plantation on Ancient Woodland Site woodland; or reinstatement of coppicing or pollarding may also be implemented.

8.8.10 At Binsted Park a tree management plan could be implemented covering all remaining Wood Pasture and Parkland HPI and an extended area around these areas. Implementation of a strategy for tree management would aim to preserve and prolong the life span of the oldest trees whilst also promoting planting new open-grown trees which may become future veterans. This measure would have to be secured via agreement with local landowners or via acquisition of land for delivery of this compensation measure.

8.8.11 There are no definitive guidelines for the levels of compensation required for loss of Ancient Woodland or Wood Pasture and Parkland HPI, and every instance should be treated on a case by case basis, requiring agreement with Natural England and the Forestry Commission. At this stage in the assessment process it is not possible to provide a definitive acceptable amount of provision of compensatory habitat. Analysis of botanical survey work undertaken in 2017 and consultation with stakeholder organisations will be necessary in order to determine appropriate compensation requirements. Consultation with stakeholders is being continued in 2018. Natural England has expressed a provisional view that compensation land should be identified in relatively close proximity to the location of impact, where feasible, paying attention to opportunities to ensure ecological connectivity at the landscape scale (e.g. as indicated in their Woods and Parks Landscape Scale Project area).

8.8.12 To be delivered successfully, woodland creation sites would need to be prepared in advance of Ancient Woodland clearance to ensure they are ready to receive translocated soils and other material. Ancient Woodland soil translocation is best achieved during the winter months when plants/shrubs/coppice stools are dormant.

8.8.13 Based on the extent of anticipated losses and in accordance with Natural England and Forestry Commission Standing Advice[54] on how to treat Ancient Semi-Natural Woodland and Plantation on an Ancient Woodland Site, the compensation requirement for Option 3 would be proportionally much higher than for Option 5A and Option 1. Option 1 would have the lowest compensation requirement of the three Scheme Options.

HABITATS

ANCIENT WOODLAND AND WOOD PASTURE AND PARKLAND HPI

8.8.14 Losses of Ancient Woodland and Wood Pasture and Parkland HPI will occur in Binsted Wood Complex LWS and Rewell Wood Complex LWS. Avoidance and likely compensation requirements are discussed under the Designated Sites section.

[54] *"Ancient semi-natural woodland and plantations on ancient woodland sites have equal protection under the National Planning Policy Framework."*

WETLAND HABITATS (WATERCOURSES, RIVER HPI AND COASTAL AND FLOODPLAIN GRAZING MARSH HPI)

8.8.15 It is likely that each of the Scheme Options would result in significant adverse effects on watercourses and associated habitats including Coastal and Floodplain Grazing Marsh HPI which includes River HPI, Reedbed HPI and Lowland Fen HPI (see Section 8.7). These impacts would arise from the permanent loss of habitat and hydrological disruption caused by road construction on the floodplain of the River Arun, Binsted Rife and Tortington Rife as well as other smaller watercourses.

8.8.16 Measures to avoid loss of wetland habitat should first be exhausted as follows:

- Avoidance of all non-necessary construction infrastructures from areas of floodplain – construction compounds, haul roads and other temporary construction features should be placed outside the floodplain;
- All construction materials, soil stockpiles and other sources of hydrological pollution/sedimentation should be stored outside of wetland habitats; and
- The viaduct or embankment should be designed to maintain hydrological connectivity along all principal drainage channels and between channels and the River Arun (noting that the existing floodwall prevents frequent hydrological exchange between the River Arun and its floodplain).

8.8.17 Mitigation to prevent hydrological changes to Binsted Rife and Tortington Rife may be most challenging to achieve as these watercourses are fed/part fed from groundwater sources. Hydrological modelling would be required to ensure the chemical composition and discharge of water into these watercourses was unaltered from baseline conditions.

8.8.18 To compensate for loss of wetland habitat most or all of the following measures would be necessary:

- Creation of new freshwater ditches, ponds and scrapes (winter/autumn seasonally wet pools) designed to provide foraging and sheltering opportunities for waterfowl, wader, amphibian, plant and invertebrate species;
- Conservation management of the existing ditch network in the Desk Study Area – for example by rotational cutting and partial dredging of different ditches and different banks of the same ditches on an inter-year cycle. Currently some ditches in the Field Survey Area are swamped by common reed which lessens the number of micro-habitats available for invertebrate, plant, fish and bird species;
- Reduce the intensity of grazing on the Arun floodplain to promote a mosaic of semi-natural, rather than short grazed grassland, scattered scrub and wetland vegetation to offer enhanced sheltering and foraging opportunities for wetland species of plant and animal;
- Creation of ponds/small lakes with islands which cannot be accessed by potential predators to allow waterfowl to loaf/shelter; and
- Control of bird predators such as foxes to reduce natural sources of bird mortality.

8.8.19 New habitat would need to be a sufficient distance from the new road to avoid sources of potential disturbance to animals (e.g. lighting, noise and vibration) and to ensure birds are not forced to fly low across a newly created road exposing them to collisions with moving vehicles.

8.8.20 In relation to wetland mammals and amphibians and to ensure hydrological connectivity, adequate measures would need to be installed under the new road to ensure passage north and south across the floodplain was not significantly impeded. A range of measures may be adopted such as underpasses and tunnels. These would need to be of sufficient size to conduct natural water flows and to allow animals to pass during times of high rainfall/discharge flow.

8.8.21 Measures would have to be implemented to ensure that pollution arising from the operational road does not enter the freshwater watercourse network, including appropriate measures to prevent pollutants entering watercourses and wetland habitats.

8.8.22 To secure the long-term favourable management of newly created wetland habitats it is likely that an organisation with the correct conservation land management competence and experience would need to be engaged and funded.

8.8.23 The area of wetland habitat affected and magnitude of impact is likely to be greater for Option 3 and Option 5A. The ability to provide habitat compensation for these options could therefore be more challenging.

8.8.24 Should an embankment design solution be selected from crossing the River Arun floodplain, the feasibility of achieving suitable freshwater wetland habitat compensation would be reduced compared to a viaduct option. This is on the basis that hydrological disruption would be far greater and that the footprint and associated habitat loss would be far greater with an embankment design.

8.8.25 There is no accepted standard amount of compensation requirement for impacts on wetland habitats. Such compensation would need to be agreed with Natural England and the Environmental Agency.

OTHER HABITATS

8.8.26 The loss of grassland, scrub and hedgerows is unlikely to have effects that are significant above the local level (see Section 8.7). Compensation for these habitats should be able to be achieved by acquiring land for habitat creation outside the permanent land take zone (where permanent road infrastructure will be placed) and/or through creation of new habitat (e.g. altering hedgerow cutting cycles or by adopting agri-environment type approaches).

8.8.27 Embankments and cuttings which are created as part of the new road Scheme should be seeded with species-rich grassland seed mixtures appropriate to the soil conditions (e.g. neutral, calcareous). Seed should be obtained from local sources wherever possible (e.g. green hay from local nature reserves).

8.8.28 Tree planting should be progressed in the Scheme landscaping to reconnect hedgerows and woodland which become severed by the Scheme and to link woodlands which are already fragmented. Consideration should be given to allowing scrub and broadleaved woodland to regenerate naturally (rather than through trees planting) over a proportion of the new road landscaping, through natural colonisation. This will encourage trees and shrubs to develop from local seed sources and it will also provide allow natural succession of habitats from open grassland to scrub and woodland.

PROTECTED AND NOTABLE SPECIES

AQUATIC FEATURES (FISH, AND INVERTEBRATES INCLUDING WHITE-CLAWED CRAYFISH)

8.8.29 Avoidance and compensation requirements addressing effects on aquatic ecological resources are the same as those which were outlined for Wetland Habitats (Coastal and Floodplain Grazing Marsh HPI, River HPI and Lowland Fen HPI). These wetland habitat creation measures would benefit amphibian, mammal, plant and invertebrate species by providing a range of different wetland habitat types. Key to achieving successful mitigation for potential impacts on fish habitats will be ensuring that passage of fish along watercourses is maintained. If an embankment design solution is selected across the River Arun floodplain, achieving the necessary hydrological connectivity north and south across the River Arun floodplain would be more challenging as culverts may restrict fish passage and would need to be designed to be of appropriate width and morphology to allow fish to pass the embankment.

LESSER WHIRLPOOL RAM'S-HORN SNAIL

8.8.30 The lesser whirlpool ram's-horn snail is a European Protected Species. The legal protection afforded to European Protected Species is outlined in Section 8.7. Because of the potential for effects on this species or damage or destruction of its sheltering habitat a European Protected Species Mitigation Licence is likely to be required from Natural England. In order to issue a licence, Natural England has to be assured that the Favourable Conservation Status of snail populations will be maintained ('the Favourable Conservation Status test'). Favourable Conservation Status is defined by the Habitats Directive which is summarised by Natural England[55] - broadly a sustainable population of a European Protected Species must be maintained on a long term basis and its geographic range must not be reduced.

8.8.31 In order to satisfy the Favourable Conservation Status test in relation to this snail and secure a European Protected Species Mitigation Licence from Natural England, Highways England would need to identify a technique for habitat clearance, in advance of road construction that displaces snails (as far as is practical) to avoid risk of its killing and injury. To address habitat loss, Highways England would need to be able to create new snail habitat of sufficiently extent and condition to compensate for snail habitat which will be removed. The wetland habitat creation measures outlined in relation to Wetland Habitats (Coastal and Floodplain Grazing Marsh HPI, River HPI and Lowland Fen HPI) would be appropriate for creating new habitat for this species.

BADGER

8.8.32 No adverse effects on badger conservation status above the Field Survey Area level are likely. However, if construction results in destruction of damage to a badger sett, these activities will be licensable under the *Protection of Badgers Act 1992*. An approach to badger mitigation will be agreed with Natural England when the findings of 2017 badger survey work are available. However, creation of artificial badger setts may be required to compensate for the loss of main badger setts and other types of badger sett. In this eventuality, land would need to be acquired for the construction of replacement badger setts. New setts would need to be located in close proximity to suitable badger foraging habitats such as woodland and within the territory of affected clans. Should badger movement routes be severed by the Scheme, it may also be necessary to construct wildlife fencing/tunnels/underpasses or overbridges to enable badgers to avoid crossing the active carriageway. A specification for badger tunnels is provided in the Design Manual for Roads and Bridges[56].

BATS

8.8.33 Loss of foraging habitat, roost loss, severance of flight paths, and potential mortality as a result if road traffic collisions are all potential impacts on bats as specified in Section 8.7.

8.8.34 Measures to avoid impacts on bats must first be fully considered before compensation is permissible. Suitable avoidance measures include:

- → Selection of a Scheme option which minimises loss of high quality bat foraging, commuting and roosting habitat (e.g. Ancient Woodland, mature hedgerows and ancient/veteran trees). Option 1 is the least damaging option from this perspective;
- → Modification of the Scheme alignment or construction footprint to avoid bat roosts;

[55] Natural England (2013). *European Protected Species: Mitigation Licensing – How to Get a Licence. Natural England*. Peterborough.

[56] Design Manual for Roads and Bridges (2001). Volume 10 Environmental Design and Management: Section 4 nature conservation
Part 2. HA 59/92. *Mitigating against effects on badgers*.

- Modification of the Scheme alignment or construction footprint to avoid severance of key bat flight paths;
- Protection of key bat foraging/commuting/roosting areas by avoidance of artificial lighting; and
- Reduction of night time light spill from the Scheme onto surrounding habitats which may be used by bats for roosting or foraging by using lighting technology with least damaging wavelengths and by using screens to direct light away from sensitive habitats.

8.8.35 All bats are European Protected Species. The legal protection afforded to European Protected Species is outlined in Section 8.4 and the Favourable Conservation Status test which must be passed to secure a European Protected Species Licence is outlined in relation to the lesser whirlpool ram's-horn snail (in this section). Any loss, damage or disturbance of bat roosts will require a European Protected Species Licence from Natural England. Scheme operation which may result in the killing or injury of bats as a result of road traffic collision may also require a European Protected Species Licence.

8.8.36 In order to satisfy the Favourable Conservation Status test in relation to bats and hence secure a European Protected Species Licence from Natural England, Highways England will have to adopt the following measures:

- Roost replacement – new roosts must be created to replace roosts lost in structures or trees.
- Connectivity and avoidance of mortality – based on available evidence, Option 5A would require wildlife crossing structures (i.e. a bespoke wildlife bridge or underpass) where the Scheme crosses north-south woody connective features which are used by bats as connective elements between roosting and foraging areas (e.g. potential wildlife bridge to replace lost connective habitat at Lake's Copse, hedgerows west of Ash Piece and hedgerows south of Tortington Common). Option 3 would require a series of wildlife crossing structures, or a long continuous crossing structure where it passes through Tortington Common/Paine's Wood/Pinewoods. Highways England is reviewing published evidence on suitable wildlife crossing design to facilitate bats crossing under/over a road. The findings of this review will be used to inform Scheme design and will be provided with the PCF Stage 3 Environmental Assessment Report.
- It is less likely that Option 1 will necessarily require a bespoke wildlife crossing feature (e.g. bridge or underpass) as this Scheme involved widening adjacent to an existing road for most of its alignment. However, were crossing features to be provided for Option 1 this may represent an opportunity for enhancement by linking bat habitats which are currently severed by the existing A27 road which may form an existing barrier to the movement of woodland adapted bat species and bats which are dissuaded by artificial lighting.
- Loss of foraging habitat – Measures to part compensate for Ancient Woodland and Wood Pasture and Parkland HPI and wetland outlined in this section are required to provide compensatory foraging opportunities for bats associated with all Scheme Options.

8.8.37 Option 3 and Option 5A are likely to result in the loss of roosts belonging to rare woodland bat species (Bechstein's bat and Alcathoe bat respectively). Given species rarity and the habitual use of multiple roosts by these woodland bat species, roost replacement techniques are experimental and uncertainty exists over whether adequate roost replacement can be achieved for these species.

8.8.38 Option 3 and Option 5A are likely to require suitable wildlife crossing structures to enable severance to be adequately mitigated and to satisfy the requirements of the Favourable Conservation Status test for the woodland bat assemblage. Individual bats have been shown to use wildlife crossing structures but definitive evidence of the efficacy of wildlife crossing to mitigate for bat at the population level is not currently available and thus the mitigation technique must be viewed as partly experimental.

8.8.39 It is likely that mitigation measures will need to be deployed in advance of construction to ensure they are successful and in place prior to habitat loss. Natural England may further require evidence that mitigation measures are successful (e.g. bats are using new roosts/green bridges) prior to licensing habitat loss. The risk of failure to deliver successful mitigation is relatively higher for Option 3 and Option 5A where experimental mitigation is likely to be required.

BIRDS

8.8.40 Significant adverse effects on birds are reported in Section 8.7 as a result of loss of breeding and foraging habitat, especially wetland and Ancient Woodland. Measures to avoid impacts on birds must first be fully considered before compensation is considered. Suitable avoidance measures to be investigated are:

- → Selection of a Scheme Option which minimises loss of high quality bird foraging and nesting habitat in Ancient Woodland, mature hedgerows and ancient/veteran trees. Option 1 is the least adverse Scheme Option from this vantage; and
- → Scheme alignment to minimise loss of Ancient Woodland and ancient/veteran trees (as outlined in the habitats part of this section).

8.8.41 Compensation for loss of breeding bird habitat may be achieved by implementing woodland and wetland habitat creation measures previously outlined in this Section.

8.8.42 Creation of new habitat to benefit wetland bird species has been tried and tested at a large number of bird nature reserves across the UK. However, specialised management techniques are required to maintain the condition of wetland bird habitats. Engagement of a specialist land management organisation may be required to achieve suitable ongoing habitat maintenance to ensure the success of mitigation measures.

8.8.43 A range of 'agri-environmental type' measures are available for creating compensatory habitats for farmland birds such as creating winter bird food buffer strips along field edges, leaving unploughed winter stubbles, creating 'skylark plots' for ground nesting species and similar initiatives. The requirement for mitigation and the exact measures to be deployed will be determined on the basis of detailed scheme design information.

8.8.44 Mitigation for impacts on barn owl is likely to require provision of artificial roost boxes greater than 1.0 kilometre from the Scheme to comply with best practice approaches as it is not possible to fully mitigate road mortality impacts on this species.

HAZEL DORMOUSE

8.8.45 Significant adverse effects resulting from loss of foraging and nesting habitat and severance of movement pathways are predicted in Section 8.7. Measures to avoid impacts on hazel dormouse must first be exhausted before compensation is considered. Suitable avoidance measures to be considered include:

- → Selection of a Scheme Option which minimises loss of high quality hazel dormouse foraging, and nesting habitat (Ancient Woodland and mature hedgerows). Option 1 is the least damaging option from this perspective; and
- → Modification of the Scheme alignment or construction footprint to minimise high quality hazel dormouse habitat in Ancient Woodland loss as already outlined in this section.

8.8.46 Hazel dormouse is a European Protected Species subject to the same requirements as those explained for the lesser whirlpool ram's-horn snail and bats in this Section. Any loss, damage or disturbance of hazel dormouse habitat is likely to require a European Protected Species Licence from Natural England.

8.8.47 In order to satisfy the Favourable Conservation Status test in relation to bats and secure a European Protected Species Licence from Natural England, Highways England is likely to have to adopt the following measures:

- Mortality and injury - displace hazel dormouse from habitats which are to be cleared for construction;
- Replace lost connective links – the same requirement for Wildlife Bridge or underpass will be associated with Option 3 and Option 5A. Option 1 is less likely to sever hazel dormouse habitat (not already severed by the existing A27 road) and is unlikely to require a wildlife bridge or underpass; and
- Loss of foraging habitat – Measures to part compensate for Ancient Woodland and Wood Pasture and Parkland HPI would be required to provide compensatory foraging and nesting opportunities for hazel dormouse associated with all Scheme Options.

8.8.48 Categorical evidence for the efficacy of wildlife crossing structures for mitigating severance impacts on hazel dormouse is currently lacking and this mitigation option must be viewed as partly experimental.

AMPHIBIANS

8.8.49 Significant adverse effects resulting from loss of foraging and breeding waterbodies and severance are predicted in Section 8.7. Measures to avoid impacts on great crested newt and toads must first be fully considered before compensation is considered. Suitable avoidance measures to be include are:

- Selection of a Scheme Option which minimises loss of waterbodies. Option 1 is the least damaging option from this perspective; and
- Modification of the Scheme alignment or construction footprint to minimise the loss of waterbodies – waterbodies are most densely distributed on the floodplain of the River Arun which is crossed by all Scheme Options.

8.8.50 Great crested newt is a European Protected Species and is subject to the same requirements as explained for the lesser whirlpool ram's-horn snail, bats and hazel dormouse in this Section. Loss or damage of significant areas of great crested newt habitat will require a European Protected Species Licence from Natural England. In order to satisfy the Favourable Conservation Status test in relation to great crested newt and secure a European Protected Species Licence from Natural England, Highways England is likely to have to adopt the following measures:

- Mortality and injury – trap and translocate great crested newt from habitats which are to be cleared for construction to prevent killing or injury;
- Loss of breeding and foraging habitat – measures to create wetland habitats are already outlined in this section and would be required to compensate for impacts on great crested newt. New pond creation to provide breeding habitat for great crested newt would be required for any great crested newt breeding ponds that are removed by the Scheme. A ratio of two new ponds for every one pond lost is a typical compensation ratio adopted by Natural England for European Protected Species Licence purposes; and
- Provision of wildlife crossing underpasses, tunnels or bridges to facilitate connections between severed great crested newt populations.

8.8.51 Although common toads are not subject to legal protection in the same way as great crested road (no mitigation licence is required), mitigation for newts would equally benefit this species.

OTTER

8.8.52 Significant adverse effects resulting from loss of an otter holt or severance of an otter movement pathway along a watercourse are not likely (Section 8.9). However, otter is a European Protected Species subject to the same requirements as explained for the lesser whirlpool ram's-horn snail, bats, hazel dormouse and great crested newt in this Section. Any loss or damage of an otter holt will require a European Protected Species License from Natural England. In order to satisfy the Favourable Conservation Status test in relation to otter and secure a European Protected Species Licence from Natural England, Highways England is likely to have to provide replacement holts for any which are loss and ensure existing holts are not disturbed by construction activities.

PLANTS

8.8.53 Local significant adverse effects on plants are predicted in associated with Options 3 and 5A. Plant mitigation may be achieved by:

- → Translocating individual plants from within the construction zone to new suitable habitat in the Desk Study Area; and/or
- → Managing habitats in the Desk Study Area to promote the habitat conditions required by species such as divided sedge and marsh-mallow and thereby increasing their abundance; and/or
- → Collecting seeds from plants in the Desk Study Area and propagating them for later introduction as mature plants; or sowing gathered seed at an appropriate time of year in appropriate substrate in the Desk Study Area.

REPTILES

8.8.54 Significant adverse effects on reptiles are predicted in associated with Options 3 and 5A, and to a lesser magnitude, Option 1. Compensatory wetland and other habitat creation measures already outlined in this section would be required to provide replacement foraging, basking and breeding habitats for reptiles. Provision of artificial hibernacula and refugia would be required to compensate for the loss of these habitats. To avoid killing or injury of reptiles, which is against the law, displacement and/or trapping and translocation of reptiles from habitats which are to be cleared for construction to prevent killing or injury will be necessary.

TERRESTRIAL INVERTEBRATES

8.8.55 Significant adverse effects on terrestrial invertebrates are likely to arise from construction of Option 3 and Option 5A and to a lesser degree Option 1 (given its smaller footprint). Measures to avoid impacts on terrestrial invertebrates are similar to those stated for avoidance of impacts on Ancient Woodland already outlined in this section. Compensatory woodland and wetland and other habitat creation measures already outlined in this section would be required to provide replacement foraging, sheltering and breeding habitats for terrestrial invertebrates.

WATER VOLE

8.8.56 Significant adverse effects on water vole are predicted in associated with Option 3 and Option 5A and to a lesser magnitude Option 1. Measures to avoid impacts on water vole must first be fully considered before compensation is considered. Suitable avoidance measures to be include are:

- → Selection of a Scheme Option which minimises loss of waterbodies. Option 1 is the least damaging option from this perspective; and
- → Modification of the Scheme alignment or construction footprint to minimise the loss of waterbodies – waterbodies are most densely distributed on the floodplain of the River Arun which is crossed by all Scheme Options.

8.8.57 Water vole is a legally protected species as summarised in Section 8.4. Any loss or damage of water vole breeding or foraging habitat will require a licence from Natural England. Licences can't be issued for the specific purpose of development but Natural England will consider issuing a licence in relation to a development proposal if the licensed action is going to provide a conservation benefit for water vole. Wetland habitat creation measures already outlined in this section would be required to compensate for significant adverse impacts on water and to secure a licence.

OTHER NOTABLE MAMMAL SPECIES

8.8.58 Measures already outlined in this Section to compensate for the loss of woodland and wetland habitats and measures outlined to create new farmland habitats for birds will provide suitable compensation for the loss of harvest mouse, brown hare and hedgehog habitat.

8.8.59 As noted for other mammal's species, severance impacts are likely to require mitigation using bespoke wildlife crossing features (e.g. underpasses or bridges). The efficacy of these structures at preserving connectivity at the population level is yet to be fully evidenced by scientific studies for all species.

GENERAL CONSTRUCTION PHASE MITIGATION

8.8.60 Irrespective of Scheme Option choice the following generic mitigation measures will reduce the magnitude of construction and operational impacts on all ecological features:

- Works should be timed to avoid sensitive periods for particular species, such as avoidance of the bird nesting season for habitat clearance (which is illegal);
- Design and use of construction lighting to minimise impacts on bats and other light sensitive species;
- The use of screening during construction to minimise the spread of noise, dust, lighting, etc. and the use of fencing to temporarily exclude species by restricting access into particular areas (such as reptile exclusion fencing);
- Installation of surface water run-off attenuation and treatment features to ensure water discharged to watercourses to avoid toxic pollutants, sediment or sources of nutrient enrichment;
- Implementation of general construction environmental best practice. This could include, but is not limited to, providing tool box talks for construction staff informing them of key ecological constraints within the area, the damping of haul routes to minimise the spread of dust, the use of drip trays and spill kits when refuelling vehicles and ensuring that open trenches are not left over night without safe means of egress for animals that may fall into them; and
- Production of a construction environmental management plan documenting all mandatory ecological avoidance, mitigation measures, methodologies and identifying those responsible for implementation.

QUANTIFYING THE EXTENT AND LOCATION OF HABITAT CREATION

8.8.61 The extent of habitat compensation land will be agreed with statutory consultees including Natural England, the Forestry Commission, the Environment Agency and the South Downs National Park Authority. It is proposed that the DEFRA biodiversity metric[57] is used to inform the quantification of mitigation requirements for habitats. Part compensation for Ancient Woodland and Wood Pasture and Parkland HPI will be specifically excluded from quantification using the DEFRA metric. Opportunities for habitat creation would be guided by Natural England's Woods and Parks Landscape Scale Project area, the South East England Biodiversity Opportunity Areas and the South Downs National Park Authority Habitat Connectivity/Ecological Networks Mapping study[58].

OPERATIONAL PHASE MITIGATION

GENERAL CONSTRUCTION PHASE MITIGATION

8.8.62 The following ecological mitigation measures would be necessary during the operational phase of the Scheme irrespective of which Scheme Option selected:

- → Design and use of road lighting to minimise impacts on bats and other light sensitive species – this may require no lighting or very limited lighting adjacent to confirmed bat crossing points;
- → The use of screening to intercept noise, vibration and dust next to key wildlife habitats;
- → Wildlife fencing to direct animals to designated crossing structures to minimise road mortality; and
- → Effective treatment/drainage systems for surface water runoff.

MANAGEMENT AND MONITORING

8.8.63 An ecology aftercare plan and a monitoring strategy will be developed when a preferred Scheme design is selected at PCF Stage 3 and will form part of the ecological information to be submitted as part of the application for a Development Consent Order. The monitoring strategy will be agreed with key stakeholders including Natural England, the Forestry Commission and the South Downs National Park Authority.

8.8.64 Specific species monitoring requirements may apply such as those relating to the need to continue bat monitoring into the operational phase of the development to fine-tune mitigation as required by the DEFRA bat survey method[59] . In addition, specific monitoring requirements will be designed to accompany any European Protected Species Licences or other Natural England licenses that are required for bats, great crested newt, hazel dormouse, water vole and other European Protected Species.

8.9 ASSESSMENT OF EFFECTS

8.9.1 Table 8-26 presents an assessment of likely residual ecological effects during construction and operational phases taking into consideration avoidance measures and the feasibility of implementing the compensation and mitigation measures outlined in Section 8.8.

[57] *DEFRA (2012). Biodiversity Offsetting Pilots: Technical Paper- the Metric for the Biodiversity Offsetting Pilots in England.*

[58] Thomson Ecology (2015). *Habitat Connectivity / Ecological Networks Mapping for the South Downs National Park*. A report for the South Downs National Park Authority.

[59] DEFRA Landscape scale surveys: Berthinussen & Altringham (2015) 'Development of a cost-effective method for monitoring the effectiveness of mitigation for bats crossing linear transport infrastructure' Appendix E Landscape effects

Table 8-26 Likely residual significant Ecological effects

IMPORTANT ECOLOGICAL FEATURE	OPTION 1	OPTION 3	OPTION 5A
The Arun Valley SAC, SPA and Ramsar site	No significant effects are likely thus no residual effects likely.		
Binsted Wood Complex LWS	Ancient Woodland, Ancient/Veteran trees and Wood Pasture and Parkland HPI are all irreplaceable. A residual significant ecological effect will remain after compensation measures have been applied.		
Rewell Wood Complex LWS	Ancient woodland is irreplaceable. A residual significant ecological effect will remain after compensation measures have been applied.		
Ancient Woodland	See Binsted Wood Complex LWS and Rewell Wood Complex LWS		
Wood pasture and parkland HPI including Ancient/Veteran trees	No residual effect likely.	Ancient/Veteran trees are irreplaceable a residual effect will remain after compensation measures have been applied. Parkland and Wood Pasture HPI is unlikely to be affected.	Ancient/Veteran trees are irreplaceable a residual effect will remain after compensation measures have been applied.
Hedgerow	No residual effects are likely. Hedgerow compensation measures are likely to be successful in the long-term.	Removal of particularly species-rich hedges is likely to result in a residual adverse effect. However, in general hedgerow compensation measures are likely to be successful in the long-term.	
Wetland Habitat (including Coastal and Floodplain Grazing Marsh HPI, River HPI, Reedbed HPI and Lowland Fen HPI)	No residual effects are likely. Habitat creation is likely to be successful in the long-term.	Uncertainty remains over whether impacts on Tortington Rife can be adequately mitigated. A residual adverse impact is probable.	Uncertainty remains over whether impacts on Binsted Rife and Tortington Rife can be adequately mitigated. A residual adverse impact is probable.
The River Arun	No residual effects are likely habitat creation is likely to be successful in the long-term.		
Waterbodies (including Pond HPI)	No residual effects are likely habitat creation is likely to be successful in the long-term.		
Grassland and other habitats	No residual effects are likely habitat creation is likely to be successful in the long-term.		
Amphibians	No residual effects are likely. Habitat creation is likely to be successful.	Uncertainty remains over whether habitat severance can be adequately mitigated. A residual adverse impact is probable.	
Aquatic Features (fish and aquatic invertebrates)	No residual effects are likely. Habitat creation is likely to be successful.	Uncertainty remains over whether habitat severance can be adequately mitigated. A residual adverse impact is probable.	
Badger	No residual effects are likely. Habitat creation and measures to facilitate badger road crossing are likely to be successful.		
Bat (the woodland bat assemblage)	No residual effects are likely. Habitat creation is likely to be successful in the long-term.	Uncertainty remains over whether habitat severance can be adequately mitigated as mitigation would be partly experimental and untested. Uncertainty remains over whether suitable roost replacement can be achieved given the rare bat species present and their complex tree roosting requirements. A residual adverse impact is likely in the long-term.	
Birds (woodland)	The woodland bird assemblage requires mature woodland which cannot be recreated in until the long-term. A residual adverse impact is likely to remain associated with the loss of woodland habitat.		

Birds (farmland)	No residual effects are likely. Habitat creation is likely to be successful in the long-term. However, this will depend on the acquisition of suitable compensation land and successful management in the long term.	
Birds (wetland)	No residual effects are likely. Habitat creation is likely to be successful in the long-term.	
Hazel dormouse	No residual effects are likely. Habitat creation is likely to be successful in the long-term.	Uncertainty remains over whether habitat severance can be adequately mitigated as mitigation would be partly experimental (e.g. wildlife crossing structures). A residual adverse impact is likely.
Otter	No residual effects are likely. Habitat creation is likely to be successful in the long-term.	
Plants	No residual effects are likely. Habitat creation is likely to be successful in the long-term.	
Reptiles	No residual effects are likely. Habitat creation and translocation measures are likely to be successful in the long-term.	
Terrestrial invertebrates	The woodland invertebrate assemblage requires mature woodland which cannot be recreated until the long-term. A residual adverse impact is likely to remain associated with the loss of woodland habitat.	
Water vole	No residual effects are likely. Habitat creation is likely to be successful.	Uncertainty remains over whether habitat severance can be adequately mitigated. A residual adverse impact is probable.
Other Notable Mammal Species	No residual effects are likely. Habitat creation is likely to be successful.	Uncertainty remains over whether habitat severance can be adequately mitigated. A residual adverse impact is probable.

8.10 CONCLUSIONS

8.10.1 This assessment has identified adverse residual ecological effects which are likely to arise from each of the Scheme Options. For the majority of designated sites, habitat and species, Option 1 is likely to have the least potential for ecological impacts of the Scheme Options.

8.10.2 Option 3 and Option 5A are likely to generate numerous significant adverse, residual ecological impacts. Comparing Option 3 to Option 5A - Option 3 has the greater ecological impact, particularly in respect of Ancient Woodland, the woodland bat assemblage and hazel dormouse. Option 5A would still significantly impact all of these features, albeit to a lower degree. Option 5A is more damaging that Option 3 in the context of impacts on Wood Pasture and Parkland HPI, Ancient/Veteran trees, Coastal and Floodplain Grazing Marsh HPI and a range of species groups including farmland birds, amphibians, water vole and notable mammal species.

8.10.3 Whichever Scheme Option is selected as the preferred route option, measures to avoid and lessen the impact on irreplaceable habitats should be pursued as outlined in Section 8.7 and 8.8 prior to finalisation of the Scheme design.

8.10.4 Mitigation for the woodland bat assemblage, hazel dormouse (and a range of other species groups) would require bespoke wildlife crossing structures to be incorporated into the Scheme design. Such measures have associated risks as they are partly experimental mitigation measures.

8.10.5 Option 1 is unlikely to require a large-scale wildlife crossing feature as habitat severance impacts are far less likely given the majority of this Scheme widens an existing road, and is therefore the easier option in relation to planning risk, associated cost, and likely programme delay. The design of wildlife crossing structures for Option 3 or Option 5A will pose a range of challenges and, at this point, there remains some uncertainty that these crossings could successfully or adequately mitigate impacts on bats or hazel dormouse in addition to other ecological resources.

8.10.6 Considering the necessary compensation requirements for impacts on woodland and wetland habitat types, no accepted standards exist for specifying the amount of habitat creation must be undertaken in compensation for impacts. This places a risk on all Scheme Options that sufficient and suitable land can be acquired for creation of compensatory habitat. The risk is magnified for Option 3 and Option 5A which have a greater land take and associated habitat losses than Option 1 and are likely to require a greater area of compensation land.

8.10.7 Overall, the assessment concludes that all three Scheme Options pose the potential for a range of adverse ecological impacts and the need for the avoidance, impact mitigation measures, compensation measures, and other bespoke impact management measures, to be developed for the preferred route as part of the Stage 3 design development process. Option 1 has the lowest ecological impact of the Options considered and is also the Scheme Option that carries the least ecological consenting and mitigation delivery risk. Option 3 and Option 5A both have considerably greater ecological impact and are both likely to generate a range of high magnitude, significant adverse, ecological effects, as well as consenting and mitigation delivery risk to the proposals.