



Norwich Western Link

Environmental Statement

Chapter 10: Biodiversity

Author: WSP UK Limited

Document Reference: 3.10.00

Version Number: 00

Date: March 2024



Contents

Glossary of Abbreviations and Defined Terms.....	6
10 Biodiversity	16
10.1 Introduction.....	16
10.2 Supporting Information	17
10.3 Legislation and Planning Policy.....	23
10.4 Policy Framework.....	28
10.5 Consultation	32
10.6 Scope of the assessment.....	50
10.7 Potential Impacts.....	59
10.8 Assessment methodology	60
10.9 Establishment of baseline conditions	62
10.10 Assessment of significance	85
10.11 Biodiversity Net Gain	96
10.12 Assessment Assumptions and Limitations.....	96
10.13 Baseline Conditions	99
10.14 Future Baseline.....	144
10.15 Summary of Important Ecological Features.....	150
10.16 Summary of Additional Mitigation.....	153
10.17 Assessment of Likely Impacts and Effects - River Wensum SAC.....	158
10.18 Assessment of Likely Impacts and Effects - Norfolk Valley Fens SAC – Potter & Scarning Fens, East Dereham.....	189
10.19 Assessment of Likely Impacts and Effects - River Wensum SSSI	192
10.20 Assessment of Likely Impacts and Effects - Potter and Scarning Fens, East Dereham SSSI	193
10.21 Assessment of Likely Impacts and Effects - Sweetbriar Road Meadows, Norwich SSSI	194
10.22 Assessment of Likely Impacts and Effects - Alderford Common SSSI	195
10.23 Assessment of Likely Impacts and Effects - Sites Non-Statutorily Designated for Biodiversity Value.....	196
10.24 Assessment of Likely Impacts and Effects - Ancient Woodland.....	220
10.25 Assessment of Likely Impacts and Effects - Habitats of Principal Importance	225



10.26 Assessment of Likely Impacts and Effects - Hedgerows.....	230
10.27 Assessment of Likely Impacts and Effects - Watercourses.....	233
10.28 Assessment of Likely Impacts and Effects - Notable, Veteran and Ancient Trees	239
10.29 Assessment of Likely Impacts and Effects - Other Habitats.....	244
10.30 Assessment of Likely Impacts and Effects - Badger	251
10.31 Assessment of Likely Impacts and Effects - Water Vole	262
10.32 Assessment of Likely Impacts and Effects - Otter.....	271
10.33 Assessment of Likely Impacts and Effects - Reptiles.....	280
10.34 Assessment of Likely Impacts and Effects - Great Crested Newt	286
10.35 Assessment of Likely Impacts and Effects - Breeding and Wintering Birds 294	
10.36 Assessment of Likely Impacts and Effects - Barn Owl	301
10.37 Assessment of Likely Impacts and Effects - Fish.....	307
10.38 Assessment of Likely Impacts and Effects - Aquatic Macroinvertebrates 313	
10.39 Assessment of Likely Impacts and Effects - Terrestrial Invertebrates .	318
10.40 Assessment of Likely Impacts and Effects - Desmoulin's Whorl Snail	323
10.41 Assessment of Likely Impacts and Effects - Macrophytes	327
10.42 Assessment of Likely Impacts and Effects - Additional Species of Principal Importance.....	332
10.43 Assessment of Likely Impacts and Effects - Invasive Non-Native Species 338	
10.44 Summary of Additional Mitigation.....	339
10.45 Summary of Biodiversity Effects	342
10.46 Cumulative effects	368
Overview	368
10.47 Rationale for projects considered in the Cumulative Impact Assessment in relation to Biodiversity.....	369
10.48 Assessment of Cumulative Impacts.....	375
10.49 Monitoring	379
10.50 References	382
Technical References	382



Tables

Table 10-1 Consultation summary table – Ecology Liaison Group 35

Table 10-2 Consultation Summary table – Consultees including Natural England and the Environment Agency 39

Table 10-3 Comparison of scoping judgments compared with **2020 Scoping Report** 51

Table 10-4 Study Areas per ecological feature 65

Table 10-5 Designated Habitats and/or Areas of Ecological Importance Scoped into Air Quality Ecological Impact Assessment..... 69

Table 10-6 Critical Loads and Levels for site habitats obtained from APIS database72

Table 10-7 Ecological surveys undertaken 74

Table 10-8 Description of Geographical Scales of Ecological Importance..... 87

Table 10-9 Characteristics of ecological impacts and effects 92

Table 10-10 EIA Classification terminology and how it relates to CIEEM's EclA guidelines 93

Table 10-11 Habitats Sites and their Qualifying Features..... 102

Table 10-12 Sites non-statutorily designated for biodiversity value 111

Table 10-13 Habitat types identified, their calculated areas and percentage of the total area within the Red Line Boundary 113

Table 10-14 Habitats of Principal Importance identified within the Red Line Boundary 117

Table 10-15 Important Ecological Features (IEF) scoped in for further assessment 150

Table 10-16 Potential construction impacts and significance of effects on sites non-statutorily designated for biodiversity value 198

Table 10-17 Potential operational impacts on sites non-statutorily designated for biodiversity value 203

Table 10-18 Loss of Habitats of Principal Importance within the Red Line Boundary 227

Table 10-19 Habitats of Principal Importance retained within the Red Line Boundary 227

Table 10-20 Habitats to be retained, temporarily lost or permanently lost within the Red Line Boundary of the Proposed Scheme..... 246



Table 10-21 Badger setts to be permanently lost to the Proposed Scheme	254
Table 10-22 Setts potentially indirectly impacted through disturbance	256
Table 10-23 Summary of Additional Mitigation measures.....	340
Table 10-24 Summary of Biodiversity Effects	344
Table 10-25 A47 North Tuddenham to Easton Dualling residual effects.....	370
Table 10-26 Sheringham and Dudgeon Extension Projects residual effects	373
Table 10-27 Hornsea Project Three Offshore Wind Farm residual effects.....	374



Glossary of Abbreviations and Defined Terms

The definition of key terms used in this report are provided below. These definitions have been developed by reference to the definitions used in EU and UK legislation and relevant guidance, as well as professional judgement based on knowledge and experience of similar schemes in the context of the Proposed Scheme.

Term	Definition
Additional Mitigation	For the purposes of this chapter, the term 'Additional Mitigation' refers to avoidance, mitigation and compensation measures beyond those considered as Embedded Mitigation.
Ancient Semi-Natural Woodland	An area of ancient woodland where the vegetation is made up of trees and shrubs native to the site and which have predominately arisen from natural regeneration.
Ancient Tree	A tree that has passed beyond maturity and is old, or aged, in comparison with trees of the same species. Characterised by biological, cultural or aesthetic features of interest.
Ancient Woodland	Any wooded area that has been continuously wooded since 1600 AD
Arboricultural Method Statement	A methodology for the implementation of any aspect of development which is within the root protection area, or has the capacity to adversely affect, any retained tree.
Arboriculturist	A person who has, through relevant education, training or experience, gained expertise in the field of trees in relation to construction.



Term	Definition
Area for temporary use during construction	Temporary construction areas. Areas for temporary use during construction such as works compounds, storage sites, welfare facilities as illustrated in Environmental Statement - Chapter 3: Description of the Scheme, Appendix 3, Figure 3.1 (Document Reference 3.03.03).
Biodiversity	Abbreviated form of 'biological diversity' referring to variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part.
British Standard BS 5837:2012	Provides guidance and recommendations for the integration of trees and development. To be interpreted by appropriately qualified and experienced persons.
British Trust for Ornithology (BTO)	A UK charity that focuses on understanding birds and, in particular, how and why bird populations are changing.
Chartered Institute for Ecology and Environmental Management (CIEEM)	The professional membership body representing and supporting Ecologists and Environmental professionals in the UK, Ireland and abroad. Previously known as Institute of Ecology and Environmental Management (IEEM).
Conservation Area	An area of special architectural or historic interest identified by the Local/County Planning Authority.
Construction Environmental Management Plan (CEMP)	Document setting out methods to avoid, minimise and mitigate environmental impacts on the environment and surrounding area. The protocols to be followed in implementing these measures in accordance with environmental commitments during construction.



Term	Definition
ECoW (Ecological Clerk of Works)	Provides advice about ecological and environmental and issues during the construction of a development. Typical issues include protected species, pollution, surface water management, material management, air quality and noise
Embedded Mitigation	Mitigation measures incorporated into the scheme design.
Environmental Barrier	The barrier constructed on the external edges of the viaduct to mitigate noise impacts to sensitive receptors.
Environmental enhancement (enhancement)	The general betterment of a habitat / area of land through, planting and / or management.
Essential Environmental Mitigation	Areas of environmental mitigation, outside the Site Boundary, as part of the overall package of environmental mitigation as part of the Proposed Scheme, as shown on the 'Essential Environmental Mitigation' plan (Document reference: 2.11.00)
European Commission	The executive body of the European Union responsible for proposing legislation, enforcing European law, setting objectives and priorities for action, negotiating trade agreements and managing implementing European Union policies and the budget.
Floodplain	Valley floor adjacent to a river that is (or was historically) inundated periodically by flood waters and is formed of sediments deposited by the river.



Term	Definition
Foxburrow Plantation green bridge	(GB2). Drawing Structure Reference. A bridge structure which carries native hedgerow planting either side of a central track for private agricultural use, over the Proposed Scheme, as shown on the 'Foxburrow Plantation green bridge GB2 Drawings Sheet 1 and 2' (Document reference: 2.06.06).
Fragmentation	A decrease in some or all types of natural habitats in a landscape, and the dividing of the landscape into smaller and more isolated pieces.
Habitat	The environment in which populations or individual species live or grow.



Term	Definition
Habitats of Principal Importance (HPI)	<p>These are all the habitats in England that were identified as requiring action in the UK Biodiversity Action Plan (UK BAP) and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework.</p> <p>Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (which came into force on 1 October 2006) requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. This list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40 of the NERC Act, to have regard to the conservation of biodiversity in England when carrying out their normal functions.</p> <p>There are 56 habitats of principal importance (previously called UKBAP priority habitats) included on the S41 list.</p>
Habitats Sites	Collective term for National Site Network sites and listed or proposed Ramsar sites.
Hydrology	The study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks.
INNS (Invasive Non-Native Species)	Species which have been introduced into areas outside their natural range through human actions and are posing a threat to native wildlife.



Term	Definition
Institute of Environmental Management and Assessment (IEMA)	The Institute of Environmental Management and Assessment is the largest professional body for environmental practitioners in the United Kingdom and worldwide.
Joint Nature Conservation Committee	A public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation.
Landscape proposals / landscaping planting	Proposed planting types, within the Site Boundary, as proposed in the 'Landscaping Plans' (Document reference: 2.07.00)
Likely Significant Effect	Any effect that may reasonably be predicted as a consequence of the plan or project that may affect the conservation objectives of the features for which a site was designated.
Local Nature Reserve (LNR)	A site of importance for wildlife, geology, education or public enjoyment. Some are also nationally important Sites of Special Scientific Interest. Local Nature Reserves must be controlled by the local authority through ownership, lease or agreement with the owner.
Morton green bridge	(GB4). Drawing Structure Reference. A bridge structure which carries native hedgerow planting either side of a central track for non-motorised users and private agricultural use, over the Proposed Scheme, as shown on the 'Morton green bridge GB4 Drawings Sheet 1 and 2' (Document reference: 2.06.07).



Term	Definition
National Site Network	Statutory designated sites of importance to nature conservation that are protected by the Conservation of Habitats and Species Regulations 2017. This includes existing SACs and SPAs, and new SACs and SPAs designated under these Regulations. Statutory designated sites of importance to nature conservation that are protected by the Conservation of Habitats and Species Regulations 2017
National Vegetation Classification (NVC)	A system of classifying natural habitat types in Great Britain according to the vegetation they contain.
NMU (non-motorised users)	A specific group of road users including walkers, cyclists or horse riders.
Notable Tree	A tree that is very large but might not qualify as ancient or veteran.
Nursery Woodland green bridge	(GB5). Drawing Structure Reference. A bridge structure which carries native hedgerow planting over the Proposed Scheme, as shown on the 'Nursery woodland green bridge GB5 Drawings Sheet 1 and 2' (Document reference: 2.06.08).
Plantation on Ancient Woodland Site	An area of ancient woodland where the former native tree cover has been felled and replaced by planted trees, usually of species not native to the site.
Ramsar Site	Wetlands of international importance, designated under the Convention on Wetlands of International Importance Especially as Waterfowl Habitat adopted 1971 (known as the Ramsar Convention).



Term	Definition
Recolonisation	The repopulation of a habitat by a previously colonising species.
Riparian zone	Transitional, semi-terrestrial area of land adjoining a river channel (including the river bank) that is regularly inundated and influenced by fresh water and can influence the condition of the aquatic ecosystem (e.g. by shading and leaf litter input and through biogeochemical exchanges).
River Wensum Viaduct	(BR1). Drawing Structure Reference. Viaduct crossing the River Wensum Special Area of Conservation and floodplain (approximately 490m long). The ten-span bridge design includes piled piers within the floodplain.
Root Protection Area	Layout design tool indicating the minimum area around a tree deemed to contain sufficient roots and rooting volume to maintain the tree's vitality.
Sett (Badger)	Sett is the habitat of a badger usually consists of a system of interconnected tunnels and chambers.
Site of Special Scientific Interest (SSSI)	A Site of Special Scientific Interest (SSSI) in Great Britain or an Area of Special Scientific Interest (ASSI) in the Isle of Man and Northern Ireland is a conservation designation denoting a protected area in the United Kingdom and Isle of Man. A SSSI (or ASSI) usually describes an area of particular interest to science due to the rare species of fauna or flora it contains - or even important geological or physiological features that may lie in its boundaries.



Term	Definition
Special Area of Conservation (SAC)	A strictly protected site designated under the EC Habitats Directive.
Special Protection Area (SPA)	A strictly protected site classified in accordance with Article 4 of the EC Birds Directive, which came into force in April 1979. SPAs are classified for rare and vulnerable birds (as listed on Annex I of the Directive), and for regularly occurring migratory species.
The Broadway green bridge	(GB1). Drawing Structure Reference. A bridge structure which carries native hedgerow planting either side of a central track for non-motorised users and private agricultural use, over the Proposed Scheme, as shown on the 'The Broadway green bridge GB1 General Arrangement Drawings Sheet 1 and 2' (Document reference: 2.06.05).
Tree Preservation Order	An order made by the Local/County Planning Authority to protect specific trees, groups of trees or woodlands in the interests of amenity.
Tud tributary culvert / Bat underpass	(CU2). Drawing Structure Reference. An underpass culvert which allows a minor watercourse tributary of the River Tud, under the Proposed Scheme, as shown on the 'Tud Tributary Bat Underpass Culvert Drawing' (Document reference: 2.06.03).
Veteran Tree	A tree that has the biological or aesthetic characteristics of an ancient tree but is not ancient in years compared with others of the same species.



Term	Definition
Water Framework Directive (WFD)	European Union directive which commits member states to achieve good qualitative status of all water bodies. The purpose of the Water Framework Directive is to establish a framework for the protection of inland surface waters, estuaries, coastal waters and groundwater.
Wildlife and Countryside Rights of Way Act 1981 (as amended)	The principal piece of UK legislation relating to the protection of wildlife.



10 Biodiversity

10.1 Introduction

Overview

10.1.1 This chapter reports the outcome of the assessment of likely significant effects arising from the Proposed Scheme on biodiversity. A full description of the Proposed Scheme is provided in **Chapter 3: Description of the Scheme** (Document Reference: 3.03.00) **of this Environmental Statement (ES)**. Impacts during the construction and operation phases of the Proposed Scheme are assessed.

10.1.2 This chapter:

- Summarises the legislative and policy framework;
- Describes consultation undertaken to date;
- Describes the methodology followed for the assessment;
- Identifies the potential impacts as a result of the Proposed Scheme;
- Identifies any Embedded Mitigation that has been adopted for the purposes of the assessment;
- Details any Additional Mitigation measures that have been identified;
- Reports the assessment of the likely significant effects of the Proposed Scheme considering legislation and the Additional Mitigation measures required to prevent, reduce or offset any significant negative effects;
- Presents the likely residual effects after these measures have been employed; and
- Details the monitoring that should be carried out for the Proposed Scheme.



10.1.3 The assessment of this topic area considers potential effects relating to the following aspects:

- Statutory and non-statutory designated sites;
- Important or protected habitats; and,
- Legally protected species, and species of conservation concern.

10.1.4 This chapter does not consider bat species. The NWL ES includes a separate chapter for the consideration of bat species (**Chapter 11: Bat Ecology** (Document Reference: 3.11.00)).

10.2 Supporting Information

10.2.1 This chapter is supported by Appendices 10.1 to 10.37 presented in the ES. Appendices 10.1 to 10.40 refer specifically to the following documents:

- Phase 1 Habitat Survey Report 2018 (**Appendix 10.1**) (Document Reference: 3.10.01)
- Ecological Desk Study 2018 (**Appendix 10.2**) (Document Reference: 3.10.02)
- Otter and Water Vole Survey Report 2020 (**Appendix 10.3**) (Document Reference: 3.10.03)
- River Wensum Fish Report 2020 (**Appendix 10.4**) (Document Reference: 3.10.04)
- Interim Reptile Survey Report 2020 (**Appendix 10.5**) (Document Reference: 3.10.05)
- Interim Desmoulin's Whorl Snail Survey Report 2020 (**Appendix 10.6**) (Document Reference: 3.10.06)
- River Wensum Crayfish Report 2020 (**Appendix 10.7**) (Document Reference: 3.10.07)



- Interim River Wensum Macrophyte Report 2020 (**Appendix 10.8**)
(Document Reference: 3.10.08)
- Phase 1 Habitat Survey Report 2021 (**Appendix 10.9**) (Document Reference: 3.10.09)
- Hedgerow Report 2021 (**Appendix 10.10**) (Document Reference: 3.10.10)
- Aquatic Ecology Survey Report 2021 (**Appendix 10.11**) (Document Reference: 3.10.11)
- Aquatic Ecology Survey Report 2022 (**Appendix 10.12**) (Document Reference: 3.10.12)
- Breeding Bird Report 2021 (**Appendix 10.13**) (Document Reference: 3.10.13)
- Desmoulin's Whorl Snail Report 2021 (**Appendix 10.14**) (Document Reference: 3.10.14)
- Fungal Survey Report 2021 (**Appendix 10.15**) (Document Reference: 3.10.15)
- Great Crested Newt Report 2021 (**Appendix 10.16**) (Document Reference: 3.10.16)
- Lichen Survey Report 2021 (**Appendix 10.17**) (Document Reference: 3.10.17)
- National Vegetation Classification Survey Report 2021 (**Appendix 10.18**) (Document Reference: 3.10.18)
- Otter and Water Vole Survey Report 2021 (**Appendix 10.19**)
(Document Reference: 3.10.19)
- Species of Principal Importance Report 2021 (**Appendix 10.20**)
(Document Reference: 3.10.20)



- Terrestrial Invertebrate Survey Report 2021 (**Appendix 10.21**)
(Document Reference: 3.10.21)
- Aquatic Macroinvertebrate Report 2021 (**Appendix 10.22**) (Document Reference: 3.10.22)
- Great Crested Newt eDNA Survey Report 2021 (**Appendix 10.23**)
(Document Reference: 3.10.23)
- Macrophyte Survey Report 2021 (**Appendix 10.24**) (Document Reference: 3.10.24)
- Reptile Survey Report 2021 (**Appendix 10.25**) (Document Reference: 3.10.25)
- River Habitat Survey Baseline Report 2021 (**Appendix 10.26**)
(Document Reference: 3.10.26)
- Wintering Bird Survey Report 2021 (**Appendix 10.27**) (Document Reference: 3.10.27)
- Barn Owl Survey Report 2021 (**Confidential Appendix 10.28**)
(Document Reference: 3.10.28)
- Badger Report 2021 (**Confidential Appendix 10.29**) (Document Reference: 3.10.29)
- Badger Report 2022 (**Confidential Appendix 10.30**) (Document Reference: 3.10.30)
- UKHab Report 2022 (**Appendix 10.31**) (Document Reference: 3.10.31)
- Ecological Mitigation Strategy (**Appendix 10.32**) (Document Reference: 3.10.32)
- Biodiversity Net Gain Technical Report (**Appendix 10.33**) (Document Reference: 3.10.33)



- Air Quality Ecological Impact Assessment (**Appendix 10.34**)
(Document Reference: 3.10.34)
- Arboricultural Impact Assessment (**Appendix 10.35**) (Document Reference: 3.10.35)
- Cumulative impacts from nearby committed developments (**Appendix 10.36**) (Document Reference: 3.10.36)
- Solar Exposure Analysis (**Appendix 10.37**) (Document Reference: 3.10.37)
- Environmental Statement Chapter 10: Biodiversity – Figures (**Appendix 10.38**) (Document Reference: 3.10.38)
- Desmoulin Whorl Snail Report 2021 (**Appendix 10.39**) (Document Reference: 3.10.39)
- Interim Badger Survey Report 2020 (**Confidential Appendix 10.40**)
(Document Reference: 3.10.40)

10.2.2 Full details of the study areas, survey methodologies, survey dates and guidance used for each survey are available in the above appendices. A summary of survey outcomes and baseline conditions with respect to biodiversity is provided in this chapter.

10.2.3 A **Habitats Regulations Assessment (HRA)** (Document Reference: 4.03.00) has been prepared in accordance with the requirements of The Conservation of Habitats and Species Regulations 2017 to establish whether the Proposed Scheme is likely to have any adverse effects on the integrity of Habitats Sites (a collective term for National Site Network sites and listed or proposed Ramsar sites). The findings presented in the HRA Report have been used to inform the assessment within the ES, where relevant.

10.2.4 The purpose of the **Ecological Mitigation Strategy** (Document Reference: 3.10.32) is to collate the mitigation strategies for all biodiversity features, excluding bats. The Ecological Mitigation Strategy was used to inform the



production of an **Outline Construction Environmental Management Plan** (OCEMP) (Document Reference: 3.03.01). The purpose of the OCEMP is to manage any environmental effects of the Proposed Scheme and to demonstrate compliance with environmental legislation.

10.2.5 The Ecological Mitigation Strategy will also form the basis of Landscape Ecological Management Plan(s) (LEMP) for the Proposed Scheme, which will be required to be brought forward by planning conditions. A LEMP will be produced in order to ensure the establishment of Landscape and Ecological commitments set out within the **Landscaping Design Plans** (Document Reference: 2.07.00) and the commitments stated within the **OCEMP** (Document Reference: 3.03.01). The LEMP intends to guide those responsible for the protection and management of the landscape and ecology elements in the design of the Proposed Scheme. The document sets out site-specific procedures and processes for management for ensuring that habitats are created / enhanced according to programme and are establishing as expected. The LEMP will be produced at the Detailed Design stage and maintained through the operational period. The key objectives of the LEMP will be to:

- Ensure the continued health and vigour of any retained existing vegetation within the Red Line Boundary;
- Ensure the successful establishment and continued healthy growth through to maturity of all proposed vegetation; and,
- Ensure the continued existence of natural habitat for existing species and sustain the ecological environment wherever possible.

10.2.6 Effects on biodiversity resources from infrastructure projects can arise from direct and indirect impacts upon designated sites, habitats or species, and be of a temporary or permanent nature. Indirect effects can occur through pollution of air and water and via changes in lighting, noise or hydrology. This chapter is therefore supported by information contained within the following chapters of the ES:



- **Chapter 6: Air Quality** (Document Reference: 3.06.00);
- **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00);
- **Chapter 9: Landscape and Visual** (Document Reference: 3.09.00);
- **Chapter 11: Bats** (Document Reference: 3.11.00);
- **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00); and,
- **Chapter 16: Climate - Climate Resilience** (Document Reference: 3.16.00).

10.2.7 An assessment of potential effects of air quality changes at sites of ecological importance resulting from the operation of the Proposed Scheme (Document Reference: 3.10.34) was informed by air quality modelling presented in the Environmental Statement **Chapter 6: Air Quality** (Document Reference: 3.06.00). This chapter was also informed by **Appendix 6.1 Outline Air Quality Compensation Strategy** (Document Reference: 6.01.01).

10.2.8 This chapter was also informed by (albeit does not assess) the **Sustainable Transport Strategy (STS)** (Document Reference 4.02.00).

10.2.9 This chapter was informed by the Essential Environmental Mitigation areas as shown on the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00).

10.2.10 This chapter is supported by the following figures within the ES (**Appendix 10.38** [Document Reference: 3.10.38]):

- **Figure 10.1:** Statutory Sites;
- **Figure 10.2:** Non-Statutory Sites;
- **Figure 10.3:** Habitat (UKHab) map; and,
- **Figure 10.4:** Habitats of Principal Importance and Ancient Woodland.



10.3 Legislation and Planning Policy

Legislative Framework

10.3.1 The applicable legislative framework is summarised as follows.

International

Habitats Directive (92/43/ EEC)

10.3.2 The Habitats Directive (92/43/EEC) sets the standard for nature conservation across the EU, and enables all 27 Member States to work together within the same strong legislative framework in order to protect the most vulnerable species and habitat types across their entire natural range within the EU. Measures must be taken by Member States to maintain and restore, at favourable conservation status, natural habitats and species of wild fauna and flora of community interest. It is implemented within England and Wales through the Conservation of Habitats and Species Regulations 2017 (as amended) (hereafter referred to as ‘the Habitats Regulations’) which allows (amongst other measures) for the designation of Special Areas of Conservation (SAC) and identifies European Protected Species (EPS) relevant to the UK. See National legislation section for a brief summary of post-Brexit changes to the Habitats Regulations.

Birds Directive (2009/147/EC)

10.3.3 The Birds Directive (2009/147/EC) provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. The directive places great emphasis on the protection of habitats suitable for supporting endangered and migratory species, introducing a system of Special Protection Areas (SPA) designated to protect important habitats. The Wildlife and Countryside Act 1981 and the Conservation of Habitats and Species Regulations 2017 (as amended) implement the requirements of the Birds Directive in England and Wales.

Water Framework Directive (2000/60/EC)

10.3.4 This European Union Directive sets out requirements and processes for waterbodies to achieve good ecological and chemical status and the



management of river basins more generally. Additional detail (including in relation to the UK Regulations which implement this Directive) is provided in **Chapter 12: Road Drainage and Water Environment** (Document Reference: 3.12.00).

National

The Environment Act 2021

10.3.5 The Environment Act legislates the enhancing of the environment in the UK by introducing measures and targets for improving air quality and waste management, increase recycling, restoring habitats and preventing species decline. This Act introduces a new legally binding target on increasing species abundance of British species by 2030. The Act also sets out the framework for Biodiversity Net Gain.

10.3.6 The Environment Act 2021 makes changes to the Natural Environment and Rural Communities (NERC) Act (2006) which updates the general duty to conserve biodiversity by adding a duty to not only conserve, but also enhance biodiversity.

Conservation of Habitats and Species Regulations 2017 (as amended)

10.3.7 In the UK, the Habitats Directive was originally transposed into law by means of the Conservation (Natural Habitats, & c.) Regulations 1994 (as amended). The Regulations came into force on 30 October 1994, and have been amended several times. Subsequently, the Conservation of Habitats and Species Regulations 2010 was created, which consolidated all the various amendments made to the 1994 Regulations in respect of England and Wales. The 2010 regulations have now been superseded by the 2017 regulations, which have also been subject to amendment, including as a result of the UK's exit from the European Union (see 'Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019', below). The Regulations provide for the designation and protection of 'European Sites' in England, the protection of 'European Protected Species', and the adaptation of planning and other controls for the protection of European Sites.



Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019

10.3.8 The amendment made as a result of the United Kingdom's exit from the European Union (hereafter referred to as the '2019 Habitats Regulations'). Many of the changes to the Regulations arising from the 2019 Habitats Regulations relate to transferring powers from the European Commission to the appropriate authorities in England and Wales. The process for Habitats Regulations Assessment and the duties of Competent Authorities as defined in the Habitats Regulations remain largely unchanged. In addition, the 2019 Habitats Regulations brought about the following (non-exclusive list):

- The creation of the National Site Network, which comprises protected sites designated under the 2017 Habitats Regulations.
- The establishment of management requirements for the National Site Network.
- Amendments to the Imperative Reasons of Overriding Public Interest (IROPI) test to replace the European Commission's former role.

Wildlife and Countryside Act 1981 (as amended)

10.3.9 The Wildlife and Countryside Act 1981 (as amended) (hereafter referred to as the 'WCA') is the principal mechanism for the legislative protection of wildlife in Great Britain. This legislation is the means by which the Bern Convention and (partially) the European Union Directives on the Conservation of Wild Birds (79/409/EEC) and Habitats Directive are implemented in the UK. The WCA includes provisions, amongst others, for the identification and designation of protected species, for the safeguarding and designation of Sites of Special Scientific Interest (hereafter referred to as SSSI), and for the designation of invasive non-native species and measures to control the spread of these.



Countryside and Rights of Way (CRoW) Act 2000

10.3.10 The Countryside and Rights of Way Act 2000 (hereafter referred to as the 'CROW Act') extends the public's ability to enjoy the countryside whilst also providing safeguards for landowners and occupiers. It gives a statutory right of access to open country and registered common land, modernises the rights of way system, gives greater protection to SSSIs, provides better management arrangements for Areas of Outstanding Natural Beauty (AONBs), and strengthens wildlife enforcement legislation.

The Natural Environment and Rural Communities (NERC) Act 2006

10.3.11 The NERC Act provides that any public body or statutory undertaker in England must have regard to the purpose of conservation of biological diversity in the exercise of their functions. The intention is to help ensure that biodiversity becomes an integral consideration in the development of policies and plans.

10.3.12 The Environment Act 2021 makes changes to the NERC Act, which updates the general duty to conserve biodiversity by adding a duty to not only conserve, but also enhance biodiversity. Public authorities are also expected to produce reports on the action they have taken under this duty when designated by the Secretary of State.

The Protection of Badgers Act 1992

10.3.13 This Act makes it an offence to kill or take a badger, or to interfere with a badger sett unless such action is licenced by Natural England. Sett interference includes damaging or destroying a sett, obstructing access to a set, and disturbing a badger whilst it is occupying a sett. The Act defines a badger sett as 'any structure or place, which displays signs indicating the current use by a badger', and Natural England takes this definition to include seasonally used setts.

The Hedgerows Regulations 1997

10.3.14 The Hedgerows Regulations (1997) make provision for the protection of important hedgerows in England and Wales. The regulations affect



hedgerows which are 20 m or more in length, or connected at both ends to another hedgerow of any length.

10.3.15 They relate to hedgerows which are on, or adjoining land used for agriculture and / or conservation purposes. They do not include hedges that are attached to or marking the boundaries of a private dwelling.

The Salmon and Freshwater Fisheries Act 1975

10.3.16 This Act covers regulation of fisheries in England and Wales and includes legislation that covers the introduction of polluting effluents, the obstruction of fish passage (screens, dams, weirs, culverts, etc), illegal means of fishing, permitted times of legal fishing, and fishing licencing (which covers electric fishing).

10.3.17 Under this Act, any person who causes or knowingly permits to flow or put or knowingly permits to be put, into any waters containing fish or into any tributaries of waters containing fish, any liquid or solid matter to such an extent as to cause the waters to be poisonous or injurious to fish, spawning grounds, spawn, or food of fish, shall be guilty of an offence.

10.3.18 The Act also requires that fish passes are installed on new and rebuilt barriers that affect waters frequented by salmon or migratory trout.

The Eels (England and Wales) Regulations 2009

10.3.19 The Eels (England and Wales) Regulations 2009 implement Council Regulation (EC) No 1100/2007 of the Council of the European Union, which required Member States to establish measures for the recovery of the stock of European eel. The regulations apply to England and Wales.

10.3.20 The Regulations give powers to the regulators (the Environment Agency and Natural Resources Wales) to implement recovery measures in all freshwater and estuarine waters in England and Wales. The aim of the regulations is to achieve 40 per cent escapement of adult eels relative to escapement levels under pristine conditions. The measures, as set out in the legislation by which



this is to be achieved, is to reduce fishing pressures, improve access and habitat quality, and reduce the impact of impingement and entrainment.

10.3.21 Under the Regulations, the regulators can serve notice to companies detailing their legal obligation to screen intakes and outfalls for European Eel *Anguilla anguilla* and/or to remove or modify obstructions to eel migration. However, it is possible for companies to be granted with exemptions if the costs of works greatly exceeds the benefits. In such a situation it is likely the regulator will seek a package of more cost-effective, “alternative measures”.

10.4 Policy Framework

National

National Planning Policy Framework

10.4.1 The National Planning Policy Framework 2023 (hereafter referred to as the ‘NPPF’) sets out the Government’s planning policies for England, and contains relevant policies specific to biodiversity and nature conservation (most notably section 15 from paragraph 180).

10.4.2 Moreover, it sets out provisions for biodiversity, including protected sites and species, for which local planning authorities (LPAs) must have regard. When determining planning applications, local planning authorities should apply principles including:

- Typically refusing development on land within or outside a Site of Special Scientific Interest that is likely to have an adverse effect on it (either individually or in combination with other developments). The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest; and
- Typically refusing development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) unless there are wholly exceptional reasons (for



example, infrastructure projects (including nationally significant infrastructure projects, orders under the Transport and Works Act and hybrid bills), where the public benefit would clearly outweigh the loss or deterioration of habitat), and a suitable compensation strategy exists.

10.4.3 Planning Practice Guidance (PPG) has been published alongside the NPPF, and is regularly updated, to provide guidance on the implementation of the planning policies. It is also a matter of government policy that Ramsar Sites are considered in the HRA process as well as European Sites, with this set out in paragraph 181 of the National Planning Policy Framework.

10.4.4 The NPPF relates to conserving and enhancing the natural environment and requires local authorities in England to take measures to:

- Protect and enhance sites of biodiversity;
- Recognise the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services;
- Maintain the character of the undeveloped coast;
- Minimise impacts and provide net gains for biodiversity;
- Prevent new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability; and
- Remediate and mitigate despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

Local

Greater Norwich Local Plan - Policy 3 – Environmental Protection and Enhancement (Greater Norwich Local Plan 2024)

10.4.5 Policy 3 requires development proposals to enhance the natural environment through:

- Being designed to respect, conserve and enhance natural assets;



- Avoiding harm to designated and non-designated assets of the natural environment, having regard to their level of significance (local, national, and international) in accordance with the requirements of the NPPF and relevant policies in other Development Plan Documents and Neighbourhood Plans;
- Following (and demonstrating) a hierarchy of seeking firstly to avoid impacts, mitigate for impacts so as to make them insignificant for biodiversity, or as a last resort compensate for losses that cannot be avoided or mitigated for;
- Undertaking a relevant assessment (such as a landscape or ecological assessment) if impacts to a natural asset might arise;
- Provision of new, or conservation or enhancement of existing, green infrastructure to contribute (directly or indirectly) to the strategic green infrastructure network having regard to local green infrastructure strategies; and,
- Respecting landscape character and retaining important views and features, having regard to landscape character assessments and sensitive areas such as landscape settings, strategic gaps and green spaces identified in Local or Neighbourhood Plans, and to the importance of the nationally designated Broads Authority area and its setting.

Norfolk County Council's Environmental Policy (2019)

10.4.6 Norfolk County Council adopted its Environmental Policy on 25 November 2019.

10.4.7 The policy aspires to encourage a thriving plant and wildlife community; make efficient and sustainable use of natural resources; enhance the beauty, heritage, and engagement with the natural environment; and enhance biosecurity.



10.4.8 The policy requires development to embed an ‘environmental net gain’ principle for development, and maximise the benefits for people and the environment, for features such as woodland. The natural environment should be protected, conserved and recovered, and support for statutory and non-statutorily designated sites should be provided. The use and provision of green spaces should be encouraged, and creation measures such as tree planting should be prioritised.

Norfolk County Council: Local Transport Plan (LTP) 4 2021 - 2036

10.4.9 The Norfolk County Council LTP4 sets out Norfolk County Council’s plans, policies and programmes on transport and transport infrastructure. The policy commits to assessing any potential loss of biodiversity as a result of the implementation of the transport strategy. This would be in order to seek to meet the objectives for biodiversity net gain as a condition of planning permission, in accordance with the Environment Act which received Royal Assent in 2021. The policy also commits to identifying opportunities for linear habitat creation along the active travel network.

Broadland District Council Environmental Strategy: Delivery Plan 2022 - 2024

10.4.10 Broadland District Council has, via the Environmental Strategy: Delivery Plan 2022-2024, committed to putting environmental considerations at the heart of delivery, and will work with the planning department to ensure all new developments consider environmental issues such as air quality and land quality.

Breckland District Council Local Plan

10.4.11 The Proposed Scheme is outside the Breckland district but in close proximity to the district, and as the Proposed Scheme is linked to the A47 scheme which is within the Breckland district, the Breckland District Council Local Plan has been considered in this chapter.

10.4.12 The Breckland Plan aims to set a spatial vision and strategy for the District, with clear economic, social and environmental objectives, and to meet the



needs and aspirations of Breckland's residents. The Local Plan forms the development plan for the District.

River Wensum Restoration Strategy 2008 - 2027

10.4.13 The River Wensum Restoration Strategy has been developed by Natural England, in partnership with the Environment Agency and the Water Management Alliance, to restore the physical functioning of the river in order that it can sustain the wildlife and fisheries characteristic of a Norfolk chalk river. Working in partnership with landowners, the Norfolk Rivers Internal Drainage Board, fishing clubs and other interested groups, 12 kilometres of the River Wensum have so far been restored, including major restoration schemes at Bintree, Great Ryburgh Common, Ryburgh End, Swanton Morley, Tatterford and Sculthorpe.

10.5 Consultation

10.5.1 **Table 10-1** includes an overview of consultation with an Ecology Liaison Group (ELG) which ran periodically through the pre-planning period. The role of the group is to provide, as part of the development of the Proposed Scheme, an in-depth local knowledge of ecological matters.

10.5.2 The group was set up to:

- Provide insight into local nature conservation priorities;
- Provide a forum for information to be shared;
- Support the implementation of the project's ecological aims and responsibilities;
- Identify shared aspirations and priorities, as well as potential opportunities and interventions;
- Identify opportunities to learn relevant lessons and share best practice from other road infrastructure schemes; and



- Discuss wildlife concerns and opportunities in relation to relevant legal protection and in line with national and local wildlife policy.

10.5.3 The ELG invited the inclusion of the following consultees:

- Natural England;
- Norfolk Wildlife Trust;
- The Royal Society for the Protection of Birds (RSPB);
- Wensum Valley Birdwatching Society;
- Woodland Trust;
- Toad Watch;
- Norwich Bat Group;
- Norfolk and Norwich Naturalist Society;
- Norfolk Amphibian and Reptile Group;
- Friends of the Tud Valley;
- Norfolk Badger Trust;
- Norfolk Rivers Trust;
- National Highways / Highways England; and
- The Environment Agency.

10.5.4 Key topics of discussion and outcomes relating to bats have been omitted from **Table 10-1** and are included in **Chapter 11: Bats** (Document Reference: 3.11.00).

10.5.5 Consultation with statutory bodies, notably Natural England and the Environment Agency, was also undertaken through the lifetime of the pre-planning period (see **Table 10-2**). Issues relating to bat ecology are included in **Chapter 11: Bats** (Document Reference: 3.11.00). Consultation with the Environment Agency related to the water environment away from biodiversity



is detailed in **Chapter 12: Road Drainage and the Water Environment**
(Document Reference: 3.12.00).

Table 10-1 Consultation summary table – Ecology Liaison Group

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
July 2019	ELG	<p>Key Topics</p> <p>Purpose of the group.</p> <p>Membership (outline and agree Terms of Reference).</p> <p>Norwich Western Link (NWL) project update.</p> <p>Outline of survey results and scope of surveys up to 2020.</p> <p>Principal areas of interest regarding the NWL.</p> <p>Key Outcomes</p> <p>Consultees committed to providing any lessons learned from previous road schemes.</p> <p>NCC confirmed that all ecological survey work would be undertaken prior to planning being submitted.</p>
October 2019	ELG	<p>Key Topics</p> <p>NWL project update.</p> <p>Outline of survey results and scope of surveys up to 2020.</p> <p>Overview of biodiversity net gain (BNG).</p> <p>Study area to discussion on opportunities and ideas for habitat creation and improvement.</p> <p>Key Outcomes</p> <p>NCC detailed that that the area for BNG that was currently being considered was within relatively close proximity to the NWL i.e. not over 10km away.</p> <p>NCC confirmed air and water monitoring will be undertaken.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
September 2020	ELG	<p>Key Topics</p> <p>NCC confirmed that the Proposed Scheme is designed to avoid ancient woodland; unfortunately, a small amount of ancient tree loss was unavoidable.</p> <p>Outline of NWL survey baseline reports 2019 provided. Approaches to survey activities agreed with Natural England.</p> <p>NWL 2020 survey scope presented including interim results and overview of the emerging ecological strategies for mitigation and compensation.</p> <p>Highways England provided an update on the following A47 schemes: North Tuddenham to Easton; Thickthorn Junction; Blofield to North Burlingham.</p> <p>Key Outcomes</p> <p>NCC confirmed viaduct runoff management – viaduct run off management has been assessed and forms part of the design for the Proposed Scheme.</p> <p>NCC confirmed that the BNG strategy will be undertaken; and woodland and wetland habitats will be targets as part of the strategy. WSP (on behalf of NCC) will continue to discuss the strategy with the group in subsequent meetings.</p>
January 2021	ELG	<p>Key Topics</p> <p>NWL project update, including timetable for the Project.</p> <p>Update on 2020 and 2021 ecological surveys. Key observations – interesting snail population near River Wensum (Desmoulin's Whorl Snail <i>Vertigo moulinsiana</i>), Great Crested Newt <i>Triturus cristatus</i> eDNA surveys carried out.</p> <p>Environmental Mitigation and Enhancement Timeline.</p> <p>NCC queried whether any attendees had information on landowners who might be interested in having environmental mitigation/improvement measures on their land as an addition to the parties it was already approaching.</p> <p>Key Outcomes</p> <p>Toad Watch provided information on ponds in relation to benefitting Common Toad <i>Bufo bufo</i>.</p> <p>NCC confirmed that winter bird surveys are underway and breeding bird surveys are planned for 2021, which will detect Marsh Harrier <i>Circus aeruginosus</i> (if present).</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
July 2021	ELG	<p>Key Topics</p> <p>NWL Project Update. Outline Business Case submitted to Department for Transport. Pre-planning application public consultation proposed in Autumn 2021. Surveys ongoing; including topographical noise and river surveys.</p> <p>2020 Survey Results and 2021 Survey Progress. Provided brief overview of 2020 results for wintering birds, Great Crested Newts (GCN), reptiles, Badgers <i>Meles meles</i>, Otters <i>Lutra lutra</i>, Water Vole <i>Arvicola amphibius</i>, Desmoulin's Whorl Snail, macrophytes, macroinvertebrates and River Habitat Survey. Survey work in 2021 to complete the baseline includes surveys for breeding birds, GCN, hedgerow, National Vegetation Classification (NVC), terrestrial invertebrates and baseline habitat surveys to inform BNG.</p> <p>Mitigation Strategy Update.</p> <p>A47 Highways England Update.</p> <p>Key Outcomes</p> <p>NCC advised that measures will be put in place in a Construction Environmental Management Plan (CEMP) and that they are working very closely with the contractor to ensure that all mitigation measures are adhered to.</p> <p>NCC outlined that should artificial Badger setts be proposed to compensate for loss of existing setts they would be closed under licence from Natural England under an approved method statement at an appropriate time of year.</p> <p>NCC acknowledged comments that dry ponds still hold suitability for GCN and confirmed that ponds recorded as dry in during the 2020 surveys were subject to an updated scoping visit in 2021 to assess if still dry, with follow-up eDNA surveys undertaken where ponds were found to hold sufficient water for sampling.</p> <p>NCC have requested data from third parties to inform impact assessment work.</p> <p>NCC outlined that a specific appendix to the Environmental Statement will cover Species of Principal Importance (SPI) including Common Toad.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
July 2022	ELG	<p>Key Topics</p> <p>NWL Project Programme and Updates. Cabinet approved Ferrovia as the NWL design and build contractor. Public consultation to be summer 2022.</p> <p>NCC confirmed that a single American Mink <i>Neovison vison</i> had been recorded by WSP, and that mink will be accounted for in the mitigation.</p> <p>NCC stated that a licence for Otter is not required at this time, and that specific habitat compensation measures for Otter have not been proposed.</p> <p>NCC stated that there are a few Badger setts in the survey area and that at present no main setts will be directly impacted by the Proposed Scheme.</p> <p>NCC stated that GCN eDNA surveys had been undertaken and that they had returned negative results.</p> <p>Key Outcomes</p> <p>Contractor has been added to list of ELG invitees.</p>
September 2022	ELG	<p>Key Topics</p> <p>NCC explained that pre-planning application public consultation is now live.</p> <p>Outline Business Case addendum approval is being finalised ahead of formal submission to Department for Transport.</p> <p>Surveys to inform the planning application are continuing on site.</p> <p>Ferrovia Construction, the design and build contractor, is using stakeholder engagement and outcomes of the public consultation to inform the design.</p> <p>Planning application is scheduled to be submitted in spring 2023.</p> <p>NCC confirmed that the possibility of satisfying net gain targets within the existing red line boundary is being investigated, including a review of the biodiversity metric and the land required.</p> <p>Ecological Mitigation and Enhancements – NCC provided an overview for habitats and protected species.</p> <p>Key Outcomes</p> <p>NCC confirmed that pond designs will include the aim of supporting wildlife and additional pond(s) away from the highway will be considered.</p>

Table 10-2 Consultation Summary table – Consultees including Natural England and the Environment Agency

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
June 2016	Natural England	<p>Key Topics</p> <p>River Wensum Special Area of Conservation / Site of Special Scientific Interest – potential impacts. Assent required for ecological base line surveys.</p> <p>Key Outcomes</p> <p>It was agreed that crossing points of the River Wensum will be considered at design stage. Natural England confirmed that no specific assent process would be required for ecological surveys. Surveys of the River Wensum are required and opportunities to maximise enhancements should be considered.</p>
October 2018	Natural England & The Environment Agency	<p>Key Topics</p> <p>Ecology Survey Scope. Other species would also be considered including macrophytes, fish and Desmoulins Whorl Snails to be undertaken from July.</p> <p>Key Outcomes</p> <p>A better understanding of scope and work required once preferred route alignment is known. The rest of species surveys would be carried out over the next year.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
October 2018	NCC (including NCC Ecologist)	<p>Key Topics</p> <p>Surveys – existing information regarding GCN, Otter, Water Vole, reptiles, breeding and wintering birds, aquatic invertebrates, terrestrial invertebrates, fish. NCC Ecologist stated there were not many GCN in the study area. NCC Ecologist confirmed the approach of first using eDNA to survey ponds within 250m of the preferred route and then doing populations surveys on the ponds where presence was confirmed. NCC Ecologist confirmed there are otter present on the Wensum and the Tudd. NCC Ecologist confirmed there are WV present on the Wensum and in ditches. NCC Ecologist confirmed there are Grass Snakes <i>Natrix helvetica</i> in the area. NCC Ecologist confirmed there are Barn Owl <i>Tyto alba</i> and Kingfisher <i>Alcedo atthis</i> in the area.</p> <p>Mitigation – habitat fragmentation is the key issues that needs to be addressed. To ensure no likely significant effect on the Wensum the key issue will be preventing water pollution (assuming the river is crossed via a viaduct).</p> <p>Compensation - Habitat compensation will be required due to loss of CWS and priority habitat i.e. woodlands and hedgerows. Outlined the vision for a landscape scale approach to the habitat compensation required which fits in with Natural England's concerns. Opportunities for links connecting the north and south should be explored.</p> <p>Key Outcomes</p> <p>Cost of green bridges to be investigated.</p> <p>Landowner map for the study area to be produced.</p> <p>Agreed to liaise with landscape architect regarding the requirements for screening as part of the scheme.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
March 2019	Natural England & The Environment Agency	<p>Key Topics</p> <p>Aquatic ecology survey methodology</p> <p>Macrophyte survey methodology</p> <p>White-clawed Crayfish <i>Austropotamobius pallipes</i> survey methodology</p> <p>Connectivity of the Proposed Scheme to spawning grounds</p> <p>National Vegetation Classification survey scope</p> <p>Key Outcomes</p> <p>Agreed to undertake aquatic surveys beyond the River Wensum, looking at functional linkage</p> <p>Agreed not to dismiss the significance of Ranunculus as an indicator of river type even if absent during surveys</p> <p>It was agreed that although likely absent from the River Wensum, White-clawed Crayfish surveys would still be undertaken.</p> <p>It was agreed that the Proposed Scheme would look to maintain connectivity between the main river channel to tributaries, spawning grounds and fry refuges.</p> <p>In regard to NVC survey, Natural England advised to survey for rare arable plants.</p>
June 2019	Natural England & The Environment Agency	<p>Key Topics</p> <p>Ecology survey programme and results of ecology surveys to date</p> <p>HRA Scoping - issued note had been reviewed by Natural England</p> <p>Key Outcomes</p> <p>Several studies to be undertaken to support impact assessment work on the River Wensum – agreed that these should include hydrogeological assessment and shading analysis. Scope of works should be sent to Natural England.</p>
November 2019	Natural England & The Environment Agency	<p>Key Topics</p> <p>Ecological impact of Preferred Route - Habitats Surveys focussing on Habitats of Principal Importance, Hedgerows and Watercourses. The Proposed scheme will result in loss of deciduous woodland.</p> <p>Key Outcomes</p> <p>Survey scope issued to Natural England for review</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
January 2020	Natural England & The Environment Agency	<p>Key Topics</p> <p>Natural England licencing policy - Discussion held regarding the use of Natural England licencing policy principles, with a focus on wetland habitat creation rather than fencing and translocation for Great Crested Newts</p> <p>Mitigation for reptiles during construction</p> <p>Water Vole mitigation - options discussed included temporary trapping; or accepting temporary disturbance and enhance surrounding area.</p> <p>Barn Owl survey methodology</p> <p>Key Outcomes</p> <p>No objections from Natural England on reptile and Water Vole mitigation proposals and Barn Owl survey methodology</p>
October 2020	Natural England / NCC	<p>Key Topics</p> <p>Shading analysis – technical note issued to Natural England</p> <p>Desmoulin’s Whorl Snail – survey methodology and mitigation</p> <p>Survey of additional groups – fungi proposed.</p> <p>Lifespan of survey data</p> <p>Key outcomes</p> <p>Natural England commented on life span of survey data - survey of habitat - if that hasn’t changed judgements can be made that species that use the habitat haven’t changed either. An explanation note will be appended to relevant historic baseline reports and this chapter to consider the 2022 re-alignment and review the previous assessment.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
December 2020	Natural England	<p>Key Topics</p> <p>Technical Notes on shading and bats issued to Natural England</p> <p>Desmoulins Whorl Snail mitigation</p> <p>Barn Owl survey methodology</p> <p>Key outcomes</p> <p>Desmoulins Whorl Snail mitigation - Natural England detailed that it is key that there is confidence the new habitat is appropriate and that the management will support the long-term population.</p> <p>Natural England confirmed in response to the technical note that shading analysis is required.</p> <p>For Barn Owls, Natural England requested habitat and food resource enhancement in addition to nest boxes</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
March 2021	Natural England	<p>Key Topics</p> <p>Lichen desk study - will look at Phase 1 Habitat Map and local records. 200m buffer from Proposed Scheme alignment. Will define requirement for field-based assessment.</p> <p>Survey data validity - NCC are preparing a Technical Note providing an overview of ecological survey data collected to date and that proposed for 2021.</p> <p>Updated Barn Owl survey scope - Scope has been developed in consultation with two Barn Owl experts which is split into three stages, based on an assessment area of 1km from the Proposed Scheme alignment.</p> <p>Species of Principal Importance (SPI) - Desk-based habitat level assessment to inform impact assessment</p> <p>Key outcomes</p> <p>Natural England case officer has been in touch with the Natural England lichen specialists and they are briefed should a review be required.</p> <p>Natural England happy in principle with survey data validity.</p> <p>Natural England agreed with Barn Owl survey scope, particularly that foraging habitat was being considered.</p> <p>Natural England happy with SPI approach though questioned whether mitigation measures would be put in place in the event of large numbers of additional SPI (such as Harvest Mouse <i>Micromys minutus</i>) being encountered on site during the construction phase. NCC advised that appropriate measures would be outlined in the CEMP and that measures put in place for other protected species such as provision of an ECoW and appropriate site management techniques would also protect additional SPI during the construction phase.</p> <p>Natural England provided feedback on HRA impact pathways primarily ensuring flow levels, form and function are captured within the HRA effect pathways. In addition to consider the combination of different pathways and their impacts on a single receptor. e.g. relatively low impacts in combination can have a greater effect. Natural England mentioned that consideration should be given 'pathway approach' rather than distance approach. Places downstream may be affected beyond the distances (realistic pathways).</p>
June 2021	Natural England	<p>Key Topics</p> <p>Review of 2020 survey results and interim results from 2021</p> <p>Protected species licencing approach</p> <p>Key outcomes</p> <p>Agreed that a Letter of No Impediment (LONI) or similar from Natural England would be an appropriate process for the Project to address protected species.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
February 2022	Natural England	<p>Key Topics</p> <p>Badger mitigation – NCC detailed that Mitigation and compensation will include:</p> <ul style="list-style-type: none"> • Development of a licence to permit closure of badger setts lost to facilitate the Proposed Scheme. • Pre-construction badger survey will be undertaken to ensure any new setts are accounted for. • Measures to maintain habitat connectivity between retained setts are also incorporated into the Proposed Scheme design, including badger tunnels, green bridges and underpasses. Fencing designed to funnel badgers towards tunnel entrances and prevent badgers crossing the road • Measures to mitigate disturbance, pollution and potential killing/injury <p>Sett closure would be conducted under a Natural England licence.</p> <p>Barn Owl mitigation – NCC detailed that measures will include:</p> <ul style="list-style-type: none"> • Relocating occupied breeding site (OBS) nest box to an appropriate location away from construction works outside breeding season in advance of works. As this will take place outside of the breeding season (September to February inclusive), it is not envisaged that a licence will be required. • Pre-works checks for nesting Barn Owl on the two potential nest sites (PNS) within the Proposed Scheme (to be detailed in CEMP). • Mitigation avoiding a net loss in suitable foraging habitat, through providing compensatory grassland habitat and nest boxes through the Habitat Compensation Strategy (HCS). • Measures will also be included to reduce collision risk such as regular management of verges and appropriate screening along the new highway to encourage Barn Owls to flight at height over the road. <p>Desmoulin's Whorl Snail Mitigation - Mitigation is focussed on ensuring no net loss in supporting habitat, as well as providing habitat enhancements for the populations present to ensure their favourable conservation status is maintained in the long-term.</p> <p>Otter mitigation - surveys covered all suitable watercourses and associated riparian habitat within and up to 800m from the Proposed Scheme (up and down stream), including the River Wensum and associated floodplain watercourses, as well as Foxburrow Stream to the south. Surveys confirmed the presence of Otter within the River Wensum, with field signs including spraints, footprints and direct sightings. No Otter holts were identified in proximity to the Proposed Scheme during the surveys and therefore it is not envisaged that a licence will be required for this species. Measures to mitigate disturbance, pollution and potential killing/injury of otters will be outlined in the CEMP. Habitat connectivity will also be maintained, notably beneath the River Wensum viaduct and temporary bailey bridge</p> <p>Water Vole mitigation – NCC proposes temporary displacement of Water Voles from impacted sections of watercourses under the appropriate class Natural England licence. Habitat connectivity will also be maintained, notably beneath the River Wensum viaduct and temporary bailey bridge. Connectivity will also be maintained at additional watercourse crossing points through appropriate design of culverts. The Proposed Scheme also aims to deliver conservation gains for the local Water Vole population through habitat compensation including enhancement of ditches.</p> <p>Key Outcomes</p> <p>Badgers – Natural England noted that it was good to see extensive bait marking and that no main setts will be lost. Mitigation tunnels under the road are a good idea but may need fine tuning following opening of the Proposed Scheme. Natural England further agreed that baseline surveys and mitigation proposals were appropriate. Natural England noted that starting the construction in September would be preferable.</p> <p>Barn Owl- Natural England asked whether compensation would be based on type 1 habitat and whether the type 2 habitat is present all year round (or are there agricultural practices that limit this). NCC mentioned that most of the existing grassland was type 2 and therefore compensation will aim to provide areas of permanent, high quality foraging habitat. This was agreed by Natural England. It was also agreed that the viaduct design was appropriate for Barn Owls.</p> <p>Desmoulin's Whorl Snail – Natural England mentioned that the predominant habitat for Desmoulin's Whorl Snail is now more commonly ditches and marshy habitat so mitigation should be clear on this. Desmoulin's Whorl Snail have humidity requirements so need to be within an appropriate climate envelope. Shallow ponds would be good mitigation and that mitigation should form extensively wide, well-engineered hydroclines with enough water that snails can track the water level to be most effective.</p> <p>Otter - Natural England mentioned that this was not a high impact scheme for Otter and it was good to see viaduct structure in place (as tunnels aren't ideal for otters). It was further highlighted that lack of lighting on the viaduct is necessary. On this basis it was agreed that the mitigation proposals for Otter were appropriate.</p> <p>Water Voles - Natural England stated that habitat creation needs to be developed well before translocation, the earlier the compensation areas are established the better. Natural England were content with mitigation proposals as long as displacement fits in with class licence distances.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
November 2022	Natural England	<p>Key Topic</p> <p>A draft badger licence submission was sent to Natural England.</p> <p>Key outcome</p> <p>Letter of No Impediment (LONI) was received in October 2023. The LONI contained the following requirements for inclusion in a full licence submission on planning determination:</p> <ul style="list-style-type: none"> • A pre-construction badger survey will be undertaken prior to submission for the mitigation licence submission to ensure that the sett information is updated and accurate at the time of application. • A Note identifying who will be responsible for Health & Safety considerations when working under the Natural England badger licence. • The badger bait-marking results map will be included. • A map of green bridges, underpass locations and similar devices (for badgers) will be provided, together with details of fence locations as determined at the detailed design stage. <p>Confirmation that the proposed artificial sett will conform to Scottish Natural Heritage’s “Guidance for the creation of artificial setts”, but as modified by Natural England in the badger class licence WML – CL35.</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
November 2022	Natural England	<p>Key Topic</p> <p>A draft water vole licence submission was sent to Natural England.</p> <p>Key outcome</p> <p>Letter of No Impediment (LONI) was received in October 2023. The LONI contained the following requirements for inclusion in a full licence submission on planning determination:</p> <ol style="list-style-type: none"> 1. Some photographs showing the site of the proposed River Wensum viaduct and of the various water courses would be useful for the actual MS used at the time of licence application. 2. Confirmation that the water vole populations remaining in water course WC5 either side of the 70m-long culvert will still have access to the wider environment via interconnecting water courses, both upstream and downstream of the proposed site of works. 3. Section 1.3.7 & 3.1.4 – confirmation that the permanent 15m-long culvert on WC5 will be constructed (as far as is possible) to provide optimum provision for water voles to pass through it, in line with the latest research and guidance for this species. 4. Section 4.2.21 – it is not intended to fence the proposed receptor sites for trapped and translocated water voles to prevent prior colonisation by local water vole populations. Bearing in mind the decreasing levels of American Mink predation at this location, could some thought be given to preparing an “emergency” fenced receptor area for use if needed? <p>Responses to the above requirements were provided to Natural England:</p> <ol style="list-style-type: none"> 1. The final licence application will include photographs of the site of the proposed River Wensum viaduct and of the various water courses. 2. The final licence application will include this confirmation and a more detailed explanation. Temporary works and permanent culverts will provide upstream and downstream connectivity. 3. The final licence application will include confirmation that the permanent 15m-long culvert on WC5 will be constructed (as far as is possible) to provide optimum provision for water voles to pass through it. Planning application drawings will be included for information. 4. Yes - the final licence application will include considerations for an emergency fenced receptor area.

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
December 2022	Environment Agency, Natural England	<p>Key topics</p> <p>Aquatic ecology surveys</p> <p>HRA Screening and next steps</p> <p>Biodiversity ES Chapter - aquatic ecology</p> <p>Geomorphology Assessment/ Shading analysis</p> <p>Construction Mitigation – Scour Protection</p> <p>Biodiversity Net Gain and Enhancement</p> <p>Key outcomes</p> <p>HRA Screening:</p> <p>Natural England queried the scoping of the River Habitat/Wider Watercourse and raised the Supplementary Advice for Conservation Objectives for consideration. NE raised the objective to target favourable condition for White-clawed Crayfish. NE raised that the Desmoulin's Whorl Snail meta population is to be considered within the assessment.</p> <p>The Environment Agency queried the missing hydrological assessment in Appendix B and that they had only seen the baseline Flood Risk Assessment of the Proposed Scheme. It was agreed that the Flood Risk Assessment would be issued to the Environment Agency when complete.</p> <p>HRA Screening – Natural England's request that the in-combination assessment consider all intersecting energy schemes (including Hornsea 3 / Sheringham Shoals) was acknowledged.</p> <p>Geomorphology Assessment/ Shading analysis - Natural England queried whether cattle under the viaduct alter land surface characteristics and increase sediment ingress. WSP outlined how the Manning Coefficient tests for a worst case in terms of roughness. It was agreed that post construction monitoring and active management would be considered.</p> <p>Construction Mitigation – Scour Protection – Natural England stated a preference for Option 4 (not Scour Protection), maintain the natural function of the floodplain. The Environment Agency stated a preference for Options 1 or 4 but that they would confirm after internal consultation.</p> <p>Biodiversity Net Gain and Enhancement – it was agreed that a list of queries relating to this topic be sent to Natural England, for Natural England to respond. 'Additionality' in enhancements was noted. Natural England noted that they have input into BNG but that overall it was the Department for Environment, Food & Rural Affairs (DEFRA).</p>

Date of consultation	Consultee	Summary of Key Topics and Key Outcomes
December 2023	Natural England	<p>Key Topics</p> <p>Natural England reviewed a draft version of the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34). Natural England raised that the critical loads for Nitrogen were incorrect as per the updates values on APIS, and that the results for Nitrogen deposition would therefore be incorrect. Natural England also raised that a rationale was needed to explain why an in-combination assessment was omitted from the document.</p> <p>Key Outcomes</p> <p>A response was provided to Natural England to:</p> <ul style="list-style-type: none"> • Clarify that the critical loads for Nitrogen were incorrect due to the report being drafted prior to the APIS updates; and • Provide assurance to Natural England that all critical loads in the final version of the Air Quality Ecological Impact Assessment will reflect contemporary APIS values. <p>Additional text explaining the relevance of an in-combination/cumulative assessment is included in the Air Quality Ecological Impact Assessment (Appendix 10.34) (Document Reference: 3.10.34).</p>
December 2023	Natural England	<p>Key Topic</p> <p>Natural England's High Level Review of Outstanding Issues as at 4 December 2023, including a review of the Outline Construction Environment Management Plan (OCEMP).</p> <p>Natural England raised that the developer needs to ensure that all measures discussed and designed, at the pre-application stage to avoid, mitigate or compensate for environmental impacts, are incorporated into the plans to design and build the scheme. Natural England also raised that the OCEMP will need to demonstrate how the construction of the proposed road will incorporate and implement these measures effectively, and in accordance with the Environmental Statement and the Habitats Regulations Assessment.</p> <p>Key Outcomes</p> <p>The OCEMP demonstrates that the construction of the proposed road will incorporate and implement all measures to avoid, mitigate or compensate for environmental impacts effectively, and in accordance with the Environmental Statement and the Habitats Regulations Assessment.</p>



10.6 Scope of the assessment

Overview

- 10.6.1 Scoping determines the issues to be covered in an Ecological Impact Assessment (EclA), in accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) EclA Guidelines (CIEEM, 2018).
- 10.6.2 The scope of this assessment has been established through an ongoing scoping process, including the production of an Environmental Impact Assessment Scoping Report in 2020 (as presented in **Appendix 5-1** (Document Reference: 3.05.01)), and the receipt of a Scoping Opinion Decision Letter in 2022, as included in **Appendix 5-2** (Document Reference: 3.05.02). Further information can be found in **Chapter 5: Approach to EIA** (Environmental Impact Assessment) (Document Reference: 3.05.00).
- 10.6.3 A Scoping Report Addendum, as presented in **Appendix 5-3** (Document Reference: 3.05.03), was submitted to NCC in July 2022 which outlined a review of the scope of the ES against a localised alignment refinement and detailed the proposed level of assessment for mitigation areas set back from the main Proposed Scheme route. A response was received on the 27 September 2022 as shown in **Appendix 5-4** (Document Reference: 3.05.04).
- 10.6.4 This section provides an update to the scope of the assessment and updates the evidence base for scoping out issues following further iterative assessment. **Table 10-3** provides an update to the scoping process summarised in the 2020 Scoping Report and includes deviations from the report as part of this assessment.
- 10.6.5 The scope of this chapter does not include bat species. The NWL ES includes a separate chapter for the consideration of bat species (**Chapter 11: Bats** (Document Reference: 3.11.00)).

Table 10-3 Comparison of scoping judgments compared with 2020 Scoping Report

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
Impacts to Paston Great Barn SAC	Scoped out	Scoped out	Designated for supporting bat species. The ES includes a separate chapter for the consideration of bat species (Chapter 11: Bats (Document Reference: 3.11.00)). This issue has therefore been scoped out of this chapter.
Impacts to Norfolk Valley Fens SAC during the operation of the Proposed Scheme	Scoped out	Scoped in	The Norfolk Valley Fens SAC was listed as 'scoped out' in the 2020 Scoping Report, as no likely significant effects were expected due to the substantial distance from the Proposed Scheme and lack of hydrological links. This feature has now been scoped back into the assessment as predicted changes in traffic volumes (see Chapter 6: Air Quality (Document Reference: 3.06.00) are considered likely to potentially affect one of the SAC component areas during the operation of the Proposed Scheme (Potter and Scarning Fens SSSI). Other component areas of Norfolk Valley Fens SAC have been excluded from this assessment as there are no impact pathways between them and the Proposed Scheme as determined within the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34).

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
<p>Assessment of direct loss of habitat during the construction phase due to construction creep only for the following features:</p> <p>River Wensum Pastures, Ringland Estates CWS</p> <p>Attlebridge Hills CWS</p> <p>Broom & Spring Hills CWS</p> <p>Wensum Pastures at Morton Hall CWS</p> <p>Primrose Grove CWS</p> <p>Gravelpit Plantation and Church Hill CWS</p> <p>Land adjoining Foxburrow Plantation CWS</p> <p>Old Covert, Wood Lane CWS</p> <p>Ancient woodland</p> <p>Hedgerows</p> <p>Habitats of Principal Importance</p>	Scoped in	Scoped out	<p>The Red Line Boundary for the Proposed Scheme is now fixed. Any other potential issues through construction are included in other impact pathways and assessed accordingly in this chapter.</p>
<p>Effects on the following during Construction and Operation:</p> <p>Swannington Upgate Common SSSI;</p> <p>Whitwell Common SSSI;</p> <p>Hockering Wood SSSI; and</p> <p>Rosie Curston's Meadow, Mattishall SSSI</p> <p>All Local Nature Reserves (LNR) and National Nature Reserves (NNR)</p>	Scoped in	Scoped out	<p>No likely significant effects are expected due to the following:</p> <p>Degradation through pollution and a reduction in air quality: substantial distance and no hydrological links between these sites and the Proposed Scheme. None of these sites are within the Zone of Influence of the Affected Road Network.</p> <p>Disturbance: The Proposed Scheme is not expected to increase visitor pressure on these features once operational.</p>

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
Effects on the following during Construction and Operation: Ave's Gap CWS; Hall Hills/ Ringland Covert CWS; Ringland Pits CWS; Jennis' Wood & Dryhill Plantation CWS; Triumph & Foxburrow Plantations CWS; Bush Meadow Plantation CWS; Lake adjacent to Concreted Plant CWS; and Park Grove CWS.	Scoped out	Scoped out	No likely significant effects are expected due to the following: No hydrological links and substantial distance from these features to the Proposed Scheme (over 200m), therefore an increase in nitrogen deposition from traffic is not expected to affect these features. Disturbance: the Proposed Scheme is not expected to increase visitor pressure on these features once operational.

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
Effects on white-clawed crayfish <i>Austropotamobius pallipes</i> during Construction and Operation.	Scoped out	Scoped out	<p>No likely significant effects are expected due to the following:</p> <p>Likely absence: Surveys undertaken in 2019 confirmed likely absence of white-clawed crayfish within the River Wensum due to the presence of the non-native American signal crayfish (<i>Pacifastacus leniusculus</i>). Signal crayfish out-compete the white-clawed crayfish through competition for refuges, reproduction interference and predation, and the introduction of a microsporidial pathogen (known as the crayfish plague) for which the white-clawed crayfish has no immunity (Peay, 2002a; 2002b; 2003). Recolonisation is now considered very unlikely due to the establishment of an American signal crayfish population. In the event of a reintroduction programme, it is anticipated that the Proposed Scheme will have no adverse effect on the re-establishment of a white-clawed crayfish population.</p>
Effects of in-channel works that would directly affect the River Wensum (including its marginal habitats).	Scoped in	Scoped out	<p>No in-channel works that will directly affect the River Wensum will be undertaken as part of the Proposed Scheme. No realignment or engineering of the river channel will be undertaken. The Wensum will instead be crossed with a viaduct, with an additional temporary bridge to permit access across the river also installed during construction but removed upon Proposed Scheme's completion. The effects of such works are therefore not included within this assessment (but for the avoidance of doubt effects from shading are included).</p>

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
Air quality impacts on the following during operation: Alderford Common SSSI; Norfolk Valley Fens SAC/ Potter & Scarning Fens, East Dereham SSSI; Church Hill Common CWS; Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS; Fen Plantation CWS; Fen West of East Tuddenham CWS; Jennis' Wood & Dryhill Plantation CWS; Lenwade Pits (East) CWS; Marriott's Way CWS; Walsingham Plantation CWS; and, Weston Meadow CWS.	Scoped out	Scoped in	Scoped in to the air quality assessment due to modelling of the Affected Road Network (Chapter 6: Air Quality (Document Reference: 3.06.00)). Assessed within the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34).

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
<p>Air quality impacts on the following during operation:</p> <p>Bawburgh/Colney Gravel Pits CWS;</p> <p>Botany Bay Farm CWS;</p> <p>Brook House Marshes CWS;</p> <p>Church Wood Ancient Woodland;</p> <p>Costessey Pits (East) CWS;</p> <p>Earlham and Colney Marshes CWS;</p> <p>East Hills CWS;</p> <p>Great Witchingham Common CWS;</p> <p>Hellesdon Pastures CWS;</p> <p>Horsham Meadows CWS;</p> <p>Intwood Carr CWS;</p> <p>Lenwade Pits (West) CWS;</p> <p>Long Dell and Westlodge Hills CWS;</p> <p>Meadow Farm Meadow CWS;</p> <p>Primrose Grove Ancient Woodland;</p> <p>Primrose Grove Ringland CWS;</p> <p>River Tud at Easton and Honingham CWS;</p> <p>River Yare (west and east), Bowthorpe CWS;</p> <p>Snake Wood Ancient Woodland;</p> <p>Sprowston Wood Ancient Woodland;</p> <p>Sweetbriar Road Meadows, Norwich SSSI; and</p> <p>Taverham Mill CWS.</p>	<p>Not Applicable</p>	<p>Scoped in</p>	<p>Scoped in to air quality assessment due to modelling of the Affected Road Network (Chapter 6: Air Quality (Document Reference: 3.06.00)). Assessed within the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34).</p>

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
Impacts of habitat degradation through a reduction in air quality during the operation phase on: <ul style="list-style-type: none"> • Amphibians (Great crested newt and common toad); • Birds; • Badgers; • Otters; • Water Voles; • Species of Principal Importance; • Reptiles; • Desmoulin's whorl snail; • Terrestrial Invertebrates; and • Aquatic macroinvertebrates. 	Scoped in	Scoped out	In response to recently published guidance (CIEEM., 2023) the impacts of habitat degradation through a reduction in air quality during the operation phase on habitats and designated nature conservation sites will remain scoped in as part of this assessment, and the impacts of habitat degradation through a reduction in air quality during the operation phase on species will not be assessed. Impacts on species have been scoped out on the premise that the latest guidance states that the impacts of changes in air quality on habitats is testable, whereas the impacts of changes in air quality on species is not. Without sound evidence, a robust assessment cannot be undertaken.

Ecological issue	Scoping as per the NWL Environmental Impact Assessment Scoping Report (WSP, 2020)	Scoping for this chapter	Justification
<p>Impact of habitat degradation through a reduction in air quality during the operation phase on the following Habitats of Principal Importance:</p> <ul style="list-style-type: none"> • Purple Moor Grass and Rush Pasture HPI; • Lowland Mixed Deciduous Woodland HPI; • Coastal and Floodplain Grazing Marsh HPI; • Wet Woodland HPI; and, • Hedgerow HPI. 	<p>Scoped in</p>	<p>Scoped out</p>	<p>HPI were not considered as a separate feature as part of the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) as it is considered that CWS would constitute a representative amount of the HPI within the ARN, and as it was concluded that a suitable assessment could not be made of HPI considering the paucity of publicly accessible information available with regards to HPI condition. Within 200m of the ARN, 2,103ha of HPI was identified, comprising 63.69% deciduous woodland. The Sites considered within the ARN cover 39.82% of all the HPI.</p> <p>The following CWS should be used as a proxy for determining the effect of habitat degradation through a reduction in air quality during the operation phase on HPI:</p> <ul style="list-style-type: none"> • Purple Moor Grass and Rush Pasture HPI - Land adjoining Foxburrow Plantation CWS • Lowland Mixed Deciduous Woodland HPI - Broom & Spring Hills CWS; • Coastal and Floodplain Grazing Marsh HPI - River Wensum Pastures CWS and the Wensum Pastures at Morton Hall CWS; • Wet Woodland HPI - River Wensum Pastures CWS, Wensum Pastures at Morton Hall CWS, and the Land adjoining Foxburrow Plantation CWS.



10.7 Potential Impacts

Construction Phase

10.7.1 The following potential construction phase impacts considered to have the potential to give rise to likely significant effects have been considered within this assessment:

- a. Mortality and / or injury of protected and notable species;
- b. Permanent and temporary removal of habitats within and adjacent to the Proposed Scheme, including the severance or fragmentation of ecological networks;
- c. Water-borne pollution (sediment loading and accidental release of hazardous materials) leading to the deterioration or degradation of habitats including their supporting role for protected and otherwise notable species, and harm to species;
- d. Air pollution leading to the deterioration or degradation of habitats including their supporting role for protected and otherwise notable species;
- e. Hydrological change;
- f. Increased shading of habitats;
- g. Disturbance through construction related noise, visuals, vibration and lighting; and,
- h. Introduction of Invasive and Non-Native Species (INNS) in the terrestrial and aquatic environments.

Operation Phase

10.7.2 The following operational phase impacts considered to have the potential to give rise to likely significant effects have been considered within this assessment:

- a. Mortality and / or injury of protected and notable species;



- b. Fragmentation of retained habitats and/or severance of wildlife corridors, territories or foraging routes;
- c. Water-borne pollution leading to deterioration of habitats including their supporting role for protected and otherwise notable species, and harm to species;
- d. Hydrological change;
- e. Disturbance from operational noise, vibration and lighting, or changes in human presence, including maintenance activities;
- f. Increased shading of habitats; and,
- g. Air pollution (including localised changes in air quality as a result of emissions from vehicles using the completed River Wensum Viaduct, and Air quality changes within the Affected Road Network (ARN)) leading to deterioration of habitats including their supporting role for protected and otherwise notable species.

10.8 Assessment methodology

Overview

10.8.1 This chapter details the analysis and assessment of potentially significant effects predicted to arise from the Proposed Scheme on the following categories of ecological feature:

- Statutory designated sites;
- Non-statutory designated sites;
- Habitats; and
- Protected and notable species.

10.8.2 The overarching EIA methodology for the Proposed Scheme is defined in **Chapter 5: Approach to EIA** (Document Reference: 3.05.00). The methodology applied to this chapter is specific to biodiversity however, and in part deviates from the approach stated in **Chapter 5**.



10.8.3 The Ecological Impact Assessment (EclA) presented in this chapter has been carried out pursuant to relevant legislation, planning policy and guidance. In accordance with the Chartered Institute of Ecology and Environmental Management (CIEEM) EclA Guidelines (CIEEM, 2018), an assessment has been undertaken that collated relevant baseline information to predict the effects of the Proposed Scheme on Important Ecological Features (IEF).

10.8.4 Important Ecological Features (IEF) are defined in section 10.10. The Chapter then presents the assessment of the potential effects arising from the construction and operation phases of the Proposed Scheme on each IEF in turn. A preliminary assessment of likely impacts and effects is first undertaken. This preliminary assessment considers Embedded Mitigation measures only.

10.8.5 The Additional Mitigation measures relevant to the IEF are then presented, and the potential residual effects arising from the construction and operation phases of the Proposed Scheme considering these measures are determined. This process is undertaken for each IEF in turn rather than working through each stage of the assessment for all features.

10.8.6 This chapter makes a distinction between the use of the terms 'mitigation' and 'compensation'. In the context of this chapter, and in line with CIEEM guidance (CIEEM, 2018), 'mitigation' is defined as measures to avoid or minimise negative effects on biodiversity features, and 'compensation' is defined as measures to offset significant residual negative effects despite the mitigation proposed. It should also be noted that for the purposes of this chapter, the term 'Additional Mitigation' is a holistic term that covers avoidance, mitigation and compensation measures beyond those considered as the Embedded Mitigation measures.

10.8.7 A significant effect is defined as an effect that could have an impact upon the structure, form, function and conservation status of a designated site, habitat and ecosystem or species population where these are defined as Important Ecological Features. The relative importance of ecological features will be valued against a geographic frame of reference.



10.8.8 Mitigation has been developed on an iterative basis, with the mitigation hierarchy followed; preference is first given to avoiding effects, then reducing remaining effects, before applying targeted mitigation where necessary. Where residual effects remain after application of targeted Mitigation Measures, compensation has then been considered.

10.9 Establishment of baseline conditions

10.9.1 A combination of numerous desk studies and field surveys were undertaken since 2018 to establish the baseline conditions of ecological features.

Desk Study

10.9.2 Numerous desk studies were undertaken to inform the ecology survey effort, ensure the validity of data, account for scheme design refinements and establish the baseline conditions of ecological features for assessment purposes. An initial desk study was undertaken in 2018. An update desk study was undertaken in 2020 to inform the production of surveys and reports undertaken from 2020-2021. A 2022 desk study was undertaken to inform the production of this chapter. The following sources were consulted to collate historical ecological records within the relevant study areas of the Proposed Scheme:

- [Ordnance Survey \(OS\) website](#)
- Online photographic resources, including publicly accessible aerial photography;
- The Multi-agency Geographic Information for the Countryside (MAGIC) service;
- Norfolk Biodiversity Information Service (NBIS);
- The Water Framework Directive (WFD) status for the catchment was obtained from the Environment Agency's Catchment Data Explorer website; and



- Existing aquatic ecology survey data was obtained from the Environment Agency's Ecology and Fish Data Explorer.

10.9.3 The desk study included:

- Collation of relevant existing biological records from third parties including the local biological records centre and relevant species recording groups;
- Collation and creation of plans showing both statutory and non-statutory designated sites and associated citations; and
- Review of relevant policy documentations and extant permissions relevant to biodiversity and the Norwich Western Link.

10.9.4 Requests to NBIS for biological records for designated sites in addition to protected and notable species were made in 2018, 2020, 2021 and 2022. The latest review of biological records considered records from the last ten years only (2012 – 2022). The request included non-statutory designated sites, Ancient Woodland, Habitats and Species of Principal Importance (HPI / SPI), internationally and nationally protected species, species protected by planning policy and species of local conservation interest.

10.9.5 The Priority Habitats Inventory (Natural England, 2023) and aerial imagery were also consulted where citations referred to Habitats of Principal Importance (HPI) (JNCC, 2012) in order to quantify the area of habitats within the Proposed Scheme.

10.9.6 Study Areas were determined based on professional judgement and with regard to the following guidelines to ensure the potential Zone of Influence (Zoi) for the Proposed Scheme are appropriately covered:

- Design Manual for Road and Bridges (Standards For Highways, 2023);
- CIEEM Guidelines for Preliminary Ecological Appraisal (CIEEM, 2017);
- CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1.



Chartered Institute of Ecology and Environmental Management.
Winchester (CIEEM, 2018).

- CIEEM Guidelines for Accessing, Using and Sharing Biodiversity Data in the UK. 2nd Edition. Chartered Institute of Ecology and Environmental Management. Winchester, UK (CIEEM, 2020).

10.9.7 The Study Areas have also been informed by emerging design information and in response to work completed by other technical specialists. This is a consistent approach with impacts considered by other chapters such as **Chapter 6: Air Quality** (Document Reference: 3.06.00) in relation to air quality impacts on designated sites and important habitats, and **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) in relation to acoustic impacts on protected and notable species.

10.9.8 Indirect impacts associated with changes in noise and vibration will be assessed qualitatively using information in **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00).

10.9.9 Indirect impacts arising from changes in hydrological conditions will be assessed qualitatively using information from **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00).

10.9.10 The Water Framework Directive (WFD) status for the catchment was obtained from the Environment Agency's Catchment Data Explorer website. Existing aquatic ecology survey data was obtained from the Environment Agency's Ecology and Fish Data Explorer.

10.9.11 Various study areas are used for the desk-based elements of the ecological assessment, which comprise a number of different distance buffers per ecological feature. Further detail is provided in Appendices 10.1 to 10.37. **Table 10-4** presents the study areas which were considered for the purposes of the ES.



Table 10-4 Study Areas per ecological feature

Feature	Study Area
Habitats Sites (SACs, SPAs and Ramsar Sites).	<p>Internationally designated sites and functionally linked land within and up to 10km from the Site Boundary.</p> <p>The principal criterion defining the Study Area is a zone of 10km surrounding the location of the Proposed Scheme, a distance appropriate to encompass possible effect pathways from the Proposed Scheme to Habitats Sites, including those hydrologically connected by the River Wensum. This aligns with Chapter 12: Road Drainage and the Water Environment (Document Reference: 3.12.00) that states that no hydrological effects will occur beyond 10km from the Scheme.</p> <p>The Study Area reflects the high sensitivity of qualifying features of Habitats Sites and the fact they often support species that are mobile and wide ranging.</p> <p>The Study Area was within 200m of the combined Affected Road Network (ARN) for sites scoped in to the Air Quality Ecological Impact Assessment.</p>
SACs designated for macrophytes; fish; Desmoulin’s Whorl Snail; amphibians.	Within and up to 2km from the Site Boundary.



Feature	Study Area
National Statutory Designated Sites (SSSIs, National Nature Reserves ((NNRs)), Local Nature Reserves (LNRs)	<p>Within and up to 5km from the Site Boundary.</p> <p>The Study Area was within 200m of the combined Affected Road Network (ARN) for sites scoped in to the Air Quality Ecological Impact Assessment.</p>
Non-statutory Designated Sites (County Wildlife Sites (CWSs)) and Roadside Nature Reserves (RNRs)	<p>Within and up to 2km from the Site Boundary, or beyond where sites are potentially hydrologically linked to the Proposed Scheme.</p> <p>Impacts on County Wildlife Sites (CWS) at distances greater than 200m, or not hydrologically linked to the Site Boundary are not considered likely and so have been discounted.</p> <p>The Study Area was within 200m of the combined Affected Road Network (ARN) for sites scoped in to the Air Quality Ecological Impact Assessment.</p>
Ancient Woodland	<p>Within and up to 200m from the Site Boundary.</p> <p>The Study Area was within 200m of the combined Affected Road Network (ARN) for features scoped in to the Air Quality Ecological Impact Assessment.</p>
Habitats of Principal Importance (HPI)	<p>Within and up to 200m from the Site Boundary.</p>
Protected and notable flora	<p>Biological records for all protected/notable flora within and up to 2km from the Site Boundary.</p> <p>Ancient/veteran hedgerows – within and directly connected (root protection area) to the Site Boundary.</p>



Feature	Study Area
Notable, veteran and ancient trees.	The Site Boundary plus a buffer of up to 15 metres. The Study Area was within 200m of the combined Affected Road Network (ARN) for features scoped in to the Air Quality Ecological Impact Assessment.
Protected and notable species	Within and up to 2km from the Site Boundary.



Air Quality Ecological Impact Assessment

10.9.12 An additional desk study assessment of potential effects of air quality changes at sites of ecological importance resulting from the operation of the Proposed Scheme was undertaken to inform the production of this chapter (Document Reference: 3.10.34).

10.9.13 The DMRB guidance (Advice Note HA 207/07) states that habitats within 0.2 kilometres of an operating road are susceptible to impacts arising from deposition of nitrogen oxides, increasing their concentrations in soil and thus raise nutrient levels, potentially leading to the development of less species-rich communities.

10.9.14 In addition, further sites were identified by traffic volume modelling to identify the extent of the Affected Road Network (ARN). The ARN is defined in **Chapter 6: Air Quality** (Document Reference: 3.06.00) following the application of the scoping criteria in LA105. The ARN was identified using traffic modelling for 2029 (opening year scenario) and 2044 (design year scenario).

10.9.15 Changes to traffic volumes would occur on the road network at some distance from the Proposed Scheme, potentially leading to significant effects on ecological features as a result of air quality changes. Ecological features within 200m of the combined ARN were therefore identified, with the following included in the air quality screening assessment modelling **Chapter 6: Air Quality** (Document Reference: 3.06.00):

- International importance – Ramsar sites, Special Protection Areas (SPAs) and Special Areas of Conservation (SACs);
- National importance – Sites of Special Scientific Interest (SSSI), ancient woodland and veteran and ancient trees; and
- County importance – County Wildlife Sites (CWS), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) and Roadside Nature Reserves (RNR).



10.9.16 A total of 59 transects covering 44 sites were scoped into the assessment.

These sites are listed in Table 10-5.

Table 10-5 Designated Habitats and/or Areas of Ecological Importance Scoped into Air Quality Ecological Impact Assessment

Designated habitat and area of ecological importance	Sites scoped into Air Quality Ecological Impact Assessment
Special Areas of Conservation	Norfolk Valley Fens SAC River Wensum SAC
Sites of Special Scientific Interest	Alderford Common SSSI Potter & Scarning Fens, East Dereham SSSI Sweetbriar Road Meadows, Norwich SSSI River Wensum SSSI
Ancient Woodland	Church Wood Ancient Woodland Primrose Grove Ancient Woodland Snake Wood Ancient Woodland Sprowston Wood Ancient Woodland



County Wildlife Sites (CWSs)	<p>Attlebridge Hills CWS</p> <p>Bawburgh/Colney Gravel Pits CWS</p> <p>Botany Bay Farm CWS</p> <p>Brook House Marshes CWS</p> <p>Broom & Spring Hills CWS</p> <p>Church Hill Common CWS</p> <p>Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS</p> <p>Costessey Pits (East) CWS</p> <p>Earlham and Colney Marshes CWS</p> <p>East Hills CWS</p> <p>Fen Plantation CWS</p> <p>Fen West of East Tuddenham CWS</p> <p>Great Witchingham Common CWS</p> <p>Hellesdon Pastures CWS</p> <p>Horsham Meadows CWS</p> <p>Intwood Carr CWS</p> <p>Jennis' Wood & Dryhill Plantation CWS</p> <p>Land Adjoining Foxburrow Plantation CWS</p> <p>Lenwade Pits (East) CWS</p> <p>Lenwade Pits (West) CWS</p> <p>Long Dell and Westlodge Hills CWS</p> <p>Marriott's Way CWS</p> <p>Meadow Farm Meadow CWS</p> <p>Mouse wood CWS</p> <p>Old Covert, Wood Lane CWS</p> <p>Primrose Grove CWS</p> <p>River Tud at Easton and Honingham CWS</p> <p>River Wensum Pastures CWS</p> <p>River Yare (west and east), Bowthorpe CWS</p> <p>Taverham Mill CWS</p> <p>Walsingham Plantation CWS</p> <p>Wensum Pastures at Morton Hall CWS</p> <p>Weston Meadow CWS</p>
Roadside Nature Reserve	Fakenham Road RNR



- 10.9.17 The Air Quality Ecological Impact Assessment identified 73 ancient and/or veteran trees within the Study Area. The Air Quality Ecological Impact Assessment states references for trees for the assessment alongside references provided for the same tree in the Arboricultural Report. For example, 'T13 (T277)' is referred to as T13 in the Air Quality Ecological Impact Assessment and T277 in the Arboricultural Report. These references have been used in this chapter for the avoidance of confusion.
- 10.9.18 The residual effect associated with emissions from construction traffic in relation to receptors considered in **Chapter 6: Air Quality** (Document Reference: 3.06.00) is not significant. While scoped in as part of the assessment undertaken in Chapter 6, air quality impacts from construction traffic on biodiversity are considered to be negligible and are therefore not considered further in this chapter.
- 10.9.19 The Air Quality Ecological Impact Assessment considered Special Areas of Conservation, SSSIs, CWS (including Local Nature Reserves (LNR), Local Wildlife Sites (LWS) and Roadside Nature Reserves (RNR)), and ancient woodland and veteran trees within 200 metres of the Affected Road Network (ARN) for the Proposed Scheme where it is predicted that nitrogen (N) deposition and ammonia (NH₃) would increase above threshold levels set out from Air Quality Pollution Information System (APIS) (CEH, 2016).
- 10.9.20 The Air Quality Ecological Impact Assessment followed a modified approach from that outlined within Figure 2.98 of LA 105 (Highways Agency, 2019), and LA 108 Biodiversity (hereafter LA 108) of the Design Manual for Roads and Bridges (Highways Agency, 2020), to consider designated habitats within 200 metres of the ARN for the Proposed Scheme where it is predicted that ammonia (NH₃), nitrogen (N) deposition and nitrous oxides (NO_x) would increase above threshold levels set out from Air Pollution Information System (APIS). **Chapter 6: Air Quality** (Document Reference: 3.06.00) provides full details on the approach to modelling and assessment of changes in annual mean NO_x concentrations, annual mean NH₃ concentrations, and N



deposition rates that would occur as a result of the operation of the Proposed Scheme.

10.9.21 Critical loads (i.e., a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge) and levels (concentrations of pollutants in the atmosphere above which direct adverse effects on features, such as human beings, plants, ecosystems or materials, may occur according to present knowledge) were obtained from the APIS database.

10.9.22 Table 10-6 displays the critical loads and levels for habitats present within each of the Sites.

Table 10-6 Critical Loads and Levels for site habitats obtained from APIS database

Habitat	NH3 critical level (µg/ m3)	N-dep critical load (N/ha/yr)	NOx critical level (µg/ m3)
Broadleaved deciduous woodland	1 - 3	10 -15	30
Fen, marsh, and swamp: Rich fens	1 - 3	15 - 25	30
Coastal, floodplain and grazing marsh	1 - 3	10 -20	30

Field Surveys

10.9.23 Alongside the PEA, various ecological surveys and assessments have been carried out targeting selected ecological features. These are fully summarised in **Table 10-7**.

10.9.24 An extensive suite of surveys was undertaken in respect of bat species. These are reported on within **Chapter 11: Bats** (Document Reference: 3.11.00).



10.9.25 Field Survey Areas were determined based on professional judgement and with regard to the guidelines listed in **Table 10-7**. Field Survey Areas were also informed by emerging design information. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.9.26 The Field Survey Areas for biodiversity features were based on the Site Boundary to inform the impact assessment of this Chapter. Essential Environmental Mitigation areas within the Red Line Boundary but beyond the Site Boundary as shown on the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00) were subjected to ecological survey including a UK Habitat Classification survey in 2022 to inform the production of this chapter. This information is sufficient to provide an ecological baseline for the Essential Environmental Mitigation areas to inform the planning application for the Proposed Scheme.

Table 10-7 Ecological surveys undertaken

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Habitats, including Habitats of Principal Importance (HPI) and Non-priority habitat (For the purpose of informing the biodiversity net-gain calculations only).	2018 (Appendix 10.1) (Document Reference: 3.10.01) 2020 (Appendix 10.9) (Document Reference: 3.10.09)	Phase 1 habitat survey methodology (JNCC, 2010)	Within and up to 50m from the Site Boundary.	Habitat data are considered valid for the planning application through supporting context from the UKHab surveys from 2022. The survey data is valid for planning submission.
Habitats, including Habitats of Principal Importance (HPI), and Non-priority habitat (For the purpose of informing the biodiversity net-gain calculations only).	2022 (Appendix 10.31) (Document Reference: 3.10.31) 2023 (Appendix 10.33) (Document Reference: 3.10.33)	Professional Version 1.1 of UKHab using the following documents: UK Habitat Classification User Maotternual (Butcher, Carey, Edmonds, Norton, & Treweek, 2020) (Butcher, Carey, Edmonds, Norton, & Treweek, UK Habitat Classification User Manual Version 1.1, 2020) (hereafter 'UKHab User Manual'); UK Habitat Classification Field Key (Carey & Butcher, 2018); The UK Habitat Classification Habitat Definitions Version 1.0 (Butcher, Carey, Edmonds, Norton, & Treweek, 2020) (Butcher, Carey, Edmonds, Norton, & Treweek, UK Habitat Classification - Habitat Definitions V1.1., 2020); and UK Habitat Classification Basic Edition: Suggested Symbology for Maps (UK Habitat Classification, 2020)	Within the Red Line Boundary.	Habitat data are considered valid for the planning application through supporting context from the UKHab surveys from 2022. The survey data is valid for planning submission.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Habitats, including Habitats of Principal Importance (HPI) and Non-priority habitat (For the purpose of informing the biodiversity net-gain calculations only).	2021 (Appendix 10.18) (Document Reference: 3.10.18)	Rodwell, (National Vegetation Classification: Users' handbook, 2006) (2006)	Within the Site Boundary.	While NVC surveys were undertaken in 2021, they are considered valid for the planning application through supporting context from the UKHab surveys from 2022. The survey data is valid for planning submission.
Hedgerows	2020 (Appendix 10.10) (Document Reference: 3.10.10) 2022 (Appendix 10.33) (Document Reference: 3.10.33)	Hedgerow Survey Handbook (Defra, 2007).	Full length of all hedgerows directly connected to the Site Boundary, including all hedgerows that fall outside the Site Boundary but are immediately connected to a hedgerow within the Site Boundary. Ancient/veteran hedgerows – within and directly connected (root protection area) to the Site Boundary.	Habitat data are considered valid for the planning application through supporting context from the UKHab surveys from 2022. The survey data is valid for planning submission.
Watercourses	2020 (Appendix 10.08) (Document Reference: 3.10.08) 2021 (Appendix 10.11) (Document Reference: 3.10.11)	River Habitat Survey Field Survey Guidance Manual: 2003 Version (Environment Agency, 2003).	500m section of the River Wensum (250m either side of the River Wensum Viaduct crossing location).	The survey data is over two years of age. However, River Condition Assessments completed in 2022 (Appendix 10.33d) (Document Reference: 3.10.33d) provide an appropriate baseline of river habitat to inform the planning submission.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Watercourses	2022 (Appendix 10.33d) (Document Reference: 3.10.33d)	A Guide to Assessing River Condition. BM3.0 version: August 2021 (Gurnell, et al., 2021)	All watercourses within and up to 10m from the Site Boundary (including creation/enhancement areas for biodiversity net-gain).	The survey data is under two years of age and is valid for planning submission.
Fungi	2020 (Appendix 10.15) (Document Reference: 3.10.15) 2021 (Appendix 10.15) (Document Reference: 3.10.15)	See Fungal Survey Report 2021 (Document Reference: 3.10.15)	All woodland and grassland within the Site Boundary.	Although the survey data for fungi is over 3 years old, fungi do not form a core key species group and are typically not included in baseline biodiversity studies. In addition, on site conditions for fungi are not considered to have altered in the intervening period. The survey data is valid for planning submission.
Lichen	2021 (Appendix 10.17) (Document Reference: 3.10.17)	Extending Our Scientific Reach in Arboreal Ecosystems for Research and Management (Cannon, et al., 2021) and The Lichens of Great Britain and Ireland (Smith, et al., 2009) A Conservation Evaluation of British Lichens and Lichenicolous Fungi, Species Status No.13 (Woods and Coppins, 2012) Sanderson et al. (2018)	200m buffer from centreline of Proposed Scheme	Although the survey data for lichen is approaching three years old, lichen do not form a core key species group and are typically not included in baseline biodiversity studies. In addition, on site conditions for lichen are not considered to have altered in the intervening period. The survey data is valid for planning submission.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Macrophytes	2019 2020 (Appendix 10.08) (Document Reference: 3.10.08) 2021 (Appendix 10.11) (Document Reference: 3.10.11) 2022 (Appendix 10.12) (Document Reference: 3.10.12)	Water Framework Directive UK Technical Advisory Group's methodology for assessing macrophytes in rivers (WFD-UKTAG, 2014). This method conforms with CEN 14184: 2003 Water Quality – Guidance standard for the surveying of aquatic macrophytes in running waters (British Standards Institution, 2014).	100m section of the River Wensum and ordinary watercourses within the Site Boundary (50m either side of crossing point).	The survey data is under two years of age and is valid for planning submission.
Fish	2020 (Appendix 10.04) (Document Reference: 3.10.04) 2022 (Appendix 10.12) (Document Reference: 3.10.12)	Electric fishing methods and techniques following guidelines developed by the Environment Agency (Beaumont, Taylor, Lee, & Welton, 2002); (Environment Agency, 2001); (Environment Agency, 2007), which conformed to British Standard BS EN 14011:2003 Water Quality. Sampling of Fish with Electricity (British Standards Institution, 2003).	100m section of the River Wensum and ordinary watercourses within the Site Boundary (50m either side of crossing point).	The survey data will be under two years of age by the time of the planning submission and is robust.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Great Crested Newt (GCN)	2020 (Appendix 10.23) (Document Reference: 3.10.23) 2021 (Appendix 10.16) (Document Reference: 3.10.16)	HSI assessment method (Amphibian and Reptile Groups of the United Kingdom (ARG UK), 2010) Oldham et al. (2000). Biggs et al. (2014) Gent & Gibson (2003) English Nature (2001)	Within and up to 500m from the Site Boundary.	The data set that informs the planning submission comprises data collected in 2020 and 2021 that covered the entire Field Survey Area. The data set is over three years of age however survey results in 2021 were mostly negative (one adult GCN was recorded in a single water body) it is therefore considered a robust baseline especially as GCN can take several years to colonise new areas. The survey data is valid for planning submission.
Wintering Birds	2020/21 (Appendix 10.27) (Document Reference: 3.10.27)	Gillings, et al. (2008). Winter Farmland Bird Survey. BTO Research Report No.494 Bibby, C.J., N.D. Burgess & D.A. Hill (1992). Bird Census Techniques. London: Academic Press Gilbert, G., Gibbons, D.W., and Evans, J. (1998). Bird Monitoring Methods: a manual of techniques for key UK species. Sandy: RSPB	Within and up to 100m from the Site Boundary.	The baseline for wintering birds is informed by a full survey undertaken over the winter of 2020/2021. While approaching three years of age, the area consistently supported a wintering bird community of no more than local importance. The survey data is valid for planning submission.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Breeding Birds	2021 (Appendix 10.13) (Document Reference: 3.10.13)	Bibby, et al. (2000)	Within and up to 100m from the Site Boundary.	<p>The baseline for breeding birds is in the form of a data set completed in 2021. This data set is over two years of age. The data set is considered to be sufficient however, as the likelihood of significant change in the breeding bird community on site in the intervening period is considered to be low.</p> <p>The survey data is valid for planning submission.</p>
Barn Owl	2021 (Confidential Appendix 10.28) (Document Reference: 3.10.28)	<p>The Barn Owl Trust (2012). Barn Owl Conservation Handbook, Pelagic Publishing, Exeter.</p> <p>Shawyer, C. R. 2011 (2011). Barn Owl Survey Methodology and Techniques for use in Ecological Assessment: Developing Best Practice in Survey and Reporting. IEEM, Winchester.</p>	<p>Within 1km of the Site Boundary.</p> <p>Stage 3 nest verification surveys: within and up to 25m from the Site Boundary for trees and 100m for structures – undertaken in alongside the bat surveys.</p>	<p>Surveys for Barn Owl is over two years old. On-site conditions are likely to have remained unaltered in the intervening period and the data is robust to inform the submission.</p> <p>The survey data is valid for planning submission.</p>

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Badger	2019 – 2020 (Confidential Appendix 10.40) (Document Reference: 3.10.40) 2020 - 2021 (Confidential Appendix 10.29) (Document Reference: 3.10.29) 2022 (Confidential Appendix 10.30) (Document Reference: 3.10.30)	Cresswell, Harris, Bunce, & Jefferies (1989); with regard for recent reviews and comment on these methods by Roper (2010) and Andrews (2013).	Within and up to 30m from the Site Boundary. Survey scope extended to cover the following woodlands; Rose Carr, The Nursery, Primrose Grove, Long Plantation, Spring Hills, Attlebridge Hills, Foxburrow Plantation, Old Covert and Unknown Woodland South of Ringland Lane. 2022 Field Survey Area was extended to include areas with known Badger setts and activity in addition to any compound areas included within the Site Boundary that had not been subject to a Badger survey previously.	With the updated surveys being carried out in 2022, the baseline is appropriate to inform the planning submission.
Badger	2021 (Confidential Appendix 10.29) (Document Reference: 3.10.29)	Delahay et al. (2000) Badger Bait Marking Survey	Within and up to 1km from Long Plantation and Foxburrow Plantations woodlands.	With the updated standard badger surveys (not bait marking surveys) being carried out in 2022, the baseline is appropriate to inform the planning submission.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Otter	2019 (Appendix 10.3) (Document Reference: 3.10.03) 2020 (Appendix 10.3) (Document Reference: 3.10.03) 2021 (Appendix 10.19) (Document Reference: 3.10.19)	Chanin (2003a) Chanin (2013b) Liles (2003)	Within the Site Boundary. Extended to 300m beyond the Site Boundary along all watercourses and associated riparian habitat (upstream and downstream). Additional upstream and downstream sections of the River Wensum and associated floodplain watercourses beyond the 2020 Field Survey Area were assessed in order to establish Otter presence up to 800m from the Proposed Scheme. At the time of survey these areas were being considered for compensation and enhancement purposes for this species.	The range of surveys completed ensures a sufficient baseline for the ES submission.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Water Vole	2019 (Appendix 10.3) (Document Reference: 3.10.03) 2020 (Appendix 10.3) (Document Reference: 3.10.03) 2021 (Appendix 10.19) (Document Reference: 3.10.19) 2022 (to inform the production of a draft Water Vole Licence for the Proposed Scheme)	Dean, et al. (2016)	Within the Site Boundary - extended to 300m beyond the Site Boundary footprint along all watercourses and associated riparian habitat (upstream and downstream). Additional upstream and downstream sections of the River Wensum and associated floodplain watercourses beyond the 2020 Field Survey Area were assessed in order to establish Water Vole presence up to 800m from the Proposed Scheme.	The range of surveys completed ensure a sufficient baseline for the planning submission.
Reptiles	2019 (Appendix 10.5) (Document Reference: 3.10.05) 2020 (Appendix 10.25) (Document Reference: 3.10.25)	Design Manual for Roads and Bridges (Standards For Highways, 2022) Herpetofauna Workers' Manual (Gent & Gibson, 2003) Reptile Survey Advice Sheet 10 (Froglife, 1999).	Within the Site Boundary.	The baseline data set for reptiles comprised full coverage of the Field Survey Area, with data collected in 2019 and 2020. While the baseline survey data will be approaching four years of age by the time of the planning submission it will still be considered appropriate. This is due to the habitats remaining consistent and that mitigation approaches would remain identical no matter the results of any updated survey.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Desmoulin's Whorl Snail	2019 (Appendix 10.6) (Document Reference: 3.10.06) 2020 (Appendix 10.39) (Document Reference: 3.10.39) 2021 (Appendix 10.14) (Document Reference: 3.10.14)	Killeen I.J. (2003) Kerney (1999)	River Wensum and associated floodplain between the Fakenham Road bridge and the Ringland Road Bridge.	The baseline survey data will be over two years old by the time of planning submission. As the snail distribution is constrained by landowner activity this data is robust for that purpose. The range of surveys completed ensure a sufficient baseline for the planning submission.
White-clawed Crayfish	2019 (Appendix 10.7) (Document Reference: 3.10.07)	'Monitoring the White-clawed Crayfish, Conserving Natura 2000 Rivers' monitoring series of guidance (Peay, 2003).	River Wensum	The baseline survey data is over two years old. Due to the presence of American Signal Crayfish, White-clawed Crayfish are likely absent within the River Wensum. It is considered that this data is robust to inform that submission.
Terrestrial Invertebrates	2021 (Appendix 10.21) (Document Reference: 3.10.21)	Invertebrate Habitat Potential Protocol (Dobson and Fairclough, unpublished) Drake et al. (2007)	Within the Site Boundary.	The baseline survey data is over two years old. It is however considered that this data is robust to inform that submission as on site conditions are not considered to have altered since the latest survey and many species groups were identified.

Feature	Years undertaken	Guidance and methodologies	Field Survey Area	Comment on validity of data
Aquatic Macroinvertebrates	2020 (Appendix 10.11) (Document Reference: 3.10.11) 2022 (Appendix 10.12) (Document Reference: 3.10.12)	Environment Agency (2017) BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (British Standards Institution, 2012) (Davy-Bowker, et al., 2008) Whalley, Hawkes, Paisley and Trigg (WHPT) metric (UKTAG (United Kingdom Technical Advisory Group), 2021)	Five sample locations on all suitable watercourses in close proximity to the Site Boundary (up and down stream), including the River Wensum and its associated floodplain watercourses and Foxburrow Stream.	The survey data is under two years of age and is valid for the planning submission.
Notable, veteran and ancient trees	2019, 2020, 2022 (see Arboricultural Impact Assessment (Document Reference: 3.10.35))	BS5837:2012 (British Standards Institution, 2012)	The Site Boundary plus a buffer of up to 15 metres.	Latest survey data is less than two years old, and therefore the data is considered to remain valid and robust for the purpose of this assessment.



10.10 Assessment of significance

10.10.1 The assessment of potentially significant effects as a result of the Proposed Scheme has considered both the construction and operation phases. The construction phase includes enabling works, demolition, earthworks and construction activities as set out in **Chapter 3: Description of Scheme** (Document Reference: 3.03.00).

Value of an ecological feature

10.10.2 The importance and value of an ecological feature is determined on a geographical scale as follows:

- a. International (within Europe);
- a. National (relating to the UK, specifically England);
- b. County (Norfolk); and
- c. Local (Broadland District, including features that are of importance at a Site or District level).

10.10.3 The CIEEM method proposes that regional importance may be used. However, this scale has not been used in this assessment, as there is no objective, unambiguous source of information for East Anglia as to what population status, level of rarity or threat/pressure would qualify for 'regional importance'.

10.10.4 The geographical scale of importance for statutory and non-statutory designated sites is assigned based on their designation. For example, National Site Network sites and Ramsar Sites (collectively referred to as 'Habitats Sites' for the purposes of this chapter) are considered of International importance, because they are designated on the basis of supporting habitats and / or species which are of importance for nature conservation at an international / European level. Sites of Special Scientific Interest and National Nature Reserves are considered to be of 'National' importance because they are designated for supporting habitats, species, and other features of importance for nature conservation at a UK level.



10.10.5 The geographical scale of importance for habitats and species is also assigned with reference to any designations or policy provisions that apply. For example, Habitats of Principal Importance (HPI), as identified by the provisions of Section 41 of the NERC Act, are considered of particular importance to the conservation of biodiversity in England. That is not to say that all HPI are considered of 'National Importance'. Extents of such habitats that form an appreciable part of the English resource, would however be considered of 'National Importance'.

10.10.6 The same approach applies to protected or otherwise notable species. For example, the Great Crested Newt (GCN) is recognised as a priority for nature conservation at a European (International) level, by way of their identification as a European Protected Species (EPS) under the Habitats Regulations. Very large populations that make up an appreciable proportion of the European population might rightly be identified as of 'International Importance'. Smaller populations that are not exceptional in the locality they occur and do not contribute particularly to the maintenance of wider populations would be of lesser importance.

10.10.7 The geographical scale of importance for habitats and species is therefore subjective, with the following factors taken into account:

- a. Legal protection;
- b. Planning policies;
- c. Distribution including relative to the Proposed Scheme;
- d. Conservation status (i.e., is the habitat/species common and widespread, or rare with a highly localised distribution); and
- e. Historical trends.

10.10.8 The approach to determining the nature conservation value and/or sensitivity of each ecological feature is outlined in Table 10-8 below.



Table 10-8 Description of Geographical Scales of Ecological Importance

Scale	Description
International	<p>National Site Network sites including: Sites of Community Importance (SCIs); SPAs; potential SPAs (pSPAs); SACs; candidate or possible SACs (cSACs or pSACs). Wetlands of International Importance (Ramsar sites), Biogenetic Reserves, World Heritage Sites and Biosphere Reserves.</p> <p>Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such.</p> <p>Resident, or regularly occurring, populations of species which may be considered at an International or European level where:</p> <ul style="list-style-type: none"> • The loss of these populations would adversely affect the conservation status or distribution of the species at this geographic scale; or • The population forms a critical part of a wider population at this scale; or • The species is at a critical phase of its life cycle at this scale.



Scale	Description
National	<p>Designated sites including: SSSIs; Marine Protected Areas (MPAs); and National Nature Reserves (NNRs).</p> <p>Areas which meet the published selection criteria e.g. JNCC (1998) for those sites listed above but which are not themselves designated as such.</p> <p>Areas of key/priority habitats identified in the UK Biodiversity Action Plan (BAP), including those published in accordance with section 41 of the Natural Environment and Rural Communities Act (2006) and those considered to be of principal importance for the conservation of biodiversity.</p> <p>Areas of Ancient Woodland, e.g. woodland listed within the Ancient Woodland Inventory.</p> <p>Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level where:</p> <ul style="list-style-type: none">• The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; or• The population forms a critical part of a wider population at this scale; or• The species is at a critical phase of its life cycle at this scale.



Scale	Description
County	<p>Designated sites including: Local Wildlife Sites; County Wildlife Sites (CWSs); and Local Nature Reserves (LNRs) designated in the county or unitary authority area context.</p> <p>Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such.</p> <p>Areas of key/priority habitats identified in the Local Biodiversity Action Plan (LBAP); and areas of habitat identified in the appropriate Natural Area Profile (or equivalent). Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level where:</p> <ul style="list-style-type: none">• The loss of these populations would adversely affect the conservation status or distribution of the species across the County; or• The population forms a critical part of a wider population; or• The species is at a critical phase of its life cycle.



Scale	Description
Local	<p>Designated sites including: LNRs designated in the local context.</p> <p>Trees that are protected by Tree Preservation Orders (TPOs).</p> <p>Areas of habitat; or populations/communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including features of value for migration, dispersal or genetic exchange.</p> <p>Areas of habitat that appreciably enrich the local habitat resources (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.</p> <p>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.</p>
Negligible	Common and widespread features that do not have an appreciable ecological value.



Important Ecological Features

10.10.9 It is impractical and inappropriate in line with CIEEM guidance for an ecological assessment to consider every habitat and species that may be affected by the Scheme. Accordingly, a threshold importance level is set and all biodiversity features that are of 'local' or higher importance will be subject to assessment.

10.10.10 For the purposes of this assessment, ecological features of 'Local' value or higher are assessed as being "Important Ecological Features" that can therefore experience significant effects. Ecological features of 'Negligible' importance are not considered sufficiently important to experience significant effects and are not assessed as being Important Ecological Features and therefore do not fit into a geographical scale. This includes common and widespread species and habitats that are not of conservation interest or not protected by planning policy.

10.10.11 Habitats such as improved and semi-improved grassland (where outside of HPI areas such as coastal and floodplain grazing marsh) and buildings or hard standing are considered to have negligible value and are not assessed as features of botanical nature conservation importance.

10.10.12 The value of habitats to support Important Ecological Features is considered under the species sections of this chapter and is separate from consideration of the botanical value of those habitats. Notable plant species are considered separately from habitats in this assessment.

Significant effects on Important Ecological Features

10.10.13 Once the evaluation of ecological features has been undertaken, the assessment identifies potential biophysical changes arising from proposed activities during the construction and operation of the Proposed Scheme that may affect features. At this stage, the assessment considers effects on features accounting for Embedded Mitigation measures.

10.10.14 A 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' (i.e. are assessed



as either positive or negative). In the context of the EclA, the significance of an effect is assessed as either significant (an appreciable effect on the structure, form, function and conservation status) or not significant (no or negligible effect on structure, form, function and conservation status).

10.10.15 The relative importance of a significant effect is determined based on the extent to which its integrity or conservation status is compromised (i.e. the magnitude of the effect) and the value of the Important Ecological Feature, defined through the geographical scale. Characteristics that should be referenced (as required) when describing ecological impacts and effects are listed in Table 10-9.

Table 10-9 Characteristics of ecological impacts and effects

Characteristic	Description
Positive or Negative	Determined according to whether the change is in accordance with nature conservation objectives and policy.
Extent	The extent is the spatial or geographical area over which the impact/effect may occur under a suitably representative range of conditions.
Magnitude	Size, amount, intensity and volume. Should be quantified where possible.
Duration	Permanent (P) or Temporary (T) in ecological terms. Where differing timescales are determined in relation to the life-cycle of the feature, these should be defined.
Timing and Frequency	The number of times an activity occurs will influence the resulting effect. Important seasonal and/or life-cycle constraints and any relationship with frequency considered.



Characteristic	Description
Reversibility	An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

10.10.16 **Table 10-10** below sets out how an effect is classified in other ES chapters and how it relates to the CIEEM EclA Guidelines based on professional judgement that is used in this chapter.

Table 10-10 EIA Classification terminology and how it relates to CIEEM's EclA guidelines

EIA Significance of an Effect as detailed in Chapter 5: Approach to EIA (Document Reference: 3.05.00)	Related CIEEM Assessment Significance of an Effect Terminology used in Chapter 10 Biodiversity (Document Reference: 3.10.00)	Description
Very Large Significant (beneficial)	Significant (positive)	Positive effect on conservation status of an Important Ecological Feature at a county, national or international scale
Moderate Significant (beneficial)	Significant (positive)	Positive effect on conservation status, structure, form or function of an Important Ecological Feature at a Local scale



EIA Significance of an Effect as detailed in Chapter 5: Approach to EIA (Document Reference: 3.05.00)	Related CIEEM Assessment Significance of an Effect Terminology used in Chapter 10 Biodiversity (Document Reference: 3.10.00)	Description
Not significant or Slight to Neutral	Not significant	No or negligible effect on structure, form, function or conservation status of an Important Ecological Feature
Moderate Significant (adverse)	Significant (negative)	Negative effect on structure, form, function or conservation status of an Important Ecological Feature at a Local scale
Very Large Significant (adverse)	Significant (negative)	Negative effect on structure, form, function or conservation status an Important Ecological Feature at a County, National or International scale

10.10.17 Effect significance will be assessed according to the CIEEM guidance which states that:

“Significance is a concept related to the weight that should be attached to effects when decisions are made. For the purpose of EIA, ‘significant effect’ is an effect that either supports or undermines biodiversity conservation objectives for ‘important ecological features’ (explained in Chapter 4) 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). Effects can be considered significant at a wide range of scales from international to local” (paragraph 5.25, page 24).



10.10.18 Ecological effects will be described in relation to the geographic scale at which they are regarded as significant – from international to local. It should be noted that in line with the guidance issued by CIEEM, an impact which has been considered as significant in ecological terms is the same as significant in EIA terms.

10.10.19 The CIEEM method is relevant for the assessment of ecological effects associated with both the construction and operational stages of the Scheme.

10.10.20 The HRA Report (4.03.00) assesses the potential for the Proposed Scheme to lead to adverse effects on the integrity of National Site Network sites. This is not presented in this ES and is being carried out separately in accordance with the requirements of the Habitats Regulations. It should be noted that the HRA assessment process only considers the impact of mitigation measures at Stage 2: Appropriate assessment, compared with this chapter where Embedded Mitigation is considered as part of the Preliminary assessment of likely impacts and effects. A ruling by the Court of Justice of the European Union (CJEU) (Sweetman v. An Bord Pleanála, Case C-258/11, CJEU judgment 11 April 2013) requires that mitigation measures should only be considered at Stage 2 Appropriate Assessment and not at screening stage or as an embedded element of a project.

Air Quality Ecological Impact Assessment

10.10.21 The Air Quality Ecological Impact Assessment considered the significance of effects where the change in modelled total nitrogen deposition (N-dep), NO_x or ammonia with the Proposed Scheme (“Do Something” scenario) in comparison to the future baseline (“Do Minimum” (without the Proposed Scheme) scenario) was greater than 1% (as an absolute number), and the critical load/ level for the habitat was exceeded. Where the 1% threshold was not exceeded, the effects were considered not likely to be significant.

10.10.22 Where the 1% threshold was exceeded, the potential ecological implications were assessed and a qualified statement regarding the potential ecological significance of effects was then produced. Significance of effects stated in the



Air Quality Ecological Impact Assessment were then presented in this Chapter as per the criteria stated in **Table 10-10**. Any significance of effects of moderate or above (either adverse or beneficial) stated in the Air Quality Ecological Impact Assessment were identified as significant in this chapter.

10.10.23 Further detail regarding the predicted changes in concentrations of NO_x, NH₃, and N deposition rates between the “Do Minimum” (future baseline without the Proposed Scheme) and “Do Something” (with the Proposed Scheme) scenarios is provided in the **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34).

10.10.24 The findings presented in the Air Quality Ecological Impact Assessment have been used to inform the assessment within the ES where relevant.

10.11 Biodiversity Net Gain

10.11.1 In light of the statutory framework for Biodiversity Net Gain (BNG) introduced by the Environment Act 2021 (Her Majesty's Stationary Office (HMSO), 2021), a **Biodiversity Net Gain Technical Report** (Document reference: 3.10.33) has been completed alongside the EclA presented in this ES. Appendix B of the BNG report outlines the relevant legislation and requirement for 10% BNG that now applies for major development under the Town and Country Planning Act 1990, and Appendix J outlines the approach to use of evolving Biodiversity Metric versions.

10.12 Assessment Assumptions and Limitations

10.12.1 The assumptions and limitations which apply to this assessment are outlined below. For each assumption or limitation an explanation of the possible impact on this chapter has been provided in addition to a description of any corrective actions that have been taken to adjust for any limitations.

10.12.2 The assessment of effects assumes that all embedded and additional mitigation measures will be successfully implemented, and effective.



Desk Study Data

- 10.12.3 Desk study data provided by biological records centres is subject to spatial coverage of biodiversity recording schemes. Negative survey results are frequently not recorded (where surveys have occurred and species likely absence has been demonstrated). Certain areas (e.g. nature reserves) are often heavily studied, whereas other areas (e.g. private farmland) have infrequently or never been visited. For this reason, 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 a particular species in desk study records has been used alongside survey data and the known or anticipated species distributions to infer whether these species may be present. Where doubt exists, a precautionary assessment has been undertaken by assuming a possible species presence in suitable habitat. This has been informed by survey data, where available, and professional judgement.

Field Survey Data

- 10.12.4 Survey data is typically valid for approximately 18 months to 3 years according to guidance from the Chartered Institute of Ecology and Environmental Management (CIEEM) regarding the validity of survey data. This is dependent on the species being surveyed. Ecological surveys, for some taxa/species groups commenced in 2018 and 2019. These surveys were subject to update in either 2020, 2021 or 2022 to inform the production of this chapter. Any limitations to the collection of baseline survey data are provided in Appendices 10.1 to 10.40 and comments in this regard are made in **Table 10-7**.
- 10.12.5 The identification of a Barbastelle *Barbastella barbastellus* roost within Rose Carr necessitated the identification of a new refinement option to the Preferred Route that would minimise and avoid direct impacts on bats and their habitats. The confirmation of the realignment of the Proposed Scheme was completed in July 2022. Additional survey work was undertaken in 2022 to update the baseline conditions in response to the realignment.



10.12.6 The considerable level of baseline data collected during the breadth of biodiversity surveys completed from 2019 - 2022 is appropriately valid to comprehensively consider the NWL alignment refinement and inform the ES within the planning application for the Proposed Scheme.

Design

10.12.7 No detail on decommissioning has been prepared and the operational lifespan of the Proposed Scheme is not yet known. In the absence of detail on decommissioning, impacts of this stage are assumed to be similar to that of construction and no separate consideration of decommissioning effects has been presented.

10.12.8 Detailed design information relating to the Proposed Scheme is not available at this stage. In the absence of detailed information, typical activities associated with construction activity of this scale have been identified using professional judgement, advice from the Principal Contractor, and information stated in **Chapter 3: Description of Scheme** (Document Reference: 3.03.00).

10.12.9 There would be no in-channel works that would directly affect the River Wensum, with no realignment or engineering of the river channel undertaken.

10.12.10 Estimates of habitat loss provided are approximate. A more detailed assessment of habitat loss will be undertaken at the Detailed Design stage.

Mitigation

10.12.11 The Flood Risk Assessment for the Proposed Scheme identified no changes in flood risk as a result of the operational scheme, and thus such effects are not included within this assessment.

10.12.12 The two stages of the assessment of effects assumes that all embedded and additional mitigation measures will be successfully implemented.

10.12.13 Ancient woodland is considered to be an irreplaceable habitat, the loss of which cannot be compensated.



10.12.14 Establishment periods (including creation, monitoring, maintenance and management activities) will be refined as part of the detailed design and production of a long term (30 year) management and maintenance plan (LEMP). Broad generic indicative establishment periods for newly created habitats have been determined using Defra (2012) guidance, and are as follows:

- Watercourses: 5 years;
- Ponds: 5 years;
- Grasslands: 5 - 10 years;
- Hedgerows: 5 - 10 years; and
- Woodland: 10 – 50 years.

10.12.15 The Assessment of Residual Likely Significant Effects section of this chapter considers the residual effects following the successful establishment of habitats, unless otherwise specified.

10.13 Baseline Conditions

Existing Baseline

Statutory designated sites

Habitats Sites

10.13.1 Two Habitats Sites were identified that met the Study Area criteria, including the area of air quality change of the ARN.

10.13.2 Both the River Wensum SAC and the Norfolk Valley Fens SAC are of International Value, and their qualifying features are summarised below.

River Wensum SAC

10.13.3 The Wensum is a naturally enriched, calcareous lowland river. The upper reaches are fed by springs that rise from the chalk and by run-off from calcareous soils rich in plant nutrients. This gives rise to beds of submerged and emergent vegetation characteristic of a chalk stream. *Ranunculus*



vegetation occurs throughout much of the river's length. The river supports an abundant and rich invertebrate fauna including the native freshwater White-clawed Crayfish (however surveys undertaken in 2019 confirmed likely absence of white-clawed crayfish within the River Wensum due to the presence of the non-native American signal crayfish) as well as a diverse fish community, including Bullhead *Cottus gobio* and Brook Lamprey *Lampetra planeri*. The site has an abundant and diverse mollusc fauna which includes Desmoulin's Whorl Snail, which is associated with aquatic vegetation at the river edge and adjacent fens. A section of the River Wensum is within the Site Boundary.

Norfolk Valley Fens SAC – Potter & Scarning Fens, East Dereham SSSI

- 10.13.4 Scarning and Potter Fens in East Dereham is 11.2 kilometres from the Proposed Scheme and covers two sites immediately adjacent to each other, with Scarning Fen to the west of Potter Fen. They cover an area of 6.2ha and together are a Site of Special Scientific Interest (SSSI), but also make up part of the Norfolk Valley Fens SAC. Potter and Scarning Fens are small calcareous valley fens on shallow peat and considered two of the finest of their type in Britain. The site grades from bryophyte-dominated communities on the open, wet parts of the site, through calcareous fen, to heathland on the drier ground.
- 10.13.5 Four UKHab habitat types were identified during the survey of the Scarning and Potter Fens undertaken during October 2022: wet woodland W1D, lowland fens f2a (more specifically calcium-rich springwater-fed fen, secondary code 7), lowland heathland h1a and modified grassland g1.
- 10.13.6 The flora is exceptionally diverse, and several uncommon mosses and liverworts have been recorded. The site has high entomological interest and supports a nationally scarce species of damselfly, the small red damselfly *Ceriagrion tenellum*. Walkover survey recorded a range of plant species, including bogbean *Menyanthes trifoliata*, devil's-bit scabious *Succisa pratensis*, great fen sedge *Cladium mariscus* and many others. Most of the open, wet areas were dominated by common reed *Phragmites australis*,



which had been cut to different heights. The wooded areas were dominated by alder *Alnus glutinosa*, a tree commonly found in wet areas, and the drier parts of site, were colonised by gorse *Ulex europaeus* and bramble *Rubus fruticosus* agg.

- 10.13.7 This site comprises a series of valley-head spring-fed fens. Such spring-fed flush fens are very rare in the lowlands. The individual fens vary in their structure according to intensity of management and provide a wide range of variation. There is a rich flora associated with these fens, including species such as Grass-of-Parnassus *Parnassia palustris*, Common Butterwort *Pinguicula vulgaris*, Marsh Helleborine *Epipactis palustris* and Pugsley's Marsh-orchid *Dactylorhiza majalis* subsp. *traunsteinerioides*. In places the calcareous fens grade into acidic flush communities on the valley sides. Within the Norfolk Valley Fens there are a number of marginal fens associated with pingos – pools that formed in hollows left when large blocks of ice melted at the end of the last Ice Age. These are very ancient wetlands and several support strong populations of Desmoulin's Whorl Snail as part of a rich assemblage of rare and scarce species in standing water habitat. At Flordon Common a strong population of narrow-mouthed whorl snail *Vertigo angustior* occurs.
- 10.13.8 The locations of the sites in relation to the Proposed Scheme and ARN are shown in Figure A-1, Sub appendix A of the **Air Quality Ecological Impact Assessment (Appendix 10.34)** (Document Reference: 3.10.34). Details of SAC Qualifying Features are provided in Table 10-11.

Table 10-11 Habitats Sites and their Qualifying Features

Site	Detail	Supporting Information
River Wensum SAC	Reasons for designation	<p>The SAC supports the following Habitats Directive Annex 1 habitats:</p> <p>Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation. (Rivers with floating vegetation often dominated by water-crowfoot).</p> <p>The SAC supports the following Habitats Directive Annex 2 species:</p> <ul style="list-style-type: none"> • White-clawed (or Atlantic stream) Crayfish (however surveys undertaken in 2019 confirmed likely absence of white-clawed crayfish within the River Wensum due to the presence of the non-native American signal crayfish). • Bullhead. • Brook Lamprey. • Desmoulin's Whorl Snail.
River Wensum SAC	Threats and pressures	<p>Based on detail within the SAC's Supplementary Advice on Conserving and Restoring Site Features (Natural England, 2022) and Site Improvement Plan (Natural England, 2014) the following threats and pressures have been identified:</p> <ul style="list-style-type: none"> • Shading of in-channel and emergent marginal vegetation; • Restriction of ground water flows leading to reduced river discharge; • Pollution from chemical and sediment entry to the channel during construction; • Pollution from chemical and sediment entry to the channel during operation; • Noise and vibration leading to disturbance of in-channel species; and • Air quality changes leading to deposition of atmospheric nitrogen.

Site	Detail	Supporting Information
River Wensum SAC	Conservation objectives	<p>Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:</p> <ul style="list-style-type: none"> • The extent and distribution of qualifying natural habitats and habitats of qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of qualifying species; and, • The distribution of qualifying species within the site. <p>Detailed Supplementary Advice on Conserving and Restoring Site Features (Natural England, 2022) is available for River Wensum SAC and has informed the HRA process.</p>
Norfolk Valley Fens SAC	Reasons for designation	<p>The SAC supports the following Habitats Directive Annex 1 habitats:</p> <ul style="list-style-type: none"> • Alkaline Fens. • Northern Atlantic Wet Heaths with <i>Erica tetralix</i>. • European dry heaths. • Semi-natural dry grasslands and scrublands facies on calcareous substrates (<i>Festuco-Brometalia</i>) (important orchid sites). • Molinia meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>). • Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>. • Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i>, <i>Anion incanae</i>, <i>Salicion albae</i>). <p>The SAC supports the following Habitats Directive Annex 2 species:</p> <ul style="list-style-type: none"> • Narrow-mouthed whorl snail. • Desmoulin's Whorl Snail.

Site	Detail	Supporting Information
Norfolk Valley Fens SAC	Threats and pressures	Based on detail within the SAC's Supplementary Advice on Conserving and Restoring Site Features (Natural England, 2019b) and Site Improvement Plan (Natural England, 2019a) the following threats and pressures have been identified: <ul style="list-style-type: none"> • Inappropriate water levels, scrub control and cutting/mowing; • Hydrological changes; • Water pollution; • Water abstraction; • Undergrazing and overgrazing; • Invasive species; • Change in land management; • Changes in species distributions; and • Air Pollution and the impact of atmospheric nitrogen deposition.
Norfolk Valley Fens SAC	Conservation objectives	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; <ul style="list-style-type: none"> • The extent and distribution of qualifying natural habitats and habitats of qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of qualifying species; • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely; • The populations of qualifying species; and, • The distribution of qualifying species within the site. Detailed Supplementary Advice on Conserving and Restoring Site Features (Natural England, 2019b) is available for Norfolk Valley Fens SAC and has informed the HRA process.



National Statutory Designated Sites

- 10.13.9 Four nationally designated sites of National Value were identified that met the Study Area criteria as described above. The locations of the sites in relation to the Proposed Scheme are shown in **Figure 10.1** (Appendix 10.38 [Document Reference: 3.10.38]). These include Potter and Scarning Fens, East Dereham SSSI, a SSSI component of the Norfolk Valley Fens SAC. This site is located outside of the 5-kilometre criteria detailed above but falls within the area of air quality change of the ARN for the Proposed Scheme.

Sweetbriar Road Meadows, Norwich SSSI

- 10.13.10 This SSSI is located 8 kilometres to the south-east of the Red Line Boundary (RLB). The citation (Natural England, 1993) for the SSSI details the following: This site consists of a series of unimproved wet meadows with permanent water-logging lying in the Wensum Valley close to Norwich. It forms the best remaining example of a type of wetland habitat which at one time was more widely occurring in the river valleys of east Norfolk, but which has been lost or progressively altered in post war years due to drainage and agricultural improvements. It is particularly unusual for a site of this quality and size to remain within an urban area and still be subject to regular winter flooding. Three principal grassland communities are present. Damp neutral grassland occurs on the higher ground of the valley side. It is generally species-rich, and the dominant grasses are Yorkshire Fog *Holcus lanatus*, Meadow Fescue *Festuca pratensis*, Tufted Hair Grass *Deschampsia cespitosa* and Sweet Vernal grass *Anthoxanthum odoratum*. Herbs present within the sward include Yellow Rattle *Rhinanthus minor*, Ragged Robin *Lychnis flos-cuculi*, Cuckoo Flower *Cardamine pratensis* and Southern Marsh Orchid *Dactylorhiza praetermissa*. Towards the valley floor neutral grassland grades into a form of marshy grassland irrigated by base-poor seepage water. This community is dominated by Bogbean, Marsh Cinquefoil *Potentilla palustris* and Common Spike-rush *Eleocharis palustris*. Other species of interest include Marsh Arrow



grass *Triglochin palustris*, Early Marsh Orchid *Dactylorhiza incarnata*, Lesser Spearwort *Ranunculus flammula* and Blunt flowered Rush *Juncus subnodulosus*. Areas of tall fen are also present in the valley bottom. This is dominated by Reed Sweet-grass *Glyceria maxima* with Marsh Marigold *Caltha palustris*, Yellow Iris *Iris pseudacorus*, Meadowsweet *Filipendula ulmaria* and Purple Small-reed *Calamagrostis canescens*. A number of drainage ditches are present. These are mostly overgrown, but the fringing vegetation includes Tubular Water Dropwort *Oenanthe fistulosa*, Lesser Water-parsnip *Berula erecta* and Creeping Jenny *Lysimachia nummularia*. The whole site is managed on traditional lines, light pony grazing without the use of artificial fertilisers or herbicides.

Alderford Common SSSI

- 10.13.11 This SSSI is located 1.3 kilometres to the north-east of the RLB. The citation (Natural England, 1993) for the SSSI details the following: Alderford Common is situated on gently undulating ground and supports a wide range of habitats developed in response to variations in soils and topography. A thin layer of glacial sands and gravels cover the underlying chalk which is exposed in abandoned marl workings. A diverse chalk flora has developed in the old pits and the site forms the only remaining example of species-rich chalk grassland in East Norfolk. A bat roost and an outstanding assemblage of breeding birds provide additional interest. The habitats represented include scrub, woodland, bracken heath, marshy grassland and ponds. Chalk grassland occurs in the bottom of the marl-pits and is dominated by Red Fescue *Festuca rubra*, Crested Hair-grass *Koeleria macrantha* and False Brome *Brachypodium sylvaticum*. Many herb-species are associated with the grassland and include Wild Basil *Clinopodium vulgare*, Burnet Saxifrage *Pimpinella saxifraga*, Dwarf thistle *Cirsium acaule*, Larger Wild Thyme *Thymus pulegoides*, Dropwort *Filipendula vulgaris* and Common Spotted Orchid *Dactylorhiza fuchsii*. Damp hollows, on low-lying ground, have a characteristic flora which includes Water



Mint *Mentha aquatica*, Marsh Pennywort *Hydrocotyle vulgaris* and a large population of Adder's Tongue *Ophioglossum vulgatum*. Secondary woodland dominated by Silver Birch *Betula pendula* and Pedunculate Oak *Quercus robur*, open Bracken heath and dense scrub surround the marl workings. Two ponds are also present and a small marshy area has developed around one with abundant Meadowsweet. The thick Blackthorn *Prunus spinosa* and Hawthorn *Crataegus monogyna* scrub provides suitable nesting sites for a wide range of breeding birds including the largest population of Nightingales *Luscinia megarhynchos* in East Norfolk. Other notable breeding birds are Lesser Whitethroat *Sylvia curruca*, Whitethroat *Sylvia communis*, Turtle Dove *Streptopelia turtur*, Woodcock *Scolopax rusticola* and Hawfinch *Coccothraustes coccothraustes*. The ponds are used as breeding sites by several species of amphibians including a small population of the scarce Great Crested Newt. An old lime-kiln is used by bats both as a winter hibernating site and as a daytime roost during the summer months.

Potter and Scarning Fens, East Dereham SSSI

10.13.12 This SSSI lies 11.2 kilometres from the Proposed Scheme and comprises small calcareous valley fens on shallow peat and are among the finest of their type in Britain. The site grades from bryophyte-dominated communities on the open, wet parts of the site, through calcareous fen, to heathland on the drier ground. The flora is exceptionally diverse, and a number of uncommon mosses and liverworts are present.

10.13.13 The central, open area of the fen is dominated by bryophytes, Bog Rush *Schoenus nigricans* and Blunt Flowered Rush. Such plant communities are now rare in Britain. The range of flowering plants is exceptional and includes Grass-of-Parnassus, Great Sundew *Drosera anglica*, Common Butterwort, Marsh Helleborine, Common Twayblade *Listera ovata* and Bogbean. A tall calcareous fen community surrounds the central area and is dominated by Common Reed, Meadowsweet and Blunt Flowered Rush. A number of



interesting plants are present including Marsh Orchid *Dactylorhiza sp.*, Marsh Lousewort *Pedicularis palustris*, Marsh Pennywort, Common Quaking Grass *Briza media* and Ragged Robin *Lychnis flos-cuculi*.

10.13.14 On the highest ground is an area of grassy heath with much Gorse and some Heather. The calcareous soils are reflected in a number of the species present including Common Quaking Grass, and Heath Speedwell *Veronica officinalis*. Alder carr has grown up on parts of the site and is gradually reducing the remaining open areas of Potter Fen. Reed, Meadowsweet, Yellow Iris and Marsh Marigold are present in the ground flora. The nationally rare Small Red Damselfly is present on the site.

River Wensum SSSI

10.13.15 The citation (Natural England, 1993) for the SSSI details the following: The River Wensum has been selected as one of a national series of rivers of special interest as an example of an enriched, calcareous lowland river. The upper reaches are fed by springs that rise from the chalk and by run-off from calcareous soils rich in plant nutrients. This gives rise to dense beds of submerged and emergent vegetation characteristic of a chalk stream. Lower down, the chalk is overlain with boulder clay and river gravels, resulting in aquatic plant communities more typical of a slow-flowing river on mixed substrate. Diversity of plant species is further enhanced by mills and weirs; upstream the river slows to produce characteristic deep water plant communities, whilst below the barriers they are replaced by species tolerant of swirling and turbulent water.

10.13.16 The River itself supports an abundant and diverse invertebrate fauna as well as a good mixed fishery. Brown Trout *Salmo trutta fario* form the major component of the fish community of the upper Wensum, whilst the middle and lower reaches are dominated by Chub *Squalius cephalus*, Pike *Esox lucius*, European Eel and Barbel *Barbus barbus*. Kingfisher and Little Grebe *Tachybaptus ruficollis* breed along the River, whilst the adjacent wetlands



have good populations of Reed Warblers *Acrocephalus scirpaceus*, Sedge Warblers *Acrocephalus schoenobaenus* and Barn Owls.

- 10.13.17 In the upper reaches on gravel substrates Lesser Water-parsnip and the Brook Water-crowfoot *Ranunculus penicillatus* form a large component of the flora. Where silt has been deposited, Spiked Water Milfoil *Myriophyllum spicatum*, Blue Water-speedwell *Veronica anagalis-aquatica*, Opposite Leaved Pondweed *Groenlandia densa*, Willow Moss *Fontinalis antipyretica* and the nationally rare Short-leaved Starwort *Callitriche truncata* occur. The middle and lower stretches of the river are characterised by rich lowland plant communities. The dominant species are Yellow Water-lily *Nuphar lutea*, Flowering Rush *Butomus umbellatus*, Fennel Pondweed *Potamogeton pectinatus*, Clasping-leaved pondweed *Potamogeton perfoliatus*, Arrowhead *Sagittaria sagittifolia* and Unbranched Bur-reed *Sparganium erectum*.
- 10.13.18 Variations in the aquatic plant community reflect the alternation of fast-flowing shallows with deep slow-moving water. The marginal and bankside communities are typical of lowland rivers. Often there are dense and continuous stands of reeds or sedges. Reed Sweet-grass is dominant in the lower reaches. Elsewhere stands of Reed Canary-grass *Phalaris arundinacea*, Greater Pond-sedge *Carex riparia*, Reedmace *Typha latifolia* and Common Reed are widespread. Where edges are not dominated by tall, straggling or low growing herbs such as Fool's Water-cress *Apium nodiflorum*, Water mint, Water Forget-me-not *Myosotis scorpioides* and Brooklime *Veronica beccabunga* occur.
- 10.13.19 All of the habitats within the SSSI are intrinsically linked to and dependent on the river for their continued existence. Appropriately, in times of drought, these adjacent wetlands have a vital role in buffering the river against low flows; in wetter periods they absorb river flood waters and become swamp-like in nature.



10.13.20 The Wensum has an abundant and diverse mollusc fauna which includes the nationally rare, Desmoulin's Whorl Snail, which is associated with aquatic vegetation at the river edge. Two other aquatic molluscs which occur, *Valvata piscinalis* and *Gyraulus albus*, have a localised distribution in England. Water beetles are well represented; *Brychnus elevatus*, of localised distribution in England, is found in deep slow-flowing sections of the river. The mayflies *Ephemerella ignita*, *Caenis luctuosa*, *Centroptilium luteolum* and *Centroptilium pennulatum* are also of local distribution. There is a species of stonefly, *Amphinemura standfussi*, more usually associated with upland rivers. The flatworm *Crenobia alpina* is of note, being a relict in southern England where it is confined to cold-water spring.

Non-statutory designated sites

10.13.21 **Table 10-12** lists the 33 sites that are non-statutorily designated for biodiversity value (comprising 32 County Wildlife Sites (CWS) and one Roadside Nature Reserve (RNR)) that met the Study Area criteria:

Table 10-12 Sites non-statutorily designated for biodiversity value

Designated Site	Importance	Approximate distance from the Red Line Boundary at closest point, and direction
Attlebridge Hills CWS (Ref: 1343)	County	Adjacent to the RLB
Bawburgh/Colney Gravel Pits CWS	County	5.6 km to the South-east
Botany Bay Farm CWS	County	4 km to the East
Brook House Marshes CWS	County	2 km to the South
Broom & Spring Hills CWS (Ref: 1341)	County	Within the RLB
Church Hill Common CWS	County	Adjacent to the RLB
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS	County	0.95 km to the South
Costessey Pits (East) CWS	County	2.4 km to the South-east
Earlham and Colney Marshes CWS	County	6.8 km to the South-east
East Hills CWS	County	4.3 km to the South-east
Fakenham Road RNR (Ref: 2116)	County	Within the RLB
Fen Plantation CWS	County	0.65 km to the South
Fen West of East Tuddenham CWS	County	0.7 km to the South-west
Gravelpit Plantation and Church Hill CWS (Ref: 2304)	County	Within the RLB, mostly adjacent.
Great Witchingham Common CWS	County	0.65 km to the North
Hellesdon Pastures CWS	County	7.2 km South-east
Horsham Meadows CWS	County	6.2 km East

Designated Site	Importance	Approximate distance from the Red Line Boundary at closest point, and direction
Intwood Carr CWS	County	10.7 km to the South-east
Jennis' Wood & Dryhill Plantation CWS	County	0.83 km to the South
Land adjoining Foxburrow Plantation CWS (Ref: 2116)	County	Within the RLB
Lenwade Pits (East) CWS	County	1.3 km to the North
Lenwade Pits (West) CWS	County	1.2 km to the North
Long Dell and Westlodge Hills CWS	County	2.9 km to the South
Marriott's Way CWS	County	0.75 km to the North
Meadow Farm Meadow CWS	County	2.5 km South-east
Mouse Wood CWS (Ref: 2050)	County	10m from the RLB
Old Covert, Wood Lane CWS (Ref 2109)	County	23m from the RLB
Primrose Grove, Ringland CWS (Ref: 2305)	County	Within the RLB
River Wensum Pastures CWS (Ref: 2303)	County	Within the RLB
Taverham Mill CWS	County	1.5 km to the South-east
Walsingham Plantation CWS	County	0.26 km to the East
Wensum Pastures at Morton Hall CWS (Ref: 2070)	County	Within the RLB
Weston Meadow CWS	County	15m from the RLB



10.13.22 The locations of the sites in relation to the Proposed Scheme are shown in **Figure 10.2** (Appendix 10.38 [Document Reference: 3.10.38]).

Habitats

Overview

10.13.23 Phase 1 Habitat (Document Reference: 3.10.01; 3.10.09), UKHab (Document Reference: 3.10.31) and NVC surveys (Document Reference: 3.10.18) were completed to provide baseline habitat data and to consider the types and distribution of habitats. A breakdown of habitat types identified within the Red Line Boundary, their calculated areas and percentage of the total area is presented in **Table 10-13** and **Figure 10.3** (Appendix 10.38 [Document Reference: 3.10.38]).

10.13.24 Nine different NVC communities/sub-communities were recorded within the grassland/arable margin survey areas, with a further five mosaics/transitional communities recorded. Within the woodland survey areas there were four different communities/sub-communities recorded, with some woodlands unable to be classified due to comprising mainly non-native conifers.

Table 10-13 Habitat types identified, their calculated areas and percentage of the total area within the Red Line Boundary

Habitat	Habitat code	Area (ha)	% of total Proposed Scheme area
Cereal crops	c1c	162.59	56.62
Fen, marsh and swamp	f2	5.42	1.89
Other neutral grassland	g3c	29.99	10.44
Arrhenatherum neutral grassland	g3c5	2.13	0.74
Lolium-Cynosurus neutral grassland	g3c6	0.15	0.05
Deschampsia neutral grassland	g3c7	0.93	0.32



Habitat	Habitat code	Area (ha)	% of total Proposed Scheme area
Modified grassland	g4	35.42	12.33
Sparsely vegetated land-ruderal/ephemeral	s 17	0.80	0.28
Developed land; sealed surface	u1b	5.69	1.98
Artificial unvegetated, unsealed surface	u1c	0.94	0.33
Wet woodland	w1d	2.71	0.95
Lowland mixed deciduous woodland	w1f	0.16	0.06
Other Lowland mixed deciduous woodland	w1f7	18.48	6.44
Other broadleaved woodland types	w1g7	0.81	0.28
Other woodland; mixed; mainly broadleaved	w1h5	16.69	5.81
Other woodland; mixed; mainly conifer	w1h6	1.67	0.58
Other coniferous woodland	w2c	2.58	0.90

Ancient Woodland

10.13.25 The following two parcels of ancient woodland, as listed on the national Ancient Woodland Inventory, are present within 200 metres of the within the Red Line Boundary and identified on **Figure 10.4** (Appendix 10.38 [Document Reference: 3.10.38]):

- Primrose Grove (central grid reference TG13061491) abuts the Red Line Boundary; and



- Mouse Wood is located approximately 7 metres to the west of the Proposed Scheme, separated by Wood Lane (B1535) which provides an access route to the Proposed Scheme.

10.13.26 Three additional ancient woodlands were scoped in as part of the Air Quality Ecological Impact Assessment:

- Church Wood Ancient Woodland (11.6 kilometres east of the Red Line Boundary);
- Snake Wood Ancient Woodland (0.8 kilometres to the east of the Red Line Boundary); and,
- Sprowston Wood Ancient Woodland (11.6 kilometres to the east of the Red Line Boundary).

10.13.27 Ancient Woodland is an Important Ecological Feature at a National scale.

Habitats of Principal Importance

10.13.28 The desk study identified the following Habitats of Principal Importance (HPI) within 200 metres of the Site Boundary:

- River (County value);
- Pond (County value);
- Coastal and Floodplain Grazing Marsh (County value);
- Deciduous Woodland (officially Lowland Mixed Deciduous Woodland) (County value); and
- Lowland Fen (County value).

10.13.29 Survey work identified the following HPI within the Red Line Boundary:

- Purple Moor Grass and rush pasture (County value);
- Coastal and Floodplain Grazing Marsh (County value);



- Lowland Mixed Deciduous Woodland (County value);
- Hedgerow (Species-rich / important hedges: County value. All other hedges: Local value);
- River (County value); and,
- Wet Woodland (County value).

10.13.30 Purple Moor Grass and rush pasture HPI was present in the south of the Red Line Boundary, to the south of Foxburrow plantation woodland and as part of the Land adjoining Foxburrow Plantation CWS. Lowland Mixed Deciduous Woodland HPI was identified beyond the western boundary the River Wensum floodplain in the north of the Red Line Boundary. Lowland Mixed Deciduous Woodland HPI was also present within the Red Line Boundary as part of Broom & Spring Hills CWS, Gravelpit Plantation, The Broadway woodland and Foxburrow Plantation. Coastal and Floodplain Grazing Marsh was present in the River Wensum floodplain in the north of the Red Line Boundary within the River Wensum Pastures CWS and the Wensum Pastures at Morton Hall CWS. Wet Woodland HPI was present in the River Wensum floodplain in the north of the Red Line Boundary, and to the south of Foxburrow plantation woodland and as part of the Land adjoining Foxburrow Plantation CWS.

10.13.31 A breakdown of HPIs identified within the Red Line Boundary is presented in **Table 10-14**. Hedgerows and rivers are considered separately below.



Table 10-14 Habitats of Principal Importance identified within the Red Line Boundary

Habitats of Principal Importance	Total Area (ha)
Purple Moor Grass and Rush Pasture	5.42
Lowland Mixed Deciduous Woodland	23.74
Coastal and Floodplain Grazing Marsh	37.21
Wet Woodland	2.71

10.13.32 Habitats of Principal Importance are Important Ecological Features at a County scale.

Hedgerows

10.13.33 Hedgerow surveys identified a total of 22 hedgerows totalling 8.27 kilometres within or partially within the Red Line Boundary (Document Reference: 3.10.10; Document Reference: 3.10.33). All of the hedgerows qualified as HPI under the Natural Environment and Rural Communities Act (NERC) 2006 (Her Majesty’s Stationery Office (HMSO), 2006) (Her Majesty’s Stationary Office (HMSO), 2006).

10.13.34 A total of eighteen hedgerows totalling 7.33 kilometres that were within or partially within the Proposed Scheme qualified as Important (as defined under the Hedgerows Regulations 1997 (Her Majesty’s Stationery Office (HMSO), 1997), however none of the hedgerows were found to contain ancient or veteran features (Document Reference: 3.10.10; Document Reference: 3.10.33).

10.13.35 Species-rich / important hedgerows are an Important Ecological Feature at a County scale. All other hedges are an Important Ecological Feature at a Local scale.

Watercourses

10.13.36 All rivers qualify as HPI under the Natural Environment and Rural Communities Act (NERC) 2006 (Her Majesty’s Stationery Office (HMSO),



2006). Sections of both the River Wensum and a tributary of the River Tud (Foxburrow stream) have been identified within the Site Boundary.

10.13.37 A River Condition Assessment (RCA) was undertaken in Summer 2022 on the River Wensum (Document Reference: 3.10.33d). Within the Survey Area as defined in the RCA, the River Wensum flows through rough pasture and showed evidence of agricultural pressures, such as bank reprofiling, nutrient input and livestock poaching. The river along the upstream reach of the Survey Area appeared to have been artificially widened and deepened, as evidenced by a mean width of 8 metres and a mean depth of over 1 metre. The river corridor was moderately vegetated with willow trees and tall herbs on both banks shading the channel. The wetted channel was uniform in flow type (deep glide) and substrate (silt). Within the Survey Area, the River Wensum contained a high diversity of aquatic plant species, the channel dominated by submerged broadleaved macrophytes such as pondweed. On both sides of the channel, bank margins were dominated by willow trees, dense stands of reeds and emergent broadleaved macrophytes. Where vegetation was not present, extensive poaching and degradation of the bank profile was evident from livestock accessing the watercourse.

10.13.38 A ditch network is present to the south of the Wensum, running parallel to the main river in many instances (as shown in **Figure 3-1** of the **Aquatic Ecology Survey Report 2022** (Document Reference: 3.10.12)). This ditch network forms part of the Wensum floodplain, playing a vital role in buffering the river against low flows during drought, and in wetter periods, absorbs much of the river flood waters. Condition assessments of these ditches undertaken in Summer 2022 showed evidence of extensive cattle poaching, dredging activities and agricultural nutrient inputs. Vegetation cover on two ditches was extensive and the channels choked with plants. Watercourse 5 (an Internal Drainage Boards (IDB) reference: DRN112G0102) also referred to as Ditch C in Aquatic Ecology Survey Report) had a slow but distinct flow, running



parallel to the Wensum on the south side of the floodplain. The ditch showed evidence of eutrophication in the form of extensive algae, decomposition of submerged macrophytes and an organic surface scum. Ditch A, west of the viaduct, showed evidence of recent dredging activity, with limited macrophyte cover, bare earth banks and soil spoils along the bank top.

10.13.39 The River Wensum within the Survey Area falls within the WFD 'Wensum Upstream (US) Norwich' water body (GB105034055881). The River Wensum is designated as a WFD main river, whilst the connected drainage ditch network, located to the south-west of the river within the Survey Area, is classed as an ordinary watercourse. The hydromorphological designation of the 'Wensum Upstream (US) Norwich' water body is 'heavily modified' and is considered to be heavily influenced by anthropogenic activity (Environment Agency, 2022a).

10.13.40 The 2019 WFD ecological status of the 'Wensum Upstream (US) Norwich' water body was classified as Moderate overall. The water body is monitored for macrophytes/phytobenthos, fish and invertebrates, which were classified as Moderate, High, and High, respectively (Environment Agency, 2022a).

10.13.41 The reasons for the macrophytes/phytobenthos combined quality element not achieving Good status are listed as:

- Diffuse source pollution from poor nutrient management;
- Diffuse source pollution from poor livestock management; and
- Point source pollution from continuous sewage discharge.

10.13.42 The 2019 WFD physico-chemical status of the 'Wensum Upstream (US) Norwich' water body was Good overall. Temperature achieved Good status, whilst ammonia, biological oxygen demand, dissolved oxygen, phosphate, and pH achieved High status (Environment Agency, 2022a).



- 10.13.43 For the purpose of this assessment, the River Wensum SAC and River Wensum SSSI and their associated features have been assessed separately to other watercourses.
- 10.13.44 A RCA was undertaken in Summer 2022 on Foxburrow Stream (Document Reference: 3.10.33d), a tributary of the River Tud, which flows west to east in the southern aspect of the Proposed Scheme. The Foxburrow Stream flows through rough pasture and shows evidence of realignment, bank reprofiling and livestock poaching. The river corridor was densely vegetated with tall herbs on both banks and some scattered trees shading the channel. The wetted channel was narrow and uniform in flow type, habitat features and substrate. At the time of the survey, the Foxburrow Stream had a low flow and shallow average water depth of 10cm. In general, the Foxburrow Stream contained a low diversity of aquatic plant species.
- 10.13.45 The River Tud within the Survey Area as defined in the RCA falls within the WFD 'Tud' water body (GB105034051000). The River Tud is designated as a WFD watercourse. The hydromorphological designation of the 'Tud' water body is 'heavily modified' and is considered to be heavily influenced by anthropogenic activity. The Foxburrow Stream is a tributary of the River Tud, located within the Tud WFD water body catchment.
- 10.13.46 The 2019 WFD ecological status of the 'Tud' water body was Good. The water body is monitored for fish and invertebrates, which were classified as Good and High respectively.
- 10.13.47 The 2019 WFD physico-chemical status of the 'Tud' water body was Moderate overall. Phosphate achieved Moderate status and temperature achieved Good status, whilst ammonia, dissolved oxygen, and pH achieved High status (Environment Agency, 2022).
- 10.13.48 The reasons for the physico-chemical status not achieving Good status are listed as:



- Diffuse source pollution from poor nutrient management;
- Diffuse source pollution from poor livestock management;
- Diffuse source pollution from transport drainage; and
- Point source pollution from continuous sewage discharge.

10.13.49 Watercourses (excluding the River Wensum and associated features) are Important Ecological Features at a County scale.

Notable, veteran and ancient trees

10.13.50 The **Arboricultural Impact Assessment** (Document Reference: 3.10.35) details the results of 377 surveyed arboricultural features, including features of High, Moderate, Low and Very Low quality in accordance with British Standard BS5837:2012 'Trees in Relation to Design, Demolition and Construction – Recommendations'. This chapter considers the high value features of notable, ancient or veteran trees. A detailed assessment of the Potential Effects, Mitigation and Residual Effects of Moderate, Low and Very Low category trees is provided in the **Arboricultural Impact Assessment** (Document Reference: 3.10.35).

10.13.51 Individual trees which possess the physical characteristics and attributes of a veteran tree are assessed as Ancient or Veteran, with diameter being the principal differentiating factor between the two. All ancient trees are also veteran, and the protection afforded to each category (and therefore sensitivity of the feature) is the same for both ancient and veteran trees. The distinction is primarily of one of arboricultural interest. Notable trees possess insufficient attributes and criteria to be considered veteran but are large specimens, exceeding a species-specific threshold for the species. Other trees that do not possess qualifying attributes and features, or diameter, but are exemplary arboricultural specimens were designated category 'A1' in the **Arboricultural Impact Assessment** (Document Reference: 3.10.35).



10.13.52 The **Arboricultural Impact Assessment** (Document Reference: 3.10.35) identified high quality trees and groups in the Study Area and these were categorised as Category A. They are the most sensitive receptors and includes all ancient and veteran trees. These sensitive receptors are listed in **Appendix 3.10.35b** (Document Reference: 3.10.35b). The Air Quality Ecological Impact Assessment scoped in 73 veteran and ancient trees.

10.13.53 In general, individual ancient or veteran trees are of high importance on the basis they are considered an irreplaceable habitat. Veteran and ancient trees are therefore considered to be an Important Ecological Feature at a National scale. Notable trees are considered to be an Important Ecological Feature at a County scale.

Protected and Notable Species

Badger

10.13.54 NBIS returned 141 records of Badger within the 2-kilometre Desk Study Area, predominantly along roads, the A1067, A47 and Hockering Wood, with scattered records occurring throughout the central Field Survey Area.

10.13.55 The requirement for Badger surveys followed the identification of suitable habitat for this species within the Site Boundary and wider landscape. These habitats comprised woodlands, arable field margins and other boundary features such as hedgerows. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.56 The Badger surveys undertaken between 2019 and 2023 identified 88 distinct badger setts. In 2022, 73 setts were identified, including four main setts, four annex, nine subsidiary and 56 outlier setts. 18 setts were searched for but were not found during the 2022 update survey but were previously recorded across the Proposed Scheme. The results of these surveys are summarised in the Norwich Western Link Road Badger Survey Report 2022 (WSP UK Ltd,



2022a). An additional active single entrance sett (S93) was incidentally identified near Primrose Grove CWS during a site visit in May 2023.

10.13.57 Badger bait-marking surveys identified three separate Badger clans with setts within the Site Boundary.

10.13.58 Badgers are an Important Ecological Feature at a Local scale. Measures are required to ensure compliance with the legislation protecting them.

Otter

10.13.59 NBIS returned 86 records of otter within the 2 kilometre Desk Study Area, located along the River Wensum and River Tud, with a single record from the A47 and two locations to the south-west.

10.13.60 The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.61 Although no specific otter surveys were undertaken in 2019, an otter was observed within the River Wensum during the white-clawed crayfish survey. Otter surveys in 2020 identified a potential holt beneath tree roots on the northern bank of the River Wensum, with shell remains and several otter droppings (spraints) also present. However, further intensive investigation in 2021 found that the habitat feature did not relate to otter, given that it did not provide sufficient shelter. Otters were also not recorded on a trail camera which focussed on the feature for a total of 68 days. Consequently, whilst it is evident that otter do utilise habitats within surveyed area of the River Wensum, no holts were considered to be present at the time of the surveys.

10.13.62 Additionally, no evidence of otters was recorded in Foxburrow Stream in the southern aspect of the Proposed Scheme and, therefore, this water course was considered unlikely to form a significant part of otter territory.

10.13.63 Otters are an Important Ecological Feature at a Local scale.



Water Vole

10.13.64 Water Vole surveys were initially undertaken in 2019, with follow-up surveys undertaken in 2020 and 2021. A further survey of sections of WC1 (Watercourse 1), WC4 and WC5 (IDB reference: DRN112G0102) (as defined in the Otter and Water Vole Survey Report 2021 (Document Reference: 3.10.19)) across the River Wensum floodplain was undertaken in November 2022. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.65 The Desk Study returned two records for Water Vole within the 2km Study Area. The nearest and most recent record of a Water Vole was of an individual found dead 650 metres south of the Proposed Scheme, near the River Tud in Honingham.

10.13.66 Surveys confirmed the presence of Water Voles in the River Wensum, as well as an adjoining ditch (WC7) and floodplain stream (WC5 (IDB reference: DRN112G0102)). Latrine counts from the surveys indicated the presence of a medium population in the River Wensum, with low populations in WC5 (IDB reference: DRN112G0102) and WC7. No evidence of Water Voles was recorded in Foxburrow Stream and therefore Water Voles have been considered likely absent from this watercourse.

10.13.67 Water Voles are an Important Ecological Feature at up to a County scale.

Birds

10.13.68 The 2022 desk study that included data requested from NBIS returned records for the following 15 bird species within 2 kilometres of the Site Boundary within the last ten years:

- Barn Owl *Tyto alba*;
- Blackbird *Turdus merula*;
- Dunnock *Prunella modularis*;



- Kestrel *Falco tinnunculus*;
- Pheasant *Phasianus colchicus*;
- Red Kite *Milvus milvus*;
- Red-legged Partridge *Alectoris rufa*;
- Robin *Erithacus rubecula*;
- Rook *Corvus frugilegus*;
- Skylark *Alauda arvensis*;
- Starling *Sturnus vulgaris*;
- Swallow *Hirundo rustica*;
- Swift *Apus apus*;
- Woodpigeon *Columba palumbus*; and,
- Wren *Troglodytes troglodytes*.

10.13.69 None of the records were from within the Site Boundary, and the closest record was Swallow 0.1 kilometres south of the Proposed Scheme. Two of these records were for species protected listed in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended); Barn Owl and Red Kite Species identified that are included on the Lists of Birds of Conservation Concern (Stanbury, et al., 2021) comprised three red listed species (Skylark, Starling and Swift) and five amber listed species (Dunnock, Kestrel, Rook, Woodpigeon and Wren).

Breeding Birds

10.13.70 Six survey visits were completed between April and July 2021 (see **Appendix 10.13**) (Document Reference: 3.10.13). The relationship between Field



Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

- 10.13.71 Given the potential impacts of the Proposed Scheme which involves a permanent loss of habitat, territory (registration) mapping techniques were undertaken (Bibby, Burgess, Hill & Mustoe, 2000). This technique forms the basis of the British Trust for Ornithology (BTO) Common Bird Census (CBC), the outcome of which provides a sufficient level of confidence when describing the breeding bird community present. The surveys were scoped before the publication of the online Bird Survey Guidelines (Bird Survey & Assessment Steering Group, 2022) however the methodology and effort applied for the Proposed Scheme is consistent with that guidance.
- 10.13.72 Surveys of breeding birds were conducted along the length of the Proposed Scheme to establish the breeding bird community present and the inclusion of any sensitive ornithological features. The Field Survey Area was expanded to also include a buffer of 100 metres to allow for all bird territories potentially exposed to disturbance to be identified. In an effort to cover this area the proposed transect route totalled approximately 13.3 kilometres in length. Due to this length and size of the Field Survey Area this transect was divided into three.
- 10.13.73 A total of 66 species were recorded during the breeding bird survey, of these 33 were known to either breed or probably breed within the Field Survey Area. Of the 66 species recorded, 33 are considered to be of conservation concern through listing on either Red or Amber Birds of Conservation Concern (BoCC), Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) or as a Species of Principal Importance (SPI). Thirteen of these species are considered to either breed or probably breed on the Site.
- 10.13.74 A kingfisher was also recorded incidentally on other survey visits, and therefore six species protected under Schedule 1 of the Wildlife and



Countryside Act 1981 (as amended) were identified. These comprised Barn Owl, Brambling *Fringilla montifringilla*, Fieldfare *Turdus pilaris*, Hobby *Falco subbuteo*, Kingfisher and Red Kite. None of these species were confirmed to be breeding although Red Kite was categorised as 'probably breeding' despite searches of habitat failing to confirm a nest site.

10.13.75 Eight species listed as a SPI were recorded during the breeding bird survey, these were: Skylark, Linnet *Linaria cannabina*, Cuckoo *Cuculus canorus*, Yellowhammer *Emberiza citrinella*, Herring Gull *Larus argentatus*, Song Thrush *Turdus philomelos*, Starling and Lapwing *Vanellus vanellus*. Nine species included on the Red List BoCC (Stanbury, et al., 2021) (Stanbury, et al., 2021) were recorded during the breeding bird survey, these were: Cuckoo, Fieldfare, Greenfinch *Chloris chloris*, Lapwing, Linnet, Skylark, Starling, Herring Gull and Yellowhammer.

10.13.76 Of these species only Greenfinch (one territory), Linnet (one territory), Skylark (24 territories), Song Thrush (seven territories) and Yellowhammer (six territories) were confirmed to be breeding in the Field Survey Area.

10.13.77 The breeding bird assemblage included no species protected under Schedule 1 of the Wildlife and Countryside Act that were confirmed to be breeding. Red Kite were considered to possibly be breeding although no nest was located. The location where Red Kite were recorded was also outside of the boundary of the Proposed Scheme. Kingfisher are known to occur on the River Wensum but were not found to be breeding during surveys. Of the other species only five considered to be breeding were of notable conservation importance (i.e. SPI or BoCC Red List): Greenfinch, Linnet, Skylark, Song Thrush and Yellowhammer. None of these species were recorded in populations that represent a notable proportion of the Norfolk county population (Taylor & Marchant, 2011). The breeding bird assemblage is therefore considered to be of Local importance.



10.13.78 Breeding birds are an Important Ecological Feature at a Local scale.

Wintering birds

10.13.79 To inform an evaluation of the habitats for bird species, four wintering bird survey visits were completed on each month between November 2020 to February 2021 (see **Appendix 10.27**) (Document Reference: 3.10.27). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.80 The survey methodology employed was based on that recommended in standard literature, e.g. Winter Farmland Bird Survey as used by for example the British Trust for Ornithology (BTO) (Bibby, Burgess & Hill, 1992, Gilbert, Gibbons & Evans, 1998, Gillings, et al., 2008).

10.13.81 A total of 74 species were recorded on or over the Field Survey Area during the wintering bird survey. This included 44 species which are legally protected or species of conservation concern.

10.13.82 The species assemblage included:

- Eight species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended);
- Eleven species listed as SPI in accordance with Section 41 of the NERC Act 2006 (also UKBAP species); and
- Fourteen BoCC Red List species.

10.13.83 Schedule 1 species comprised Red Kite, Peregrine *Falco peregrinus*, Kingfisher, Cetti's Warbler *Cettia cetti*, Crossbill *Loxia curvirostra*, Fieldfare, Redwing *Turdus iliacus*. Red List and / or SPI included Greenfinch, Grey Wagtail *Motacilla cinerea*, Herring Gull, Lapwing, Linnet, Marsh Tit *Poecile palustris*, Mistle Thrush *Turdus viscivorus*, Lesser Redpoll *Acanthis cabaret*, Song Thrush, Starling, Woodcock and Yellowhammer.



10.13.84 The species recorded were broadly typical of woodland and farmland habitat. No notable aggregations of waterbirds were recorded in the River Wensum floodplain.

10.13.85 The wintering bird assemblage identified no notable waterbird aggregations associated with the River Wensum and its associated floodplain. Eight species protected under Schedule 1 of the Wildlife and Countryside Act were recorded with two of these being species (Redwing; Fieldfare) that are designated for their restricted breeding populations in the UK rather than their substantial wintering populations. The Field Survey Areas were subject to occasional sightings of Red Kite, Peregrine and Crossbill while the River Wensum supported Kingfisher and Cetti's Warbler. Of the Red List / SPI species recorded Yellowhammer, Linnet, Song Thrush, Starling were regularly recorded and Lapwing, Herring Gull, Marsh Tit and Woodcock were occasional.

10.13.86 Overall, it is considered that the wintering assemblage is consistent with woodland and arable areas in the Wensum Valley and does not support populations of species that are deemed to be important at a County level. The wintering bird assemblage is therefore considered to be of Local importance.

10.13.87 Wintering birds are an Important Ecological Feature at a Local scale.

Barn Owl

10.13.88 Surveys confirmed the presence of Barn Owls across the Field Survey Area and within the surrounding local area, with evidence of the species found in the north, south and centre of the Field Survey Area (see **Confidential Appendix 10.28**) (Document Reference: 3.10.28). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.



- 10.13.89 Several Barn Owls were observed during the field surveys, with a total of eight individuals recorded, indicating a high prevalence across the Field Survey Area.
- 10.13.90 Suitable Barn Owl foraging habitat was identified within the Site Boundary and surrounding Field Survey Area, including towards the north of the Proposed Scheme where grassland surrounds the River Wensum.
- 10.13.91 The Stage 3 nest verification surveys identified a total of three occupied breeding sites (OBS) and thirteen potential nest sites (PNS) within trees and buildings (see **Confidential Appendix 10.28**) (Document Reference: 3.10.28). No confirmed OBS are located within the Site Boundary, the closest OBS is a Barn Owl nest box 70 metres from the Proposed Scheme. There are two PNS in trees which fall within the Site Boundary. Full details are provided in the Barn Owl Survey Report 2021 (Document Reference: 3.10.28).
- 10.13.92 According to the Norfolk Bird Atlas (Taylor & Marchant, 2011) the Barn Owl is widespread in Norfolk, but its numbers have declined both nationally and in Norfolk. Barn Owls are therefore an Important Ecological Feature at a Local scale.

Reptiles

- 10.13.93 NBIS returned 68 records for slow worm *Anguis fragilis*, 26 Common Lizard *Zootoca vivipara*, 75 Grass Snake and 10 Adder *Vipera berus* from the 2 kilometre Desk Study Area with records scattered across the Field Survey Area, with Grass Snake records concentrated in the south-east.
- 10.13.94 The survey work identified three common reptile species (Common Lizard, Grass Snake and Slow Worm) within the Field Survey Area (see **Appendix 10.25**) (Document Reference: 3.10.25). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.



10.13.95 Reptiles were recorded within and in the vicinity of The Broadway woodland and Foxburrow Plantation in the south of the Proposed Scheme. One Grass Snake was recorded on a southern hedgerow that bordered Breck Road. Sixteen Slow Worm were recorded during the survey, with individuals present by a hedgerow to the south of Foxburrow Plantation, along a woodland ride in the plantation, on an arable field margin between Foxburrow Plantation and The Broadway woodland, and along the southern boundary of The Broadway.

10.13.96 Reptiles are an Important Ecological Feature at a Local scale.

Great Crested Newt

10.13.97 NBIS returned 221 records of Great Crested Newt with the 2-kilometre Desk Study Area, of which seven locations were from within the Field Survey Area.

10.13.98 GCN surveys, comprising Habitat Suitability Index (HSI) and Environmental DNA (eDNA) presence / likely absence surveys, were undertaken on ponds within and up to 500 metres from the Proposed Scheme. Ponds which returned a positive result for GCN eDNA were subject to further population size class assessment surveys in 2021. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.99 The results of the eDNA surveys indicated the presence of GCN in waterbodies 15 and 16 (as defined in the **Great Crested Newt eDNA Survey Report 2021** (Document Reference: 3.10.23)), respectively situated approximately 280 metres and 272 metres from the Proposed Scheme. Further surveys were therefore undertaken at these water bodies, and the adjacent water body 17 in 2021 to establish population size class. This recorded a peak count of one adult GCN in Water Body 15, indicating the presence of a 'small' population in accordance with standard guidelines. However, no GCN were recorded in Water Bodies 16 or 17 during any of the six survey visits, indicating that the positive eDNA result returned in 2020 was



likely to be a false positive. GCN were therefore considered to be likely absent from Water Bodies 16 or 17 following the population size class assessment surveys.

10.13.100 Great Crested Newts are an Important Ecological Feature at a Local scale.

Fish

10.13.101 A search of the Environment Agency's Ecology and Fish Data Explorer returned data from an Environment Agency catch depletion electric fishing survey carried out in 2019, at a site approximately 8.2km downstream of the proposed River Wensum viaduct. A total of 456 fish were caught during the survey, with the Minnow *Phoxinus phoxinus* dominating the assemblage. Three species of conservation interest, Brook Lamprey, Bullhead (both Annex II species and qualifying features of the River Wensum SAC designation) and European Eel (species of Principal Importance) were recorded in the Environment Agency survey. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.102 Ecologists conducted a 40-minute timed, catch per unit effort (CPUE) electric fishing survey over a 150-metre stretch of the River Wensum in August 2022 ((Survey Area shown in **Figure 3-3** of the **Aquatic Ecology Survey Report 2022** (Document Reference: 3.10.12)). A total of nine species were caught during the survey. The species captured included Dace *Leuciscus leuciscus*, Pike, Chub, Perch *Perca fluviatilis*, Roach *Rutilus rutilus*, Rudd *Scardinius erythrophthalmus*, Stone Loach *Barbatula barbatula*, Three-spined Stickleback *Gasterosteus aculeatus*, and Minnow. No species of conservation importance were captured.

10.13.103 A qualitative (presence / likely absence) electric fishing survey of the ditch network was also conducted in August 2022 ((Survey Area shown in **Figure 3-**



3 of the **Aquatic Ecology Survey Report 2022** (Document Reference: 3.10.12)). A total of three species were caught during the survey, including Brook / River Lamprey *Lampetra* spp., Minnow, and Three-spined Stickleback.

10.13.104 No fish were caught during the quantitative one-run electric fishing survey of Foxburrow Stream carried out in August 2022.

10.13.105 Fish populations are assessed as a IEF of International importance as Bullhead and Brook Lamprey are both qualifying features of the River Wensum SAC.

Aquatic macroinvertebrates

10.13.106 A search of the Environment Agency Fish and Ecology Data Explorer website returned data from an Environment Agency aquatic macroinvertebrate survey carried out in spring 2021, at a site located approximately 1.63 kilometre upstream of the proposed crossing of the River Wensum by the Proposed Scheme. No protected species were identified in the sample, however the invasive non-native New Zealand Mud Snail *Potamopyrgus antipodarum* was recorded. It should be noted that this species is widespread throughout the UK and is considered naturalised. The aquatic macroinvertebrate community recorded classified the River Wensum at the sampling location as having Fairly High conservation value in spring 2021.

10.13.107 Aquatic macroinvertebrate surveys were carried out on the River Wensum, the ditch network, and Foxburrow Stream in spring and autumn 2022((Survey Area shown in **Figure 3-1** of the **Aquatic Ecology Survey Report 2022** (Document Reference: 3.10.12)). Document Reference The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.108 The aquatic macroinvertebrate communities observed classified the River Wensum and WC5 (IDB reference: DRN112G0102) as having Low conservation value in spring 2022. Ditch B was classified in spring 2022 as



having Fairly High conservation value. In autumn 2022 Ditch B was classified as having an aquatic macroinvertebrate community of Low conservation value, with the River Wensum having Moderate conservation value. WC5 (IDB reference: DRN112G0102) was classified in autumn 2022 as having Fairly High conservation value (WSP UK Ltd, 2021).

10.13.109 Foxburrow Stream was classified as having an aquatic macroinvertebrate community of Moderate conservation value in both spring and autumn 2022.

10.13.110 Three species of note under Community Conservation Index scoring, Red-legged Moss Beetle *Hydraena rufipes*, Grannom Caddisfly *Brachycentrus subnubilus*, and Pale Evening Dun Mayfly *Procloeon bifidum*, were identified in the samples. One individual of the red- Red-legged Moss Beetle was recorded in the Ditch B spring sample, with another individual recorded in the WC5 (IDB reference: DRN112G0102) autumn sample. Three individuals of the Grannom Caddisfly were recorded in the River Wensum upstream autumn sample, with another individual recorded in the River Wensum downstream autumn sample. One individual of the Pale Evening Dun Mayfly was recorded in the River Wensum upstream autumn sample, with another individual recorded in the WC5 (IDB reference: DRN112G0102) autumn sample.

10.13.111 Due to the presence of regionally Notable species, aquatic macroinvertebrates are considered to be an Important Ecological Feature at a County scale.

Terrestrial Invertebrates

10.13.112 NBIS returned multiple records of invertebrate species for groups including Coleoptera (beetles), Diptera (true flies), Hemiptera (true bugs), Hymenoptera (ants, bees, wasps and sawflies), Lepidoptera (butterflies and moths), Odonata (dragonflies and damselflies). These include species protected under the Wildlife and Countryside Act 1981 (as amended) such as Norfolk



Hawker *Anaciaeschna isosceles* and Desmoulin's Whorl Snail. The latter species is discussed in an independent section below.

- 10.13.113 A Survey of the Proposed Scheme was assessed for its potential to support important terrestrial invertebrate assemblages by a suitably experienced entomologist, on 27 April 2021 (Document Reference: 3.10.21). Survey effort was focussed on habitats that were most likely to be directly impacted by the Proposed Scheme (e.g., through habitat loss).
- 10.13.114 An invertebrate habitat potential assessment survey was undertaken with reference to the (as yet unpublished) Invertebrate Habitat Potential Protocol (Dobson and Fairclough, unpublished). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.
- 10.13.115 Distinct areas of terrestrial habitat (often geographically separated from each other) identified during the habitat potential assessment with potential to support valuable invertebrate assemblages, were allocated land parcel numbers 1-12 (as defined in the **Terrestrial Invertebrate Survey Report 2021** (Document Reference: 3.10.21)) and subject to targeted survey in spring (April), summer (June) and late summer / early autumn (August / September) 2021. These parcels predominantly comprised woodland (deciduous and mixed), woodland edge (with scrub and grassland), hedgerows (and their margins), marshy grassland and road verges of neutral grassland with dense patches of flowering plants. Therefore, the targeted survey was designed to target data collection of key indicator groups associated with such habitats. The following sampling methods were employed: pan traps, pitfall traps, window traps, light trapping, sweep-netting, beating and grubbing.
- 10.13.116 Overall, the surveyed area was found to support a diverse invertebrate fauna, which included forty-three species currently regarded as Nationally Rare, Scarce, Data Deficient or Section 41 Species of Principal Importance.



However, closer examination of this number reveals that certain parcels supported more rarities than others. Parcel 7 supported seventeen such rarities, followed by Parcel 1, with nine rarities, Parcel 9 with five rarities and Parcel 3 with three rarities. All other parcels had one or no rarities.

10.13.117 Pantheon analysis (Webb, et al., 2018) reveals that the majority of these species are those associated with woodland and flower-rich grassland and disturbed ground habitats. The following terrestrial invertebrate resources were identified as being of particular importance for invertebrates:

- Roadside verge habitat either side of Fakenham Road (A1067) (Parcel 7) - This roadside verge has a diverse invertebrate fauna that includes seventeen species recorded with a conservation status.
- Woodland habitat in the north of the Field Survey Area (Parcels 1 and 3) - Parcels 1 and 3 recorded twelve species with conservation status. These mostly include species of decaying wood, a habitat that is prevalent in over mature trees mainly positioned at the boundaries of the woodland parcels.
- Hedgerows north of Weston Road (Parcel 9) - Five species with an attributed conservation status were recorded from the hedgerow network with mature and over-mature trees and associated wide, herb-rich arable field margins north of Weston Road.

10.13.118 The terrestrial invertebrate population identified within the surveyed area is an Important Ecological Feature at a County scale.

10.13.119 Baseline information for Desmoulin's Whorl Snail is presented below. This species is considered independently as part of this chapter as it is a qualifying feature of the River Wensum SAC and therefore of International importance.



Desmoulin's Whorl Snail

- 10.13.120 The requirement for survey of this species was established in 2018 following their identification through the Scheme's ecological desk study, as they comprise a Qualifying Feature of the River Wensum SAC, that is crossed by the Proposed Scheme.
- 10.13.121 Surveys comprised both a desk study and field work to identify habitats occupied by Desmoulin's Whorl Snail in the River Wensum valley. The Desk study comprised a review of ecological records of Desmoulin's Whorl Snail from within 2 kilometres of the Proposed Scheme, as well as identification of sites designated for its protection. Field work comprised spot sampling of the invertebrate community within the Wensum floodplain and Foxburrow stream between 2019 and 2021. Initial surveys in 2019 (**Appendix 10.6** (Document Reference: 3.10.06)) were extended by further work in 2020 (**Appendix 10.39** (Document Reference: 3.10.39)) due to changes in the Proposed Scheme design and to sample a wider area of the Wensum Valley. An update survey of areas where Desmoulin's Whorl Snail had previously been identified was undertaken in 2021 (**Appendix 10.14** (Document Reference: 3.10.14)) to confirm continued presence or likely absence.
- 10.13.122 Sampling involved collection of molluscs from vegetation directly by surveyors and their subsequent identification to species level. Habitat suitability was also assessed through analysis of vegetation at sampling sites. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.
- 10.13.123 Survey work indicated the presence of Desmoulin's Whorl Snail in three floodplain ditches (WC1, WC3 and WC4) within the Field Survey Area, as well as a large, scattered population within the Wensum floodplain approximately 1 kilometre to the southeast. A section of WC1 falls within the Site Boundary. Habitat within this section of WC1 became unsuitable for supporting Desmoulin's Whorl Snail in 2021 subsequent to sampling works, and so this



species is no longer considered to be present in the Site Boundary for the purpose of this assessment.

- 10.13.124 Desmoulin's Whorl Snail is a widespread species that is chiefly distributed in a broad band of country from central-southern England to East Anglia (Kerney, 1999), but is assessed as a IEF of International importance as it is a qualifying feature of the River Wensum SAC.

Terrestrial vascular plants

- 10.13.125 NBIS returned records for species listed as Norfolk Rare Plants such as large yellow-sedge *Carex flava* and tubular water-dropwort.
- 10.13.126 Hoary Mullein *Verbascum pulverulentum* was recorded within the grassland north of Fakenham Road, most recently during the 2022 UK Habitat Classification Survey (UKHab Report 2022 (Document Reference: 3.10.31)). Hoary Mullein is a species considered notable due to its native distribution being confined to East Anglia, it is considered introduced elsewhere nationally. This species is not listed under any national or local conservation legislation or initiatives.
- 10.13.127 Corn Spurrey *Spergula arvensis* and Common Cudweed *Filago vulgaris* were recorded occasionally on arable margins within the Proposed Scheme, these species are considered 'Vulnerable' and 'Near Threatened' respectively in the Vascular Plant Red List for England (2014). However, these species are commonplace and well distributed nationally and are not afforded any statutory protection.
- 10.13.128 Terrestrial vascular plants, comprising protected and / or notable flora are not considered to be an Important Ecological Feature.

Macrophytes

- 10.13.129 A search of the Environment Agency Fish and Ecology Data Explorer website returned data from an Environment Agency macrophyte survey carried out in



summer 2021, at a site located approximately 1.70km upstream of the proposed crossing. No protected species were identified in the sample, however the invasive non-native Nuttall's waterweed *Elodea nuttallii* was recorded. No water crow-foot species of note were recorded in the survey. Four species listed on the designation of habitat type 3260 'watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation'; Claspingleaved pondweed, fennel pondweed, water starwort *Callitriche* sp., and common water moss *Fontinalis antipyretica* were recorded.

- 10.13.130 Macrophyte surveys were carried out on the River Wensum, the ditch network, and Foxburrow Stream in summer 2022 ((Survey Area shown in **Figure 3-2** of the **Aquatic Ecology Survey Report 2022** (Document Reference: 3.10.12)). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.
- 10.13.131 A total of 25 macrophyte taxa were recorded in the 2022 macrophyte survey of the River Wensum, 12 of which are LEAFPACS2 scoring taxa. Claspingleaved pondweed was the most dominant species, accounting for an estimated 60% of the Survey Area's total macrophyte cover. No invasive non-native species were recorded in the survey.
- 10.13.132 Stream water-crowfoot, a species characteristic of the River Wensum SAC, was the only species of water-crowfoot observed. A further, six species or groups associated with *Ranunculus* spp. in 'watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' were sampled; water starwort, common water moss, claspingleaved pondweed, curled pondweed *Potamogeton crispus*, and spiked water milfoil.
- 10.13.133 Macrophyte surveys were also conducted on the ditch network. One species of note was recorded in Ditch A. Small patches of frogbit *Hydrocharis morsus-*



ranae were recorded. The species is classified as Vulnerable on the Vascular Plant Red List for Great Britain (Cheffings & Farrell, 2005).

10.13.134 A total of eight macrophyte taxa were recorded in the 2022 macrophyte survey of Foxburrow Stream, two of which are LEAFPACS2 scoring taxa. Fool's watercress was the most dominant species, accounting for 50% of the total macrophyte cover. No invasive non-native species were recorded in the survey.

10.13.135 Due to the presence of species listed as members of the Annex I habitat 3260 community, a qualifying feature of the River Wensum SAC, aquatic macrophytes are assessed as a IEF of International importance.

Lichen

10.13.136 A total of 22 lichen species were recorded across the four Field Survey Areas (**Appendix 10.17**) (Document Reference: 3.10.17). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**. All species were recorded on the bark of trees and shrubs, with no terricolous species recorded. No lichen species of conservation interest were found. It is therefore considered very unlikely that the Study Area supports any lichen species of conservation importance.

10.13.137 The 22 lichen species recorded in the four Field Survey Areas are all species that have no formal national conservation status.

10.13.138 Lichen is not an Important Ecological Feature.

Fungi

10.13.139 **The Fungal Survey Report (Appendix 10.15)** (Document Reference: 3.10.15) determined Nursery Woodlands to be of negligible ecological importance in terms of its mycological interest. It is a relatively recent feature with low vascular plant diversity and dominated by non-native trees. The



fungi associated with The Nursery are correspondingly limited in their diversity.

- 10.13.140 The other woodlands and plantation areas are regarded as being of local ecological importance since they appreciably enrich the local resource, but no rare or protected fungi were recorded from any of these wooded areas and only one species (*Mycena abramsii*) appears not to have been previously recorded from Norfolk. This species is small and nondescript, requiring microscopic examination to determine its identity so is therefore likely to be often overlooked. It is described by Legon and Henrici (2005) as 'rarely reported but apparently widespread'.
- 10.13.141 Within the context of the locality, the greatest fungal diversity appears to be associated with Rose Carr on account of the variety of habitats present, although Long Plantation also supports a moderately diverse range of species. Foxburrow Plantation with the associated marshy ground to the south is likely to support a more varied range of species than was observed during the spring survey on account of the range of habitats and tree species present. Only a small part of Spring Hills falls within the Field Survey Area and most of this appears to be of fairly recently planted origin. The Unnamed Woodland (South of Ringland Lane), as located within the **Fungi Survey Report** (Document Reference: 3.10.15) also contains recent planting, and these latter sites appear to be of somewhat lower value in the local context.
- 10.13.142 No evidence of *Battarrea phalloides* was found in any of the hedgerows, although some are considered to be potentially suitable locations for this species, notably the hedgerow alongside Ringland Lane and the hedgerow north of Weston Road which both support sandy ground. On the basis of the Fungi Survey Report (DOC REF), however, they are judged to be of no more than local mycological interest. The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.



10.13.143 Fungi is not an Important Ecological Feature.

Additional Species of Principal Importance (SPI)

10.13.144 Brown Hare *Lepus europaeus*, Harvest Mouse, Western European Hedgehog *Erinaceus europaeus*, Polecat *Mustela putorius*, and Common Toad were scoped into this assessment due to suitable habitat being present within the Proposed Scheme and its locality, as well as local and / or incidental records being returned for these species.

10.13.145 NBIS returned 270 records of hedgehog, 11 records of harvest mouse and 90 records of Brown Hare. Incidental records for Brown Hare and Hedgehog within the Proposed Scheme were made during the ecological survey work undertaken (**Appendix 10.20**) (Document Reference: 3.10.20). The relationship between Field Survey Areas and the Site Boundary and Red Line Boundary of the Proposed Scheme is outlined in **Table 10-7**.

10.13.146 The Harvest Mouse is potentially present within Site Boundary. Brown Hare were confirmed present within Site Boundary from both incidental and local records. Hedgehog are considered likely to be present within the Site Boundary.

10.13.147 The desk study did not return any local records of Common Toad within a 2 kilometre radius of the Site Boundary, and no targeted field surveys were undertaken for this species. Five incidental records of Common Toad were recorded during other ecological surveys undertaken in relation to the Proposed Scheme:

- Three individuals recorded in rough grassland along the southern edge of Ringland Lane during reptile surveys undertaken in 2019; and
- Two individuals recorded within Rose Carr woodland during March 2021.



- One individual recorded in rough grassland along the southern edge of the A1067 during terrestrial invertebrate surveys undertaken in 2021.

10.13.148 Harvest mouse, Brown Hare, Hedgehog and Common Toad are Important Ecological Features at a Local scale.

Invasive Non-Native Species

10.13.149 The following invasive non-native species listed on Schedule 9 of the WCA were identified as incidental records during ecological surveys undertaken between 2018 and 2022:

- Himalayan Balsam *Impatiens glandulifera* was identified along the River Wensum and within the Field Survey Area (Document Reference: 3.10.01) in 2018, however no records of this species were made within 2km of the Site Boundary;
- Rhododendron *Rhododendron* sp. was recorded in Foxburrow Plantation and Variegated Yellow Archangel *Lamium galeobdolon* was recorded in Broadway Woodland during the **2022 UK Habitat Classification survey** (Document Reference: 3.10.31). Variegated Yellow Archangel was also recorded in woodland along the Broadway during the **2021 NVC survey** (Document Reference: 3.10.18);
- Surveys undertaken in 2019 confirmed the presence of the non-native American Signal Crayfish within the River Wensum (Document Reference: 3.10.07); and
- Surveys undertaken in 2020 recorded the presence of the non-native American Mink at WC5 (IDB reference: DRN112G0102) (Document Reference: 3.10.03).

10.13.150 INNS are not considered to be Important Ecological Features but management of them to stop their spread has been considered in developing the mitigation measures for the Proposed Scheme.



10.14 Future Baseline

Overview

- 10.14.1 The EIA Regulations require consideration of the likely evolution of the baseline conditions over time, without the implementation of the Proposed Scheme as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge.
- 10.14.2 The future baseline is not anticipated to differ significantly from the current baseline. Operational effects have therefore been assessed against the current baseline. The predicted changes to ecological features described below may alter the future baseline. However, it is not anticipated that these will result in significant changes and therefore they are not considered in the assessment.
- 10.14.3 Climate change is the single most prevalent factor when attempting to predict the future baseline of an ecosystem or species community. Climate change affects ecology via multiple pathways. Impacts on species are considered to include changes in distribution and abundance, the timing of seasonal events and habitat use and, as a consequence, there are likely to be changes in the composition of plant and animal communities. Habitats and ecosystems are also likely to change in character.
- 10.14.4 Assessing the potential impacts of climate change on ecological features is problematic as species trends in distribution and population size are influenced by other factors. These include environmental considerations (such as atmospheric pollution and land use) and population biology (such as density dependence). These different factors can work in combination to bring about change. Moorcroft & Speakman (2015) present a study which summarises key research on the impacts of climate change on habitats and species in the UK. They conclude that there is strong evidence that climate



change is affecting UK biodiversity. Importantly, impacts are expected to increase as the magnitude of climate change increases.

- 10.14.5 The distributions of many species are shifting northwards, including some species which have colonised the UK from mainland Europe while some species are seen to be utilising habitats at a higher altitude than known previously.
- 10.14.6 With regards to the key ecological features known to be present in the Red Line Boundary, it is difficult to predict with considerable confidence as to their likely response to climatic change. However, the following section presents known information on the medium and long-term trends in distribution and abundance for such features.
- 10.14.7 There are no known committed developments or changes to management in the area that will affect the future baseline at the opening year.

Habitats and Vascular Plants

- 10.14.8 Grassland habitats are widespread in the Red Line Boundary. Such areas are considered to be highly sensitive to changes in rainfall. An increase in summer drought conditions has the potential to lead to a decline in wet grassland communities including rush pastures and water meadows. Woodlands are also considerably sensitive to drought conditions. Increased frequency of droughts may lead to a change in species composition in woodland extents.
- 10.14.9 Habitats such as the grasslands, scrub and woodland as shown on the **'Essential Environmental Mitigation' plan** (Document reference: 2.11.00) are likely to become more suitable and provide further opportunities for species. Habitats are likely to mature with grasslands and scrub undergoing succession in the absence of any prescriptive management. Although this is unlikely to alter the valuations of the species groups presented in the Baseline Conditions section above.



- 10.14.10 Ash dieback, also known as Chalara dieback of ash, is a serious disease that is killing ash across Europe. It is likely that ash trees in the area will die because of ash dieback, so gaps in woodland and tree lines can be expected to occur where this species is currently present.

Birds

- 10.14.11 The British Trust for Ornithology breeding farmland bird index shows a decline of 56% since 1970. This pattern of long-term decline has been apparent for many years. However, the breeding bird community within the Study Area for these animals is more characteristic of disturbed and developed habitats (e.g. urban areas, intensive agriculture) which are not exposed to such steep declines.

Badger

- 10.14.12 The Badger population in England and Wales has recently been estimated to be 485,000 in 2011 – 2014 and is considered to have increased rapidly since the 1980s (Judge, Wilson, Macarthur, McDonald & Delahay, 2017) (Judge, Wilson, Macarthur, McDonald, & Delahay, 2017). Mild winters have the potential to lead to increases in badger populations through more widespread and abundant food resource and the potential for consistently earlier onset of Spring.

Water Vole

- 10.14.13 Water Vole distribution declined by 30% between 2006 and 2015, and their population densities continue to fall (McGuire & Whitfield, 2017) (McGuire & Whitfield, 2017). Whilst there was a slight increase in Water Vole distribution between 2011 and 2015, and Norfolk remains a stronghold for Water Vole within the UK, current conservation efforts are not considered sufficient and Water Vole numbers continue to fall. This is largely due to fragmentation and loss of habitat as well as predation by the American Mink.



Otter

- 10.14.14 Historically Otter suffered a steady slow decline in numbers from the late 18th century onwards, as a result of a combination of factors including water pollution and hunting. National Otter surveys begun in the 1970s, when they had been lost from most of England. Since surveys begun in the 1970s their numbers have increased and are predicted to continue increasing until they have recolonised the rest of Great Britain by 2030 (Sainsbury, et al., 2019). Climate change does have the potential however to affect the Otters distribution due to water levels and fish availability (Cianfrani, et al., 2011).

Reptiles

- 10.14.15 Common reptile species such as the Common Lizard are declining in the UK, as a result of habitat loss and fragmentation. There is potential however that the results of climate change, with warming summers and earlier springs could benefit these ectothermic species, resulting in an increase in population (Mather-Gratton, 2021).

Amphibians

- 10.14.16 Many common amphibian species are declining in numbers in the UK, for example a study into the population trend of toads indicated that Toad populations have declined by 68% in the last 30 years (Petrovan & Schmidt, 2016). Climate change has the potential to further accelerate the decline of amphibian species through decline of food resources, reduced survival, changes to behaviour and increased disease (Blaustein, et al., 2010; Reading, 2007).

Terrestrial invertebrates

- 10.14.17 Terrestrial invertebrates cover a vast and wide-ranging group of organisms that include many different species in groups such as insects, spiders, slugs and snails. Insects alone number somewhere around 24,000 species in the Britain and Ireland (Brock, 2021). Population trend data does exist for many



groups, particularly of those that have been well-studied, but there are many gaps, and many groups lack crucial species information. The UK's flying insects have been reported to have declined by around 60% within the last 20 years (Ball, et al., 2021). The reasons for this are complex, but many consider the primary reasons to include issues such as, rising temperatures and changes in weather patterns due to climate change, habitat loss and fragmentation from urbanisation and land development, as well as modern farming and agricultural practices which can be harmful to invertebrates across a landscape scale. Raising the importance of the declining state of our insect fauna and educating people across the board is crucial to reverse these declines and reduce the risk of widespread ecological collapse.

Aquatic habitats

- 10.14.18 It is considered likely that aquatic habitats and species present within the Study Area would decline. Impacts from climate change would increase drought conditions and create drier climates, putting pressures on existing aquatic features and their ability to support aquatic species. Changes in aquatic communities may occur as new species are introduced and others, preferring cooler climate conditions, are outcompeted. By far the most significant influence would come from changes in land use. The current land use is predominately agricultural, with a combination of arable and grazing pastures. Where agricultural management practices and pressures on aquatic features cease over time, natural recovery within aquatic habitats would be expected.

Summary

- 10.14.19 Whilst there may be some changes in species populations and distribution in the longer term, land management is likely to have a greater influence on biodiversity than the Proposed Scheme over much of the Study Area within the timescale of construction of the Proposed Scheme. To provide information on medium-term changes in species distribution, and due to the mobile nature



of several species of conservation concern which may be impacted by the Proposed Scheme, pre-construction surveys will be undertaken for certain vulnerable species prior to the commencement of construction works.



10.15 Summary of Important Ecological Features

10.15.1 **Table 10-15** lists the Important Ecological Features (IEF) that have been scoped in for further assessment:

Table 10-15 Important Ecological Features (IEF) scoped in for further assessment

Feature	Importance
Additional Species of Principal Importance (Harvest mouse, Brown Hare, Hedgehog and Common Toad)	Local
Ancient woodland	National
Aquatic macroinvertebrates	County
Aquatic macrophytes	International
Attlebridge Hills CWS	County
Badger	Local
Barn Owl	Local
Bawburgh / Colney Gravel Pits CWS	County
Botany Bay Farm CWS	County
Breeding Birds	Local
Brook House Marshes CWS	County
Broom & Spring Hills CWS	County
Church Hill Common CWS	County
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS	County
Coastal and Floodplain Grazing Marsh HPI	County
Costessey Pits (East) CWS	County
Desmoulin's Whorl Snail	International
Earlham and Colney Marshes CWS	County
East Hills CWS	County



Feature	Importance
Fakenham Road RNR	County
Fen Plantation CWS	County
Fen West of East Tuddenham CWS	County
Fish	International
Gravelpit Plantation and Church Hill CWS	County
Great Crested Newt	Local
Great Witchingham Common CWS	County
Hedgerows	County / Local
Hellesdon Pastures CWS	County
Horsham Meadows CWS	County
Intwood Carr CWS	County
Jennis' Wood & Dryhill Plantation CWS	County
Land adjoining Foxburrow Plantation CWS	County
Lenwade Pits (East) CWS	County
Lenwade Pits (West) CWS	County
Long Dell and Westlodge Hills CWS	County
Lowland Mixed Deciduous Woodland HPI	County
Marriott's Way CWS	County
Meadow Farm Meadow CWS	County
Mouse Wood CWS	County
Norfolk Valley Fens SAC	International
Notable, veteran and ancient trees	National / County
Old Covert, Wood Lane CWS	County
Other habitats	Local
Otter	Local
Potter and Scarning Fens, East Dereham SSSI	National



Feature	Importance
Primrose Grove CWS	County
Purple Moor Grass and Rush Pasture HPI	County
Reptiles	Local
River HPI (Watercourses)	County
River Tud at Easton and Honingham CWS	County
River Wensum Pastures CWS	County
River Wensum SAC	International
River Wensum SSSI	National
River Yare (west and east), Bowthorpe CWS	County
Taverham Mill CWS	County
Terrestrial Invertebrates	County
Walsingham Plantation CWS	County
Water Vole	County
Wensum Pastures at Morton Hall CWS	County
Weston Meadow CWS	County
Wet Woodland HPI	County
Wintering Birds	Local

10.15.2 INNS are not considered to be Important Ecological Features, but measures may be required during construction to avoid infringing the legislation intended to prevent their spread by human activities.



10.16 Summary of Additional Mitigation

10.16.1 This section sets out the overarching Additional Mitigation which will be implemented to avoid, minimise and compensate for impacts during the construction and operation of the Proposed Scheme. For the purposes of this chapter, the term 'Additional Mitigation' refers to avoidance, mitigation and compensation measures beyond those considered as the Embedded Mitigation measures which are described for each feature in the following sections of this chapter. Additional Mitigation Measures specific to each IEF are stated per feature in sections 10.17 to 10.43.

Approaches to Mitigation Measures

10.16.2 Mitigation measures will depend on the target species, species group or habitat. The general approaches that are listed under this section are applicable to all IEFs.

- Habitat creation – Habitat creation will be undertaken to replace areas lost to the Proposed Scheme, including the creation of new areas of woodland, wetland and grassland. Newly created habitats will be either planted, sown or left to re-colonise naturally.
- Habitat enhancement – Areas of habitat (such as watercourses and ditch networks) within and adjacent to the Proposed Scheme will be managed to improve their condition.
- Translocation or displacement – Features will be moved or displaced from an area affected by the Proposed Scheme (the donor site) to a new area (a receptor site) that will be managed for wildlife.
- The creation of features to provide replacement (or additional) breeding, sheltering and hibernating opportunities.
- The creation of new (or the enhancement of existing) structures or features to provide replacement (or additional) connective habitat.



Overarching Construction Phase Mitigation

10.16.3 An **Outline Construction Environmental Management Plan (OCEMP)**

(Document Reference: 3.03.01) has been produced for the Proposed Scheme, alongside an **Ecological Mitigation Strategy** (Document Reference: 3.10.32).

10.16.4 The OCEMP includes the following considerations that are relevant to all IEFs:

- INNS management;
- Dust suppression and dampening down during demolition and construction activities, to include haul routes;
- Noise and vibration suppression to reduce noise and vibration from construction to negligible levels;
- Air quality controls – e.g. switching off engines and avoid excessive revving of vehicles;
- Pollution prevention measures;
- Transport, storage and disposal of hazardous waste and oils;
- Low level and directional lighting close to ecological features, and the use of construction lighting with well located, modern light fittings in accordance with best practice to minimise light intrusion to surrounding sensitive features;
- Fish translocation prior to dewatering activities – as explained below;
- Covering or adapting excavations to avoid mammal entrapment;
- Displacement techniques prior to habitat clearance;
- Ecologically sensitive construction measures, including biosecurity measures; and



- Protection of trees.

10.16.5 Mitigation in relation to dust emissions includes the following relevant mitigation:

- Dust management measures during preparation and maintenance of the Site;
- Regular on-site and off-site inspections, including for evidence of dust soiling and dust deposition;
- Measures to minimise dust generation from operating vehicles and machinery;
- Measures to minimise and / or suppress dust generation from demolition, fabrication, and construction activities; and
- Specific measures to address dust generation from earthworks impacts.

10.16.6 Any temporary lighting during construction will adhere to a Construction Lighting Management Plan (CLMP), which will detail the mitigation measures that are to be implemented to reduce adverse effects from on-site lighting. The CLMP is subject to approval alongside the final CEMP(s).

10.16.7 Biosecurity measures should be implemented during the construction phase to prevent the spread of INNS. Biosecurity is defined as a set of precautions that aim to minimise the risk of moving non-native species, parasites and diseases. Measures are likely to include:

- The briefing and training of workers on good biosecurity practices appropriate to their role;
- Equipping workers with the necessary equipment, Personal Protective Equipment (PPE) and substances to implement biosecurity control measures, including effective hygiene and sanitation practices. This



would most frequently comprise Virkon S disinfectant tablets, sprayers and brushes to clean and disinfect equipment and PPE prior to leaving site;

- Ensure that Defra's "Check, Clean, Dry" principles are followed and ensure that all PPE and survey equipment is clean and dry (and if necessary, disinfected) prior to going to and from site; and,
- Where possible, workers should park vehicles on hard standing areas and check / clean tyres prior to leaving site.

10.16.8 An Ecological Clerk of Works (ECoW) will be appointed during the construction phase to ensure all ecological method statements are followed correctly, and that works are avoiding and / or minimising risk to biodiversity features.

10.16.9 To avoid potential adverse effects upon protected species, their breeding and movement will be considered through specific mitigation measures. For example, the timing of construction works will be planned to avoid periods such as the nesting bird season (March to August inclusive) and should consider key fish migration periods in consultation with Environment Agency Fisheries Officer to agree appropriate measures to avoid the obstruction of passage or disturbance to fish moving to upstream reaches for spawning.

10.16.10 The OCEMP will be used to produce a Construction Environmental Management Plan (CEMP). The CEMP will be produced by the Principal Contractor prior to the commencement of works on site. All measures to protected biodiversity features during the construction phase will be incorporated within the CEMP.

10.16.11 Specific measures relating to compensation and enhancement works for protected / notable habitats and species, involving habitat creation and enhancement will be incorporated within a Landscape Ecological Management Plan (LEMP).



10.16.12 All relevant Environmental Permits, Best Practice Guidance and Regulations, British Standards, and monitoring in respect of air quality, noise and vibration, hydrology and protection of ecological features will be adhered to. This will include the Guidance for Pollution Prevention (GPP) series, with specific reference to GPP5: Works and maintenance in or near water (Natural Resources Wales, 2018).

10.16.13 Industry standard methods and procedures to ensure air quality impacts are minimised throughout all phases of the project will be implemented.

Overarching Operation Phase Mitigation

10.16.14 The following operational phase mitigation measures are proposed:

- Implementation of a Landscape and Ecological Management Plan to ensure that newly created key habitats reach their target condition; and,
- Wildlife fencing to direct animals to designated crossings structures to minimise road mortality.
- An 8m exclusion zone from the River Wensum SAC boundary, in which no permanent structures (such as viaduct supporting structures) will remain.

Compensation

10.16.15 An **Outline Air Quality Compensation Strategy** (Document Reference: 6.01.01) has been produced to compensate for the air quality impacts reported in **Appendix 34: Air Quality Ecological Impact Assessment** (Document Reference: 6.01.01) and inform the production of the Final Air Quality Compensation Strategy.



10.17 Assessment of Likely Impacts and Effects - River Wensum SAC

Embedded Mitigation

10.17.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to the River Wensum SAC. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum SAC / SSSI and ancient woodland.
- Landscape planting as part of the Scheme design.
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy** (Document Reference: 4.04.00) and **Drainage Design Plans** (Document Reference: 2.08.00) has been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin



6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Proposed Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.
- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see Chapter 7: Noise and Vibration (Document Reference: 3.07.00) for further details).

Preliminary Assessment of Likely Impacts and Effects

Construction

10.17.2 In the absence of Additional Mitigation measures, the following potential impacts during the construction phase have been identified:

- Temporary and permanent loss of supporting floodplain habitat due to land-take;
- Changes in hydrological conditions – non-flood condition river flows and ground water levels;
- Changes in hydrological conditions – increased flood risk;
- Shading of in-channel vegetation from the under-construction viaduct and temporary bailey bridge;



- Fragmentation of the landscape by construction of the Proposed Scheme;
- Localised changes in air quality due to emissions of construction vehicles;
- Sediment and chemical run-off;
- Dust emissions;
- Noise and vibrational disturbance; and,
- Introduction of invasive non-native plant (e.g. Himalayan balsam) and animal (e.g. signal crayfish) species.

10.17.3 These potential impacts are discussed in turn below.

Temporary and permanent loss of supporting floodplain habitat due to land-take

10.17.4 Qualifying Features of the River Wensum SAC with the potential to be impacted comprise:

- Watercourses with *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and
- Desmoulin's Whorl Snail.

10.17.5 The temporary and permanent loss of habitat across the River Wensum floodplain due to land-take could affect processes on which the river and its vegetation community rely.

10.17.6 Functional interactions between the River Wensum and surrounding floodplain would not be affected by the Proposed Scheme. Compared to the



wider floodplain, a relatively small area currently used for livestock grazing will fall within the Red Line Boundary and be subject to construction phase effects, with piling forming the supports of the viaduct left following the completion of this phase, but which will not be located within the River itself. There will be no reduction in the extent of floodplain habitat that functionally supports the River Wensum, and no effect of the dynamic environment of the river. Latitudinal connectivity of the floodplain with the river, via throughflow of groundwater and surface water flow, and flow through floodplain drains and ditches will not be affected by the Proposed Scheme.

- 10.17.7 Chalk rivers are reliant on organic matter inputs from outside the river channel (“allochthonous” organic matter) through autumn and winter, receiving this material from overhanging or adjacent trees and woodland in the floodplain via delivery of dead leaves in autumn (Berrie, 1992) (Joyce, 2008). Dead wood, important for river function as an organic matter resource and habitat for fish, also enters this way. The River Wensum, where it is crossed by the Proposed Scheme, is surrounded by floodplain grasslands grazed by cattle, with only limited sources of dead leaves or dead wood (some mature willow trees are present but there are few overhanging trees that would be lost) which enter the river from other parts of the floodplain, higher in the catchment. The limited floodplain adjacent to the River Wensum within the Red Line Boundary is therefore not an important area of supporting habitat to the watercourse or its associated in-channel *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.
- 10.17.8 Therefore, the loss of floodplain habitat to temporary works areas, as well as permanent infrastructure associated with the Scheme viaduct will therefore not lead to significant adverse effects on the watercourse or its associated vegetation communities, including *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.



- 10.17.9 Bullhead use marginal and mid-channel stands of vegetation as places to forage and as places of shelter from predators. However, as demonstrated above in relation to water courses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, floodplain habitat within the Proposed Scheme provides very limited support to habitat within the River Wensum. Additionally, the habitats within WC5 are unlikely to support bullhead. Fish surveys recorded an absence of bullhead in WC5 and poor suitability to support bullhead. Bullhead require coarse substrates with large stones for breeding, and prefer natural, sinuous channel forms with associated riffle and pool and substrates (Perrow, 2003). The temporary and permanent loss of floodplain habitat as a result of the Proposed Scheme will therefore not lead to significant effects on bullhead.
- 10.17.10 Desmoulin's whorl snail uses floodplain habitat surrounding the River Wensum to complete its lifecycle but is not found within the Wensum channel. This species is present within the Red Line Boundary (RLB) in watercourses WC3 and WC4, and outside of the RLB in the Wensum floodplain 1 kilometre to the south-east. Desmoulin's whorl snail present within WC3 and WC4 will not be significantly impacted by temporary or permanent loss of supporting floodplain habitat due to land-take. The works associated with the Proposed Scheme in these areas comprise habitat enhancements only, that will benefit Desmoulin's whorl snail and other species. These enhancement works will be undertaken using sensitive working methods and under ecological supervision.
- 10.17.11 Desmoulin's whorl snail will not be significantly impacted by any temporary or permanent loss of supporting floodplain habitat due to land-take within the Site Boundary and additional temporary construction areas. Watercourses and floodplain habitat within these areas are not currently occupied by this species, and so any temporary works in the floodplain will not significantly impact this species as no Desmoulin's whorl snail habitat will be lost. The



permanent habitat loss in this area will be restricted to viaduct piers and a maintenance track, allowing for the reinstatement and retention of the majority of floodplain habitat beneath the viaduct. This will allow for the potential future colonisation of Desmoulin's whorl snail in this area.

10.17.12 Fish surveys recorded lamprey larvae in WC5. River and brook lamprey are indistinguishable in their larval form. Due to the presence of lamprey larvae within silt deposits in WC5 (IDB reference: DRN112G0102), realignment of floodplain ditches (specifically WC5 (IDB reference: DRN112G0102)) and associated culverting activities have the potential to cause temporary loss of supporting Brook Lamprey habitat within the Wensum floodplain. Loss of habitat within the River Wensum floodplain due to land-take, either temporary or permanent, could affect processes within the river itself on which Brook Lamprey rely.

Significance of Effect

10.17.13 Due to the potential impact to Brook Lamprey during the construction period, this effect represents a potential temporary, short term and direct impact that would lead to a significant negative effect at the International scale in the absence of additional mitigation.

Changes in hydrological conditions – non-flood condition river flows and ground water levels

10.17.14 Qualifying Features of the River Wensum SAC with the potential to be impacted comprise:

- Watercourses with *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and,
- Desmoulin's Whorl Snail.



10.17.15 Analysis of potential effects on river flows and groundwater have concluded no such changes are anticipated (**Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)), and water resources within the River Wensum and its floodplain would not be affected by the Proposed Scheme.

10.17.16 Although piling will require dewatering around the pile locations, the areas affected will be small compared to the chalk aquifer feeding the River Wensum, will be short-term during construction and to be highly localised. The most notable construction-phase impacts in the River Wensum and adjacent ditches on the floodplain would occur during high-magnitude events (e.g., 1 in 20 years or 5% annual exceedance probability or greater), which have a low likelihood of occurrence within the timeframe of the construction phase. In addition, any potential alterations to the bed and bank forms that may occur would be highly localised and are likely to be off set in the short (< 5 - 10 years) term by sedimentation during successive flood events.

Significance of Effect

10.17.17 This effect is concluded to be not significant.

Changes in hydrological conditions – increased flood risk

10.17.18 As set out in (**Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)), the River Wensum SAC may be at risk of changes in hydrological conditions during construction in the absence of mitigation. The temporary works structures including the bailey bridge across the River Wensum will act to increase flood risk by acting to confine river discharge in the area upstream. There will therefore be an increased tendency of upstream areas to flood under flood conditions, and increased water velocity through the confined works area.

10.17.19 However, modelling of river flows undertaken to support the Proposed Scheme's design and to inform the Environmental Statement (**Chapter 12:**



Road Drainage and Water Environment (Document Reference: 3.12.00))

has shown that under a 1 in 2-year return period, which is the most likely scenario during construction, no change to geomorphological processes or receptors are anticipated during the construction phase, and that the channel is predicted to remain as a transport-dominated system with no morphological adjustments due to erosion. Modelling suggests that during the temporary works phase, there could be a localised change in habitat biotopes, with a change from glide habitat to riffle-run habitat within the zone of the temporary works. However, habitat biotopes would return to baseline during operation. Structures present during the construction phase will not lead to river discharge changes, including peak flows, under flood conditions over and above that would normally occur when the River Wensum is in flood, and to which vegetation is naturally adapted. No significant departures to the naturalised flow of the river are expected despite structures being present.

10.17.20 Therefore, the River Wensum and its vegetation would not be affected by hydrological changes through increased flood risk during the construction phase. The following Qualifying Features of the River Wensum SAC would not be affected by hydrological changes through increased flood risk during the construction phase:

- Watercourses with *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and,
- Desmoulin's Whorl Snail.

Significance of Effect

10.17.21 This effect is concluded to be not significant.



Shading of in-channel vegetation from the under-construction viaduct and temporary bailey bridge

10.17.22 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- Bullhead;
- Desmoulin's Whorl Snail and,
- Brook Lamprey.

10.17.23 In-channel vegetation is reliant on light, and shading could cause dieback of *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation stands and other in-channel and riparian vegetation that Brook Lamprey or Bullhead rely on. Both the under-construction viaduct and temporary bailey bridge represent sources of shading.

10.17.24 Garbey et al. (2006) demonstrated that a 50% reduction in light intensity leads to a reduction in biomass of pond water-crowfoot *Ranunculus peltatus*. It is therefore considered that the design for the viaduct will result in levels of shading that could reduce water-crowfoot abundance directly underneath the structure. *Ranunculus* spp. is still able to regenerate under such conditions, however. Stream water-crowfoot, and clasping-leaved pondweed were the most abundant species found within the Wensum at the viaduct location. Like pond water-crowfoot, both species have Ellenberg light indicator values of 7 (Ellenberg, 1991). As such, it is likely that these species will respond similarly to pond water-crowfoot and will still be able to regenerate and adapt to a reduction in light intensity. It is concluded there will be a potential change in the composition of the plant community in areas affected by shading from the under-construction viaduct. However, some of the plants within the vegetation



community which are more shade tolerant could still grow, while others which are less tolerant of shade may be eventually replaced. Additionally, the plasticity observed in the morphology of many macrophyte species in response to lower light conditions will enable plants to adapt (Garbey et al. 2006). Along the entirety of the River Wensum SAC length, the effect on the vegetation feature from a potential localised change is expected to be negligible.

- 10.17.25 The presence of the temporary bailey bridge will likely result in localised shading and temporary loss of the macrophyte community within the immediate vicinity of the temporary crossing. As the temporary crossing is transient in nature, no long-term vegetation loss is foreseen. Following removal of the temporary bailey bridge it is expected that the vegetation community will recolonise areas affected by shading. Along the entirety of the River Wensum SAC length, the effect on the vegetation feature from a potential localised change is expected to be negligible (with potential effects in an area <0.1ha, when compared to the total area of the River Wensum SAC (306.79ha)).
- 10.17.26 Bullhead and Brook Lamprey use stands of vegetation including (but not limited to) the *Water courses with Ranunculion fluitantis and Callitriche-Batrachion vegetation* described above within the river channel during their life cycle. The temporary loss of macrophytes as described above will result in a temporary loss of shelter and food items for bullhead and Brook Lamprey within the immediate vicinity of the under-construction viaduct and temporary bailey bridge. The direct effects of the temporary crossing and the under-construction viaduct on these species will be negligible due to their tolerance of shade and their ability to change their individual spatial distribution (i.e. move in and out of shade freely). Following recolonisation by macrophytes after the removal of the temporary bailey bridge, shelter and food availability will be restored to their original or similar state. Similarly, effects from the



change in vegetation structure localised below the under-construction viaduct, such as changes to shelter and food availability will be negligible.

10.17.27 Desmoulin's Whorl Snail uses floodplain habitat surrounding the River Wensum to complete its lifecycle, but the Site Boundary does not coincide with floodplain habitat occupied by Desmoulin's Whorl Snail. There will be no effect of shading on Desmoulin's Whorl Snail.

Significance of Effect

10.17.28 This effect is concluded to be not significant.

Fragmentation of the landscape by construction of the Proposed Scheme

10.17.29 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- Bullhead;
- Desmoulin's Whorl Snail and,
- Brook Lamprey.

10.17.30 No realignment of the River Wensum will occur, and no obstacles (weirs, culverts etc) will be engineered into the Wensum as a result of the Scheme. However, temporary diversion and culverting (both permanent and temporary) will occur within the River Wensum floodplain on WC5. This has the potential to cause temporary fragmentation of watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation within the Wensum floodplain. WC5 does not share the same characteristics of the River Wensum and does not support *Ranunculus* within the Site Boundary (Document Reference: 3.10.12). Thus, it is not characteristic of a watercourse with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. However, WC5 has a supporting function for



the River Wensum SAC, where temporary fragmentation may have a minor effect on the feature.

- 10.17.31 Due to the recorded absence of bullhead in WC5 and poor suitability to support bullhead (bullhead require coarse substrates with large stones (Perrow, 2003)), the proposed temporary diversion and culverting on WC5 is not expected to cause fragmentation for bullhead populations.
- 10.17.32 Due to the presence of lamprey larvae within silt deposits in WC5 (IDB reference: DRN112G0102), realignment of floodplain ditches (specifically WC5 (IDB reference: DRN112G0102)) and associated culverting activities have the potential to cause temporary fragmentation of Brook Lamprey habitat within the Wensum floodplain.
- 10.17.33 Although the Proposed Scheme crosses the River Wensum floodplain, the use of a viaduct in its design will maintain a link between habitats either side of the Proposed Scheme alignment and avoid effects of fragmentation and the separation of the existing Desmoulin's whorl snail populations. The principal dispersal mechanism of Desmoulin's Whorl snail is waterborne transportation, and snails typically disperse across floodplains during periods of flooding (Killeen, 2003). The Proposed Scheme design will retain the majority of existing connective floodplain habitat within the Site Boundary, as the design of the viaduct structure minimises the number of piers required and therefore the amount of permanent habitat loss within the floodplain. This will allow for the potential future colonisation of Desmoulin's whorl snail in this area. The Proposed Scheme design also ensures the retention of up- and downstream connectivity of watercourses across the Wensum floodplain for the duration of the operation of the Proposed Scheme, and this will further reduce the risk of fragmentation. The culverting of WC5 to facilitate the construction of a temporary works platform will allow the passage of water and will be reduced to the minimum length required to support a permanent maintenance track for the Proposed Scheme operational period. It should be noted that the ditches



and the river margins of the Wensum in the crossing area are either not suitable for Desmoulin's whorl snail or returned negative results for this species during surveys. Habitat beneath the viaduct will remain passable for this species for the duration of the Proposed Scheme.

Significance of Effect

10.17.34 Due to the potential impact to Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and Brook Lamprey during the construction period, this effect represents a potential temporary, short term and direct impact that would lead to a significant negative effect at the International scale in the absence of additional mitigation.

Localised changes in air quality due to emissions of construction vehicles

10.17.35 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- Bullhead;
- Desmoulin's Whorl Snail and,
- Brook Lamprey.

10.17.36 Lowland rivers such as the River Wensum are typically nutrient poor, with the availability of phosphorus (rather than nitrogen) within the ecosystem limiting the growth of *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation as well as other macrophyte species and algae (English Nature, 1999; Natural England, 2022). Analysis of nitrogen to phosphorus ratios within the River Wensum confirm phosphorus is the limiting nutrient (Document Reference 3.10.34b). Emissions from Proposed Scheme construction vehicles would lead to deposition of nitrogen compounds as a result of exhausts during the construction phase including nitrogen dioxide and nitrate (see Environmental



Statement **Chapter 6: Air Quality** (Document Reference: 3.06.00) and **ES Appendix 10.34 Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34)); phosphorus is not released by vehicle exhausts and would not become elevated in the River Wensum as a result of localised air quality changes. Levels of phosphorus in the River Wensum ecosystem would therefore not change as a result of the Proposed Scheme and will remain as a growth-limited factor for in-stream plants. Thus, the sensitivity of vegetation of the River Wensum to air quality changes during the construction phase is low. A far greater risk to the River Wensum is the input of nitrogen from agricultural run-off through pollution events which would see concentrations of nitrogen enter the river at orders of magnitude greater than from air quality changes due to the Proposed Scheme (Natural England, 2022).

- 10.17.37 The overall area of the River Wensum exposed to air quality changes would be small due to the small overlap between the River Wensum and the Proposed Scheme construction footprint, and the relatively limited period of time required to construct the Proposed Scheme (i.e., construction phase air quality changes will be temporary).
- 10.17.38 The Wensum is also sensitive to acidification (Natural England, 2022) and deposition of acids (e.g., NH_x, SO₂) from exhaust fumes of construction traffic would affect the water column. However, as with nitrogen deposition, the small overlap between the River Wensum and the Proposed Scheme construction footprint would restrict the potential for acidification, and the calcareous chemistry of the river water (Berrie, 1992) would buffer the resulting change in pH to non-perceptible levels.
- 10.17.39 Site-specific supplementary advice for River Wensum SAC identifies air quality changes as a potential effect on Bullhead, Brook Lamprey or Desmoulin's Whorl Snail through changes to its habitat, rather than through direct effects on individuals. However, as discussed above for *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation, neither nitrogen deposition nor



water acidification would significantly alter Bullhead or Brook Lamprey habitat within the River Wensum. The temporary nature of the construction works, alongside the distance of the population of this feature from the Site Boundary (~80 metre), will avoid effects of localised changes in air quality due to emissions of construction vehicles on Desmoulin's Whorl Snail.

10.17.40 Thus, Bullhead, Desmoulin's Whorl Snail or Brook Lamprey, or watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, will not be affected by localised changes in air quality due to emissions of construction vehicles.

Significance of Effect

10.17.41 This effect is concluded to be not significant.

Sediment and chemical run-off

10.17.42 As set out in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), the River Wensum SAC may be at risk of increased chemical and sediment loading during construction in the absence of mitigation. The risk is associated with construction activities within the River Wensum floodplain.

10.17.43 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and,
- Desmoulin's Whorl Snail.

10.17.44 Chalk rivers are sensitive to sediment inputs which can smother stands of vegetation and fill pore-spaces within the riverbed (the 'hyporheic zone')



(Joyce, 2008), causing significant effects on in-channel vegetation. In addition, the accidental release of chemicals (e.g., fuels, lubricants) into the river channel could kill vegetation directly in the area surrounding the Proposed Scheme's River Wensum crossing, as well as downstream, affecting Bullhead or Brook Lamprey. Sediment and chemical run-off could also kill bullhead directly.

10.17.45 Desmoulin's Whorl Snail uses floodplain habitat surrounding the River Wensum to complete its lifecycle and is not found within the Wensum itself, nor within the Site boundary where it crosses the Wensum floodplain; however, it is found in the wider floodplain surrounding the Proposed Scheme with the closest population identified by survey being ~80 metre to the west. The Scheme threatens Desmoulin's Whorl Snail through sediment and chemical run-off into the surrounding floodplain habitat, such as the drainage ditch network.

Significance of Effect

10.17.46 The significance of the effect from chemical and sediment run-off will depend on the extent, magnitude, type, duration and frequency of the pollution incident. However, it can be predicted that an increase in chemical and sediment loading associated with construction activities across the Wensum floodplain during the construction period represents a potential temporary, short term, direct and reversible impact that would lead to a significant negative effect at the International scale in the absence of additional mitigation.

Noise and vibrational disturbance

10.17.47 Increased levels of construction related noise and vibration relative to the baseline situation are anticipated during construction. Data on noise and vibration are provided in **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00). Construction of the Proposed Scheme will generate



vibrational and percussive noise adjacent to the River Wensum as a result of works to build the proposed viaduct.

10.17.48 Noise and vibration could affect qualifying interests of statutory designated sites using habitats outside the boundaries of those sites within functionally linked land. Fish, including Bullhead and Brook Lamprey, are sensitive to noise and vibration disturbances from construction activities such as pile driving and movement of heavy machinery. The extent to which intense underwater sound might adversely impact on fish is dependent upon the level of noise, its frequency, duration and / or the repetition rate of the sound (Hastings and Popper, 2005). The range of potential impacts from intense sound sources, such as pile driving, includes immediate death, permanent or temporary tissue damage and hearing loss, behavioural changes and masking effects.

10.17.49 Lethal effects may occur to fish species where source levels of noise exceed between 207 and 213 dB re 1 μ Pa for fish with high and low hearing sensitivity respectively (Popper & Hastings, 2009). Physical injury may occur when source levels of noise exceed 186 dB re 1 μ Pa (Popper & Hastings, 2009). Fish may exhibit a behavioural response to noise which is above 135 dB re 1 μ Pa (Hawkins et al. 2014).

10.17.50 *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation is not sensitive to noise and vibrational disturbance. Desmoulin's Whorl Snail is not considered to be sensitive to noise and vibrational disturbance, as both these effects are not identified as attributes in site-specific supplementary advice on conserving and restoring site features for River Wensum SAC (Natural England, 2022)

10.17.51 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Bullhead; and,
- Brook Lamprey.



Significance of Effect

10.17.52 Increased levels of construction related noise and vibration during the construction period represents a temporary, short term, and direct impact within a localised area that would lead to a significant negative effect at the International scale in the absence of additional mitigation.

Dust emissions

10.17.53 Habitat degradation through pollution or a reduction in air quality caused by dust emissions could lead to reduced functionality of habitats to support qualifying features. The deposition of dust onto aquatic and terrestrial habitats can lead to soiling of plant surfaces, affecting photosynthesis and ecological functioning. Effects are more pronounced during periods of drought when dust can build up on vegetation and plants are stressed by other factors. For demolition and construction activities lasting for less than a year, vegetation usually recovers within a year of the activity ceasing (Holman. C., 2014).

10.17.54 The River Wensum SAC was identified as potentially at a 'large' risk of being impacted by dust emissions in **Chapter 6: Air Quality** (Document Reference: 3.06.00) as it is within 50 metre of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Without appropriate mitigation it is considered that construction dust impacts resulting in soiling or discolouration of exposed surfaces or increased sediment loading could lead to the reduced functionality of habitats to support qualifying features.

Significance of Effect

10.17.55 Increased dust emissions associated with construction activities during the construction period represents a temporary, short-term, direct and reversible impact that would lead to a significant negative effect at the International scale in the absence of additional mitigation.



Introduction of invasive non-native plant and animal species

10.17.56 The introduction of invasive non-native plant and animal species can lead to resident aquatic species being outcompeted, predated upon, and subjected to the introduction and spread of disease. Indirect effects can occur from the introduction of invasive species such as Himalayan Balsam, which when colonised causes bank erosion and increased sediment input.

10.17.57 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and,
- Desmoulin's Whorl Snail.

10.17.58 Movement of vehicles during the construction phase and importation of materials to site represents a potential vector for invasive species that, if established, could affect *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation, Bullhead or Brook Lamprey.

10.17.59 Conditions required to support the above species would be threatened by the introduction of invasive non-native plant and animal species that could put additional pressure on existing vegetation up and downstream of the Proposed Scheme and change conditions within the river, potentially degrading the habitats. The introduction of invasive non-native plant and animal species could also have a direct negative interaction with species such as Bullhead and Brook Lamprey and reduce populations and their viability.

10.17.60 The Proposed Scheme also threatens Desmoulin's Whorl Snail through introduction of invasive non-native plant and animal species during



construction into the surrounding floodplain habitat, such as the drainage ditch network, and their spread into habitat occupied by this species.

Significance of Effect

10.17.61 The introduction of invasive non-native plant and animal species during the construction period represents a permanent, direct, reversible and long-term impact that would lead to a significant negative effect at the International scale in the absence of additional mitigation.

Operation

10.17.62 In the absence of Additional Mitigation measures, the following potential impacts have been identified during the operation phase:

- Shading of in-channel vegetation by the operational viaduct;
- Sediment and chemical run-off (including road salt);
- Localised changes in air quality as a result of emissions from vehicles using the completed viaduct;
- Wide-scale air quality changes within the Affected Road Network (ARN); and,
- Noise and vibrational disturbance.

10.17.63 These potential impacts are discussed in turn below.

Shading of in-channel vegetation by the operational viaduct

10.17.64 The River Wensum SAC may be at risk of changes to the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation macrophyte community from shading from viaduct when operational, and Bullhead and Brook Lamprey may be subjected a temporary loss of shelter and food items.

10.17.65 Garbey *et al.* (2006) demonstrated that a 50% reduction in light intensity leads to a reduction in biomass of pond water-crowfoot. It is therefore considered



that the design for the viaduct will result in levels of shading that could reduce water-crowfoot abundance directly underneath the structure. *Ranunculus* spp. is however able to regenerate under such conditions. Stream Water-crowfoot, and Claspingleaved Pondweed were the most abundant species found within the Wensum at the viaduct location from macrophyte surveys carried in 2022 (Document Reference 3.10.12). Like pond water-crowfoot, both species have Ellenberg light indicator values of 7 (Ellenberg, 1991). As such, it is likely that these species will respond similarly to pond water-crowfoot and will still be able to regenerate and adapt to a reduction in light intensity. It is concluded there will be a potential change in the composition of the plant community in areas affected by shading from the under-construction viaduct. However, some of the plants within the vegetation community which are more shade tolerant could still grow, while others which are less tolerant of shade may be eventually replaced. Additionally, the plasticity observed in the morphology of many macrophyte species in response to lower light conditions will enable plants to adapt (Garbey et al. 2006). Indirect effects on vegetation through poaching of soil as a result of livestock sheltering under the viaduct are not expected, as this would occur only infrequently in response to rain, with the length of the viaduct offering shelter would avoid congregation at high densities.

- 10.17.66 There will be no effect of shading on Desmoulin's Whorl Snail as there will be no suitable wet ditch habitat close enough or underneath the operational viaduct, the nearest suitable habitat supporting this species being ~80 metres away. Ditches and river margins found within the shading zone are not suitable to support Desmoulin's Whorl Snail. Thus, no Desmoulin's Whorl Snail habitat will be lost, and the effect of shading of vegetation by the operational viaduct (which crosses suitable habitat for this species in the River Wensum floodplain) on this species will be not significant.



10.17.67 The direct effects of shading from the viaduct on fish (including Bullhead and Brook Lamprey) will be negligible due to their tolerance of shade and the ability of fish to change their individual spatial distribution (i.e. move in and out of shade freely), potential changes to the vegetation community below the viaduct will have a negligible effect on these species.

Significance of Effect

10.17.68 This effect will be not significant.

Localised changes in air quality as a result of emissions from vehicles using the completed viaduct

10.17.69 The River Wensum SAC is designated for features that are not directly impacted by air quality, however, should the SAC integrity be adversely impacted, then these qualifying features may be indirectly impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and,
- Desmoulin's Whorl Snail.

10.17.70 Lowland rivers such as the River Wensum are typically nutrient poor, with the availability of phosphorus (rather than nitrogen) within the ecosystem limiting the growth of *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation as well as other macrophyte species and algae (English Nature, 1999; Natural England, 2022). Analysis of nitrogen to phosphorus ratios within the River Wensum confirm phosphorus is the limiting nutrient (Document Reference 3.10.34b)). Emissions from vehicles using the Proposed Scheme during operation would lead to deposition of nitrogen compounds as a result of exhausts including nitrogen dioxide and nitrate (Environmental Statement **Chapter 6: Air Quality** (Document Reference: 3.06.00)); phosphorus is not



released by vehicle exhausts and would not become elevated in the River Wensum as a result of localised air quality changes. Levels of phosphorus in the River Wensum ecosystem would therefore not change as a result of the Proposed Scheme and will remain as a growth-limiting factor for in-stream plants. Thus, the sensitivity of vegetation of the River Wensum to air quality changes during the operational phase is low. Input of nitrogen from agricultural run-off could lead to effects on the River Wensum, but such inputs would be pollution events with concentrations of nitrogen orders of magnitude greater than from air quality changes due to the Proposed Scheme (Natural England, 2022).

- 10.17.71 Nitrogen deposition would not significantly raise the nutrient status of the river due to the small overlap between the River Wensum and the operational cross section of the viaduct, the Wensum only being 10 – 12 metres wide beneath it. The height of the viaduct will also reduce nitrogen compound deposition, with exhaust fumes dispersing before descending to the level of the River Wensum. In addition, given the surrounding land uses, nitrogen from existing background agricultural run-off into the Wensum is relatively high and that received by the water column from vehicles using the completed viaduct would not be perceptible above existing inputs to the river.
- 10.17.72 The Wensum is also sensitive to acidification (Natural England, 2022), and deposition of acids (e.g. NH_x , SO_2) from exhaust fumes traffic would affect the water column. However, as with nitrogen deposition the small overlap between the River Wensum and the Proposed Scheme construction footprint would restrict the potential for acidification, and the calcareous chemistry of the river water (Berrie, 1992) would buffer the resulting change in pH to non-perceptible levels.
- 10.17.73 Localised changes in air quality due to emissions of vehicles using the operational viaduct is not a likely effect of the Proposed Scheme on Bullhead, Brook Lamprey, or Desmoulin's Whorl Snail. Site-specific supplementary



advice for River Wensum SAC identifies air quality changes as a potential effect on Bullhead, Brook Lamprey, or Desmoulin's Whorl Snail through changes to its habitat, rather than through direct effects on individuals. However, as discussed above for *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation, neither nitrogen deposition nor water acidification would significantly alter Bullhead, Brook Lamprey, or Desmoulin's Whorl Snail habitat within the River Wensum.

10.17.74 In the area where air quality changes would occur (up to 200 metres from the operational Proposed Scheme) Desmoulin's Whorl Snail exists in habitat comprising mostly intensively managed grassland cultivated for hay / silage and that are grazed, intersected with smaller areas of less intensive management and grazing; ditches are mostly dry and associated with scrub. No fen, marsh and swamp habitats are present where this metapopulation is found. The habitats supporting the Desmoulin's Whorl Snail metapopulation within the zone of air quality change are subject to agricultural improvement, involving nutrient enrichment (e.g., from nitrogen inputs from grazing animals) and not sensitive to the limited increase in nutrients as would result from air quality changes from road emissions (Air Pollution Information System (APIS), 2023).

Significance of Effect

10.17.75 This effect will be not significant.

Sediment and chemical run-off (including road salt)

10.17.76 As set out in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), the River Wensum SAC may be at risk of increased chemical and sediment loading during scheme operation in the absence of mitigation. The risk is associated with surface run-off from the carriageway within the River Wensum floodplain.



10.17.77 Qualifying Features of the River Wensum SAC with the potential to be impacted:

- Watercourses with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation;
- Bullhead;
- Brook Lamprey; and
- Desmoulin's Whorl Snail.

10.17.78 Chalk rivers are sensitive to sediment inputs which can smother stands of vegetation and fill pore-spaces within the riverbed (the 'hyporheic zone') (Joyce, 2008), causing significant effects on in-channel vegetation. In addition, accidental release of chemicals (e.g., fuels, lubricants) into the river channel could kill vegetation directly in the area surrounding the Proposed Scheme's River Wensum crossing, as well as downstream.

10.17.79 Increasing sediment and chemical loading of the River Wensum SAC caused by accidental sediment and chemical run-off from the carriageway or during a pollution event could threaten the conditions in the water column that support *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and maintain supporting habitat structure / function. Unmitigated run-off could kill this vegetation in the area surrounding the Proposed Scheme, as well as downstream.

10.17.80 Increasing sediment and chemical loading of the River Wensum SAC caused by accidental sediment and chemical run-off during construction would also threaten individual Bullhead and Brook Lamprey, and the vegetation stands that these species use for sheltering and foraging purposes. The accidental release of chemicals and sediments into the watercourse could kill vegetation and individual Bullhead and Brook Lamprey.



- 10.17.81 Sediment and chemical run-off into the surrounding floodplain habitat, such as the drainage ditch network, would also threaten individual Desmoulin's Whorl Snail present in the wider floodplain surrounding the Proposed Scheme.
- 10.17.82 **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00) also assessed the potential risk of pollutants migrating towards the River Wensum via groundwater flow, as part of the **Surface Water Drainage Strategy** (Document Reference: 4.04.00) that includes five infiltration basins which discharge to ground. The **Appendix 12.5: River Wensum Crossing – Groundwater Modelling Report** (Document Reference: 3.12.05) assessed the impacts in relation to salt migrating to the underlying groundwater receptors. Salt migrates via a groundwater pathway only and not via surface water receptors. **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00) determined that there is likely to be a direct, permanent, long-term Slight effect (not significant) on the River Wensum prior to the implementation of additional mitigation measures. As per the criteria stated in Section 10.10, this effect is therefore not significant.
- 10.17.83 Embedded mitigation such as the inclusion of drainage basins and other features detailed in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), will reduce the risk of sediment and chemical run-off to negligible levels. Routine run-off, comprising contaminants from the wear of car brakes, tyres, antifreeze etc. washed off the surface in rainfall events but excluding accidental spillages, is not a major source of soluble nitrogen entering watercourses, nitrogen is excluded from tools used to assess effects of surface water run-off on water quality (Highways England, 2020). Increases in nitrogen availability in water courses could lead to eutrophication, the process of nutrient enrichment, which often leads to significant changes to vegetation communities forming a habitat as those that readily absorb nitrogen outcompete those normally present.



Although spillages could represent acute sources of nitrogen these can be expected to be rare and mitigation included in the Scheme's operational drainage design, which comprises a groundwater infiltration system would attenuate nitrogen inputs to the River Wensum in such cases to negligible levels.

Significance of Effect

10.17.84 This effect will be not significant.

Noise and vibrational disturbance

10.17.85 Increased levels of noise and vibration relative to the baseline situation are anticipated during scheme operation. Data on noise and vibration are provided in **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00).

10.17.86 *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation is not sensitive to noise and vibrational disturbance. Desmoulin's Whorl Snail is not considered to be sensitive to noise and vibrational disturbance, as both these effects are not identified as attributes in site-specific supplementary advice on conserving and restoring site features for River Wensum SAC (Natural England, 2022).

10.17.87 Operation of the Proposed Scheme will generate noise and vibrational adjacent to the River Wensum. Noise will not only be transmitted directly through the air, vibration and percussive energy will be transmitted through support piers to the ground and then onto the River Wensum. Fish such as Bullhead and Brook Lamprey are sensitive to such sources of disturbance which could displace them from viable habitat in the vicinity of works, which may have effects on the survival of individuals and consequently effects on the wider populations in the Wensum. Qualifying Features of the River Wensum SAC with the potential to be impacted therefore comprise:

- Bullhead; and
- Brook Lamprey.



10.17.88 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration will provide a level of noise mitigation for ecological features, including those listed as Qualifying Features of the River Wensum SAC.

10.17.89 The River Wensum SSSI and SAC covers a vast area, well beyond the detailed calculation area. Moderate noise level changes of moderate magnitude are anticipated in the area of the SSSI and SAC closest to the Proposed Scheme (**Figure 7.5 of Chapter 7: Noise and Vibration** (Document Reference: 3.07.00)). However, these are not considered to be of a significant level to disturb fish within the river, and the absolute noise levels modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. Brook Lamprey have no swim bladder, and therefore have a lower sensitivity to sound pressure (Turnpenny and Nedwell, 1994). On this basis and considering that noise increases of a moderate magnitude will occur only for a very small area of the overall SSSI and SAC and the ability of Bullhead and Brook Lamprey to move free away from disturbances, it is considered that the operational road traffic noise effects are not significant.

Significance of Effect

10.17.90 This effect will be not significant.

Additional Mitigation

10.17.91 Mitigation measures that are listed in Section 10.16 and specific to the River Wensum SAC are detailed below, and considered by specific impact, where relevant.

10.17.92 Measures to protect riparian and aquatic habitats from disturbance or degradation, outlined in the OCEMP. Measures include:



- A 3 metre construction exclusion zone from the SAC boundary of the River Wensum.
- Noise, vibration, lighting and biosecurity measures employed during construction to avoid negative impacts on the River Wensum.
- Sediment, pollution and surface water run off controls in proximity to the River Wensum and any hydrologically connected watercourses.

Temporary and permanent loss of supporting floodplain habitat due to land-take

10.17.93 Culverting of WC5 (IDB reference: DRN112G0102) will require temporary dewatering and diversion of a section of the existing watercourse. Aquatic ecology surveys of the ditch in 2022 found the presence of lamprey ammocetes (larvae) using the silt deposits within the channel as shelter. Brook Lamprey larvae feed and grow in organic sediments in marginal and mid-channel stands of vegetation. The temporary realignment of WC5 (IDB reference: DRN112G0102) will result in access to silt deposits being temporarily limited and movement restricted during the construction period.

10.17.94 An FR2 application for authorisation to use fishing instruments other than rod and line will be submitted to the EA in advance of the works in order to use electric fishing and ancillary equipment (such as hand nets) to allow fish translocation of lamprey larvae and other fish present within WC5 (IDB reference: DRN112G0102) to a safe location, with appropriate habitat to support them. This will be carried out by a trained ecologist and will avoid fish and lamprey entrapment within the ditch during construction. Temporary and permanent culverts will be placed so that the invert level is below the existing bed level, to prevent impedance of fish movement. Once construction is complete, WC5 (IDB reference: DRN112G0102) will be returned to its original alignment, with an expectation that habitat will naturally reinstate itself with flow regimes and recovery of macrophyte cover over time. Permanent culverts



on WC5 (IDB reference: DRN112G0102) that remain to allow maintenance access to the viaduct will be designed so that fish and lamprey movement is not inhibited by the structure, with an oversized design and natural substrate.

10.17.95 As part of the additional enhancements (which are additional to mitigation and not designed to mitigate impacts), areas within the Wensum and Wensum floodplain are expected to be enhanced (via interventions such as in-channel features, vegetation planting and bank reprofiling) to improve aquatic habitat that supports a variety of aquatic fauna and flora, including those qualifying features of the River Wensum SAC.

Changes in hydrological conditions – increased flood risk

10.17.96 Measures to protect riparian and aquatic habitats from increased flood risk, outlined in the OCEMP and as discussed above.

10.17.97 Additional enhancements to Wensum / Wensum floodplain (such as reconnecting floodplains, planting and bank reprofiling) will result in a net improvement to aquatic habitats and reduction in flood risk.

10.17.98 Restoration of bank profiles within the Site Boundary following removal of temporary routes / crossings.

10.17.99 Removal of temporary routes / crossings upon completion of the construction phase following a methodology that minimises impacts to the riparian zone and in-channel habitats.

Sediment and chemical run-off

10.17.100 Measures to address potential impacts on water quality during construction and operation, and avoid sediment and chemical run-off into the River Wensum have been mandated by their inclusion in the Proposed Scheme OCEMP. These measures are described in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00) and will reduce the



risk of sediment and chemical run-off and impacts on water quality to negligible levels. Measures include:

- Chemicals and fuels must be stored in secure containers located away from watercourses or water bodies;
- Spill kits must be available;
- Implementation of a construction-phase **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) to intercept, capture and attenuate surface water runoff.

Noise and vibrational disturbance – construction

10.17.101 The Proposed Scheme OCEMP outlines measures that must be taken to reduce the risk of noise and vibration disturbance during the construction phase to negligible levels.

Introduction of invasive non-native plant and animal species

10.17.102 Mitigation measures that will avoid introduction of invasive non-native plant and animal species during construction into the River Wensum have been included as part of the design of the Proposed Scheme and are set out in the OCEMP.

Dust Emissions

10.17.103 A series of measures to address potential impacts on air quality during construction have been identified. These are detailed in **Table 6-12** of **Chapter 6: Air Quality** (Document Reference: 3.06.00) and comprise a number of Best Practicable Means to mitigate potential dust impacts, as described above.

Fragmentation of the landscape by construction of the Proposed Scheme

10.17.104 Areas within the Wensum and Wensum floodplain will be enhanced to improve aquatic habitat that supports a variety of aquatic fauna and flora, and contribute to the targets of the qualifying features of the SAC by restoring



natural river habitat function and processes, and the extent of in-channel riparian habitats. This will balance temporary or permanent losses in the floodplain aquatic habitats and contribute to the targets for the feature.

Assessment of Residual Likely Significant Effects

Construction

10.17.105 Following implementation of the mitigation measures set out above, residual effects on the River Wensum SAC are predicted to be not significant during construction.

Operation

10.17.106 Following implementation of the mitigation measures set out above, residual effects on the River Wensum SAC are predicted to be not significant during operation.

10.18 Assessment of Likely Impacts and Effects - Norfolk Valley Fens SAC – Potter & Scarning Fens, East Dereham

Preliminary Assessment of Likely Impacts and Effects

Operation

Wide-scale air quality changes within the Affected Road Network (ARN)

10.18.1 Oxides of nitrogen (NO_x) and ammonia (NH₃) would be emitted as part of the Proposed Scheme's operation phase. This could lead to nitrogen and acid deposition on habitats within statutory designated sites of international and national importance. This could contribute to increased nutrient nitrogen levels and acidification of habitats within statutory designated sites which could result in changes to the structure, composition and function of the habitats.

10.18.2 Changes in traffic volumes present a potential effect pathway to one component area of Norfolk Valley Fens SAC, which lies adjacent to the Proposed Scheme's ARN. This area is: Potter and Scarning Fens SSSI (near East Dereham; 11.2 kilometres from the Proposed Scheme). Other



component areas of Norfolk Valley Fens SAC have been excluded from this assessment as there are no effects pathways between them and the Proposed Scheme.

10.18.3 Site-specific supplementary advice on conservation objectives indicates that the following qualifying features of the Norfolk Valley Fens SAC are either not present at Potter and Scarning Fen or not within 200m of the ARN and so will not be impacted by air quality changes within the Affected Road Network (ARN):

- Northern Atlantic Wet Heaths with *Erica tetralix*;
- European dry heaths;
- Semi-natural dry grasslands and scrublands facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites);
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*);
- Narrow-mouthed whorl snail;
- Desmoulin's Whorl Snail;
- *Alluvial forests* with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Anion incanae*, *Salicion albae*) and,
- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*.

10.18.4 'Alkaline Fens' was the only qualifying feature of the Norfolk Valley Fens SAC with the potential to experience a reduction in air quality and associated reduced functionality of habitat to support qualifying features due to air quality changes within the ARN.



- 10.18.5 Perceptible effects of air quality changes are typically limited to within 200 metres of their source (Highways England, 2019), in this case adjacent roads included within the Scheme ARN. This 200m zone overlaps with the boundary of Potter and Scarning Fen. As Alkaline Fen habitat is present this and could lead to effects on this habitat through chemical changes to soil (e.g. nutrient status, soil pH) or direct contact between aerial pollutants and plants (e.g. soot).
- 10.18.6 Fen habitat lies within the 200 metres zone adjacent to the A47 where effects of air quality changes will occur as a result of the ARN, with modelling predicting an increase in the deposition of aerial pollutants above 1% of the critical load for this habitat type up to ~60 metres away from the A47 roadside (as shown by transect modelling of air quality changes, see Document Reference 3.06.00 as well as its supporting appendices, 3.06.05, and 3.06.07. The 1% of critical load measurement is used as a threshold to differentiate between significant and non-significant effects. Modelled effects would occur through the deposition of nitrogen compounds including ammonia (NH₃) and nitrogen oxides (NO_x) that could affect habitats through nutrient enrichment and consequent plant community change, and through direct toxicity. The model predicts changes for the Proposed Scheme opening year and for them to persist. Fen habitat within this 60 metre area (and therefore exceeding 1% of critical load) represents 5% of that present at Potter and Scarning Fen.
- 10.18.7 Although the ARN model predicts an effect of air quality change on fen habitat at Potter and Scarning Fen, it is reasonable to predict that in reality, the change will be much less than the model predicts. Several factors not incorporated in the model would attenuate air quality changes as a result of the ARN so nitrogen compound deposition would not exceed 1% of the critical load for fen habitat.
- 10.18.8 The ARN model does not consider the 30m of woodland present along the A47 between the A47 and fen habitat within Potter and Scarning Fen. This will



attenuate changes in air quality by acting as a barrier to emissions, and although will not exclude deposition of nitrogen compounds from the ARN completely, will significantly reduce their concentration.

10.18.9 Alkaline fenland habitat (i.e., that overlying calcareous geology) such as that present at Potter and Scarning Fen is not limited in terms of plant growth by nitrogen. Rather, it is phosphorus limited. Therefore, an increase in nitrogen availability will not result in a deleterious effect on vegetation as a result of nutrient enrichment, as the growth-limiting nutrient will not be elevated by the predicted air quality change (McBride et al., 2011). In addition, impacts exceeding 1% of critical load occur over less than 0.1% of the SAC.

Significance of Effect

10.18.10 The effect of habitat degradation in the form of air quality changes within the ARN on alkaline fen would be not significant, and therefore the effect of habitat degradation in the form of air quality changes on the SAC would also be not significant.

Additional Mitigation

10.18.11 No additional operational phase mitigation measures are required.

Assessment of Residual Likely Significant Effects

Operation

10.18.12 The impacts on the Norfolk Valley Fens SAC - Potter & Scarning Fens, East Dereham are predicted to be negligible with effects predicted to be not significant.

10.19 Assessment of Likely Impacts and Effects - River Wensum SSSI

10.19.1 The assessment described above for the River Wensum SAC is also relevant to the River Wensum SSSI as the extent of and features within both the SAC and the SSSI are the same within the Study Area. The SSSI citation (Natural England, 1993) contains a list of flora and fauna that is mostly associated with



the river and riparian habitats, where the likely impacts and effects from the Proposed Scheme would be the same as for the River Wensum SAC. Further detail specific to the River Wensum SSSI is provided in the **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34).

10.19.2 The SSSI citation does include breeding Barn Owl and overwintering Hen Harrier *Circus cyaneus*, two bird species that are not wholly dependent on the riparian habitat of the River Wensum. Wintering birds and Barn Owls are considered as separate IEFs in this chapter in the wider context of the Proposed Development.

10.19.3 The temporary bailey bridge will ensure that there are no direct negative impacts to the River Wensum SSSI during the construction phase. No permanent viaduct infrastructure will encroach within the boundary of the River Wensum SSSI during the operation phase. Impacts on the River Wensum SSSI are predicted to be negligible with effects predicted to be not significant.

10.20 Assessment of Likely Impacts and Effects - Potter and Scarning Fens, East Dereham SSSI

10.20.1 The assessment described above for the Norfolk Valley Fens SAC is also relevant to the Potter & Scarning Fens, East Dereham as the extent of both the SAC and the SSSI is the same within the Study Area.

10.20.2 Impacts on Potter & Scarning Fens, East Dereham SSSI are predicted to be negligible with effects predicted to be not significant.



10.21 Assessment of Likely Impacts and Effects - Sweetbriar Road Meadows, Norwich SSSI

Preliminary Assessment of Likely Impacts and Effects

Operation

Habitat Degradation

- 10.21.1 Changes in concentrations of NO_x, NH₃, and N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within statutory designated sites of national importance. This could contribute to increased nutrient nitrogen levels and acidification of habitats within statutory designated sites which could result in changes to the structure, composition and function of the habitats.
- 10.21.2 It is predicted that there would be a decrease in N-dep and NH₃ as a result of the Proposed Scheme. This is due to the Proposed Scheme diverting traffic from other roads and thereby reducing associated vehicular emissions in proximity to the SSSI.
- 10.21.3 Background N-dep and NH₃ levels already exceed the lower critical load for the habitat. As such, the incremental decreases in N-dep and NH₃ experienced as a result of the Proposed Scheme are unlikely to lead to long-term perceptible improvements to the habitat, for example through an increase in species diversity or a beneficial change in community composition due to the minor decreases predicted. Any subtle effects that do occur are therefore not predicted to significantly affect key features of the designated habitat.
- 10.21.4 The magnitude and extent of changes in NH₃ or NO_x levels due to the Proposed Scheme are unlikely to significantly affect the key characteristics of the SSSI. Further detail is provided in the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34).



Significance of Effect

10.21.5 The effect of habitat degradation on this feature due to changes in air quality as a result of emissions from vehicles using the completed Proposed Scheme will be not significant.

Assessment of Residual Likely Significant Effects

Operation

10.21.6 The effect of habitat degradation on this feature due to changes in air quality as a result of emissions from vehicles using the completed scheme will be not significant.

10.22 Assessment of Likely Impacts and Effects - Alderford Common SSSI

Preliminary Assessment of Likely Impacts and Effects

Operation

Habitat Degradation

10.22.1 Changes in concentrations of NO_x, NH₃, and N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within statutory designated sites of national importance. This could contribute to increased nutrient nitrogen levels and acidification of habitats within statutory designated sites which could result in changes to the structure, composition and function of the habitats.

10.22.2 Significant exceedances in N deposition are only present up to 10m into Alderford Common SSSI, where woodland forms the dominant habitat type. Significant exceedances in ammonia are only present up to 3m into the SSSI. No impact will occur to the SSSI as the key characteristics of the qualifying habitats are unlikely to be affected due to the absence of calcareous grassland in the impacted location. Further detail is provided in the Air Quality Ecological Impact Assessment (Document Reference: 3.10.34).



Significance of Effect

10.22.3 The effect of habitat degradation on this feature due to changes in air quality as a result of emissions from vehicles using the completed scheme will therefore be not significant.

Assessment of Residual Likely Significant Effects

Operation

10.22.4 The effect of habitat degradation on this feature due to changes in air quality as a result of emissions from vehicles using the completed scheme will be not significant.

10.23 Assessment of Likely Impacts and Effects - Sites Non-Statutorily Designated for Biodiversity Value

Embedded Mitigation

10.23.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to designated sites.

Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible.
- Landscape planting as part of the Proposed Scheme design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.



- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A Drainage Strategy and Drainage Design Plans (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of Otter, Water Vole, fish and aquatic invertebrates.

Preliminary Assessment of Likely Impacts and Effects

Construction

10.23.2 **Table 10-16** lists the potential construction impacts and significance of effects on CWS during the construction phase in the absence of Additional Mitigation measures.

Table 10-16 Potential construction impacts and significance of effects on sites non-statutorily designated for biodiversity value

Site	Description of impact(s)	Significance of effect
River Wensum Pastures, Ringland Estates CWS	<p>Habitat loss: direct loss of habitat due to the construction of the viaduct piers, permanent maintenance roads, construction compounds and non-motorised user (NMU) routes within the Red Line Boundary. This will result in the loss of <i>Deschampsia</i> neutral grassland, <i>Holcus-Juncus</i> neutral grassland, and modified grassland.</p> <p>Habitat degradation through pollution or reduction in air quality.</p>	<p>The loss of habitat at this CWS during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale.</p> <p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>
Attlebridge Hills CWS	<p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>
Broom & Spring Hills CWS	<p>Habitat loss: direct loss of habitat within the CWS through land take to facilitate the development. This will result in the loss of 0.18ha of lowland mixed deciduous woodland and other mixed woodland.</p> <p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>The loss of habitat at this CWS during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale.</p> <p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>

Site	Description of impact(s)	Significance of effect
Wensum Pastures at Morton Hall CWS	<p>Habitat loss: potential for direct loss of habitat through permanent maintenance roads, construction compounds and non-motorised user (NMU) routes.</p> <p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>The loss of habitat at this CWS during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale that is not reversible in the absence of additional mitigation.</p> <p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>
Primrose Grove CWS	<p>Habitat loss: direct loss of habitat within the CWS. 17.2ha of Primrose Grove CWS is within the Red Line Boundary of the Proposed Scheme, resulting in the loss of 1.3ha of mixed (mainly coniferous) woodland.</p> <p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>The loss of habitat at this CWS during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale that is not reversible in the absence of additional mitigation.</p> <p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>
Gravelpit Plantation and Church Hill CWS	<p>Habitat degradation through pollution or reduction in air quality.</p>	<p>This CWS does not fall within 200m of the ARN and is not within 200m of any road. The effects of habitat degradation at this CWS during construction will therefore be not significant.</p>

Site	Description of impact(s)	Significance of effect
Land adjoining Foxburrow Plantation CWS	<p>Habitat loss: direct loss (including severance) of habitat within the CWS and construction of NMU routes. This will result in the loss of 0.76ha of purple moor grass and rush pasture.</p> <p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>The loss of habitat at this CWS during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale that is not reversible in the absence of additional mitigation.</p> <p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>
Old Covert, Wood Lane CWS	<p>Habitat degradation through pollution: potential for liquid runoff entering the groundwater during construction, effecting the functionality of the habitats within the CWS.</p> <p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>Habitat degradation at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>
Mouse Wood CWS	<p>Habitat degradation through pollution: potential for liquid runoff entering the groundwater due to increased construction traffic on the B1535. Potential impact on the functionality of the habitats within the CWS.</p> <p>Habitat degradation through reduction in air quality: Potential for increased nitrogen deposition arising from construction access along the B1535, adjacent to the CWS.</p> <p>Disturbance through construction related lighting, noise, visual and vibration due to activities including the construction access along the B1535, adjacent to the CWS.</p>	<p>Habitat degradation and disturbance at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>

Site	Description of impact(s)	Significance of effect
Fakenham Road RNR	<p>Habitat loss: Direct loss of an area of this RNR to facilitate development. This will result in the loss of 0.0283ha of neutral grassland. 0.1148ha of this RNR will be retained.</p> <p>Habitat degradation through pollution: potential for liquid runoff entering the groundwater during construction, effecting the functionality of the habitats within the RNR.</p> <p>Habitat degradation through pollution or reduction in air quality. This includes a 'Large' risk of being impacted by dust emissions as it is within 50m of the construction activities, and therefore the sensitivity of the receiving environment is 'high'. Construction dust impacts could result in soiling or discolouration of exposed surfaces.</p>	<p>The loss of 0.028ha of neutral grassland habitat at this CWS during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale in the absence of additional mitigation.</p> <p>Habitat degradation and disturbance at this CWS during the construction period represents a temporary, reversible, direct and short-term impact that would result in a significant negative effect at a County scale.</p>



Operation

10.23.3 **Table 10-17** lists the potential operational impacts that could impact the CWS during the construction phase in the absence of Additional Mitigation measures. Further detail regarding the characteristics of potential air quality impacts (including extent, magnitude, duration, frequency, timing and reversibility) is provided in the **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34).

Table 10-17 Potential operational impacts on sites non-statutorily designated for biodiversity value

Site	Resource importance	Description of potential impact	Significance of effect
Attlebridge Hills CWS	County	Habitat degradation through reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Bawburgh / Colney Gravel Pits CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Botany Bay Farm CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.

Site	Resource importance	Description of potential impact	Significance of effect
Brook House Marshes CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>
Broom & Spring Hills CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that this CWS will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This CWS will experience a moderate adverse effect caused by an increase in NH₃ levels in 2029 and 2044.</p> <p>Habitat degradation due to a reduction in air quality at this CWS during the operational period represents a permanent, direct and long-term impact that would result in a significant negative effect at a County scale without additional mitigation.</p>

Site	Resource importance	Description of potential impact	Significance of effect
Church Hill Common CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Costessey Pits (East) CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.

Site	Resource importance	Description of potential impact	Significance of effect
Earlham and Colney Marshes CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>
East Hills CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>

Site	Resource importance	Description of potential impact	Significance of effect
Fakenham Road RNR	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that this RNR will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This RNR will experience a moderate adverse effect caused by an increase in N-dep levels in 2029 and 2044 and a moderate adverse effect caused by an increase in NH₃ levels in 2029 and 2044.</p> <p>Habitat degradation during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the County scale without additional mitigation.</p>
Fen Plantation CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>Not predicted to experience a change in N-dep, NH₃, or NO_x greater than 1% of the critical load or level for the pollutants in either of the modelling years, 2029 and 2044.</p> <p>Habitat degradation through a reduction in air quality would result in an effect that is not significant.</p>

Site	Resource importance	Description of potential impact	Significance of effect
Fen West of East Tuddenham CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Gravelpit Plantation and Church Hill CWS	County	Habitat degradation through reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	This CWS does not fall within 200m of the ARN, therefore the effects of habitat degradation at this CWS during operation will be not significant.
Great Witchingham Common CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	Not predicted to experience a change in N-dep, NH ₃ , or NO _x greater than 1% of the critical load or level for the pollutants in either of the modelling years, 2029 and 2044. Habitat degradation through a reduction in air quality would result in an effect that is not significant.

Site	Resource importance	Description of potential impact	Significance of effect
Hellesdon Pastures CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>
Horsham Meadows CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>
Intwood Carr CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>

Site	Resource importance	Description of potential impact	Significance of effect
Jennis' Wood & Dryhill Plantation CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.

Site	Resource importance	Description of potential impact	Significance of effect
Land adjoining Foxburrow Plantation CWS	County	<p>Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO_x, NH₃, and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.</p> <p>Disturbance: According to the NMU Provision plan shown in Appendix 1 of the Proposed Scheme Transport Assessment (Document Reference 4.01.01), a new dedicated restricted byway will be constructed to the east of the dual carriageway. This byway (Route 1b) will bisect the CWS. As Route 1 is intended to divert an existing public right of way (Honingham RB1), there is the potential for increased visitor presence along Route 1b and therefore through the CWS during the operation period.</p>	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that this CWS will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This CWS will experience a moderate adverse effect caused by an increase in NH₃ levels in 2029 and 2044.</p> <p>Habitat degradation during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the County scale without additional mitigation.</p> <p>Route 1b will closely follow the highway mainline element of the new proposed dual carriageway within the Proposed Scheme to minimise the extent of land take, and will not grant the users of this byway any access to Land adjoining Foxburrow Plantation CWS. The Proposed Scheme is therefore not expected to result in a change in visitor presence at the CWS, and is therefore not anticipated to significantly affect the CWS.</p> <p>The effects of disturbance caused by vehicular activity during the operation of the Proposed Scheme has been considered per IEF elsewhere in this chapter.</p>

Site	Resource importance	Description of potential impact	Significance of effect
Lenwade Pits (East) CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	Not predicted to experience a change in N-dep, NH ₃ , or NO _x greater than 1% of the critical load or level for the pollutants in either of the modelling years, 2029 and 2044. Habitat degradation through a reduction in air quality would result in an effect that is not significant.
Lenwade Pits (West) CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	Not predicted to experience a change in N-dep, NH ₃ , or NO _x greater than 1% of the critical load or level for the pollutants in either of the modelling years, 2029 and 2044. Habitat degradation through a reduction in air quality would result in an effect that is not significant.
Long Dell and Westlodge Hills CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.

Site	Resource importance	Description of potential impact	Significance of effect
Marriott's Way CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>
Meadow Farm Meadow CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>
Mouse Wood CWS	County	Habitat degradation through reduction in air quality: Increased traffic within 200m of CWS. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>

Site	Resource importance	Description of potential impact	Significance of effect
Old Covert, Wood Lane CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Primrose Grove CWS	County	The CWS encompasses Primrose Grove Ancient woodland and extends towards the south and into the Northern Woodlands (including Rose Carr, Long Plantation and the Nursery). Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that this CWS will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This CWS will experience a moderate adverse effect caused by an increase in NH ₃ levels in 2029 and 2044 (see Document Reference: 3.10.34 for further detail). Habitat degradation during the operational period therefore represents a permanent, long-term and direct impact, that would result in a significant negative effect at the County scale without additional mitigation.

Site	Resource importance	Description of potential impact	Significance of effect
River Tud at Easton and Honingham CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
River Wensum Pastures, Ringland Estates CWS	County	<p>Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO_x, NH₃, and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.</p> <p>Habitat loss: increased shading from the viaduct has the potential to effect habitat within the CWS during the growing season. Plant species are predicted to still be able to regenerate and adapt to a reduction in light intensity however, and more shade tolerant species will still grow. Impacts to species dependent on the habitat of the CWS are therefore expected to be negligible.</p> <p>Disturbance: potential increase in visitor pressure due to NMU route improvements within the CWS.</p>	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that this CWS will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This CWS will experience a moderate adverse effect caused by an increase in N-dep levels in 2029 and 2044, a moderate adverse effect caused by an increase in NH₃ levels in 2029 and 2044, and a moderate adverse effect caused by an increase in NO_x levels in 2044.</p> <p>Habitat degradation during the operational period therefore represents a permanent, long-term and direct impact, that would result in a significant negative effect at the County scale without additional mitigation.</p> <p>The effect of the loss of habitat at this CWS during the operational period will be not significant.</p> <p>The existing public right of way 'Ringland FP2' passes along the southern boundary of the CWS, and 'Route 7' passes through the CWS within the footprint of the Site Boundary. According to the NMU Provision plan (Document Reference 4.01.01), these routes will be preserved to provide access over this pedestrian route. This footpath will pass under the viaduct, and so access will be preserved. The footpath will remain as unmade where it crosses through the floodplain of the Wensum Valley and wetland paddocks to minimise impact on flooding and existing habitats and protected species. Route 10a, a new proposed footpath, will be installed within the CWS, along a proposed maintenance track, to link with the existing Route 7. As Ringland FP2 and Route 7 will be retained, and no additional routes or route improvements are proposed other than the addition of Route 10a along the proposed maintenance track, any increases in visitor presence caused by the addition of Route 10a within the CWS would result in an effect that is not significant.</p>

Site	Resource importance	Description of potential impact	Significance of effect
River Yare (west and east), Bowthorpe CWS	County	Habitat degradation through a reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	Not predicted to experience a change in N-dep, NH ₃ , or NO _x greater than 1% of the critical load or level for the pollutants in either of the modelling years, 2029 and 2044. Habitat degradation through a reduction in air quality would result in an effect that is not significant.
Taverham Mill CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.
Walsingham Plantation CWS	County	Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO _x , NH ₃ , and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.	The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS. Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.

Site	Resource importance	Description of potential impact	Significance of effect
Wensum Pastures at Morton Hall CWS	County	<p>Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO_x, NH₃, and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.</p> <p>Disturbance: potential increase in visitor pressure due to NMU route improvements within the CWS.</p>	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that this CWS will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This CWS will experience a moderate adverse effect caused by an increase in NH₃ levels in 2029 and 2044.</p> <p>Habitat degradation during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the County scale without additional mitigation.</p> <p>According to the NMU Provision plan (Document Reference 4.01.01), no additional NMU routes or route improvements are proposed within this CWS, the effect of any changes to visitor pressure within the CWS are not expected to be significant.</p>
Weston Meadow CWS	County	<p>Habitat degradation through pollution or reduction in air quality. Changes in concentrations of NO_x, NH₃, and / or N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition on habitats within designated sites. This could contribute to increased nutrient nitrogen levels and acidification of habitats within designated sites which could result in changes to the structure, composition and function of the habitats.</p>	<p>The Air Quality Ecological Impact Assessment (Document Reference: 3.10.34) determined that the Proposed Scheme would not have a significant effect on this CWS.</p> <p>Habitat degradation through a reduction in air quality would therefore result in an effect that is not significant.</p>



10.23.4 The air quality modelling for all non-statutorily designated sites is located in Section 6.6 of **Chapter 6: Air Quality** (Document Reference: 3.06.00).

Additional Mitigation

10.23.5 General mitigation measures detailed in section 10.16 are also relevant to Sites non-statutorily designated for biodiversity value.

10.23.6 The design of Essential Environmental Mitigation (Document reference: 2.11.00) has included the planting of hoary mullein within the 0.1148ha of Fakenham Road RNR that is to be retained, and 0.031ha of new planting, to mitigate the loss of habitat and this notable plant species at Fakenham Road RNR.

Compensation

10.23.7 The implementation of Final Air Quality Compensation Strategy to compensate for air quality impacts during the operational phase. The **Outline Air Quality Compensation Strategy** (Document Reference: 6.01.01) includes the following measures to compensate for air quality impacts at Sites non-statutorily designated for biodiversity value, that will be used to inform the production of the Final Air Quality Compensation Strategy:

- Management opportunities to promote improvement of the natural habitat for native species;
- Increase the diversity of the canopy cover;
- The removal of coniferous species not native to the locality;
- The creation of open areas to promote a diverse understory ground flora;
- The veteranisation of a selection of trees;
- A reduction in the grazing pressure caused by cattle;



- The implementation of a grassland management regime and deer fencing to promote natural regeneration; and,
- Seeding and planting to improve species diversity.

10.23.8 These measures will compensate for, but not directly mitigate, the impacts of a reduction in air quality during the operation phase.

Assessment of Residual Likely Significant Effects

Construction

10.23.9 Following implementation of the mitigation measures set out above, residual effects on Sites non-statutorily designated for biodiversity value are predicted to be not significant during construction.

Operation

10.23.10 Following implementation of the Additional Mitigation measures, including a Final Air Quality Compensation Strategy to compensate for operational air quality impacts, the operation of the Proposed Scheme is likely to have a residual significant negative effect at a County scale due to habitat degradation caused by a reduction in air quality on the following Sites non-statutorily designated for biodiversity value:

- Wensum Pastures at Morton Hall CWS;
- Broom and Spring Hills CWS;
- Land Adjoining Foxburrow Plantation CWS;
- Primrose Grove CWS;
- River Wensum Pastures CWS; and
- Fakenham Road RNR.



10.23.11 It is however considered that these effects will be compensated for in the long term following the implementation of the Final Air Quality Compensation Strategy.

10.23.12 The residual effects on the remaining Sites non-statutorily designated for biodiversity value are predicted to be not significant during operation.

10.24 Assessment of Likely Impacts and Effects - Ancient Woodland

Embedded Mitigation

10.24.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to ancient woodland.

Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably ancient woodland.
- A retaining wall in proximity to the Primrose Grove Ancient Woodland to minimise the footprint of the Proposed Scheme as it passes the ancient woodland. The retaining wall is approximately 125 metres long and 10 metres high and aligned at least 15 metres away from the ancient woodland to protect the woodland trees from physical impacts.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A Drainage Strategy and Drainage Design Plans (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the



ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.24.2 Mitigation to avoid any direct impacts to ancient woodland trees and tree roots is embedded within the design of the Proposed Scheme. No direct impacts to ancient woodland (i.e. woodland loss) are therefore expected. This effect is concluded to be not significant. Impacts to notable, veteran and ancient trees are considered separately below.

Habitat Degradation

10.24.3 In the absence of mitigation, the root protection areas of trees within ancient woodland could potentially be degraded during the construction phase. Pollution during construction could also potentially lead to the degradation of this ancient woodland.

Significance of Effect

10.24.4 The degradation of ancient woodland due to construction related activities represents a direct, short-term and reversible impact that would result in a significant negative effect at the National scale in the absence of additional mitigation.

Operation

Habitat Degradation

10.24.5 Ancient woodland may be subjected to degradation through pollution such as run-off or a reduction in air quality during the operation period. However, due to embedded mitigation such as the inclusion of drainage basins and other features detailed in the **Drainage Strategy and Drainage Design Plans**



(Document Reference: 2.08.00) for the Proposed Scheme, the effects of run-off will be reduced to imperceptible levels.

10.24.6 The effect of air quality on ancient woodland was modelled and the results are set out in **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34). Changes in concentrations of NO_x, NH₃, and N deposition as part of the Proposed Scheme's operation phase could lead to nitrogen and acid deposition. This could contribute to increased nutrient nitrogen levels and acidification of habitats such as ancient woodland, which could result in changes to habitat structure, composition and function. This would be a temporary and reversible impact.

10.24.7 The **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34) determined that Primrose Grove will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme. This ancient woodland will experience a moderate adverse effect caused by an increase in N-dep levels in 2029 and 2044, and a large adverse effect caused by an increase in NH₃ levels in 2029 and 2044.

10.24.8 The **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34) determined that for Church Wood Ancient Woodland the baseline N deposition levels are almost three times higher than the assigned critical load in the absence of the Proposed Scheme, likely due to the Site's close proximity to the Broadland Northway. A minor predicted increase in NH₃ is also unlikely to affect the key characteristics of the Site.

10.24.9 Snake Wood Ancient Woodland will experience a decrease in NO_x, N-dep and NH₃ as a result of the Proposed Scheme. This is due to the Proposed Scheme diverting traffic from other roads and thereby reducing associated vehicular emissions in proximity to the ancient woodland. Background NO_x, N-dep and NH₃ levels already exceed the lower critical load for the habitat. As such, the incremental decreases in NO_x, N-dep and NH₃ experienced as a



result of the Proposed Scheme are unlikely to lead to long-term perceptible improvements to the habitat, for example through an increase in species diversity or a beneficial change in community composition due to the minor decreases predicted. Any subtle effects that do occur are therefore not predicted to significantly affect key features of the designated habitat. The magnitude and extent of changes in N-dep, NH₃ or NO_x levels due to the Proposed Scheme are unlikely to significantly affect the key characteristics of the ancient woodland.

10.24.10 Sprowston Wood Ancient Woodland is not predicted to experience a change in N-dep, NH₃, or NO_x greater than 1% of the critical load or level for the pollutants in either of the modelling years, 2029 and 2044.

10.24.11 Further detail is provided in the **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34).

Significance of Effect

10.24.12 Habitat degradation of Snake Wood Ancient Woodland, Church Wood Ancient Woodland and Sprowston Wood Ancient Woodland due to a change in air quality will result in an effect that is not significant.

10.24.13 The Proposed Scheme is predicted to contribute to a short-term retarding of improvement in N-dep at Primrose Grove, and despite the woodland already experiencing high levels of NH₃, the increase in NH₃ levels predicted from the Proposed Scheme may cause further decline on species diversity. Therefore, habitat degradation at Primrose Grove Ancient Woodland during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the National scale without additional mitigation.



Additional Mitigation

10.24.14 In addition to the OCEMP, retained trees and hedgerow must be protected in accordance with the **Outline Arboricultural Method Statement** (Document Reference 3.03.01d).

10.24.15 Mitigation proposals will include tree planting that ultimately will increase canopy cover (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the '**Essential Environmental Mitigation**' plan [Document reference: 2.11.00]).

Compensation

10.24.16 The implementation of a Final Air Quality Compensation Strategy to compensate for air quality impacts during the operational phase. The **Outline Air Quality Compensation Strategy** (Document Reference: 6.01.01) includes the following measures to compensate for air quality impacts, that will be used to inform the production of the Final Air Quality Compensation Strategy:

- Management opportunities to promote improvement of the natural habitat for native species;
- Increase the diversity of the canopy cover;
- The removal of coniferous species not native to the locality;
- The creation of open areas to promote a diverse understory ground flora;
- The veteranisation of a selection of trees;
- A reduction in the grazing pressure caused by cattle;
- The implementation of a grassland management regime and deer fencing to promote natural regeneration; and,



- Seeding and planting to improve species diversity.

10.24.17 These measures will compensate for, but not directly mitigate, the impacts of a reduction in air quality during the operation phase.

Assessment of Residual Likely Significant Effects

Construction

10.24.18 Following the implementation of additional mitigation measures the residual effects during construction are expected to be not significant.

Operation

10.24.19 Following the implementation of additional mitigation measures the residual effect on ancient woodland during the operation period is a significant negative effect at a National scale on Primrose Grove ancient woodland.

10.24.20 It is however considered that this effect will be compensated for in the long term following the implementation of the Final Air Quality Compensation Strategy.

10.25 Assessment of Likely Impacts and Effects - Habitats of Principal Importance

Embedded Mitigation

10.25.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to HPI. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid land take from HPI, where possible. The provision of a viaduct over the River Wensum reduces land take by minimising the number of piers within the floodplain Coastal and Floodplain Grazing Marsh HPI, for example.



- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.25.2 Construction of the Proposed Scheme and the associated site and vegetation clearance work is expected to lead to the direct loss of areas of Habitats of Principal Importance (HPI). HPI to be permanently lost within the Red Line Boundary of the Proposed Scheme comprise Hedgerows, Purple Moor Grass and Rush Pasture, Lowland Deciduous Woodland and Coastal and Floodplain Grazing Marsh (see **Table 10-18** below). Hedgerows and rivers are considered separately below. Loss of HPI can lead to the severance or fragmentation of HPI.



Table 10-18 Loss of Habitats of Principal Importance within the Red Line Boundary

HPI	Total area (ha)	Total loss (ha)
Purple Moor Grass and Rush pasture	5.42	1.05
Lowland Mixed Deciduous Woodland	23.74	4.03
Coastal and Floodplain Grazing Marsh	37.21	14.41
Wet Woodland	2.71	0

Habitat Degradation

10.25.3 HPI that are retained (see **Table 10-19** below) could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. Water affected by construction activities could lead to changes in water quality or the botanical composition of HPI.

Table 10-19 Habitats of Principal Importance retained within the Red Line Boundary

HPI	Total area (ha)	Total retained (ha)
Purple Moor Grass and Rush pasture	5.42	4.37
Lowland Mixed Deciduous Woodland	23.74	19.71
Coastal and Floodplain Grazing Marsh	37.21	22.80
Wet Woodland	2.71	2.71

Significance of Effect

10.25.4 The loss of areas of HPI during the construction period represent long-term, permanent and direct impacts in the absence of additional mitigation, and this would lead to significant negative effects at the County scale.

10.25.5 The degradation of areas of HPI during the construction period represents a short-term, temporary, reversible and direct impact that would lead to a significant negative effect at the County scale without additional mitigation.



Operation

Habitat Degradation

10.25.6 HPI may be subjected to degradation through pollution such as the contamination of watercourses and / or waterbodies associated with road related runoff. However, due to embedded mitigation such as the inclusion of drainage basins and other features detailed in the **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) for the Proposed Scheme, the effects of run-off will be reduced to imperceptible levels.

Significance of Effect

10.25.7 This effect would be not significant.

Additional Mitigation

10.25.8 In addition to the measures stated in Section 10.16, proposals for habitat compensation have been designed with regard to the impacts on HPI.

Mitigation measures include the enhancement of woodland, the creation of woodland and scrub, and the creation or enhancement of grassland (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00)).

10.25.9 Coastal and floodplain grazing marsh HPI comprises an integrated network of wetland habitats including other HPI types (e.g. purple moor grass and rush pasture HPI). The loss of coastal and floodplain grazing marsh HPI and purple moor grass and rush pasture HPI will be compensated by the creation of purple moor grass and rush pasture HPI within existing areas of low / medium distinctiveness grassland habitats in the areas of coastal and floodplain grazing marsh HPI within the Red Line Boundary (see the 'Grassland Creation / Enhancement Area (Ha)' presented in the '**Essential Environmental Mitigation**' plan [Document reference: 2.11.00]). This will be



considered as both the enhancement of existing coastal and floodplain grazing marsh and the creation of new purple moor grass and rush pasture.

10.25.10 The degree to which wetland compensation measures can successfully recreate the hydrological (water quality and quantity) and soil moisture conditions required by Purple Moor Grass and Rush pasture and Coastal and Floodplain Grazing Marsh depends on the extent of habitat affected and degree to which hydrology is disrupted.

Assessment of Residual Likely Significant Effects

Construction

10.25.11 Following implementation of the mitigation measures set out above, the impacts of habitat degradation on HPI during the construction period will be reduced to negligible levels, and the residual effects are expected to be not significant.

10.25.12 Areas of the following HPI will be lost as a result of the Proposed Scheme (Hedgerows and watercourses are considered separately below):

- Lowland Mixed Deciduous Woodland;
- Purple Moor Grass and Rush pasture; and,
- Coastal and Floodplain Grazing Marsh.

10.25.13 The creation of new habitat would be undertaken during the construction period but will take time to mature. A significant negative effect at the County scale is predicted during the construction phase until the completion of habitat creation establishment periods (see Section 10.12). Once habitats are established the residual effects will be not significant.

Operation

10.25.14 The residual effects on HPI are predicted to be not significant.



10.26 Assessment of Likely Impacts and Effects - Hedgerows

Embedded Mitigation

10.26.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to hedgerows.

Relevant Embedded Mitigation includes:

- Landscape planting as part of the Scheme design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.26.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is also expected to directly impact hedgerows in the form of habitat loss, and this could lead to the severance and fragmentation of retained hedgerow habitat.



- 10.26.3 According to **Appendix 33c: Metric** (Document reference: 3.10.33c) of the **Biodiversity Net Gain Technical Report** (Document Reference: 3.10.33)), hedgerow loss will comprise the removal of 4.375 kilometres of hedgerow habitat. This loss could affect the functionality of this habitat type to support protected or notable species.

Habitat Degradation

- 10.26.4 Hedgerows could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period.

Disturbance

- 10.26.5 Species listed under Schedule 5 of the Wildlife and Countryside Act 1981 that are supported by a hedgerow could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Disturbance could temporarily reduce the availability of suitable habitat within the local landscape; however, this habitat is widely represented in the wider local landscape. Species-specific assessments of impacts associated with disturbance during construction are considered by species below.

Significance of Effect

- 10.26.6 The loss of 7.37 kilometres of hedgerow represents a permanent, direct and long-term impact that is not reversible in the absence of additional mitigation, that would result in a significant negative effect at the County scale.
- 10.26.7 The degradation of hedgerows during the construction period represents a temporary, short-term, direct and reversible impact that would result in a significant negative effect at the County scale without additional mitigation.



Operation

Habitat Degradation

10.26.8 Hedgerows may be subjected to degradation through pollution such as road related runoff. However, due to embedded mitigation such as the inclusion of drainage basins and other features detailed in the **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) for the Proposed Scheme, the effects of run-off will be reduced to imperceptible levels.

Disturbance

10.26.9 Species listed under Schedule 5 of the Wildlife and Countryside Act 1981 that are supported by a hedgerow could potentially be subject to lighting, noise, visual and vibration disturbance during operation, and this may lead to changes in behaviour. Disturbance could temporarily reduce the availability of suitable habitat within the local landscape; however, this habitat is widely represented in the wider local landscape. Species-specific assessments of impacts associated with disturbance during operation are considered by species below.

Significance of Effect

10.26.10 Habitat degradation during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the County scale without additional mitigation.

Additional Mitigation

10.26.11 In addition to the measures stated in Section 10.16, the proposals for habitat compensation have been designed with regard to the impacts on hedgerows. Mitigation measures include the creation or enhancement of approximately 16 kilometres of hedgerow habitat (see the '**Essential Environmental Mitigation**' plan [Document reference: 2.11.00] and **Biodiversity Net Gain Technical Report 2023** (Document Reference: 3.10.33)).



Assessment of Residual Likely Significant Effects

Construction

10.26.12 Following implementation of the mitigation measures set out above, a significant negative effect at the County scale is predicted during the construction phase until the habitat creation and compensation measures have reached their target condition (see paragraph 5.5.14). Following establishment, residual effects are expected to be not significant.

Operation

10.26.13 The residual effects on Hedgerows are predicted to be not significant.

10.27 Assessment of Likely Impacts and Effects - Watercourses

Embedded Mitigation

10.27.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to watercourses.

Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)). Targeted planting of trees and vegetation near watercourses will provide shading and riparian habitat diversity.
- The provision of a viaduct over the River Wensum and floodplain providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for



the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of Otter, Water Vole, fish and aquatic invertebrates. Features have been included in the culvert design to simulate natural conditions as much as possible. Features include natural beds and widespan height and widths to simulate natural conditions which will allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections.



Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

- 10.27.2 Construction of the Proposed Scheme and associated culverting and vegetation clearance work is expected to lead to both temporary and permanent loss of a proportion of open aquatic habitats.
- 10.27.3 Temporary and permanent losses are shown below. It should be noted that these lengths are approximate areas of loss and based on a worst-case scenario of the Proposed Scheme. This is based on certain areas being removed in the absence of detailed information.
- 10.27.4 Construction within the River Wensum floodplain and Foxburrow stream will result in the following losses:
- The temporary loss of up to 125m of open aquatic habitat on WC5 (IDB reference: DRN112G0102);
 - The permanent loss of 22m of open aquatic habitat on WC5 (IDB reference: DRN112G0102); and
 - The permanent loss of 77m of open aquatic habitat on Foxburrow stream.

Disturbance

- 10.27.5 Noise, vibration and lighting disturbance from temporary works could disturb aquatic fauna using aquatic habitat both inside and outside the Proposed Scheme.

Introduction of invasive non-native plant and animal species

- 10.27.6 The introduction of invasive non-native species to aquatic habitats could have an adverse impact, degrading aquatic habitats and putting pressure on native aquatic species.



Habitat Degradation

- 10.27.7 Water affected by pollution draining from the Proposed Scheme could enter watercourses including the River Wensum and through other drainage pathways (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)). This could provide an impact pathway affecting aquatic habitats and aquatic species within them, for example via the transport of water-borne pollution following a pollution incident or increased silt run-off.

Significance of Effect

- 10.27.8 The loss of open aquatic habitat on Foxburrow Stream (77m) and WC5 (IDB reference: DRN112G0102) (22 metres) during the construction period represents a long-term, direct and permanent impact that would result in a significant negative effect at the County scale without additional mitigation.
- 10.27.9 The temporary loss of open aquatic habitat (98 metres) on WC5 (IDB reference: DRN112G0102) during the construction period represents a long-term, direct and permanent and reversible impact that would result in a significant negative effect at the County scale without additional mitigation.
- 10.27.10 The significance of effect of the degradation of aquatic habitat during the construction period from drainage is dependent on the type, extent, magnitude, duration and frequency of the pollution. However, it can be predicted that an increase in chemical and sediment loading during the construction period represents a short-term, temporary, direct and reversible impact that would lead to a significant negative effect at the County scale without additional mitigation.
- 10.27.11 The disturbance of aquatic fauna during the construction period represents a short-term, temporary, direct and reversible impact that would lead to a significant negative effect at the County scale without additional mitigation.



10.27.12 The introduction of invasive non-native species to aquatic habitat during the construction period represents a long-term, direct, permanent and reversible impact that would lead to a significant negative effect at the County scale without additional mitigation.

Operation

Habitat Degradation

10.27.13 Water draining from the Proposed Scheme could enter watercourses through drainage pathways (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)). This could provide an impact pathway affecting aquatic habitats and aquatic species within them, for example via the transport of water-borne pollution following a pollution incident or increased road related run-off.

10.27.14 As part of embedded mitigation, a 1.2 metres high environmental barrier along the entire length of viaduct will reduce the likelihood of impacts to the aquatic environment as a result of salt spray, noise or other road-related adverse effects. Additionally, the Scheme's drainage design will minimise any impacts through drainage pathways, as detailed further in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00).

Habitat Loss and Severance

10.27.15 The provision of a viaduct over the Wensum floodplain will reduce the effects of shading, habitat fragmentation and degradation of watercourses. Connectivity will also be maintained for fish and macroinvertebrate passage at WC5 (IDB reference: DRN112G0102) and Foxburrow stream crossing points through the appropriate design of culverts. However, open aquatic habitat will be lost due to the presence of the permanent culverts.



Significance of Effect

10.27.16 The significance of effect of the degradation of aquatic habitat during operation from drainage is dependent on the type, extent, magnitude, duration and frequency of the pollution incident and subsequent run off. However, as determined by the **Drainage Network Water Quality Assessment** (Document Reference: 3.12.01) the proposed surface water drainage system is deemed acceptable for the receiving waterbodies, therefore this effect will be not significant.

10.27.17 The loss of open aquatic habitat represents a long-term, direct, permanent impact that would lead to significant negative effects at the County scale without additional mitigation.

Additional Mitigation

10.27.18 Measures to protect riparian and aquatic habitats from disturbance or degradation, outlined in the OCEMP.

10.27.19 The enhancement of ditches and restoration of watercourses totalling approximately 1.67 kilometre in length, and the enhancement of bankside terrestrial habitat along these sections, will be provided in the Essential Environmental Mitigation as shown on the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00).

10.27.20 Improved condition as a result of improvement works (for BNG purposes and impact mitigation) on Wensum / Wensum floodplain and Foxburrow stream (such as in-channel features, vegetation planting and bank reprofiling) will result in a net benefit to aquatic habitats in both the Wensum and Tud catchments. The location and proposals for compensatory river habitats and enhancement measures have also been informed by use of the Natural England Biodiversity Metric 3.1 as part of a **Biodiversity Net Gain assessment** (Document Reference: 3.10.33).



Assessment of Residual Likely Significant Effects

Construction

10.27.21 Following implementation of the mitigation measures set out above, it is predicted that the impacts of aquatic habitat loss would remain as a minor adverse with effects predicted to be significant adverse in the short term at a County scale whilst planting matures, and enhancements establish during this period. Following enhancement establishment, residual effects are expected to be not significant.

Operation

10.27.22 No significant residual effects.

10.28 Assessment of Likely Impacts and Effects - Notable, Veteran and Ancient Trees

Embedded Mitigation

10.28.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Notable, Veteran and Ancient Trees. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible. This resulted in a reduction in the number of veteran trees being directly impacted from twelve to seven (see **Chapter 4: Alternatives** (Document Reference: 3.04.00) for further details).
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside



drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.28.2 The Proposed Scheme includes the loss of irreplaceable habitat in the form of the removal of seven ancient or veteran trees (T20; T49; T77; T82; LG138; LG141; T220).

10.28.3 The impacts of the Proposed Scheme on other high-quality trees (Category A trees – see the **Arboricultural Impact Assessment (Appendix 10.35)** (Document Reference: 3.10.35) for further detail), tree groups and woodlands (Category A features) involves the removal of 25 trees, and the removal or part removal from six tree groups (including linear features). Additionally, two woodlands would be partly impacted. Details of removals and part removals of these features are included in the **Arboricultural Survey Schedule** (Appendix 10.35a (Document Reference: 3.10.35a).

Habitat Degradation

10.28.4 The root protection areas of ancient or veteran trees could potentially be degraded during the construction phase in the absence of mitigation. Notable, veteran and ancient trees could also be subjected to habitat degradation through pollution and a reduction in air quality during the construction period without additional mitigation measures.



Significance of Effect

10.28.5 The loss of high-quality tree features comprising 25 trees, including seven ancient or veteran trees, and the loss or partial loss of six tree groups represents a permanent, direct and long-term impact that is not reversible, that would result in a significant negative effect at the National scale without additional mitigation.

10.28.6 The degradation of notable, veteran and ancient trees during the construction period represents a temporary, short-term, direct and reversible impact that would result in a significant negative effect at the National scale without additional mitigation.

Operation

Habitat Degradation

10.28.7 Notable, veteran and ancient trees may be subjected to degradation through pollution such as run-off during the operation period. However, due to embedded mitigation such as the inclusion of drainage basins and other features detailed in the **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) for the Proposed Scheme, the effects of run-off will be reduced to imperceptible levels.

10.28.8 Notable, veteran and ancient trees may be subjected to degradation through pollution such a reduction in air quality during the operation period. Nitrogen deposition can have negative effects upon tree health, although the manifestation of significant effects, such as declines in tree health leading to the earlier mortality of individuals may not be readily predicted due to the multitude of factors which influence it. For example, lichen communities above ground and mycorrhizal fungi below ground can be altered following changes in air quality, which can then in turn indirectly affect the veteran tree.

10.28.9 A total of 73 trees were scoped into the **Air Quality Ecological Impact Assessment** (Document Reference: 3.10.34). The assessment determined



that the following trees will be significantly affected by habitat degradation due to a reduction in air quality caused by the Proposed Scheme:

- T13 (T277), T12 (T278), T11 (T279), T3 (T268), T10 (T281), T24 (T105), T23 (T45), T16 (T99), T19 (T74), and T9 (T295) will experience a moderate adverse effect caused by an increase in NH₃ levels in 2029 and 2044; and
- T26 (T152), T25 (T113), T18 (T72), T17 (T96), T6 (T160), and T21 (T34) will experience a moderate adverse effect caused by an increase in NH₃ levels in 2044 only.

Significance of Effect

10.28.10 Habitat degradation of notable, veteran and ancient trees T13 (T277), T12 (T278), T11 (T279), T3 (T268), T10 (T281), T24 (T105), T23 (T45), T16 (T99), T19 (T74), T9 (T295), T26 (T152), T25 (T113), T18 (T72), T17 (T96), T6 (T160), and T21 (T34) during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the National scale without additional mitigation.

Additional Mitigation

10.28.11 An initial arboricultural method statement includes detail on actions around individual trees and groups of trees to outline approaches to removal and protection including the establishment of construction exclusion zones. Retained trees and hedgerow must be protected in accordance with British Standard BS5837:2012 Trees in Relation to Construction, including the erection of appropriate demarcation fencing encompassing root protection areas.

10.28.12 Mitigation proposals will include tree planting that ultimately will increase canopy cover.



10.28.13 Retained trees and hedgerows must be protected in accordance with **Outline Arboricultural Method Statement** (Document Reference: 3.03.01d), including the erection of appropriate demarcation fencing encompassing root protection areas.

Compensation

10.28.14 Ancient and veteran trees provide an irreplaceable habitat, and their direct loss cannot be mitigated. The Arboricultural Impact Assessment (**Appendix 10.35**) (Document Reference: 3.10.35) includes an outline of a compensation strategy that identifies measures to compensate for this direct loss.

10.28.15 The implementation of a Final Air Quality Compensation Strategy to compensate for air quality impacts during the operational phase. The Final Air Quality Compensation Strategy will include measures such as implementing enhanced buffering around veteran trees to reduce impacts from agricultural activities, implementing soil quality improvement measures, and improvements via the pruning or crown reduction of veteran trees to prolong tree lifespan. These measures will compensate for, but not directly mitigate, the impacts of a reduction in air quality during the operation phase.

Assessment of Residual Likely Significant Effects

Construction

10.28.16 Following the implementation of the mitigation measures stated above, the residual effect of habitat degradation on notable, veteran and ancient trees will be not significant.

10.28.17 The residual effect of habitat loss on notable, veteran and ancient trees is a significant negative effect. This is due to the removal of irreplaceable habitat in the form of ancient or veteran trees (occurring outside of ancient woodland) that cannot be mitigated.



Operation

10.28.18 The residual effect of degradation through a reduction in air quality during the operation period on high quality trees, tree groups and woodlands (Category A features) remains a significant negative effect at a National scale.

10.28.19 It is however considered that this effect will be compensated for in the long term following the implementation of the Final Air Quality Compensation Strategy.

10.29 Assessment of Likely Impacts and Effects - Other Habitats

Embedded Mitigation

10.29.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to habitats. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible;
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be



built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

- 10.29.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to both temporary and permanent removal of a proportion of habitats. Habitats identified within the Proposed Scheme provide a mosaic of supporting habitat for a range of protected and notable species and include Habitats of Principal Importance (considered separately below). Habitat loss can lead to habitat severance or fragmentation and can affect the functionality of habitat to support protected / notable species and the achievement of biodiversity net-gain.
- 10.29.3 Habitat loss within the Red Line Boundary of the Proposed Scheme is detailed in the **Biodiversity Net Gain Assessment** (Document Reference: 3.10.33) and presented in **Table 10-20** below.



Table 10-20 Habitats to be retained, temporarily lost or permanently lost within the Red Line Boundary of the Proposed Scheme

Habitat	Habitat code	Area (ha)	% of total Proposed Scheme area	Habitat loss (ha)	Retained habitat (ha)
Cereal crops	c1c	162.59	56.62	161.83	0.76
Fen, marsh and swamp	f2	5.42	1.89	1.05	4.37
Other neutral grassland	g3c	29.99	10.44	12.99	17.0
Arrhenatherum neutral grassland	g3c5	2.13	0.74	2.12	0.01
Lolium-Cynosurus neutral grassland	g3c6	0.15	0.05	0.15	0
Deschampsia neutral grassland	g3c7	0.93	0.32	0.74	0.19
Modified grassland	g4	35.42	12.33	27.56	7.86
Sparsely vegetated land- ruderal/ephemeral	s 17	0.80	0.28	0	0.8
Developed land; sealed surface	u1b	5.69	1.98	5.69	0
Artificial unvegetated, unsealed surface	u1c	0.94	0.33	0.94	0
Wet woodland	w1d	2.71	0.95	0	2.71
Lowland mixed deciduous woodland	w1f	0.16	0.06	0	0.16
Other Lowland mixed deciduous woodland	w1f7	18.48	6.44	3.91	14.57
Other broadleaved woodland types	w1g7	0.81	0.28	0.3	0.51



Habitat	Habitat code	Area (ha)	% of total Proposed Scheme area	Habitat loss (ha)	Retained habitat (ha)
Other woodland; mixed; mainly broadleaved	w1h5	16.69	5.81	1.95	14.74
Other woodland; mixed; mainly conifer	w1h6	1.67	0.58	0.3	1.37
Other coniferous woodland	w2c	2.58	0.90	2.58	0



Habitat Degradation

10.29.4 Habitats could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. This includes the potential for liquid runoff associated with construction to enter directly into waterbodies or groundwater during the construction period, and result in changes in water quality and the botanical composition of habitats. The mobilisation of dust from construction activities could be relevant to ecological features up to 50 metres from construction activities, and dust deposition on vegetation could have effects on habitats suitable for supporting numerous species, limiting breeding success and reducing foraging opportunities. This could affect the functionality of habitats to support protected or notable species.

Significance of Effect

10.29.5 The temporary loss of habitats and the degradation of habitats during the construction period represent short-term and direct impacts that would lead to significant negative effects at the Local scale.

10.29.6 The permanent loss of habitat represents a long-term direct impact that would lead to a significant negative effect at the Local scale in the absence of additional mitigation.

Operation

Habitat Degradation

10.29.7 Habitats may be subjected to degradation through pollution or a reduction in air quality during the operation period. This could lead to the reduced functionality of habitats and impact on biodiversity net-gain targets.

10.29.8 However, due to embedded mitigation such as the inclusion of drainage basins and other features detailed in the **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) for the Proposed Scheme, the effects of run-off will be reduced to imperceptible levels.



Significance of Effect

10.29.9 Habitat degradation during the operational period represents a permanent, long-term and direct impact, that would result in a significant negative effect at the local scale without additional mitigation.

Additional Mitigation

10.29.10 Measures mandated by their inclusion in the OCEMP include protection measures for retained habitats, including in relation to run-off and dust management. Retained trees and hedgerow must be protected in accordance with the **Outline Arboricultural Method Statement** (Document Reference: 3.03.01d), including the erection of appropriate demarcation fencing encompassing root protection areas.

10.29.11 Within the Essential Environmental Mitigation as shown on the **'Essential Environmental Mitigation' plan** (Document reference: 2.11.00), habitats such as arable land are to be lost in favour of better quality and higher condition habitats as part of habitat mitigation, creation and enhancement proposals. The following mitigation will be undertaken (see the **Biodiversity Net Gain Technical Report** for areas of habitat creation (**Appendix 10.33**) (Document Reference: 3.10.33)):

- Woodland enhancement;
- Woodland and scrub creation; and,
- Grassland creation and / or enhancement.

10.29.12 The location and proposals for compensatory habitats and enhancement measures have also been informed by use of the Natural England Biodiversity Metric 3.1 as part of a Biodiversity Net Gain assessment. This metric assigns relative values to habitats depending on a range of factors such as distinctiveness, condition, and scarcity. The metric then combines these factors with the area of each habitat impacted, to provide a score for the



number of Biodiversity Units lost. The results of the Biodiversity Net Gain Assessment, including the values of habitat creation and enhancement to be undertaken are provided in a separate report (Document Reference: 3.10.33, (see **Appendix 10.33a, Figure 2** for post-development landscape plan habitats)).

10.29.13 All new landscape / habitat creation would be subject to a long term (30 year) management and maintenance plan – the LEMP. The management plan would prescribe the maintenance regimes for all different landscape / habitats considering the aims, objectives and functions of each area of planting / habitat. The management plan would also set out proposals for monitoring the condition of landscape and habitat creation areas, to assess how these develop post-construction.

10.29.14 In the long term the use of specific areas for ecological mitigation and enhancement would increase its suitability for, and use by, numerous species.

Compensation

10.29.15 The implementation of an Air Quality Compensation Strategy will compensate for air quality impacts during the operational phase. Although the **Outline Air Quality Compensation Strategy** (Document Reference: 6.01.01) addresses designated sites as the focus of the strategy, the CWS designations incorporate other habitats including the habitats specified within this section. The **Outline Air Quality Compensation Strategy** (Document Reference: 6.01.01) therefore provides a fundamental compensation basis for these habitats.

Assessment of Residual Likely Significant Effects

Construction

10.29.16 Following the implementation of the mitigation measures stated above, the residual effect of habitat degradation on Other Habitats will be not significant.



10.29.17 The creation of new habitat would be undertaken during the construction period but will take time to mature. A significant negative effect at the Local scale is predicted during the construction phase until the completion of habitat creation establishment periods (see Section 10.12). Once habitats are established the residual effects of habitat loss on Other Habitats will be not significant.

Operation

10.29.18 Following the implementation of the mitigation measures stated above, and once reinstated, created and enhanced habitats have established, it is predicted that operational effects would be not significant.

10.30 Assessment of Likely Impacts and Effects - Badger

Embedded Mitigation

10.30.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to badgers. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum SAC / SSSI and ancient woodland, and therefore retain as much badger sett building, foraging and commuting habitat as possible.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum, which includes a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.
- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at



speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.

- Green bridges and underpasses are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use/navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns



at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.30.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to the removal of a proportion of habitats. This would result in the direct loss of habitat suitable for use by badgers for sett building, foraging and commuting purposes. Some loss of habitat suitable for badgers would be permanent, associated with the built footprint of new infrastructure and lasting for at least the duration of the operational period. This loss could affect the functionality of the remaining areas of suitable habitat type to support badgers and will reduce the availability of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape, however.

10.30.3 **Table 10-21** lists the setts within the Site Boundary that will be directly impacted by construction works and as such will be permanently lost to the Proposed Scheme. This includes setts that fall within 30m of proposed bore pile locations. Sett IDs were obtained from **Confidential Appendices 10.29** (Document Reference: 3.10.29) and **10.30** (Document Reference: 3.10.30).



Table 10-21 Badger setts to be permanently lost to the Proposed Scheme

Sett ID	Sett Classification	Sett Activity	Anticipated Impact
S1	Subsidiary	Seven disused entrances; five partially active entrances; and six active entrances.	Permanently lost
S2	Outlier	Two disused entrances; one partially active entrance; and one active entrance.	Permanently lost
S6	Outlier	One active entrance.	Permanently lost
S17	Outlier	One disused entrance.	Permanently lost
S26	Outlier	Sett not found 2022 2019 and 2020: One disused entrance.	Permanently lost
S27	Outlier	One disused entrance; and one active entrance.	Permanently lost
S35	Outlier	One active entrance.	Permanently lost
S36	Outlier	One partially active entrance.	Permanently lost
S50	Outlier	Three active entrances.	Permanently lost
S51	Outlier	One partially active entrance.	Permanently lost
S52	Outlier	One active entrance.	Permanently lost
S53	Outlier	One active entrance.	Permanently lost
S54	Outlier	One partially active entrance.	Permanently lost
S63	Subsidiary	One disused entrance; and four active entrances.	Permanently lost
S72	Outlier	Three disused entrances.	Permanently lost

Habitat Severance

10.30.4 The Proposed Scheme will create a barrier to badger dispersal that will also lead to the severance and fragmentation of habitat suitable for supporting badgers. These impacts are likely to reduce the ability of badgers to move between foraging and breeding habitats. This could lead to a change to the



distribution and abundance of badgers and may segregate existing badger clans. Measures to maintain habitat connectivity between setts are incorporated into the Proposed Scheme design however, including badger tunnels, green bridges and underpasses.

Injury and Mortality

- 10.30.5 Any badgers present within or in proximity to areas of construction could also be at risk of injury or being killed during site and vegetation clearance operations.

Habitat Degradation

- 10.30.6 Habitats suitable for supporting badgers could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. The risk of habitat degradation significantly impacting badgers is considered to be negligible however, as this species is not considered to be sensitive to nitrogenous air pollution.

Disturbance

- 10.30.7 Increased levels of human activity and the presence of large machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction.
- 10.30.8 Badgers could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour such as vacating a sett.
- 10.30.9 Given the scale of the construction works associated with the Proposed Scheme, and the low existing noise levels in the area, significant adverse construction noise and vibration effects are likely. Construction activities for both temporary works and the viaduct could cause disturbances to badger through plant, machinery and personnel movement and additional lighting. Disturbance could temporarily affect the functionality of the remaining areas of suitable habitat type to support this species, and temporarily reduce the



availability of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however.

10.30.10 **Table 10-22** summarises the survey results for all setts that are within a 20 metre buffer of the Site Boundary and may be indirectly impacted by the scheme through disturbance.

Table 10-22 Setts potentially indirectly impacted through disturbance

Sett ID	Sett Classification	Sett Activity	Anticipated Impact
S3	Outlier	Sett not found 2022. 2019 and 2020: One active entrance.	Potentially disturbed
S4	Outlier	One partially active entrance.	Potentially disturbed
S5	Outlier	One partially active entrance; three disused entrances.	Potentially disturbed
S15	Outlier	One active entrance.	Potentially disturbed
S16	Outlier	Sett not found 2022 2019 and 2020: Two partially active entrances.	Potentially disturbed
S28	Main	Two disused entrances; four partially active entrances; and three active entrances.	Potentially disturbed
S38	Outlier	Sett not found 2022 2021: One partially active entrance.	Potentially disturbed
S55	Outlier	One partially active entrance.	Potentially disturbed
S61	Outlier	One partially active entrance; and one active entrance.	Potentially disturbed
S62	Outlier	One active entrance.	Potentially disturbed



Sett ID	Sett Classification	Sett Activity	Anticipated Impact
S80	Outlier	Two active entrances.	Potentially disturbed
S81	Outlier	<i>Sett not found</i> 2019 and 2020: One disused entrance.	Potentially disturbed
S83	Subsidiary	Four disused entrances; and four partially active entrances.	Potentially disturbed
S84	Outlier	Two active entrances.	Potentially disturbed
S93	Outlier	One active entrance	Potentially disturbed

Significance of Effect

10.30.11 The injury and mortality of badgers during the construction period represents a permanent, direct, long-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.

10.30.12 The disturbance of badgers during the construction period represents direct temporary, reversible and short-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.

10.30.13 The effect of degradation of badger habitat during the construction period is concluded to be not significant.

10.30.14 The loss of badger habitat during the construction period represents a permanent, direct and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

10.30.15 The severance of badger habitat during the construction period represents a permanent, indirect and long-term impact that is not reversible in the absence of additional mitigation and would result in a significant negative effect at the Local scale.



Operation

Injury and Mortality

10.30.16 Badger are susceptible to mortality associated with vehicle collision.

10.30.17 The risk of injury or mortality by vehicle collision is considered to be negligible however, with embedded mitigation included in the Proposed Scheme design comprising the provision of a viaduct, and green bridges and fencing designed to funnel badgers towards green bridge and underpass entrances, and access tracks will be subject to occasional usage only.

Habitat Degradation

10.30.18 Habitat suitable for supporting badgers may be subjected to degradation through pollution during the operation period. The risk of habitat degradation significantly impacting badgers is considered to be negligible however, as this species is not considered to be sensitive to these impacts. Embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), will also reduce the effects of run-off to imperceptible levels.

Disturbance

10.30.19 Disturbance through lighting, noise, visual and vibration during the operational period could lead to potential effect on badger behaviour.

10.30.20 Daytime noise levels in areas of badger habitat near to the Proposed Scheme indicate that the majority of areas will be subjected to noise levels of below 55 dB LA10,18h during the operational period (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.5**). The majority of habitat suitable for supporting badger will be subjected to an increase in noise levels of up to 9.9 dB LA10,18h, with some areas subjected to an increase in noise levels of up to and above 10 dB LA10,18h (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.7**). Absolute noise levels



modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2 metre environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for ecological features. On this basis and considering the ability of badgers to move away from disturbances, it is considered that the risk of these increases in noise levels significantly impacting badgers is considered to be negligible.

- 10.30.21 Embedded within the design of the Proposed Scheme is the commitment for the scheme to remain generally unlit during the operational period. Operational lighting will be restricted to minimal lighting to specific elements, including a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions. These are not considered to be of a level to significantly disturb badgers.

Significance of Effect

- 10.30.22 The effects of injury and mortality to Badgers, the degradation of Badger habitat, or of disturbance to Badgers during the operational period are concluded to be not significant.

Additional Mitigation

- 10.30.23 Works will occur under a Badger Licence as necessary. A summary of mitigation to be included in a Badger Licence for the Proposed Scheme is provided below. A Letter of No Impediment was provided by Natural England in November 2023 following a review of this approach to mitigation.



- 10.30.24 All vegetation clearance required within 10 – 20 metres of active setts facilitate the Scheme will adhere to the measures designed to minimise the risk of damage or disturbance to retained setts, including:
- All vegetation clearance works within 20 metres of known Badger setts will be completed under the direct supervision of a suitably experienced ecological clerk or works.
 - Prior to the start of vegetation clearance, an area within a minimum distance of 10 metres of any Badger sett entrance that displays signs of current use by a Badger must be clearly marked using coloured tape, string, paint or other markers. Any further setts which are discovered during vegetation clearance must be similarly marked as soon as their presence becomes known.
- 10.30.25 The Badger Licence will list the setts that will require closure under a Natural England Licence. This includes setts within 30 metres of proposed bored pile locations (if disturbance is reasonably expected to result in a longer-term impact e.g., more than four to six weeks on the badgers occupying that sett, or cause tunnel collapse). Those setts that fall within the 30 metres of bored pile locations will need to be closed prior to piling activities within this exclusion zone.
- 10.30.26 Artificial sett(s) are usually required prior to the planned closure or destruction of a main sett. An artificial sett will be constructed prior to the closure of setts S1 (a large subsidiary) and S2, S6, S27 and S72 (nearby outliers). These setts were initially determined to be a main sett and multiple annexe setts during surveys between 2019 and 2020, however bait marking surveys undertaken in 2021 confirmed that this sett lies within the territory of a larger and more active main sett, S48. Due to the high levels of Badger activity recorded at S1 and the surrounding setts, it was determined that an artificial sett may be beneficial to gain a higher likelihood of successful closure and reduce the likelihood of Badger excavating back into the sett. The artificial



sett will be protected throughout construction and remain protected in-situ post construction.

10.30.27 Vegetation clearance works are planned to take place prior to some active setts being excluded. The Badger Licence will also include measures to minimise the risk of damage or disturbance to retained setts, methods to close setts that are not currently in use, and best practise protocols.

10.30.28 Measures to mitigate disturbance, pollution and potential killing / injury of badgers during the construction phase of the Proposed Scheme are included in the OCEMP. These include the following measures in addition to those noted above involving sett replacement:

- A pre-construction badger survey would be carried out at least three months in advance of site clearance in areas of potential badger habitat commencing to ensure any new information is obtained.
- A further survey would be completed within one week prior to site clearance commencing. These surveys would reconfirm levels of badger activity in advance of site clearance commencing. This would allow identification of any additional mitigation required, in the unlikely event levels of activity had increased or locations had changed in the three months prior to site work commencing.
- Excavations must be covered or securely fenced (with no potential access points beneath fencing) or a means of egress from shallow excavations must be provided when the construction site is closed (e.g. overnight) to prevent entrapment of animals, specifically badgers;
- avoidance of storage of plant and materials on areas of potential foraging habitat (e.g. retained grassland);



- Where night works are specifically required, these will be undertaken following the guidance of the ECoW to avoid disturbance by artificial lighting;
- where required use of lighting hoods, cowls or shields to avoid light spill onto setts or badger paths; and
- a buffer, up to 30 metres, around setts located outside the Site Boundary but still affected by works, where heavy plant will be avoided and landscaping activities using small plant or hand tools will be acceptable.

Assessment of Residual Likely Significant Effects

Construction

10.30.29 Following implementation of the mitigation measures set out above, residual effects on Badgers are predicted to be not significant upon completion of construction.

Operation

10.30.30 Following implementation of the mitigation measures set out above, the residual effect is predicted to be not significant.

10.31 Assessment of Likely Impacts and Effects - Water Vole

Embedded Mitigation

10.31.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Water Voles.

Relevant Embedded Mitigation includes:

- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the water



vole in-channel and bank-side habitat within the River Wensum SAC / SSSI. The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it



enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

- Where culverts are required these will be 'oversized' culverts wherever feasible (with mammal ledges, where practicable) in culverts to encourage the passage of Water Voles.
- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.31.2 Construction of the Proposed Scheme will result in the loss of terrestrial and aquatic habitats which are suitable for use by Water Vole for breeding, commuting, foraging and sheltering. These habitats mainly occur on the River Wensum floodplain.

10.31.3 The provision of Embedded Mitigation such as the design of a viaduct over the Wensum with a span arrangement and pier design that avoids damage to banks and riparian zones will reduce the impacts of habitat loss.



10.31.4 Construction in the vicinity of the River Wensum and floodplain will however result in the following habitat losses:

- The temporary loss of 78 metres of Water Vole habitat along the banks of WC5 (IDB reference: DRN112G0102) (the location of WC5 (IDB reference: DRN112G0102) is presented in the **Otter and Water Vole Survey Report 2021** (Document Reference: 3.10.19));
- The permanent loss of 22 metres of Water Vole habitat along the banks of WC5 (IDB reference: DRN112G0102);
- The temporary loss of 100 metres of Water Vole in-channel habitat at WC5 (IDB reference: DRN112G0102); and,
- The temporary loss of a minor section of Water Vole habitat along the banks of WC7, also presented in Document Reference: 3.10.19.

10.31.5 The losses of these habitats are likely to reduce the availability of breeding, commuting, foraging and sheltering habitats for Water Vole, and could affect Water Vole distribution and abundance. However, there are large areas of alternative habitat outside of the Scheme which will provide alternative burrowing and foraging habitat and will not be affected by the Proposed Scheme.

Habitat Severance

10.31.6 The construction of the Proposed Scheme has the potential to sever Water Vole habitat into areas either side of the new road in the area of the River Wensum floodplain, and there is a risk of severance of Water Vole habitat due to the requirement to culvert a section of WC5 to facilitate the construction of the Temporary Works Platform.

10.31.7 The provision of Embedded Mitigation such as the viaduct over the Wensum and the use of oversize culverts will however reduce the effects of



habitat fragmentation on this species and allow the movement of Water Vole underneath the viaduct and across the Wensum floodplain.

Injury and Mortality

- 10.31.8 Any Water Voles present within or in proximity to areas of construction could also be at risk of injury or being killed or injured during construction activities.

Habitat degradation

- 10.31.9 Habitats suitable for supporting Water Voles could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. Water affected by construction activities could lead to changes in water quality or the botanical composition of habitats. The mobilisation of dust from construction activities could be relevant to ecological features up to 50m from construction activities. Dust deposition on vegetation could have effects on habitats suitable for supporting Water Voles, limiting breeding success and reducing foraging opportunities.
- 10.31.10 Contaminants or spillages entering the smaller watercourses in close proximity to the Proposed Scheme would have a significant impact as contaminants may take longer to be dispersed or diluted through normal processes. The above impacts could affect the functionality of habitats to support Water Voles.

Disturbance

- 10.31.11 Increased levels of human activity and the presence of large machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction. Given the scale of the construction works associated with the Proposed Scheme, and the low existing noise levels in the area, significant adverse construction noise and vibration effects are likely.
- 10.31.12 Water Voles could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in



behaviour. Disturbance from temporary works could deter Water Voles from commuting and foraging along suitable aquatic habitat including the River Wensum, as any such disturbance would take place during day time (Water Voles are typically most active during daylight hours). Disturbance from temporary works could also lead to the abandonment of Water Vole burrows. Disturbance could temporarily affect the functionality of the remaining areas of suitable habitat type to support this species, and temporarily reduce the availability of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however.

Significance of Effect

10.31.13 The injury and mortality of Water Voles during the construction period represents a permanent, direct, long-term impact that would result in a significant negative effect at the County scale in the absence of additional mitigation.

10.31.14 The disturbance of Water Voles and degradation of Water Vole habitat during the construction period represent temporary, reversible and short-term impacts that would result in a significant negative effect at the County scale in the absence of additional mitigation.

10.31.15 The loss and severance of Water Vole habitat during the construction period represents permanent and long-term impacts in the absence of additional mitigation and would result in a significant negative effect at the County scale.

Operation

Habitat Degradation

10.31.16 Habitat suitable for supporting Water Voles may be subjected to degradation through pollution such as the contamination of watercourses and / or waterbodies associated with road related runoff. However, due to



embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), the effects of run-off will be reduced to imperceptible levels.

Disturbance

- 10.31.17 Disturbance through lighting, noise, visual and vibration during the operational period could lead to potential effect on Water Vole behaviour.
- 10.31.18 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2 metre environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for ecological features.
- 10.31.19 Daytime noise levels in areas of Water Vole habitat near to the Proposed Scheme indicate that the majority of areas will be subjected to noise levels of below 55 dB $L_{A10,18h}$ during the operational period (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.5**). The majority of habitat suitable for supporting Water Voles will be subjected to an increase in noise levels of up to 9.9 dB $L_{A10,18h}$, with some areas subjected to an increase in noise levels of up to and above 10 dB $L_{A10,18h}$ (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.7**). However, these increases in noise levels are not considered to be of a significant level to disturb Water Voles, and the absolute noise levels modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. On this basis and considering the ability of Water Voles to move away from disturbances, it is considered that the operational road traffic noise effects are not significant.
- 10.31.20 Embedded within the design of the Proposed Scheme is the commitment for the scheme to remain generally unlit during the operational period. Operational lighting will be restricted to minimal lighting to specific



elements, including a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions. These are not considered to be of a level to significantly disturb Water Voles.

Injury and Mortality

10.31.21 The risk of injury or mortality by vehicle collision is considered to be low, with embedded mitigation also comprising the provision of a viaduct over the Wensum and underpasses to reduce the risk of vehicle collision.

Significance of Effect

10.31.22 The effects of injury and mortality, or disturbance, or degradation of Water Vole habitat during the operational period will be not significant.

Additional Mitigation

10.31.23 A licence will be required to translocate Water Voles from an impacted section of WC5 (IDB reference: DRN112G0102). Licenced conservation protection works will also include receptor area enhancements and habitat permeability design.

10.31.24 Measures that will be contained within the licence have been summarised in this section, where relevant. A Letter of No Impediment was provided by Natural England in November 2023 following a review of this approach to mitigation.

10.31.25 To allow trapping and relocating of water voles, a 'receptor site' for captured animals must be available. Options for proposed receptor sites have been provided as part of the draft licence (see **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) for further details).



- 10.31.26 Habitat management and enhancement in these areas prior to the translocation of Water Voles will increase the carrying capacity of these watercourses in the short-term.
- 10.31.27 The OCEMP will require that a survey for mink presence across the floodplain will also be undertaken to assess the risk of Water Vole predation from this species prior to the translocation activities.
- 10.31.28 The trapping and translocation of Water Voles from WC5 (IDB reference: DRN112G0102) will be undertaken between 1st March – 15th April. WC5 (IDB reference: DRN112G0102) will then be made unsuitable for Water Voles under ecological supervision, prior to the installation of a temporary culvert. The risk of Water Vole re-colonising the bankside works areas at WC5 (IDB reference: DRN112G0102) for the duration of the construction phase is therefore considered to be negligible. Water Voles will be able to commute between upstream and downstream sections of the temporary culvert, retaining connectivity for the duration of the construction phase.
- 10.31.29 The temporary culvert will be removed and replaced with a permanent box culvert structure (approximately 22 metres in length) towards the end of the construction period. The habitat cleared along each bank of WC5 (IDB reference: DRN112G0102) for the temporary culvert will be reinstated upon the completion of the construction phase.
- 10.31.30 Precautionary measures included in the OCEMP for the Proposed Scheme include measures to avoid or minimise potential visual disturbance effects and pollution. Pollution prevention guidelines included within the OCEMP are designed to prevent water-borne pollution impacts to suitable aquatic habitat during construction. The exclusion zone from the River Wensum SAC and other watercourses will be installed and micro-sited under the supervision of an Ecological Clerk of Works to ensure the protection of existing Water Vole burrows.



10.31.31 The enhancement of ditches and restoration of former watercourses as part of the Essential Environmental Mitigation as shown on the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00) (in addition to the Water Vole receptor areas stated above), wetland habitat creation measures (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) , and measures to translocate Water Vole are anticipated to be successful at providing replacement habitat for this species.

Assessment of Residual Likely Significant Effects

Construction

10.31.32 Following implementation of the mitigation measures set out above, residual effects on Water Voles are predicted to be not significant upon completion of construction.

Operation

10.31.33 The residual effect is predicted to be not significant.

10.32 Assessment of Likely Impacts and Effects - Otter

Embedded Mitigation

10.32.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Otters. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, such as areas of suitable otter sheltering, commuting and foraging habitat within the River Wensum SAC / SSSI.
- Landscape planting as part of the Scheme design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the



viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- Where culverts are required these will be 'oversized' culverts wherever feasible (with mammal ledges, where practicable) to encourage the passage of Otter.



- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

- 10.32.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to the removal of a proportion of habitats. This would result in the direct loss of habitats suitable for use by otter for foraging, commuting and sheltering purposes. These habitat losses mainly occur where the Scheme crosses the River Wensum floodplain and will be mostly temporary in nature (see 9.15.4).
- 10.32.3 No Otter holts were considered to be present at the time of the surveys however, and the impact of habitat loss within the Proposed Scheme during construction is not expected to lead to any perceptible impacts on suitable habitat due to the provision of Embedded Mitigation in the form of a viaduct over the Wensum.
- 10.32.4 There is abundant alternative habitat for Otters present along the River Wensum and associated watercourses both upstream and downstream of the Proposed Scheme. Otters have large home ranges as identified in Ecology of the European Otter (Chanin P., 2003a) with individual otters commonly having home ranges covering 25 – 50 kilometres of river channel.



10.32.5 The risk of habitat loss significantly impacting Otters is considered to be negligible.

Habitat Severance

10.32.6 The River Wensum has been found to support Otter for the purposes of commuting and foraging, and the construction of the Proposed Scheme has the potential to sever otter habitat into areas either side of the new road and create a barrier to dispersal. The temporary closure of WC5 to facilitate the construction of a culvert for the duration of the construction period is not considered to significantly impact Otters, The inclusion of mammal ledges, where practicable, within this temporary culvert will allow the passage of Otters during the construction period. The provision of other Embedded Mitigation such as the viaduct over the Wensum will also reduce the effects of habitat fragmentation on this species and allow the movement of otter underneath the viaduct and across the Wensum floodplain.

10.32.7 The risk of habitat severance significantly impacting Otters is considered to be negligible.

Injury and Mortality

10.32.8 Any Otters present within or in proximity to areas of construction could be at risk of injury or being killed or injured during construction activities.

Habitat Degradation

10.32.9 Habitats suitable for supporting Otter could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period.

Disturbance

10.32.10 Increased levels of human activity and the presence of large machinery such as excavators and piling rigs have the potential to lead to increased visual disturbance during construction. Given the scale of the construction works associated with the Proposed Scheme, and the low existing noise



levels in the area, significant adverse construction noise and vibration effects are also likely.

10.32.11 Otters could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Disturbance from temporary works could cause otters to vacate a holt or reduce foraging or commuting activity. Visual disturbance from temporary works could deter Otters from commuting and foraging along suitable aquatic habitat including the River Wensum, and noise and visual disturbance could disturb Otters from using both terrestrial and aquatic habitat outside the Proposed Scheme.

10.32.12 There is however abundant alternative habitat for Otters present along the River Wensum and associated watercourses both upstream and downstream of the Proposed Scheme. Otters have large home ranges as identified in Ecology of the European Otter (Chanin P., 2003a) with individual Otters commonly having home ranges covering 25 – 50 kilometres of river channel. Any disturbance impacts would also likely take place during the day time (as per the standard core working hours presented in the **OCEMP** (Document Reference: 3.03.01)) and be relatively short-lived, and Otters are typically most active at other times of day (around dusk and dawn and overnight). The risk of Otters in proximity to the Proposed Scheme being disturbed during the construction period is therefore considered to be low.

Significance of Effect

10.32.13 The effects of loss and severance of Otter habitat during the construction period is concluded to be not significant.

10.32.14 The effect of injury and mortality or disturbance of Otters during the construction period is concluded to be not significant.

10.32.15 The degradation of otter habitat during the construction period represents a temporary, reversible and short-term impact that would result in a



significant negative effect at the Local scale in the absence of additional mitigation.

Operation

Injury and Mortality

- 10.32.16 The risk of injury or mortality by vehicle collision is considered to be low, with embedded mitigation also comprising the provision of a viaduct over the Wensum and underpasses to reduce the risk of vehicle collision.

Disturbance

- 10.32.17 Disturbance through lighting, noise, visual and vibration during the operational period could lead to potential effect on Otter behaviour.
- 10.32.18 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2m environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for ecological features.
- 10.32.19 Daytime noise levels in areas of Otter habitat near to the Proposed Scheme indicate that the majority of areas will be subjected to noise levels of below 55dB LA10,18h during the operational period (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.5**). The majority of habitat suitable for supporting Otters will be subjected to an increase in noise levels of up to 9.9dB LA10,18h, with some areas subjected to an increase in noise levels of up to and above 10dB LA10,18h (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.7**). However, these are not considered to be of a significant level to disturb Otters, and the absolute noise levels modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. On this basis and considering the ability of Otters to move away from disturbances, it is considered that the operational road traffic noise effects are not significant.



10.32.20 Visual disturbance is anticipated to be minimal and is not expected to have a material effect on otters, as potential sources for this would be limited to operation and maintenance of the Viaduct.

10.32.21 Embedded within the design of the Proposed Scheme is the commitment for the scheme to remain generally unlit during the operational period. Operational lighting will be restricted to minimal lighting to specific elements, including a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions. These are not considered to be of a level to significantly disturb Otters.

Habitat Degradation

10.32.22 Habitat suitable for supporting Otters may be subjected to degradation through pollution such as the contamination of watercourses and / or waterbodies associated with road related runoff. However, due to embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), the effects of run-off will be reduced to imperceptible levels. It is considered that the operational effects due to habitat degradation through pollution such as the contamination of watercourses and / or waterbodies associated with road related runoff are not significant.

Significance of Effect

10.32.23 The effects of injury and mortality, or disturbance, or habitat degradation on Otters during the operational period will be not significant.

Additional Mitigation

10.32.24 Precautionary measures would be included in the OCEMP for the Proposed Scheme and would include measures to avoid or minimise potential visual disturbance effects.



10.32.25 Certain construction compounds and demolition areas would be surrounded by hoardings to reduce visual effects due to the presence of construction traffic, plant and equipment, as well as demolition of existing and construction of built form.

10.32.26 Measures to prevent visual disturbances to otter include provision of hoarding as identified above. Pollution prevention guidelines that would be included within the OCEMP would also prevent water-borne pollution impacts to suitable aquatic habitat during construction.

10.32.27 Measures to mitigate disturbance, pollution and potential killing / injury of otters during the construction phase of the Proposed Scheme are included in the OCEMP. These include:

- fencing dangerous areas of the construction site (e.g. deep excavations) or providing a means of egress from shallow excavations;
- avoidance of night works where possible. Where night works are specifically required, these will be undertaken following the guidance of the ECoW to avoid disturbance by artificial lighting; and,
- where required use of lighting hoods, cowls or shields to avoid light spill onto watercourses and banks.

10.32.28 In addition, the following measures would be completed specifically in relation to otter:

- Pre-construction surveys to reconfirm the status of Otter habitat usage of the Site and surrounding watercourses up to 250 metres from the Proposed Scheme;
- Avoidance of any obstructions to established Otter paths and access to open water;
- The marking of, and adherence to, 30 metre exclusion zones around any holts and shelters identified as a result of updated survey prior to



site clearance and construction activities occurring. If otters are known or suspected to be breeding, the exclusion zone could be extended to a 200 metre radius. However, it could be reduced to 100 metres depending on the nature of the works, topography and natural screening. This would require judgement from an experienced ecologist; and

- If breeding was confirmed and exclusion zones of the size set out above were not possible, works would be undertaken in accordance with a European Protected Species Mitigation Licence (EPSML) to derogate the legislation protecting otter (except during periods of active breeding).

10.32.29 Although not mitigation, the enhancement of water courses in the River Wensum floodplain designed principally for Water Vole habitat will also provide additional habitat for Otter foraging and commuting (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the **'Essential Environmental Mitigation' plan** [Document reference: 2.11.00]).

Assessment of Residual Likely Significant Effects

Construction

10.32.30 Following implementation of the mitigation measures set out above, the residual effects on Otters are predicted to be not significant upon completion of construction.

Operation

10.32.31 The residual effects on Otters are predicted to be not significant.



10.33 Assessment of Likely Impacts and Effects - Reptiles

Embedded Mitigation

10.33.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to reptiles. Relevant Embedded Mitigation includes:

- Landscape planting as part of the Proposed Scheme's design (see Landscaping Design Plans (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.
- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes.



- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of reptile species such as grass snakes.
- The provision of earth bunds within the design, which will provide screening from noise.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

- 10.33.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to the removal of a proportion of habitats. This would result in the direct loss of habitats suitable for use by reptiles for basking, commuting, foraging and hibernating purposes. Some loss of habitat suitable for reptiles would be permanent, associated with the built footprint of new infrastructure and lasting for at least the duration of the operational period. This loss could affect the functionality of the remaining areas of suitable habitat type to support reptiles and will reduce the availability



of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however.

- 10.33.3 Removal of habitats could reduce the availability of suitable reptile habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however.

Habitat Severance

- 10.33.4 The construction of the Proposed Scheme will sever reptile habitat into areas either side of the new road and could create a barrier to reptile movement. These impacts are likely to reduce the ability of reptiles to move between suitable habitats.

- 10.33.5 Some loss of habitat suitable for reptiles would be permanent, associated with the built footprint of new infrastructure and lasting for at least the duration of the operational period. Other habitat loss in areas that may be used by reptiles would be temporary in nature.

Injury and Mortality

- 10.33.6 Any reptiles present within or in proximity to areas of construction could also be at risk of injury or being killed during site and vegetation clearance operations.

Habitat Degradation

- 10.33.7 Habitats suitable for supporting reptiles could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. This could affect the functionality of habitats to support reptiles.

Disturbance

- 10.33.8 Reptiles could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Increased levels of human activity and the presence of large



machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction. Retained habitats could be subject to a substantial level of disturbance during the construction of the Proposed Scheme, which would include construction of new infrastructure, movement of machinery and vegetation clearance. Disturbance in suitable habitats could temporarily reduce the availability of suitable reptile habitat within the local landscape. These habitats are widely represented in the wider local landscape however.

Significance of Effect

10.33.9 The injury and mortality of reptiles during the construction period represents a permanent, direct, long-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.

10.33.10 The disturbance of reptiles and degradation of reptile habitat during the construction period represents a temporary, reversible and short-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.

10.33.11 The loss and severance of reptile habitat during the construction period represents a permanent and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

Operation

Injury and Mortality

10.33.12 The risk of injury or mortality by vehicle collision is considered to be low, with embedded mitigation also comprising the provision of a viaduct over the Wensum and underpasses to reduce the risk of vehicle collision.

Habitat Degradation

10.33.13 Habitat suitable for supporting reptiles may be subjected to degradation through pollution during the operation period, however the risk of habitat



degradation significantly impacting reptiles is considered to be negligible.

Embedded mitigation such as the **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) will reduce the effects of run-off to imperceptible levels.

Disturbance

- 10.33.14 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2 metre environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for ecological features.
- 10.33.15 Daytime noise levels in areas of reptile habitat near to the Proposed Scheme indicate that the majority of areas will be subjected to noise levels of below 55dB LA_{10,18h} during the operational period (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.5**). The majority of habitat suitable for supporting reptile will be subjected to an increase in noise levels of up to 9.9dB LA_{10,18h}, with some areas subjected to an increase in noise levels of up to and above 10dB LA_{10,18h} (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.7**). However, these are not considered to be of a significant level to disturb reptiles, and the absolute noise levels modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. On this basis and considering the ability of reptiles to move away from disturbances, it is considered that the operational road traffic noise effects are not significant.
- 10.33.16 Embedded within the design of the Proposed Scheme is the commitment for the scheme to remain generally unlit during the operational period. Operational lighting will be restricted to minimal lighting to specific elements, including a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also



proposed that signage lighting will be required at junctions. These are not considered to be of a level to significantly disturb reptiles.

Significance of Effect

10.33.17 The effects of injury and mortality or disturbance during the operational period will be not significant.

10.33.18 The effect of degradation of habitat suitable for supporting reptiles during the operation period is concluded to be not significant.

Additional Mitigation

10.33.19 Vegetation clearance in areas that may support reptiles would be carried out under a Precautionary Method of Working (PMoW), to minimise the risk of individual reptiles being killed or injured.

10.33.20 Prior to construction activities, reptiles will be persuaded to migrate into retained habitat through a two-stage vegetation clearance. Vegetation will be cut outwards from any suitable habitat to the extent of the retained habitat, down 150mm on one day followed by down to ground level on the following day. Any potential existing refugia on Site (e.g. log piles) will be dismantled by hand and relocated to the retained area. Works will be temporarily halted if individual animals are encountered to allow the animal to disperse from the work site. This activity will be supervised by an ecologist to minimise the risk of killing or injury to reptiles, who will search vegetation for reptiles prior to clearance each day.

10.33.21 Vegetation clearance of suitable reptile habitat will be completed within the reptile active season (indicatively March to September / October inclusive, depending on weather conditions) to ensure reptiles are mobile and able to migrate away from the works area into retained suitable habitat.

10.33.22 The proposals for reinstatement, enhancement and compensatory habitat (including reptile refugia) as set out in the **Ecological Mitigation Strategy** (Document Reference: 3.10.32) and the **'Essential Environmental**



Mitigation' plan [Document reference: 2.11.00]), would provide replacement habitat for local reptile populations, which would include the creation of species rich grassland, woodland, scrub and a waterbody.

Assessment of Residual Likely Significant Effects

Construction

10.33.23 Following implementation of the mitigation measures set out above, the residual effects on reptiles during the construction of the Proposed Scheme are predicted to be not significant.

Operation

10.33.24 The residual effects on reptiles are predicted to be not significant.

10.34 Assessment of Likely Impacts and Effects - Great Crested Newt

Embedded Mitigation

10.34.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Great Crested Newts (GCN). Relevant Embedded Mitigation includes:

- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes. Green bridges can facilitate the movement of species such as GCN.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document



Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

- Where culverts are required, these will be 'oversized' culverts wherever feasible to allow the passage of amphibians.
- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

- 10.34.2 Site and vegetation clearance associated with the construction of the Proposed Scheme and the creation of Essential Environmental Mitigation as shown on the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00) would result in the removal of a proportion of the habitats suitable to support Great Crested Newts (GCN) within the Proposed Scheme



and potentially lead to the severance and fragmentation of GCN habitat and populations. It is expected that these habitats would be lost or subject to a substantial level of disturbance during the construction of the Proposed Scheme, which would include construction of new infrastructure, movement of machinery and vegetation clearance.

10.34.3 Works associated with the Proposed Scheme within 500 metres of Water Body 15 (as defined in **Great Crested Newt Report 2021** (Document Reference: 3.10.16), which supports a small population of GCN, comprise:

- The creation of approximately 2.28ha of woodland and scrub habitat on managed arable land, considered of negligible value to GCN;
- The creation and enhancement of approximately 729 metres of hedgerow habitat (considered to have a negligible impact on GCN); and,
- The temporary loss of approximately 0.75ha of habitat to a temporary construction area on managed arable land, considered of negligible value to GCN and situated approximately 280 metres from Water Body 15 at its closest point.

10.34.4 No other habitats will be lost within 500 metres of Water Body 15.

10.34.5 The Proposed Scheme will therefore result in:

- the temporary loss of approximately 0.75ha of habitat of negligible value within 500 metres (but beyond 250 metres) of Water Body 15; and
- the permanent loss of approximately 2.28ha of habitat of negligible value within 500 metres of Water Body 15.

10.34.6 The Proposed Scheme and Water Body 15 are well connected by scrub, hedgerow and woodland habitats, with an intercepting country lane (Paddy's Lane) considered unlikely to pose a significant barrier to GCN



dispersal into the Proposed Scheme. Good quality terrestrial habitats in the form of scrub, hedgerow, woodland and rough grassland are also present in the immediate vicinity of Water Body 15 which would provide ample opportunities for core foraging and refuge.

10.34.7 Research undertaken by Natural England suggests that newts will rarely move further than 200 – 250 metres from a breeding pond, with much reduced distances recorded where adjacent habitats are of good quality (Cresswell & Whitworth, 2004). Jehle (2000) also determined a terrestrial zone of 63m, within which 95% of summer refuges were located. In addition, following the breeding season, Jehle & Arntzen (2000) recorded 64% of newts within 20 metres of the pond edge. With the aforementioned literature and compiled survey data in mind, together with the good quality terrestrial habitat that immediately surrounds Water Body 15, as well as the distance between the Proposed Scheme and this water body, the likelihood of this species occurring within the Site Boundary is considered to be low.

10.34.8 Natural England's rapid risk assessment tool assessed the loss of 3.03ha of habitat within 500m of Water Body 15 as resulting in an offence being 'Amber: likely', given that 1 – 5ha land will be lost or damaged 100 - 250 metres from a breeding pond, and 0.5- 1ha will be lost or damaged beyond 250 metres from a breeding pond. The NE rapid risk assessment tool guidance does however state that the following factors could decrease the risk of committing an offence:

- Small population size; or
- Poor terrestrial habitat.

10.34.9 It is therefore considered that this assessment can be reduced to 'Green: Offence highly unlikely' considering the following factors:

- small population size (a peak count of one adult GCN in Water Body 15);



- the creation and enhancement of hedgerow habitat is considered to have a negligible impact on GCN;
- the temporary loss of 0.75ha of habitat and permanent loss of 2.28ha of habitat comprises habitat of negligible value to GCN; and
- the temporary loss of 0.75ha of habitat will occur beyond the typical dispersal distance of GCN from a breeding pond.

10.34.10 This suggests that the Proposed Scheme is not anticipated to have any significant impact on the local Great Crested Newt population. However, there still remains a low residual risk of individual GCN occurring on the Proposed Scheme, given that it is situated within the typical maximum dispersal distance of this species.

10.34.11 The Proposed Scheme will create a barrier to GCN dispersal and is likely to result in increased levels of GCN mortality. Only one GCN population was present within 500 metres of the Proposed Scheme and good quality terrestrial habitats in the form of scrub, hedgerow, woodland and rough grassland was present in the immediate vicinity of the pond, which would provide ample opportunities for core foraging and refuge. The potential severance of habitat suitable to support GCN is not expected to materially affect the condition or ability of GCN to persist in the environment.

Injury and Mortality

10.34.12 Any GCN present within or in proximity to areas of construction could also be at risk of injury or being killed or injured during construction activities.

Habitat Degradation

10.34.13 Habitats suitable for supporting GCN could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. Water affected by construction activities could lead to changes in water quality or the botanical composition of habitats. Contaminants or spillages entering waterbodies in close proximity to the



Proposed Scheme could have a significant impact as contaminants may take longer to be dispersed or diluted through normal processes. The above impacts could affect the functionality of habitats to support GCN.

- 10.34.14 The mobilisation of dust from construction activities could be relevant to ecological features up to 50m from construction activities. Dust deposition on vegetation could have effects on habitats suitable for supporting GCN, limiting breeding success and reducing foraging opportunities.

Disturbance

- 10.34.15 GCN could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Increased levels of human activity and the presence of large machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction. Retained habitats could be subject to a substantial level of disturbance during the construction of the Proposed Scheme, which would include construction of new infrastructure, movement of machinery and vegetation clearance. Disturbance in suitable habitats could temporarily reduce the availability of suitable GCN habitat within the local landscape. These habitats are widely represented in the wider local landscape however.

Significance of Effect

- 10.34.16 The injury and mortality of GCN during the construction period represents a permanent, direct, long-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.
- 10.34.17 The disturbance of GCN and degradation of GCN habitat during the construction period represents a temporary, reversible and short-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.



10.34.18 The loss of GCN habitat during the construction period represents a permanent, direct and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

10.34.19 The severance of GCN habitat during the construction period represents a permanent, indirect and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

Operation

Injury and Mortality

10.34.20 The risk of injury or mortality by vehicle collision is considered to be negligible. This will be further minimised through embedded mitigation comprising the provision of a viaduct over the Wensum and underpasses elsewhere in the Proposed Scheme.

Habitat Degradation

10.34.21 Habitat suitable for supporting GCN may be subjected to degradation through pollution during the operation period. Embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), will however reduce the effects of run-off to imperceptible levels.

10.34.22 The risk of habitat degradation significantly impacting GCN is considered to be negligible.

Disturbance

10.34.23 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2 metres environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for ecological features.



10.34.24 The risk of disturbance during operation significantly impacting GCN is considered to be negligible.

Significance of Effect

10.34.25 The effects of injury and mortality or disturbance during the operational period will be not significant.

10.34.26 The effect of degradation of habitat suitable for supporting GCN during the operation period is concluded to be not significant.

Additional Mitigation

10.34.27 Vegetation clearance and habitat creation works in areas that may support GCN would be carried out under a PMoW, to minimise the risk of individual GCN being killed or injured. This would be implemented by the Principal Contractor during implementation of the Proposed Scheme.

10.34.28 The following works within 500m of Water Body 15 (as defined in the **Great Crested Newt eDNA Survey Report 2021**, Document Reference: 3.10.23) will proceed under a non-licenced Method Statement, as detailed in the OCEMP:

- the temporary loss of 0.75ha of habitat of negligible value within 500 metres (but beyond 250 metres) of Water Body 15 to facilitate the Temporary Construction Area;
- The creation and enhancement of 729 metres of hedgerow habitat; and
- the permanent loss of 2.28ha of habitat of negligible value within 500 metres of Water Body 15 to facilitate the creation of woodland and scrub habitat.

10.34.29 This OCEMP will outline appropriate timings and sensitive methods of habitat clearance in order to mitigate the low residual risk of encountering GCN. It will also outline appropriate site management techniques such as



appropriate storage of materials to avoid GCN colonising the works footprint immediately prior to or during construction.

- 10.34.30 No specific habitat compensation for GCN is proposed given that the Proposed Scheme will only result in the temporary loss of 0.75ha of arable land, considered of negligible value to GCN, within 500m of Water Body 15. The creation of new habitat within proximity to existing populations will provide an enhancement in habitat for Great Crested Newts (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the '**Essential Environmental Mitigation**' plan [Document reference: 2.11.00]).

Assessment of Residual Likely Significant Effects

Construction

- 10.34.31 Following implementation of the mitigation measures set out above, the residual effects on this species during the construction phase are predicted to be not significant.

Operation

- 10.34.32 The residual effects on GCN are predicted to be not significant.

10.35 Assessment of Likely Impacts and Effects - Breeding and Wintering Birds

Embedded Mitigation

- 10.35.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to birds. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the suitable wintering bird habitat across the River Wensum and floodplain, and the breeding bird habitat within areas of ancient woodland.



- Landscape planting as part of the Scheme design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.
- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes.
- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the



re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.35.2 Site and vegetation clearance during construction works would result in the removal of a proportion of the habitats within Proposed Scheme such as woodland, grassland, scrub and hedgerows that are suitable for a range of breeding and wintering birds. The use of the viaduct to cross the River Wensum and its associated floodplain will prevent the loss of wetland habitat that supports bird species.

Habitat Degradation

10.35.3 Habitats suitable for supporting breeding and wintering birds could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. As set out in **Chapter 6: Air Quality** (Document Reference: 3.06.00), mobilisation of dust from construction activities could be relevant to ecological features up to 50 metres from construction activities. Dust deposition on vegetation could have effects on habitats suitable for supporting breeding and wintering birds, limiting breeding success and reducing foraging opportunities, although such effects are unlikely to materially affect breeding success of populations around the Proposed Scheme.

Disturbance

10.35.4 Breeding and wintering birds could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Increased levels of human activity and the presence of large machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction. It is however likely that



birds that are temporarily disturbed would be displaced to other suitable habitat in the surrounding landscape. Consequently, any displacement of bird species is not expected to materially affect their condition or ability to persist in the environment.

Significance of Effect

10.35.5 The disturbance of breeding and wintering birds and the degradation of their habitat during the construction period represents a temporary, reversible and short-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.

10.35.6 The loss of breeding and wintering bird habitat during the construction period represents a permanent and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

Operation

Habitat Degradation

10.35.7 Habitat suitable for supporting breeding and wintering birds may be subjected to degradation through pollution during the operation period, however the risk of habitat degradation significantly impacting breeding and wintering birds is considered to be negligible. Embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), will reduce the effects of run-off to imperceptible levels.

Disturbance

10.35.8 Noise, vibration and lighting during operation may have an adverse impact on birds. Birds using the habitats adjacent to Fakenham Road or the A47 are likely to already be adapted to the noise and visual disturbance of live traffic currently present on the carriageway.



10.35.9 Daytime noise levels in areas of bird habitat near to the Proposed Scheme indicate that the majority of areas will be subjected to noise levels of below 55dB LA_{10,18h} during the operational period (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.5**). The majority of habitat suitable for supporting birds will be subjected to an increase in noise levels of up to 9.9dB LA_{10,18h}, with some areas subjected to an increase in noise levels of up to and above 10 dB LA_{10,18h} (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.7**). However, these are not considered to be of a significant level to disturb birds, and the absolute noise levels modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. It is anticipated that noise levels during operation would not give rise to significant negative effects on breeding and wintering birds.

10.35.10 Embedded within the design of the Proposed Scheme is the commitment for the scheme to remain generally unlit during the operational period. Operational lighting will be restricted to minimal lighting to specific elements, including a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions. These are not considered to be of a level to significantly disturb birds.

Injury or Mortality

10.35.11 The risk of injury or mortality by vehicle collision is considered to be low, as embedded mitigation comprising the use of features such as sloped earth bunds and embankments will encourage birds to fly higher and reduce the risk of collision with vehicles.



Significance of Effect

10.35.12 The effect of degradation of habitat suitable for supporting breeding and wintering birds during the operation period is concluded to be not significant.

10.35.13 The effects of injury and mortality or disturbance during the operational period will be not significant.

Additional Mitigation

10.35.14 The OCEMP includes measures to reduce the risk of habitat degradation during the construction phase to negligible levels.

10.35.15 If carried out during the breeding season, vegetation and site clearance could cause the destruction or damage of active nests and any eggs or live young present. The following specific measures that are detailed in the OCEMP would be implemented :

- Vegetation and site clearance would take place between September and February inclusive, i.e., outside the main bird breeding season, wherever practicable. Should it be necessary to remove habitats suitable for breeding birds during the nesting season, these would be subject to a pre-clearance check by an experienced ornithologist. The check will be undertaken prior to the vegetation removal taking place; and
- In the event any active nests are found, clearance works would be halted within a minimum distance of 5m from the nest. This buffer distance would be varied on the advice of the ornithologist, dependent on the nature of affected habitats and the species of bird involved. Clearance works would not recommence until any young had fledged and left the nest, with a re-inspection by an ecologist to confirm the absence of active nests.



10.35.16 Surveys identified Red Kite, listed on Schedule 1 on Wildlife and Countryside Act (1981), as 'probable breeders' at the Proposed Scheme although no nest was located. Red Kites usually nest in the canopy of tall trees. Should tree clearance be undertaken during nesting bird season, then pre-clearance checks would be undertaken as described above. If Red Kite, or any other Schedule 1 bird species is identified, then further checks should be undertaken by a licenced ornithologist. Checks will focus on recording behaviour to establish whether there is evidence of active nests. This will include a check for forms of display, courtship feeding and / or nest building. If there is evidence of nesting, the checks will aim to establish an approximate location, from which an appropriate buffer will be implemented to avoid the risk of intentional or reckless disturbance.

10.35.17 The proposals for reinstatement, enhancement and compensatory habitat would provide habitat for breeding and wintering birds (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the '**Essential Environmental Mitigation**' plan [Document reference: 2.11.00]). This would include the following habitat creation and enhancement opportunities:

- Woodland, hedgerow, scrub and grassland creation habitat creation or enhancement proposed in relation to bats and Barn Owls will also benefit birds by providing additional foraging and nesting habitat.
- To enhance potential nesting opportunities across the Site, bird boxes could be installed in suitable locations within retained habitat. Bird box designs should reflect the nesting requirements for species known to be present within the local area and that are local conservation priorities, as well as common and widespread farmland and woodland species.
- In general, boxes should be installed on mature trees 2-4m high and placed to avoid strong sunlight and the wettest winds (usually north to



east, depending on the shade level), and the entrance should face slightly downwards to protect from the rain. Boxes should have a clear flight path on the approach and be relatively undisturbed. Bird boxes should not require regular maintenance, however annual checks of the bird boxes are recommended. The checks will assess the boxes condition and identify where remedial action may be required.

Assessment of Residual Likely Significant Effects

Construction

10.35.18 Following implementation of the mitigation measures set out above, the residual effects on Breeding and Wintering Birds during the construction of the Proposed Scheme are predicted to be not significant.

Operation

10.35.19 The residual effect is predicted to be not significant.

10.36 Assessment of Likely Impacts and Effects - Barn Owl

Embedded Mitigation

10.36.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Barn Owls.

Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the suitable foraging habitat in and around the River Wensum and floodplain and the suitable nesting habitat within areas of ancient woodland.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a



reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes.
- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.



Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

- 10.36.2 The construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to the direct loss of habitats suitable for use by Barn Owl for breeding and foraging purposes. Impacts will include the direct loss of two PNS: Tree number 20 and Tree number 16. Tree number 20 is within the footprint of the construction area of the viaduct over the River Wensum floodplain, and Tree number 16 is within the footprint of the embankment works to the north of Church Hill lane.

Habitat Degradation

- 10.36.3 Habitats suitable for supporting Barn Owl could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. Dust deposition on vegetation could have effects on habitats suitable for supporting Barn Owl, limiting breeding success and reducing foraging opportunities. This could affect the functionality of habitats to support Barn Owl.

Disturbance

- 10.36.4 Barn Owl could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Increased levels of human activity and the presence of large machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction. It is however likely that birds that are temporarily disturbed would be displaced to other suitable habitat in the surrounding landscape. Consequently, any displacement of bird species is not expected to materially affect their condition or ability to persist in the environment.



Significance of Effect

- 10.36.5 The disturbance of Barn Owl and the degradation of Barn Owl habitat during the construction period represents a temporary, reversible and short-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.
- 10.36.6 The loss of Barn Owl habitat during the construction period represents a permanent and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

Operation

Injury and Mortality

- 10.36.7 Barn Owl is particularly susceptible to mortality associated with vehicle collision. Where the Proposed Scheme severs the territory of a Barn Owl, potentially separating foraging areas from nest or roost locations, an increased risk of death or injury from vehicle collisions is likely.
- 10.36.8 However, the risk of injury or mortality by vehicle collision is considered to be low, as embedded mitigation comprising the use of features such as sloped earth bunds and embankments will encourage birds to fly higher and reduce the risk of collisions with vehicles.

Disturbance

- 10.36.9 Noise, vibration and lighting during operation may have an adverse impact on Barn Owl. Barn Owl using the habitats adjacent to Fakenham Road or the A47 are likely to already be adapted to the noise and visual disturbance of live traffic currently present on the carriageway.
- 10.36.10 Daytime noise levels in areas of Barn Owl habitat near to the Proposed Scheme indicate that the majority of areas will be subjected to noise levels of below 5 dB LA10,18h during the operational period (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.5**). The majority of habitat suitable for supporting Barn Owl will be subjected to an increase in



noise levels of up to 9.9dB LA_{10,18h}, with some areas subjected to an increase in noise levels of up to and above 10 dB LA_{10,18h} (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00), **Figure 7.7**). However, these are not considered to be of a significant level to disturb Barn Owl, and the absolute noise levels modelled reduce noticeably at greater distances from the Proposed Scheme towards the edges of the detailed calculation area and are below the Lowest Observed Adverse Effect Level. It is anticipated that noise levels during operation would not give rise to significant negative effects on Barn Owl.

- 10.36.11 Embedded within the design of the Proposed Scheme is the commitment for the scheme to remain generally unlit during the operational period. Operational lighting will be restricted to minimal lighting to specific elements, including a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions. These are not considered to be of a level to significantly disturb Barn Owls.

Significance of Effect

- 10.36.12 The effects of injury and mortality or disturbance during the operational period will be not significant.

Additional Mitigation

- 10.36.13 Additional mitigation to mitigate impacts to Occupied Breeding Sites and Potential Nesting Sites during Construction is detailed in the OCEMP.
- 10.36.14 Mitigation is also focused on avoiding a net loss in suitable foraging habitat, through providing compensatory grassland habitat. The loss of habitats during works will be offset by extensive enhancement areas of habitat that will be suitable for Barn Owl. The proposals for enhancement and compensatory habitat as set out in the **Ecological Mitigation Strategy** (Document Reference: 3.10.32) include:



- Grassland creation and enhancement; and
- Provision of nest boxes.

10.36.15 Compensatory habitat creation and enhancement for Barn Owls is also focussed >1 kilometre from the Proposed Scheme to encourage Barn Owls to commute away from the traffic corridor.

10.36.16 Barn Owl boxes will be positioned in the wider area adjacent to the Proposed Scheme, at sufficient distance to avoid road traffic collision mortality.

10.36.17 Therefore, although research has shown that where this low- and slow-flying species roosts and forages in close proximity to active major roads it is likely that road traffic mortality will deplete local populations, the risk of Barn Owl mortality will be minimised via the provision of new Barn Owl nest boxes away from the Proposed Scheme, to encourage the breeding success of Barn Owl in the wider landscape.

10.36.18 Barn Owls will benefit in the long term from the gain in habitats including grasslands which may support a greater abundance of prey species than existing habitats.

Assessment of Residual Likely Significant Effects

Construction

10.36.19 Following implementation of the mitigation measures set out above, the residual effects on Barn Owls during the construction of the Proposed Scheme are predicted to be not significant.

Operation

10.36.20 The residual effect is predicted to be not significant.



10.37 Assessment of Likely Impacts and Effects - Fish

Embedded Mitigation

10.37.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to fish. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum SAC / SSSI.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.
- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed



Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

- Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of fish. Features have been included in the culvert design to simulate natural conditions as much as possible. Features include natural beds and widespan height and widths to simulate natural conditions which will allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss and Severance

10.37.2 During the construction phase of the proposed viaduct, the temporary loss of macrophytes due to shading from the temporary works crossing and under-construction viaduct will result in a temporary loss of shelter, food items, and breeding habitat for fish within the immediate vicinity of both



structures, within the River Wensum. However, the temporary crossing (and to a lesser extent the viaduct) will provide some shelter from predation and beneficial shade during warmer weather when in-situ. The direct effects of the temporary crossing and viaduct on fish will be negligible due to their tolerance of shade and their ability to change their individual spatial distribution (i.e. move in and out of shade freely).

10.37.3 Where culverts are to be constructed on the Foxburrow Stream and WC5 (IDB reference: DRN112G0102) of the Wensum Ditch Network (Application Document Reference 2.6, Tud Tributary Culvert / Bat Underpass - CU2 and Maintenance Access Crossing - MA1), effects on fish and fish movement are expected. Both permanent culverts have been designed to mitigate impacts to fish within each aquatic habitat. Features include natural beds and widespan height and widths, which will encourage fish movement through the culverts, and allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections. Despite the inclusion of fish passage within the culvert design, adverse effects are anticipated due to the degradation and loss of open aquatic habitat through culverting activities. Any temporary diversions of temporary sections of culvert on WC5 (IDB reference: DRN112G0102) will be removed upon completion of the construction phase, which will lessen the long-term adverse effects, making them reversible / temporary.

Habitat Degradation

10.37.4 Water draining from the constructional areas of the Proposed Scheme could enter watercourses including the River Wensum, Foxburrow stream and other drainage pathways (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00) during construction. This could provide an impact pathway affecting fish, for example via the transport of water-borne pollution following a pollution incident or increased silt run-off.



Disturbance

10.37.5 Any construction works in close proximity to aquatic features have the potential to cause disturbance to fish populations due to noise and vibration. Given the scale of the construction works associated with the Proposed Scheme, and the low existing noise levels in the area, significant increases in construction noise and vibration are likely. Construction activities for both temporary works and the viaduct could cause disturbances to fish through plant, machinery and personnel movement and additional lighting. Effects on resident fish will be negligible due to their ability to move away from the disturbance temporarily. Effects on migratory movements of salmonids, lamprey and eels passing through the site are minimal as construction will not cause a barrier to movement in the Wensum and these species have the ability to move away from temporary disturbances.

Significance of Effect

10.37.6 The loss, severance, disturbance and degradation of fish habitat during the construction period represents a permanent, direct, reversible and long-term impact on fish (excluding Bullhead and Brook Lamprey, assessed as part of the River Wensum SAC), that would result in a significant negative effect at the County scale in the absence of additional mitigation.

Operation

Habitat Loss

10.37.7 The direct effects of shading from the viaduct on fish will be negligible due to their tolerance of shade and the ability of fish to change their individual spatial distribution (i.e. move in and out of shade freely).

10.37.8 Indirect effects from shading on aquatic fauna are possible through the loss of shelter, food items and breeding habitat. However, as it is unlikely that there will be an overall loss of macrophytes within the Wensum, and as set out Solar Exposure Analysis Report (WSP, 2022e), indirect effects on fish are also unlikely.



10.37.9 Where permanent culverts are to be constructed on the Foxburrow Stream and WC5 of the Wensum Ditch Network (Application Document Reference 2.06.00), significant effects on fish and fish movement are expected. Both culverts have been designed to mitigate impacts to fish within each aquatic habitat. Features include natural beds and widespan height and widths to simulate natural conditions, which will encourage fish movement through the culverts and allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections. Despite the inclusion of fish passage within the culvert design, adverse effects are anticipated due to the localised degradation of an aquatic habitat and loss of open water habitat.

Habitat Degradation and Disturbance

10.37.10 Noise levels within areas of suitable fish habitat are predicted to be at the most 60 dB LA10,18h during operation (refer to **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00)). Fish are unlikely to be disturbed at or in proximity to the Proposed Scheme given that the operational noise does not exceed that of the ambient sound levels. Supporting structures of the viaduct will not be situated within the channel of the River Wensum, minimising effects of vibration on fish. It is therefore anticipated that noise and vibration levels during operation would not give rise to significant negative effects on fish.

10.37.11 Salt spray and contaminants from the viaduct are unlikely to be of a high enough concentration and with the embedded mitigation measures (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)). Additionally, the Scheme's drainage design will minimise any impacts through drainage pathways, as detailed further in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00). Therefore, negligible effects on aquatic macroinvertebrates are expected from surface water, salt spray and



contaminant run-off, due to salinity and contaminant levels remaining well below EQS thresholds and suitable drainage systems and pollution controls being in place.

Significance of Effect

10.37.12 The loss of open aquatic habitat due to permanent culverts represent a long-term, direct and permanent impact that is not reversible that would lead to significant negative effects on fish at the Local scale without additional mitigation.

10.37.13 No significant effect is expected from habitat degradation and disturbance.

Additional Mitigation

10.37.14 Precautionary measures would be included in the OCEMP for the Proposed Scheme and would include measures to avoid or minimise potential impacts to fish.

10.37.15 Pollution prevention guidelines that would be included within the OCEMP would also prevent water-borne pollution impacts to aquatic habitats during construction.

10.37.16 Measures to mitigate disturbance, pollution and potential killing / injury of fish (including eels and lamprey) and loss of riparian habitat during the construction phase of the Proposed Scheme are included in the OCEMP.

10.37.17 Fish rescue and translocation prior to dewatering activities on WC5 (IDB reference: DRN112G0102).

10.37.18 The temporary culvert on the diverted section of WC5 (IDB reference: DRN112G0102) will be removed upon completion of the construction phase and the ditch realigned to its previous course.

10.37.19 The mitigation measures in relation to invasive non-native species are included in the OCEMP.



10.37.20 The enhancement of features to improve condition on the Wensum, Wensum floodplain and Foxburrow stream (such as in-channel features, vegetation planting and bank reprofiling) will result in a net improvement to aquatic habitats for the benefit of fish in both the Wensum and Tud catchments.

Assessment of Residual Likely Significant Effects

Construction

10.37.21 Following implementation of additional mitigation measures, the residual effects on fish are predicted to be not significant upon completion of construction.

Operation

10.37.22 Following implementation of additional mitigation measures, including the availability of enhanced areas of watercourse, effects on fish are predicted to be not significant during operation.

10.38 Assessment of Likely Impacts and Effects - Aquatic Macroinvertebrates

Embedded Mitigation

10.38.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to aquatic macroinvertebrates. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum SAC / SSSI.
- Landscape planting as part of the Proposed Scheme's design (see Landscaping Design Plans (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a



reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of aquatic fauna and improve habitat connectivity. Features have been included in the culvert design to simulate natural conditions as much as possible. Features include natural beds and widespan height and widths to simulate natural



conditions which will allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections.

- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss and Severance

10.38.2 During the construction phase of the proposed viaduct, the temporary loss of macrophytes due to shading from the temporary works crossing and under-construction viaduct will result in a temporary loss of shelter, food items, and breeding habitat for aquatic macroinvertebrates within the immediate vicinity of both structures. The direct effects of the temporary crossing and viaduct on aquatic macroinvertebrates will be negligible due to their tolerance of shade and their ability to change their individual spatial distribution. Habitat suitable for supporting the aquatic macroinvertebrate community present is available both upstream and downstream of the site.

10.38.3 Where culverts are to be constructed on the Foxburrow Stream and WC5 (IDB reference: DRN112G0102) of the Wensum Ditch Network, effects on the aquatic macroinvertebrate community are expected. Both culverts have been designed to mitigate impacts to fish and allow fish passage within each aquatic habitat. Features include natural beds and widespan height and widths. While preliminary designed to encourage fish movement through the culverts, will also allow for aquatic macroinvertebrate movement and for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections. Despite the inclusion of fish passage within the culvert



design, adverse effects are anticipated on aquatic macroinvertebrates due to the degradation and loss of open aquatic habitat through culverting activities.

Habitat Degradation

- 10.38.4 Water draining from the Proposed Scheme could also enter watercourses including the River Wensum and through other drainage pathways (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)). This could provide an impact pathway affecting water quality sensitive aquatic macroinvertebrates, should pollution or sediment be released into these aquatic pathways.

Significance of Effect

- 10.38.5 The loss, severance, disturbance and degradation of aquatic macroinvertebrate habitat during the construction period represents a permanent, direct and long-term impact that would result in a significant negative effect at the County scale in the absence of additional mitigation.

Operation

Habitat Loss

- 10.38.6 The direct effects of shading from the viaduct on aquatic macroinvertebrates will be negligible due to their tolerance of shade and the ability of most species to change their individual spatial distribution (i.e. move in and out of shade freely).
- 10.38.7 Indirect effects from shading on aquatic macroinvertebrates are possible through the loss of shelter, food items and breeding habitat. However, as it is unlikely that there will be an overall loss of macrophytes within the Wensum, the indirect effects on aquatic macroinvertebrates are also unlikely.



Habitat Degradation

10.38.8 Salt spray and contaminants from the viaduct are unlikely to be of a high enough concentration with the embedded mitigation measures (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)). Additionally, the Scheme's drainage design will minimise any impacts through drainage pathways, as detailed further in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00). Therefore, negligible effects on aquatic macroinvertebrates are expected from surface water, salt spray and contaminant run-off, due to salinity and contaminant levels remaining well below EQS thresholds and suitable drainage systems and pollution controls being in place.

Significance of Effect

10.38.9 Due to the presence of a Regionally Notable species, the loss of open aquatic habitat due to permanent culverts represent a long-term, direct and permanent impact that would lead to significant negative effects on aquatic macroinvertebrates at the County scale, without additional mitigation.

10.38.10 No significant effect is expected from habitat degradation.

Additional Mitigation

10.38.11 Additional mitigation and enhancement measures in relation to aquatic macroinvertebrates are as outlined within the mitigation and measures highlighted for fish.

Assessment of Residual Likely Significant Effects

Construction

10.38.12 Following implementation of additional mitigation measures, the residual effects on aquatic macroinvertebrates are predicted to be not significant upon completion of construction.



Operation

10.38.13 Following implementation of additional mitigation measures, including the availability of enhanced areas of watercourse, effects on aquatic macroinvertebrates are predicted to be not significant during operation.

10.39 Assessment of Likely Impacts and Effects - Terrestrial Invertebrates

Embedded Mitigation

10.39.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to terrestrial invertebrates. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably habitat suitable to support diverse invertebrate assemblages at the River Wensum SAC / SSSI and in areas of ancient woodland.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.
- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise**



and Vibration (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.

- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.



Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.39.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to the removal of a proportion of habitats. This would result in the direct loss of habitats suitable for use by terrestrial invertebrates. Some loss of habitat suitable would be permanent, associated with the built footprint of new infrastructure and lasting for at least the duration of the operational period. This loss could affect the functionality of the remaining areas of suitable habitat type to support this species and will reduce the availability of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however. The presence of the viaduct as embedded mitigation will however prevent impacts on species such as Norfolk Hawker that utilise the River Wensum.

10.39.3 The loss of suitable habitat could decrease the availability of foodplants for terrestrial invertebrate populations.

Habitat Degradation

10.39.4 Habitats suitable for supporting terrestrial invertebrates could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. Water affected by construction activities could lead to changes in water quality or the botanical composition of habitats. The mobilisation of dust from construction activities could be relevant to ecological features up to 50m from construction activities. Dust deposition on vegetation could have effects on habitats suitable for supporting terrestrial invertebrates. This could affect the functionality of habitats to support terrestrial invertebrates.



Disturbance

- 10.39.5 The risk of disturbance to terrestrial invertebrates during construction activities is considered to be negligible.

Injury and Mortality

- 10.39.6 Any terrestrial invertebrates present within or in proximity to areas of construction could also be at risk of injury or being killed or injured during construction activities.

Significance of Effect

- 10.39.7 The injury and mortality of terrestrial invertebrates during the construction period represents a permanent, direct, long-term impact that would result in a significant negative effect at the County scale in the absence of additional mitigation.
- 10.39.8 The effects of disturbance of Terrestrial Invertebrates and the degradation of Terrestrial Invertebrate habitat are concluded to be not significant.
- 10.39.9 The loss of Terrestrial Invertebrate habitat during the construction period represents a permanent, direct and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

Operation

Habitat Degradation

- 10.39.10 Habitat suitable for supporting Terrestrial Invertebrates may be subjected to degradation through pollution during the operation period.
- 10.39.11 Embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), will reduce the effects of run-off to imperceptible levels.



10.39.12 The risk of habitat degradation significantly impacting Terrestrial Invertebrates is therefore negligible.

Disturbance

10.39.13 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2 metre environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for ecological features.

10.39.14 The risk of disturbance during operation significantly impacting terrestrial invertebrates is considered to be negligible.

Significance of Effect

10.39.15 The effects of disturbance during the operational period will be not significant.

10.39.16 The effects of degradation of habitat suitable for supporting terrestrial invertebrates during the operation period is concluded to be not significant.

Additional Mitigation

10.39.17 Measures stated in Section 10.16 will mitigate impacts on terrestrial invertebrates. Measures of particular relevant to terrestrial invertebrates comprise:

- The following measures detailed in the **OCEMP** (Document Reference: 3.03.01): dust suppression and dampening down during demolition and construction activities; noise and vibration suppression; air quality controls; pollution prevention measures; low level and directional lighting;
- Habitat creation in the Essential Environmental Mitigation as shown on the '**Essential Environmental Mitigation**' plan (Document reference: 2.11.00) would include suitable habitat features for a range of terrestrial



invertebrate species (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32); and,

- Log piles created as reptile refugia will also serve as invertebrate habitat. These would be placed in grassland and scrub habitats, within sunny positions to benefit invertebrate species.

Assessment of Residual Likely Significant Effects

Construction

10.39.18 Following implementation of the mitigation measures set out above, the residual effects on Terrestrial Invertebrates are predicted to be not significant.

Operation

10.39.19 The residual effect is predicted to be not significant.

10.40 Assessment of Likely Impacts and Effects - Desmoulin's Whorl Snail

Embedded Mitigation

10.40.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Desmoulin's Whorl Snail. Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum SAC / SSSI, for which the Desmoulin's Whorl Snail is a Qualifying Feature.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to



the constraints of the site by minimising the number of piers within the floodplain. Additionally, a 1.2 metres environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Degradation

- 10.40.2 Habitats suitable for supporting Desmoulin's Whorl Snail could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. Water affected by construction activities



could lead to changes in water quality or the botanical composition of habitats. The mobilisation of dust from construction activities could be relevant to ecological features up to 50 metres from construction activities. Dust deposition on vegetation could have effects on habitats suitable for supporting Desmoulin's Whorl Snail. This could affect the functionality of habitats to support Desmoulin's Whorl Snail.

Significance of Effect

- 10.40.3 The degradation of Desmoulin's Whorl Snail habitat during the construction period represents a temporary, reversible and short-term impact that would result in a significant negative effect at the International scale in the absence of additional mitigation.

Operation

Habitat Degradation

- 10.40.4 Habitat suitable for supporting Desmoulin's Whorl Snail may be subjected to degradation through pollution during the operation period. This could lead to the reduced functionality of habitats to support this species. This species is dependent on the maintenance of existing calcareous conditions in the local environment. With the embedded mitigation measures (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), negligible effects on Desmoulin's Whorl Snail are expected from contaminant run-off.

Significance of Effect

- 10.40.5 The effect of the potential degradation of habitat suitable for supporting Desmoulin's Whorl Snail during the operation period would not be significant.

Additional Mitigation

- 10.40.6 Precautionary measures would be included in the OCEMP (Document Reference: 3.03.01) for the Proposed Scheme and would include measures to protect retained habitats and avoid or minimise potential pollution impacts.



Pollution prevention guidelines that would be included within the OCEMP would also prevent water-borne pollution impacts to suitable aquatic habitat during construction.

10.40.7 Mitigation for Desmoulin's Whorl Snail is focussed on ensuring no net loss in supporting habitat, as well as providing habitat enhancements for the populations present to ensure their favourable conservation status is maintained in the long-term. The enhancement and creation of new habitat across the Wensum floodplain will create a larger area suitable to support this species.

10.40.8 The following habitat creation and enhancement measures (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the '**Essential Environmental Mitigation**' plan [Document reference: 2.11.00]) are proposed for Desmoulin's Whorl Snail to increase the abundance and supporting habitat of this species:

- Enhancement of ditches to include widening and reprofiling to provide more edge habitat and fencing to protect ditch margins from cattle. The widening of ditches creates hover margins for the vegetation to rise and fall with changing water levels.
- Once ditches have been widened (without removing any sedge floating mats present, where practicable) floating mats of species such as sedges or reed sweet-grass can be installed.

Assessment of Residual Likely Significant Effects

Construction

10.40.9 Following implementation of the mitigation measures set out above, the residual effects on Desmoulin's Whorl Snail are predicted to be not significant.

Operation

10.40.10 The residual effect is predicted to be not significant.



10.41 Assessment of Likely Impacts and Effects - Macrophytes

Embedded Mitigation

10.41.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to macrophytes.

Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum SAC / SSSI.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the floodplain.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays



will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

- Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of aquatic fauna and improve habitat connectivity. Features have been included in the culvert design to simulate natural conditions as much as possible. Features include natural beds and wide span height and widths to simulate natural conditions which will allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.41.2 The installation of the temporary works crossing on the River Wensum will result in a reduction in sunlight hours, solar radiation, and illuminance.

This will likely result in localised shading and temporary loss of the macrophyte community within the immediate vicinity of the temporary crossing. As the temporary crossing is transient in nature, no long-term vegetation loss or reduction to roughness is foreseen. Following removal of the temporary crossing it is expected that the macrophyte community will recolonise areas affected by shading, and therefore no long-term impacts on the macrophyte community are anticipated.

10.41.3 The construction of the viaduct across the River Wensum will result in a reduction in sunlight hours, solar radiation, and illuminance. This will likely result in localised shading and a temporary change to the macrophyte assemblage within the immediate vicinity of the viaduct as the macrophyte community adjusts to the light conditions. Due to the design of the viaduct, a height of 10.9 metres above the watercourse and no support structures within the channel, significant effects are not expected, with no long-term vegetation



loss or reduction to roughness foreseen. Therefore, no long-term impacts on the macrophyte community are anticipated.

10.41.4 Where permanent culverts are to be constructed on the Foxburrow Stream and WC5 (IDB reference: DRN112G0102) of the Wensum Ditch Network, effects on the macrophyte community are expected. Both culverts have been designed to minimise changes to flow dynamic and allow more light to reach the watercourses. Despite this design, adverse effects are anticipated on aquatic macrophytes from heavy shading and degradation of natural habitat from culverting activities. The temporary section of culvert on WC5 (IDB reference: DRN112G0102) will be removed upon completion of the construction phase, which will lessen the adverse effects, making them reversible / temporary.

Habitat Degradation

10.41.5 Water draining from the Proposed Scheme could also enter watercourses including the River Wensum and through other drainage pathways (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)). This could provide an impact on macrophyte communities, for example via the transport of water-borne pollution following a pollution incident or increased silt run-off.

Significance of Effect

10.41.6 The loss of macrophyte habitat during the construction period represents a long-term, direct, permanent impact that would result in a significant negative effect at the Local scale without additional mitigation.

10.41.7 The degradation of macrophyte habitat during the construction period represents a short-term, temporary, reversible impact that would result in a significant negative effect at the Local scale without additional mitigation.



Operation

Habitat Loss

- 10.41.8 As set out in the **Solar Exposure Analysis Report** (Application Document Reference 3.10.37), there will be a potential change in the composition of the plant community in areas affected by shading, but it is unlikely to significantly impact the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation community present or result in a permanent loss of macrophyte vegetation. There is unlikely to be a significant effect as some of the plants within the macrophyte community present which are more shade tolerant could still grow, while others which are less tolerant of shade may eventually be replaced. Additionally, the plasticity observed in the morphology of many macrophyte species in response to lower light conditions will enable plants to adapt to the light conditions. Therefore, it is unlikely that shading from the operation phase of the proposed viaduct over the River Wensum will result in an overall loss of in-channel macrophytes.
- 10.41.9 Where culverts are to be constructed on the Foxburrow Stream and WC5 (IDB reference: DRN112G0102) of the Wensum Ditch Network, significant effects on macrophytes are expected. For example, a reduction in taxon percentage cover of Fool's watercress is expected on Foxburrow Stream. Features have been included in the culvert design to simulate natural conditions as much as possible. Features include natural beds and widespan height and widths to simulate natural conditions which will allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections. This will lessen the adverse effects on macrophytes and allow for a more natural habitat and flow dynamic to exist both within and either side of the culverted sections. The design will allow more light to reach the channel, promoting macrophyte growth. Despite this, minor adverse effects are anticipated due to the localised loss of open aquatic habitat.



Habitat Degradation

10.41.10 Water draining from the Proposed Scheme could also enter watercourses including the River Wensum and through other drainage pathways (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00). This could provide an impact on macrophyte communities, for example via the transport of water-borne pollution following a pollution incident or increased silt run-off. Embedded mitigation measures (further details are provided in **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00)) will control and reduce the likelihood of pollution or silt reaching the watercourses, therefore a negligible effect on macrophytes is expected.

10.41.11 Salt spray and contaminants from the viaduct are unlikely to be of a high enough concentration and the Scheme's drainage design will minimise any impacts through drainage pathways. Therefore, negligible effects on macrophytes are expected from surface water, salt spray and contaminant run-off, due to salinity and contaminant levels remaining well below EQS thresholds and suitable drainage systems and pollution controls being in place.

Significance of Effect

10.41.12 The loss of open aquatic habitat due to permanent culverts represent a long-term, direct and permanent impact that would lead to significant negative effects on macrophytes at the Local scale in the absence of additional mitigation.

10.41.13 No significant effect is expected from habitat degradation.

Additional Mitigation

10.41.14 Additional mitigation and enhancement measures in relation to macrophytes are as outlined within the mitigation and measures highlighted for fish.



10.41.15 Additionally, measures to suitably reinstate riparian vegetation following construction are included as part of the OCEMP to mitigate potential effects on macrophytes.

Assessment of Residual Likely Significant Effects

Construction

10.41.16 Following planting and enhancement establishment and adjustment of macrophytes to light conditions, the residual effects are expected to be not significant.

Operation

10.41.17 Following implementation of the mitigation measures set out above, effects on macrophytes are predicted to be not significant during operation.

10.42 Assessment of Likely Impacts and Effects - Additional Species of Principal Importance

Embedded Mitigation

10.42.1 The design of the Proposed Scheme, where possible, has included for embedded mitigation to avoid potential adverse effects to Species of Principal Importance (SPI). Relevant Embedded Mitigation includes:

- The proposed alignment of the Proposed Scheme is designed to avoid important ecological features where possible, most notably the River Wensum and ancient woodland.
- Landscape planting as part of the Proposed Scheme's design (see **Landscaping Design Plans** (Document Reference: 2.07.00)).
- The provision of a viaduct over the River Wensum providing a considered architectural design for the viaduct. The design of the viaduct structure comprises a ten-span single-deck bridge with a reinforced concrete deck slab. The span arrangement responds well to the constraints of the site by minimising the number of piers within the



floodplain. Additionally, a 1.2 metre environmental barrier proposed for the entire length of both carriageways of the River Wensum viaduct will provide noise mitigation for ecological features.

- A low noise road surface type (stone mastic asphalt) is incorporated within the current design for the Proposed Scheme. For context, at speeds above 75kph, a low noise road surface would be 3dB quieter than a standard hot rolled asphalt surface type (see **Chapter 7: Noise and Vibration** (Document Reference: 3.07.00) for further details). This will provide noise mitigation for ecological features.
- Green bridges are proposed to provide multi-functional connections east to west, across the Proposed Scheme. The green bridges have been designed in response to their setting, to replicate as so far as is practicable, the conditions which enable use / navigation by wildlife such as linear vegetation and 'dark' corridors, to ensure continued use of these routes. The Proposed Scheme design also includes the provision of underpasses. Where culverts are required, these will be 'oversized' culverts wherever feasible to encourage the passage of SPI.
- Drainage systems designed to intercept and divert run-off away from watercourses and floodplains, most notably the River Wensum. A **Drainage Strategy and Drainage Design Plans** (Document Reference: 2.08.00) have been developed as part of the Proposed Scheme to collect surface water from the carriageway. The road will be built so water flows into grassed swales, catchpits and roadside drainage ditches with attenuation to intercept silt and sediment at the edge of the carriageway. This ensures water is suitably treated before it enters a final drainage basin where the treated water either infiltrates into the ground, discharges into the Foxburrow Stream (Basin 5) or to the A47 surface water drainage system (Basin 6). Sediment forebays



will have suitably wetted areas for planting. A pollution control valve will be incorporated into the design of each basin for spillage control.

- The provision of earth bunds within the design, which will provide screening from noise.
- The Proposed Scheme is generally to remain unlit during the operational period, and this will be restricted to minimal lighting to specific elements. These include a minimal number of lighting columns at the southern extent of the Scheme, leading to the junction with the re-aligned A47. It is also proposed that signage lighting will be required at junctions.

Preliminary Assessment of Likely Impacts and Effects

Construction

Habitat Loss

10.42.2 Construction of the Proposed Scheme and associated site and vegetation clearance work is expected to lead to the removal of a proportion of habitats. This would result in the direct loss of habitats suitable for use by SPI such as Hedgehog, Brown Hare and Common Toad. Some loss of habitat suitable for SPI would be permanent, associated with the built footprint of new infrastructure and lasting for at least the duration of the operational period. This loss could affect the functionality of the remaining areas of suitable habitat type to support SPI, and will reduce the availability of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however.

Habitat Severance

10.42.3 The construction of the Proposed Scheme will sever habitat into areas either side of the new road. The Scheme may create a barrier to animal passage and prevent SPI movement across territories. Measures to maintain



habitat connectivity are incorporated into the Proposed Scheme design however, including tunnels, green bridges and underpasses.

Habitat Degradation

- 10.42.4 Habitats suitable for supporting SPI could be subjected to habitat degradation through pollution and a reduction in air quality during the construction period. This could affect the functionality of habitats to support SPI.

Injury and Mortality

- 10.42.5 Any SPI present within or in proximity to areas of construction could be at risk of injury or being killed or injured during construction activities, however the risk of injury or mortality during construction activities is considered to be low.

Disturbance

- 10.42.6 SPI could potentially be subject to lighting, noise, visual and vibration disturbance during construction, and this may lead to changes in behaviour. Increased levels of human activity and the presence of large machinery such as excavators and piling rigs has the potential to lead to increased visual disturbance during construction.
- 10.42.7 Disturbance could temporarily affect the functionality of the remaining areas of suitable habitat type to support this species, and temporarily reduce the availability of suitable habitat within the local landscape. The habitats that would be removed are widely represented in the wider local landscape however.

Significance of Effect

- 10.42.8 The effect of injury and mortality of SPI during the construction period is concluded to be not significant.



10.42.9 The disturbance of SPI and degradation of SPI habitat during the construction period represents a temporary, reversible and short-term impact that would result in a significant negative effect at the Local scale in the absence of additional mitigation.

10.42.10 The loss and severance of SPI habitat during the construction period represents a permanent, direct and long-term impact in the absence of additional mitigation and would result in a significant negative effect at the Local scale.

Operation

Injury and Mortality

10.42.11 SPI such as Hedgehogs and Common Toads are susceptible to mortality associated with vehicle collision.

10.42.12 The risk of injury or mortality by vehicle collision is considered to be low however, with embedded mitigation included in the Proposed Scheme design comprising the provision of green bridges, underpasses and oversize culverts, and fencing designed to prevent larger species crossing the road, and access tracks will be subject to occasional usage only.

Habitat Degradation

10.42.13 Habitat suitable for supporting SPI may be subjected to degradation through pollution during the operation period, however the risk of habitat degradation significantly impacting SPI is considered to be negligible. Embedded mitigation such as the inclusion of drainage basins and other features detailed in 'Fine sediment management - OM-RDWE-01' of **Chapter 12: Road Drainage and the Water Environment** (Document Reference: 3.12.00), will also reduce the effects of run-off to imperceptible levels.

Disturbance

10.42.14 Embedded Mitigation measures comprising relevant and specific commitments with respect to noise and vibration including a 1.2m



environmental barrier along the entire length of both carriageways of the River Wensum viaduct will provide a level of noise mitigation for SPI such as Common Toad.

10.42.15 The risk of disturbance during operation significantly impacting SPI is considered to be negligible.

Significance of Effect

10.42.16 The effects injury and mortality, or disturbance, or degradation of habitat suitable for supporting SPI during the operational period will be not significant.

Additional Mitigation

10.42.17 Measures to mitigate disturbance, pollution and potential killing / injury of SPI during the construction phase of the Proposed Scheme are included in the OCEMP. This includes measures such as:

- Animal burrows (excluding badger setts and water voles) on site will be carefully excavated in a manner that allows animals to safely escape before works commence;
- Ecological supervision will be required during animal burrow excavations and vegetation clearance activities;
- Any holes that are excavated on site will be covered overnight to prevent animals from falling in. Open pits, open pipes and other excavations will need to be covered at the end to prevent mammals from being trapped. If this is not possible, a broad plank can be placed in excavations to allow animals to escape. Excavations should be checked first thing each morning, prior to the start of works that day. Any animals found within excavations should be allowed to escape and move off, or carefully removed and placed within suitable habitat cover before site works commence.



- Prior to construction activities, any potential existing refugia on Site (e.g. log piles) will be dismantled by hand and relocated to the retained area. Works in a localised area will be temporarily halted if individual animals are encountered to allow the animal to disperse from the work site. This activity will be supervised by an ecologist to minimise the risk of killing or injury to Species of Principal Importance, who will hand search vegetation for these species prior to clearance each day.

10.42.18 The proposals for reinstatement, enhancement and compensatory habitat would provide replacement habitat for local Species of Principal Importance populations, which would include the creation of species rich grassland, woodland, scrub and a waterbody (see the **Ecological Mitigation Strategy (Appendix 10.32)** (Document Reference: 3.10.32) and the **'Essential Environmental Mitigation' plan** [Document reference: 2.11.00]).

Assessment of Residual Likely Significant Effects

Construction

10.42.19 Following implementation of the mitigation measures set out above, the residual effects on Species of Principal Importance are predicted to be not significant.

Operation

10.42.20 The residual effect is predicted to be not significant.

10.43 Assessment of Likely Impacts and Effects - Invasive Non-Native Species

10.43.1 Construction activities within the Proposed Scheme could potentially result in the spread of Himalayan Balsam, Rhododendron or Variegated Yellow Archangel into areas they do not currently occupy. This could be via movement of spoil as part of earthworks operations, or via plant and personnel if clothing and equipment is not suitably cleaned following work in areas supporting invasive non-native plant species.



10.43.2 Himalayan balsam was identified along the River Wensum; however no records of this species were made within 2 kilometres of the Proposed Scheme. Rhododendron was recorded in Foxburrow Plantation and Variegated Yellow Archangel was recorded in Broadway Woodland.

10.43.3 Whilst not an IEF, the accidental spread of INNS could result in a breach of legislation pertaining to preventing the spread of INNS, including Section 14 of the Wildlife and Countryside Act (1981), as amended. As such, measures to support legal compliance and prevent the incidental spread of invasive species have been included in the OCEMP.

10.43.4 Additional Mitigation measures that will avoid impacting invasive non-native species have been mandated by their inclusion in the Proposed Scheme OCEMP. This includes a survey for mink presence across the floodplain to assess the risk of Water Vole predation from this species prior to the translocation activities.

10.43.5 A pre-construction ecological survey would be completed in the active growing season (approximately April to August inclusive) prior to vegetation and site clearance commencing in any part of the Site.

10.44 Summary of Additional Mitigation

10.44.1 **Table 10-23** provides a summary of the association between the Additional Mitigation measures and the Important Ecological Features referred to in this chapter.

Table 10-23 Summary of Additional Mitigation measures

Key to table:

+ = Additional Mitigation measure of particular relevance to IEF, - = Additional Mitigation measure not of particular relevance to IEF

Additional Mitigation measure	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature
Additional Mitigation measure	River Wensum SAC/SSSI	Sites Non-Statutorily Designated for Biodiversity Value	Ancient Woodland	Habitats of Principal Importance	Hedgerows	Watercourses	Notable, Veteran and Ancient Trees	Other Habitats	Badger	Water Vole	Otter	Reptiles	Great Crested Newt	Breeding and Wintering Birds	Barn Owl	Fish	Aquatic Macroinvertebrates	Terrestrial Invertebrates	Desmoulin's Whorl Snail	Macrophytes	Additional Species of Principal Importance	Invasive Non-Native Species
Habitat creation	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
Habitat enhancement	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
Translocation or displacement	+	-	-	-	-	-	-	-	+	+	+	+	+	-	-	+	-	-	-	-	-	-
Creation of breeding, sheltering and hibernating features	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-	+	-
Creation of connective habitat	+	-	-	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
INNS management (CEMP)	+	+	-	+	+	+	+	+	-	-	-	-	-	-	-	+	+	+	+	+	-	+
Dust suppression (CEMP)	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Noise and vibration suppression (CEMP)	+	+	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	-	-	-	+	-
Air quality controls (CEMP)	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Pollution prevention measures (CEMP)	+	+	+	+	+	+	+	+	-	+	+	-	+	-	-	+	+	+	+	+	+	-
Transport, storage and disposal of hazardous waste and oils (CEMP)	+	+	+	+	+	+	+	+	-	+	+	-	+	-	-	+	+	+	+	+	+	-
Construction Lighting Management Plan (CLMP)	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+	+	-	-	+	-
Covering or adapting excavations (CEMP)	+	+	-	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-	-	-	+	-
Biosecurity measures (CEMP)	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	-

Additional Mitigation measure	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	Important Ecological Feature	
Additional Mitigation measure	River Wensum SAC/SSSI	Sites Non-Statutorily Designated for Biodiversity Value	Ancient Woodland	Habitats of Principal Importance	Hedgerows	Watercourses	Notable, Veteran and Ancient Trees	Other Habitats	Badger	Water Vole	Otter	Reptiles	Great Crested Newt	Breeding and Wintering Birds	Barn Owl	Fish	Aquatic Macroinvertebrates	Terrestrial Invertebrates	Desmoulin's Whorl Snail	Macrophytes	Additional Species of Principal Importance	Invasive Non-Native Species	
Tree protection (CEMP)	+	+	+	+	+	-	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Appointment of an Ecological Clerk of Works (CEMP)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-	-	-
Ecologically sensitive timing of works (CEMP)	+	+	-	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
Wildlife fencing to minimise road mortality	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	+	-	-
Exclusion zone from the River Wensum SAC boundary	+	-	-	-	-	+	-	-	-	+	+	-	-	-	-	+	+	-	+	+	-	-	-
Final Air Quality Compensation Strategy	-	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compensation Strategy for Notable, Veteran and Ancient Trees	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Badger licence	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Vole licence	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Pre-construction survey	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	-	-	-	+	+	+



10.45 Summary of Biodiversity Effects

10.45.1 This section provides a summary of the outcomes of the Ecological Impact Assessment undertaken in this chapter to predict the effects of the Proposed Scheme on ecological features.

10.45.2 The assessment first determined the potential effects arising from the construction and operation phases of the Proposed Scheme on Important Ecological Features considering Embedded Mitigation measures only. The assessment then presented the Additional Mitigation measures and determined the potential residual effects arising from the construction and operation phases of the Proposed Scheme on Important Ecological Features considering these measures. These steps are detailed fully in the above sections and summarised in **Table 10-24**.

10.45.3 The assessment of Residual likely Significant Effects determined the potential effects arising from the construction and operation phases of the Proposed Scheme to be not significant for the majority of Important Ecological Features.

10.45.4 The only residual significant negative effects arising from the construction and operation phases of the Proposed Scheme according to the criteria presented in **Table 10-10** are:

- The effect of habitat loss during the construction period on notable, veteran and ancient trees; and,
- The effect of habitat degradation due to a reduction in air quality during the operation of the Proposed Scheme on the following IEFs:
 - Notable, veteran and ancient trees;
 - Wensum Pastures at Morton Hall CWS;



- Primrose Grove Ancient Woodland;
- Primrose Grove CWS;
- Broom and Spring Hills CWS;
- Land Adjoining Foxburrow Plantation CWS;
- River Wensum Pastures CWS; and,
- Fakenham Road RNR.

10.45.5 It is however considered that the effect of habitat degradation due to a reduction in air quality during the operation of the Proposed Scheme on the above IEFs will be compensated for in the long-term following the implementation of the Final Air Quality Compensation Strategy.

Key to table:

+/- = Positive or Negative, P/T = Permanent or Temporary, D/I = Direct or Indirect, ST/MT/LT = Short Term, Medium Term or Long Term, N/A = Not Applicable

Table 10-24 Summary of Biodiversity Effects

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
River Wensum SAC	Construction	Temporary and permanent loss of supporting floodplain habitat due to land-take	Significant negative effect at the International scale / - / T / D / ST	Fish translocation prior to dewatering activities	Not significant
River Wensum SAC	Construction	Changes in hydrological conditions – non-flood condition river flows and ground water levels	Not significant	N/A	Not significant
River Wensum SAC	Construction	Changes in hydrological conditions - increased flood risk	Not significant	N/A	Not significant
River Wensum SAC	Construction	Shading of in-channel vegetation from the under-construction viaduct and temporary bailey bridge	Not significant	N/A	Not significant
River Wensum SAC	Construction	Fragmentation of the landscape by construction of the Proposed Scheme	Significant negative effect at the International scale / - / T / D / ST	Fish translocation prior to dewatering activities	Not significant
River Wensum SAC	Construction	Localised changes in air quality due to emissions of construction vehicles	Not significant	N/A	Not significant
River Wensum SAC	Construction	Sediment and chemical run-off	Significant negative effect at the International scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone.	Not significant
River Wensum SAC	Construction	Dust emissions	Significant negative effect at the International scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
River Wensum SAC	Construction	Noise and vibrational disturbance	Significant negative effect at the International scale / - / T / D / ST	Construction Hoarding. Noise and vibration reduction measures. River Wensum exclusion zone.	Not significant
River Wensum SAC	Construction	Introduction of invasive non-native plant (e.g. Himalayan balsam) and animal (e.g. signal crayfish) species	Significant negative effect at the International scale / - / P / D / LT	Measures to control the spread as per the OCEMP. River Wensum exclusion zone.	Not significant
River Wensum SSSI	Construction	Temporary and permanent loss of supporting floodplain habitat due to land-take	Significant negative effect at the National scale / - / T / D / ST	Fish translocation prior to dewatering activities	Not significant
River Wensum SSSI	Construction	Changes in hydrological conditions – non-flood condition river flows and ground water levels	Not significant	N/A	Not significant
River Wensum SSSI	Construction	Changes in hydrological conditions - increased flood risk	Not significant	N/A	Not significant
River Wensum SSSI	Construction	Shading of in-channel vegetation from the under-construction viaduct and temporary bailey bridge	Not significant	N/A	Not significant
River Wensum SSSI	Construction	Fragmentation of the landscape by construction of the Proposed Scheme	Significant negative effect at the National scale / - / T / D / ST	Fish translocation prior to dewatering activities	Not significant
River Wensum SSSI	Construction	Localised changes in air quality due to emissions of construction vehicles	Not significant	N/A	Not significant
River Wensum SSSI	Construction	Sediment and chemical run-off	Significant negative effect at the National scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
River Wensum SSSI	Construction	Dust emissions	Significant negative effect at the National scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone.	Not significant
River Wensum SSSI	Construction	Noise and vibrational disturbance	Significant negative effect at the National scale / - / T / D / ST	Construction Hoarding. Noise and vibration reduction measures. River Wensum exclusion zone.	Not significant
River Wensum SSSI	Construction	Introduction of invasive non-native plant (e.g. Himalayan balsam) and animal (e.g. signal crayfish) species	Significant negative effect at the National scale / - / P / D / LT	Measures to control the spread as per the OCEMP. River Wensum exclusion zone.	Not significant
River Wensum Pastures, Ringland Estates CWS	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
River Wensum Pastures, Ringland Estates CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Attlebridge Hills CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Broom & Spring Hills CWS	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Broom & Spring Hills CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Wensum Pastures at Morton Hall CWS	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Wensum Pastures at Morton Hall CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Primrose Grove CWS	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Primrose Grove CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Gravelpit Plantation and Church Hill CWS	Construction	Habitat degradation	Not significant	N/A	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Land adjoining Foxburrow Plantation CWS	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Land adjoining Foxburrow Plantation CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Old Covert, Wood Lane CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Mouse Wood CWS	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Mouse Wood CWS	Construction	Disturbance	Significant negative effect at the County scale / - / T / D / ST	Noise, lighting and vibration reduction measures.	Not significant
Fakenham Road RNR	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Fakenham Road RNR	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Other Habitats	Construction	Habitat loss (temporary)	Significant negative effect at the Local scale / - / T / D / ST	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Other Habitats	Construction	Habitat loss (permanent)	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Other Habitats	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / D / ST	Pollution control measures.	Not significant
Ancient woodland	Construction	Habitat loss	Not significant	N/A	Not significant
Ancient woodland	Construction	Habitat degradation	Significant negative effect at the National scale / - / T / D / ST	Pollution control measures. Protection measures for retained habitats	Not significant
Purple Moor Grass and Rush Pasture HPI	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Purple Moor Grass and Rush Pasture HPI	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Lowland Mixed Deciduous Woodland HPI	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Lowland Mixed Deciduous Woodland HPI	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Coastal and Floodplain Grazing Marsh HPI	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Coastal and Floodplain Grazing Marsh HPI	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Wet Woodland HPI	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant
Hedgerow HPI	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Hedgerow HPI	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Watercourses	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Watercourses	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone.	Not significant
Watercourses	Construction	Introduction of invasive non-native plant and animal species	Significant negative effect at the County scale / - / P / D / LT	Measures to control the spread of invasive non-native plant and animal species as per the OCEMP.	Not significant
Watercourses	Construction	Disturbance	Significant negative effect at the County scale / - / T / D / ST	Construction Hoarding. Noise and vibration reduction measures. River Wensum exclusion zone	Not significant
Notable, veteran and ancient trees	Construction	Habitat loss	Significant negative effect at the National scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Significant negative effect at the National scale / - / P / D / LT
Notable, veteran and ancient trees	Construction	Habitat degradation	Significant negative effect at the National scale / - / T / D / ST	Pollution control measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Badger	Construction	Injury and Mortality	Significant negative effect at the Local scale / - / P / D / LT	Pre-construction surveys. Licenced works. Precautionary Method of Working.	Not significant
Badger	Construction	Disturbance	Significant negative effect at the Local scale / - / T / D / ST	Construction Hoarding. Pre-construction surveys. Noise and vibration reduction measures. Licenced works. Precautionary Method of Working.	Not significant
Badger	Construction	Habitat degradation	Not significant	N/A	Not significant
Badger	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary. Licenced works.	Not significant
Badger	Construction	Habitat severance	Significant negative effect at the Local scale / - / P / I / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Water Vole	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary. Licenced works.	Not significant
Water Vole	Construction	Habitat severance	Significant negative effect at the County scale / - / P / I / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Water Vole	Construction	Injury and mortality	Significant negative effect at the County scale / - / P / D / LT	Pre-construction surveys. Licenced works. Precautionary Method of Working.	Not significant
Water Vole	Construction	Disturbance	Significant negative effect at the County scale / - / T / D / ST	Construction Hoarding. Pre-construction surveys. Noise and vibration reduction measures. Licenced works. Precautionary Method of Working.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Water Vole	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / I / ST	Pollution control measures.	Not significant
Otter	Construction	Habitat loss	Not significant	N/A	Not significant
Otter	Construction	Habitat severance	Not significant	N/A	Not significant
Otter	Construction	Injury and mortality	Not significant	N/A	Not significant
Otter	Construction	Disturbance	Not significant	N/A	Not significant
Otter	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / I / ST	Pollution control measures.	Not significant
Reptiles	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Reptiles	Construction	Habitat severance	Significant negative effect at the Local scale / - / P / I / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Reptiles	Construction	Injury and mortality	Significant negative effect at the Local scale / - / P / D / LT	Precautionary Method of Working.	Not significant
Reptiles	Construction	Disturbance	Significant negative effect at the Local scale / - / T / D / ST	Construction Hoarding. Noise and vibration reduction measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Reptiles	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / I / ST	Pollution control measures.	Not significant
Great Crested Newt	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Great Crested Newt	Construction	Habitat severance	Significant negative effect at the Local scale / - / P / I / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Great Crested Newt	Construction	Injury and mortality	Significant negative effect at the Local scale / - / P / D / LT	Precautionary Method of Working.	Not significant
Great Crested Newt	Construction	Disturbance	Significant negative effect at the Local scale / - / T / D / ST	Construction Hoarding. Noise and vibration reduction measures.	Not significant
Great Crested Newt	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / I / ST	Pollution control measures.	Not significant
Breeding and wintering birds	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Breeding and wintering birds	Construction	Disturbance	Significant negative effect at the Local scale / - / T / D / ST	Construction Hoarding. Noise and vibration reduction measures. Precautionary Method of Working.	Not significant
Breeding and wintering birds	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / I / ST	Pollution control measures.	Not significant
Barn Owl	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Barn Owl	Construction	Disturbance	Significant negative effect at the County scale / - / T / D / ST	Construction hoarding. Pre-construction surveys. Noise and vibration reduction measures. Precautionary Method of Working.	Not significant
Barn Owl	Construction	Habitat degradation	Significant negative effect at the County scale / - / T / I / ST	Pollution control measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Fish	Construction	Habitat loss and severance	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary. Ecologically sensitive construction measures. River Wensum exclusion zone	Not significant
Fish	Construction	Habitat degradation	Significant negative effect at the County scale / - / P / D / LT	Pollution control measures. River Wensum exclusion zone. Ecologically sensitive construction measures. Measures to control the spread of invasive non-native plant and animal species as per the OCEMP.	Not significant
Fish	Construction	Disturbance	Significant negative effect at the County scale / - / P / D / LT	Noise and vibration reduction measures. River Wensum exclusion zone.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Aquatic Macroinvertebrates	Construction	Habitat loss and severance	Significant negative effect at the County scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary. Ecologically sensitive construction measures. River Wensum exclusion zone.	Not significant
Aquatic Macroinvertebrates	Construction	Habitat degradation	Significant negative effect at the County scale / - / P / D / LT	Pollution control measures. River Wensum exclusion zone. Ecologically sensitive construction measures. Measures to control the spread of invasive non-native plant and animal species as per the OCEMP.	Not significant
Terrestrial Invertebrates	Construction	Habitat loss	Significant negative effect at the County scale / - / P / D / LT	Habitat creation	Not significant
Terrestrial Invertebrates	Construction	Habitat degradation	Not significant	N/A	Not significant
Terrestrial Invertebrates	Construction	Disturbance	Not significant	N/A	Not significant
Terrestrial Invertebrates	Construction	Injury and mortality	Significant negative effect at the County scale / - / P / D / LT	Ecologically sensitive construction measures.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Desmoulin's Whorl Snail	Construction	Habitat degradation	Significant negative effect at the International scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone. Ecologically sensitive construction measures.	Not significant
Macrophytes	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary. Ecologically sensitive construction measures. River Wensum exclusion zone.	Not significant
Macrophytes	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / D / ST	Pollution control measures. River Wensum exclusion zone. Ecologically sensitive construction measures. Measures to control the spread of invasive non-native plant and animal species as per the OCEMP.	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Additional Species of Principal Importance	Construction	Habitat loss	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Additional Species of Principal Importance	Construction	Habitat severance	Significant negative effect at the Local scale / - / P / D / LT	Reinstatement, creation and enhancement of habitats within the Red Line Boundary.	Not significant
Additional Species of Principal Importance	Construction	Habitat degradation	Significant negative effect at the Local scale / - / T / D / ST	Pollution control measures.	Not significant
Additional Species of Principal Importance	Construction	Injury and mortality	Not significant	N/A	Not significant
Additional Species of Principal Importance	Construction	Disturbance	Significant negative effect at the Local scale / - / T / D / ST	Ecologically sensitive construction measures.	Not significant
River Wensum SAC	Operation	Shading of in-channel vegetation by the operational viaduct	Not significant	N/A	Not significant
River Wensum SAC	Operation	Sediment and chemical run-off (including road salt)	Not significant	N/A	Not significant
River Wensum SAC	Operation	Localised changes in air quality as a result of emissions from vehicles using the completed viaduct	Not significant	N/A	Not significant
River Wensum SAC	Operation	Noise and vibrational disturbance	Not significant	N/A	Not significant
River Wensum SSSI	Operation	Shading of in-channel vegetation by the operational viaduct	Not significant	N/A	Not significant
River Wensum SSSI	Operation	Sediment and chemical run-off (including road salt)	Not significant	N/A	Not significant
River Wensum SSSI	Operation	Localised changes in air quality as a result of emissions from vehicles using the completed viaduct	Not significant	N/A	Not significant
River Wensum SSSI	Operation	Noise and vibrational disturbance	Not significant	N/A	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Norfolk Valley Fens SAC – Potter & Scarning Fens, East Dereham	Operation	Air quality changes within the Affected Road Network	Not significant	N/A	Not significant
Potter & Scarning Fens, East Dereham SSSI	Operation	Air quality changes within the Affected Road Network	Not significant	N/A	Not significant
Sweetbriar Road Meadows, Norwich SSSI	Operation	Habitat degradation	Not significant	N/A	Not significant
Alderford Common SSSI	Operation	Habitat degradation	Not significant	N/A	Not significant
Attlebridge Hills CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Bawburgh/Colney Gravel Pits CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Botany Bay Farm CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Brook House Marshes CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Broom and Spring Hills CWS	Operation	Habitat degradation	Significant negative effect at a County scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a County scale / - / P / D / LT
Church Hill Common CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Church Meadow, Alder Carr, Three Corner Thicket and Nursery Plantation CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Costessey Pits (East) CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Earlham and Colney Marshes CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
East Hills CWS	Operation	Habitat degradation	Not significant	N/A	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Fakenham Road RNR	Operation	Habitat degradation	Significant negative effect at a County scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a County scale / - / P / D / LT
Fen Plantation CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Fen West of East Tuddenham CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Gravelpit Plantation and Church Hill CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Great Witchingham Common CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Hellesdon Pastures CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Horsham Meadows CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Intwood Carr CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Jennis' Wood & Dryhill Plantation CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Land Adjoining Foxburrow Plantation CWS	Operation	Habitat degradation	Significant negative effect at a County scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a County scale / - / P / D / LT
Land Adjoining Foxburrow Plantation CWS	Operation	Disturbance: potential increase in visitor pressure due to NMU route improvements within the CWS.	Not significant	N/A	Not significant
Lenwade Pits (East) CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Lenwade Pits (West) CWS	Operation	Habitat degradation	Not significant	N/A	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Long Dell and Westlodge Hills CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Marriott's Way CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Meadow Farm Meadow CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Mouse Wood CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Old Covert, Wood Lane CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Primrose Grove CWS	Operation	Habitat degradation	Significant negative effect at a County scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a County scale / - / P / D / LT
River Tud at Easton and Honingham CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
River Wensum Pastures CWS	Operation	Habitat degradation	Significant negative effect at a County scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a County scale / - / P / D / LT
River Wensum Pastures CWS	Operation	Habitat loss	Not significant	N/A	Not significant
River Wensum Pastures CWS	Operation	Disturbance	Not significant	N/A	Not significant
River Yare (west and east), Bowthorpe CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Taverham Mill CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Walsingham Plantation CWS	Operation	Habitat degradation	Not significant	N/A	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Wensum Pastures at Morton Hall CWS	Operation	Habitat degradation	Significant negative effect at a County scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a County scale / - / P / D / LT
Wensum Pastures at Morton Hall CWS	Operation	Disturbance	Not significant	N/A	Not significant
Weston Meadow CWS	Operation	Habitat degradation	Not significant	N/A	Not significant
Other Habitats	Operation	Habitat degradation	Significant negative effect at a Local scale / - / P / D / LT	Final Air Quality Compensation Strategy Habitat mitigation, creation and enhancement	Not Significant
Primrose Grove Ancient Woodland	Operation	Habitat degradation	Significant negative effect at a National scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a National scale / - / P / D / LT
Church Wood Ancient Woodland	Operation	Habitat degradation	Not significant	N/A	Not significant
Snake Wood Ancient Woodland	Operation	Habitat degradation	Not significant	N/A	Not significant
Sprowston Wood Ancient Woodland	Operation	Habitat degradation	Not significant	N/A	Not significant
Purple Moor Grass and Rush Pasture HPI	Operation	Habitat degradation	Not significant	N/A	Not significant
Lowland Mixed Deciduous Woodland HPI	Operation	Habitat degradation	Not significant	N/A	Not significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Coastal and Floodplain Grazing Marsh HPI	Operation	Habitat degradation	Not significant	N/A	Not significant
Wet Woodland HPI	Operation	Habitat degradation	Not significant	N/A	Not significant
Hedgerow HPI	Operation	Habitat degradation	Not significant	N/A	Not significant
Watercourses	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Watercourses	Operation	Habitat loss and severance	Significant negative effect at a County scale / - / P / D / LT	Aquatic enhancements	Not Significant
Notable, veteran and ancient trees	Operation	Habitat degradation	Significant negative effect at a National scale / - / P / D / LT	Final Air Quality Compensation Strategy	Significant negative effect at a National scale / - / P / D / LT
Badger	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Badger	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Badger	Operation	Disturbance	Not Significant	N/A	Not Significant
Water Vole	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Water Vole	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Water Vole	Operation	Disturbance	Not Significant	N/A	Not Significant
Otter	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Otter	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Otter	Operation	Disturbance	Not Significant	N/A	Not Significant
Reptiles	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Reptiles	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Reptiles	Operation	Disturbance	Not Significant	N/A	Not Significant
Great Crested Newt	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Great Crested Newt	Operation	Habitat degradation	Not Significant	N/A	Not Significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Great Crested Newt	Operation	Disturbance	Not Significant	N/A	Not Significant
Breeding and wintering birds	Operation	Disturbance	Not Significant	N/A	Not Significant
Breeding and wintering birds	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Breeding and wintering birds	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Barn Owl	Operation	Disturbance	Not Significant	N/A	Not Significant
Barn Owl	Operation	Injury and Mortality	Not Significant	N/A	Not Significant
Fish	Operation	Habitat loss	Significant negative effect at a Local scale / - / P / ID / LT	Aquatic enhancements	Not Significant
Fish	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Fish	Operation	Disturbance	Not Significant	N/A	Not Significant
Aquatic Macroinvertebrates	Operation	Habitat loss	Significant negative effect at a County scale / - / P / D / LT	Aerial emissions reduction measures Aquatic enhancements	Not Significant
Aquatic Macroinvertebrates	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Terrestrial Invertebrates	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Terrestrial Invertebrates	Operation	Disturbance	Not Significant	N/A	Not Significant
Desmoulin's Whorl Snail	Operation	Habitat degradation	Not Significant	N/A	Not Significant

Feature	Phase	Potential Impact	Significance of Effect considering Embedded Mitigation	Additional Mitigation	Significance of Effect considering Additional Mitigation
Macrophytes	Operation	Habitat loss	Significant negative effect at a Local scale / - / P / D / LT	Aerial emissions reduction measures Aquatic enhancements	Not Significant
Macrophytes	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Additional Species of Principal Importance	Operation	Disturbance	Not Significant	N/A	Not Significant
Additional Species of Principal Importance	Operation	Habitat degradation	Not Significant	N/A	Not Significant
Additional Species of Principal Importance	Operation	Injury and Mortality	Not Significant	N/A	Not Significant



10.46 Cumulative effects

Overview

10.46.1 The assessment to identify any other projects which could give rise to a significant cumulative effect via in-combination effects is included within Appendix 36: Cumulative impacts from nearby committed developments (Document Reference: 3.10.36). Significance of effect is addressed in **Chapter 20: Cumulative Effects** (Document Reference: 3.20.00).

10.46.2 This section considers any potential cumulative effects on sensitive Biodiversity features to determine whether they would be significant or not (outlined in **Chapter 20: Cumulative Effects** (Document Reference: 3.20.00)). The following committed developments identified are of a scale and nature to have potential cumulative effects:

- A47 North Tuddenham to Easton;
- Sheringham and Dudgeon Extension Projects; and
- Hornsea Project Three Offshore Wind Farm.

10.46.3 The inter-project assessment considers the potential for each plan or project to influence the site. In order for a cumulative effect to arise, the nature of two effects does not necessarily have to be the same. Potential cumulative effects considered below comprise impacts to:

- Designated sites;
- Habitats; and,
- Protected and/or notable species and/or their habitat.

10.46.4 A full list of nearby committed developments shortlisted for consideration within the in-combination and cumulative effects



assessment of this Environmental Statement is provided in Document Reference: 3.10.36.

10.46.5 The onshore elements of the Hornsea Project Three Offshore Wind Farm scheme and the Sheringham and Dudgeon Extension Projects have been considered below.

10.47 Rationale for projects considered in the Cumulative Impact Assessment in relation to Biodiversity

A47 North Tuddenham to Easton

10.47.1 The consented A47 North Tuddenham to Easton scheme involves dualling of the A47 by National Highways which lies to the south of the Proposed Scheme when developed will connect to the Proposed Scheme at its southern extent. The dualling of the A47 will introduce dualling of the single carriageway section of the A47 between Norwich and Dereham, linking together two existing sections of dual carriageway. The scheme will provide a new route to the south of Hockering and to the north of Honningham and include new junctions.

10.47.2 **Table 10-25** lists the significance of residual effects (excluding bats) that are presented in Chapter 8: Biodiversity of the A47 North Tuddenham to Easton Dualling Environmental Statement (Highways England, 2021).

Table 10-25 A47 North Tuddenham to Easton Dualling residual effects

Biodiversity Feature	Project phase	Significance of residual effect	Related CIEEM Assessment Significance of an Effect Terminology used in this chapter
NERC Act (2006) S41 priority habitats: hedgerows, deciduous woodland, floodplain grazing marsh	Construction	Moderate adverse	Significant (negative)
NERC Act (2006) S41 priority habitats: good quality semi- mature grassland, ponds	Construction	Slight beneficial	Not significant
Norfolk priority habitats	Construction	Slight adverse	Not significant
Botanical (woodland and floodplain)	Construction	Slight adverse	Not significant
Botanical (grasslands)	Construction	Slight beneficial	Not significant
Breeding birds	Construction	Slight adverse	Not significant



Biodiversity Feature	Project phase	Significance of residual effect	Related CIEEM Assessment Significance of an Effect Terminology used in this chapter
Breeding birds	Operation	Slight adverse	Not significant
Barn Owl	Construction	Moderate adverse (Residual effect would be downgraded to slight adverse once landowner agreement for the mitigation boxes are in place)	Significant (negative)
Barn Owl	Operation	Slight adverse	Not significant
Wintering birds	Construction	Slight adverse	Not significant
Wintering birds	Operation	Slight adverse	Not significant

10.47.3 This development is also adjacent to the Proposed Scheme, and the construction of the A47 dualling is likely to take place alongside the construction of the Proposed Scheme.

10.47.4 There is therefore the possibility that there would be a temporal and geographical overlap in the construction of the Proposed Scheme and this development. This could result in cumulative impacts and effects on



biodiversity features such as nearby designated nature conservation sites and any protected and notable species occurring in this area.

Sheringham and Dudgeon Extension Projects

- 10.47.5 Two offshore windfarm projects with a joint export cable system, offshore and onshore, connecting to the national grid transmission network at Norwich Main substation. The onshore cable will intersect the Proposed Scheme and will cross the River Wensum ~1.5km to the north-west of the Scheme.
- 10.47.6 The high-level construction programme provided in the Environmental Statement for this development (Equinor, 2022) indicates a construction start year of 2025, with the onshore elements undertaken from 2025 to 2027.
- 10.47.7 There is therefore the possibility that there would be a temporal and geographical overlap in the construction of the Proposed Scheme and this development. This could result in cumulative impacts and effects on biodiversity features such as nearby designated nature conservation sites and any protected and notable species occurring in this area.
- 10.47.8 **Table 10-26** lists the significance of residual effects (excluding bats) that are presented in the Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Environmental Statement Volume 1 Chapter 20: Onshore Ecology and Ornithology (Equinor, 2022).

Table 10-26 Sheringham and Dudgeon Extension Projects residual effects

Impact	Project phase	Significance of residual effect	Related CIEEM Assessment Significance of an Effect Terminology used in this chapter
Damage to River Wensum SAC/SSSI and Weybourne Cliffs SSSI	Construction	Minor adverse	Not significant
Damage to non-statutory designated sites	Construction	Minor adverse - negligible	Not significant
Loss or Damage to Valued Habitat	Construction	Minor adverse - negligible	Not significant
Spread of INNS	Construction	Minor adverse	Not significant
Potential Mortality, harm, disturbance to protected species and/or their habitat	Construction	Minor adverse - negligible	Not significant

Hornsea Project Three Offshore Wind Farm

10.47.9 Hornsea Project Three is 2 kilometres from the Proposed Scheme on the west-side of Attlebridge and includes the installation of an electricity cable which will cross the River Wensum.



10.47.10 The cable installation operations are planned to start during 2025 with all works scheduled to be finished by 2027. The development intersects with the Proposed Scheme and the temporal and geographical overlapping of construction phases could result in cumulative impacts to numerous biodiversity features including nearby designated sites and any protected or notable species present in the area.

10.47.11 **Table 10-27** lists the significance of residual effects (excluding bats) that are presented in Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 3, Chapter 3: Ecology and Nature Conservation (Orsted, 2018).

Table 10-27 Hornsea Project Three Offshore Wind Farm residual effects

Impact	Project phase	Significance of residual effect	Related CIEEM Assessment Significance of an Effect Terminology used in this chapter
Loss of hedgerow habitat	Construction	Minor positive	Not significant
Disturbance to birds that are designated features of the North Norfolk Coast SPA/Ramsar	Construction	Minor adverse	Not significant



Impact	Project phase	Significance of residual effect	Related CIEEM Assessment Significance of an Effect Terminology used in this chapter
Temporary habitat loss and disturbance from construction and use of access tracks to have adverse impacts on wintering pink-footed goose	Construction	Minor adverse	Not significant

10.48 Assessment of Cumulative Impacts

10.48.1 The below sections provide an assessment of the potential level of impact following the potential for cumulative impacts stated above.

Cumulative Impacts on Designated Sites

Construction

10.48.2 The Proposed Scheme, the Hornsea Project Three Offshore Wind Farm scheme and the Sheringham and Dudgeon Extension Projects have the potential to cumulatively impact the River Wensum SAC/SSSI during the construction period.

10.48.3 The HRA screening report for the A47 determined that there will be no Likely Significant Effects on any of the qualifying features of the River Wensum SAC. Embedded mitigation included within the Sheringham and



Dudgeon Extension Projects has avoided any direct impacts to this site, with a residual effect being assessed as not significant. The Hornsea Project Three Offshore Wind Farm scheme crosses the River Wensum but also includes embedded mitigation to avoid directly impacting this feature. The scale of the cable works is also not considered significant in relation to the anticipated construction works for the Proposed Scheme. The HRA for the Proposed Scheme concluded that there will be no adverse effects on the River Wensum SAC. Therefore, the likelihood of cumulative impacts to the River Wensum SAC/SSSI is low.

10.48.4 No residual significant effects to other designated sites are predicted due to the Proposed Scheme, the A47, the Hornsea Project Three Offshore Wind Farm scheme or the Sheringham and Dudgeon Extension Projects during the construction period. No cumulative impacts to these features are therefore predicted.

Operation

10.48.5 A significant negative residual effect on the following designated sites is predicted during the operation period of the Proposed Scheme due to a reduction in air quality:

- Wensum Pastures at Morton Hall CWS;
- Primrose Grove CWS;
- Broom and Spring Hills CWS;
- Land Adjoining Foxburrow Plantation CWS;
- River Wensum Pastures CWS; and,
- Fakenham Road RNR.

10.48.6 Chapter 8: Biodiversity of the A47 Environmental Statement stated for the River Wensum SSSI and County Wildlife Sites that “No significant



effects from air quality have been assessed". Chapter 8: Biodiversity of the A47 Environmental Statement also stated that once the scheme is operational, there will be no significant effect from pollution. No significant negative residual effects on designated sites are predicted due to the A47, the Hornsea Project Three Offshore Wind Farm scheme or the Sheringham and Dudgeon Extension Projects during the operation period.

10.48.7 No cumulative impacts to designated sites during the operation period are therefore predicted.

Cumulative Impacts on Habitats

Construction

10.48.8 The A47 is predicted to cause a significant negative residual effect on hedgerow HPI, deciduous woodland HPI, and floodplain grazing marsh HPI. Despite the A47 being adjacent to the Proposed Scheme, and the construction of the A47 being likely to take place alongside the construction of the Proposed Scheme, there is not the potential for a significant cumulative impact to these features during the construction period. No significant residual negative effects to hedgerows, deciduous woodland or floodplain grazing marsh are predicted due to the Proposed Scheme following the establishment of reinstated, created and enhanced habitats. The habitat compensation and enhancement for the Proposed Scheme have been designed with regard to the impacts on HPI and will result in the enhancement of woodland, the creation of woodland and scrub, and the creation or enhancement of grassland.

10.48.9 The residual impacts to HPI associated with the Hornsea Project Three Offshore Wind Farm scheme and the Sheringham and Dudgeon Extension Projects are also predicted to be not significant as they will be temporary and of moderate, low or negligible magnitudes respectively.

10.48.10 No cumulative impacts to HPI are therefore predicted.



10.48.11 A significant negative residual effect on notable, veteran and ancient trees is predicted during the operation period of the Proposed Scheme due to the loss of this irreplaceable habitat, and due to habitat degradation due to a reduction in air quality. No significant residual effects to habitats are predicted for the Hornsea Project Three Offshore Wind Farm scheme and the Sheringham and Dudgeon Extension Projects, and the A47 will not result in a significant negative residual effect on this habitat type. No cumulative impacts to notable, veteran and ancient trees are therefore predicted.

10.48.12 No cumulative effects are predicted for other habitat types during the construction period.

Operation

10.48.13 No cumulative impacts during the operation period are predicted.

Cumulative Impacts on Protected or Notable Species

Construction

10.48.14 There is the potential for cumulative impacts on Protected or Notable Species during the construction phase.

10.48.15 The A47 North Tuddenham to Easton will result in a residual significant negative effect on Barn Owl during the construction phase. This residual effect would be downgraded to slight adverse (and therefore a residual effect that is not significant) once landowner agreement for the mitigation boxes is in place, however. The Proposed Scheme will not result in a significant negative residual effect on Barn Owl, and therefore no cumulative impacts to this species during the construction period are predicted.

10.48.16 As no significant negative residual effects on other protected or notable species are predicted due to the A47, the Hornsea Project Three Offshore Wind Farm scheme or the Sheringham and Dudgeon Extension



Projects during the construction period, no other cumulative impacts to are predicted.

Operation

10.48.17 No significant negative residual effects on protected or notable species are predicted due to the proposed Scheme, the A47, the Hornsea Project Three Offshore Wind Farm scheme or the Sheringham and Dudgeon Extension Projects during the operation period. No cumulative impacts during the operation period are therefore predicted.

10.49 Monitoring

10.49.1 Ecological monitoring surveys would be required to assess the efficacy of the mitigation stated in the Additional Mitigation sections of this chapter and confirm the findings of this impact assessment. Monitoring will be targeted to mitigation actions that will require ongoing consideration of success and management of specific measures.

10.49.2 The monitoring of retained features and of mitigation measures is referenced in **Chapter 9: Landscape and Visual** (Document Reference: 3.09.00), and will be detailed fully in a Landscape Ecological Management Plan(s) (LEMP) for the Proposed Scheme, which will be required to be brought forward by planning condition.

10.49.3 Monitoring requirements during construction activities will be stated in the CEMP for the Proposed Scheme. Specific measures relating to monitoring for the duration of the Proposed Scheme will be presented within the Landscape and Ecological Management Plan.

Habitats

10.49.4 A survey of landscape and habitat creation areas including reinstated, created, and enhanced habitats would be completed in years



1, 3, 5, 10, 20 and 30 following the completion of the construction phase. This would assess the success of habitat mitigation measures.

Watercourses

10.49.5 River Condition Assessments of existing watercourse and enhancement watercourses will be carried out in years 1, 3, 5, 10, 20 and 30 (in accordance with Biodiversity Net Gain guidance) following the completion of the construction phase. This would assess the success of aquatic habitat mitigation measures and enhancements.

Water Vole

10.49.6 As per the Water Vole licence, targeted Water Vole surveys of watercourses and waterbodies within the Proposed Scheme would be completed for three years post-construction. The first survey will look to confirm establishment of good quality habitat for Water Vole and search for signs of Water Voles in the enhanced habitats of the connected watercourses to confirm use of the new culvert. Subsequent surveys will monitor habitat condition and connectivity through the new culvert and search for signs of Water Vole in all watercourses, which will include carrying out latrine counts to assess relative population density.

Barn Owl

10.49.7 Barn Owl surveys of existing nesting sites and newly installed barn owl boxes should be undertaken in years 1, 3 and 5 following the completion of construction mitigation works.

Badger

10.49.8 Pre-construction Badger surveys and continued monitoring throughout the construction stage will be necessary to ensure legal compliance and to overcome any survey limitations.



10.49.9 Badgers will also be surveyed during the operation period to ensure all licence conditions are met.

Desmoulin's Whorl Snail

10.49.10 A minimum of five years monitoring post-construction of newly created or enhanced ditch habitat to assess the success of habitat mitigation measures and enhancements.



10.50 References

Technical References

Natural Resources Wales. (2018). *Guidance for Pollution Prevention: Works and maintenance in or near water*. GPP5.

UK Statutory Instruments. (2017). *Conservation of Habitats and Species Regulations SI 2018/1012*. London: The National Archives.

Amphibian and Reptile Groups of the United Kingdom (ARG UK). (2010, May). Great Crested Newt Habitat Suitability Index. Retrieved from ARG UK: [Great Crested Newt Habitat Suitability Advice](#)

Andrews, R. (2013, December). In Practice Issue 82: Countryside Management (Dec 2013). Classification of badger setts *Meles meles* in the UK. A Review and Guidance for Surveyors. Retrieved from CIEEM: Bulletin of the Chartered Institute of Ecology and Environmental Management: [CIEEM](#)

Baker, J. (2016). Biodiversity Net Gain: Good Practice Principles for Development. CIEEM, CIRIA, IEMA. 10.13140/RG.2.2.24841.85608.

Ball, L., Still, R., Riggs, A., Skillbeck, A., Shardlow, M., Whitehouse, A., & Tinsley-Marshall, P. (2021). *Technical Report. The Bugs Matter Citizen Science Survey: counting insect 'splats' on vehicle number plates reveals a 58.5% reduction in the abundance of actively flying insects in the UK between 2004 and 2021*. Buglife and Kent Wildfire Trust.

Bas, C., Kuyper, T. W., Noordeloos, M. E., & Vellinga, E.C. (1988-2018). *Flora Agaricina Neerlandica, Volume 1 – Critical Monographs on Families of Agarics and Boleti Occurring in the Netherlands*. Rotterdam: A.A. Balkema.

Beaumont, W.R., Taylor, A. A., Lee, M. J., & Welton, J. (2002). *Guidelines for Electric Fishing Best Practice. R&D Technical Report W2-054/TR*. Bristol: Environment Agency.

Bibby, C., Burgess, N., & Hill, D. (1992). *Bird Census Techniques*. London: Academic Press.



Bibby, C., Burgess, N., & Hill, D. (1992). *Bird Census Techniques*. London: Academic Press.

Biggs, J., Ewald, N., Valentini, A., Gaboriaud, C., Griffiths, R., Foster, J., . . . Dunn, F. (2014). *Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (Triturus cristatus) environmental DNA*. Oxford: Freshwater Habitats Trust.

Bird Survey & Assessment Steering Group, (2022). *Bird Survey Guidelines for assessing ecological impacts, v.1.0.0*. Retrieved from Bird Survey Guidelines: [Bird Survey Guidelines](#)

Blaustein, A., Walls, S., Bancroft, B., Lawler, J., Searle, C., & Gervasi, S. (2010). Direct and indirect effects of climate change on amphibian populations. *Diversity*, 2: 281-313.

Bosanquet, S. D., Ainsworth, A. M., Cooch, S. P., Genney, D. R., & Wilkins, T. C. (2018). *Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 14 Non-lichenised Fungi*. Peterborough: Joint Nature Conservation Committee.

Breitenbach, J., & Kränzlin, F. (1984-2005). *Fungi of Switzerland, volumes 1-6. Lucerne: Mykologia*.

Bresadola, J. (1927-1933). *Iconographia Mycologica*. Milan: Museo Tridentino di Scienze Naturali.

British Standards Institution. (2003). *BS EN 14011:2003: Water Quality Sampling of Fish with Electricity*. London: BSI.

British Standards Institution. (2012). *BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters*. London: BSI

British Standards Institution. (2012). *BS5837:2012: Trees in Relation to Design, Demolition and Construction to Construction*. London: BSI.



British Standards Institution. (2014). *BS EN 14184:2014 Water quality. Guidance for the surveying of aquatic macrophytes in running waters*. London: BSI

Broadland District Council. (n.d.). Environmental Strategy 2022-2024. Retrieved from [Broadland District Council Environmental Strategy](#)

Brock, P. D. (2021). *Britain's Insects: A Field Guide to the Insects of Great Britain and Ireland*. Princeton, NJ: Princeton University Press.

Butcher, B., Carey, P., Edmonds, R., Norton, L., & Treweek, J. (2020, September). UK Habitat Classification – Habitat Definitions V1.1. Retrieved from UK Habitat Classification: [UK Habitat](#)

Butcher, B., Carey, P., Edmonds, R., Norton, L., & Treweek, J. (2020, September) *UK Habitat Classification User Manual Version 1.1*. Retrieved from UK Habitat Classification: [UK Habitat](#)

Cannon, C. H., Borchetta, C., Anderson, D. L., Arellano, G., Barker, M., Carron, G., . . . Spenko, M. (2021). Extending Our Scientific Reach in Arboreal Ecosystems for Research and Management. *Frontiers in Forests and Global Change*.

Carey, P., & Butcher, B. (2018, May). *UK Habitat Classification Field Key*. Retrieved from UK Habitat Classification: [UK Habitat](#)

CEH. (2016). Retrieved from UK Air Pollution Information System (APIS): [UK Air Pollution Information System](#)

Chanin, P. (2003a). *Ecology of the European Otter. Conserving Natura 2000 Rivers Ecology Series No, 10*. Peterborough: English Nature.

Chanin, P. (2013b). *Monitoring the Otter (Lutra lutra). Conserving Natura 2000 Rivers Ecology Series No, 10*. Peterborough: English Nature.

Cheffings, C., & Farrell, L. (2005). *The Vascular Plant Red Data List for Great Britain. Species Status No. 7. ISSN 1473-0154*. Peterborough: Joint Nature Conservation Committee.



Cianfrani, C., Le Lay, G., Maiorano, L., Satizábal, H. F., Loy, A., & Guisan, A. (2011). Adapting global conservation strategies to climate change at the European scale: The otter as a flagship species. *Biological Conservation*, 2068-2080. [Biological Conservation, 2068-2080](#).

CIEEM. (2017). Guidelines for Preliminary Ecological Appraisal, 2nd edition. Winchester.

CIEEM. (2018). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1*. Chartered Institute of Ecology and Environmental Management. Winchester.

CIEEM. (2019, April). *Advice note on the Lifespan of Ecological Reports and Surveys*. Retrieved from CIEEM: [CIEEM Advice Note](#)

CIEEM. (2019, April). *Advice note on the Lifespan of Ecological Reports and Surveys*. Retrieved from CIEEM: [CIEEM Advice Note](#)

CIEEM. (2020). *Guidelines for Accessing, Using and Sharing Biodiversity Data in the UK. 2nd Edition*. Chartered Institute of Ecology and Environmental Management. Winchester, UK.

CIEEM. (2023). *Advice on Ecological Assessment of Air Quality Impacts, Version 2*. Winchester, UK.: Chartered Institute of Ecology and Environmental Management. .

Cresswell, P., Harris, S., Bunce, R. G., & Jefferies, D. J. (1989). The badger (*Meles meles*) in Britain: present status and future population changes. *Biological Journal of the Linnean Society* 38(1), 91-101.

Cresswell, W., & Whitworth, R. (2004). *An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt Triturus cristatus (ENRR576)*. Peterborough: English Nature.

Davy-Bowker, J., Clarke, R., Corbin, T., Vincent, H., Pretty, J., Hawczak, A., . . . Jones, I. (2008). *River Invertebrate Classification Tool. (SNIFFER project WFD72C)*. Edinburgh, Scotland, UK: Scotland & Northern Ireland Forum for Environmental Research.



Dean, M., Strachan, R., Gow, D., & Andrews, R. (2016). *The Water Vole Mitigation Handbook (The Mammal Society Mitigation Guidance Series)*. London: The Mammal Society.

Defra. (2007). *Hedgerow Survey Handbook. A standard procedure for local surveys in the UK*. London: Defra.

DEFRA; Natural England. (2012, March). *Biodiversity Offsetting Pilots - Technical Paper: the metric for the biodiversity offsetting pilot in England*. Retrieved from [DEFRA Bio Technical Paper](#)

Drake, C., Lott, D., Alexander, K., & Webb, J. (2007). *Surveying terrestrial and freshwater invertebrates for conservation evaluation*. Natural England Research Report NERR005. Peterborough: Natural England.

English Nature. (2001). *Great crested newt mitigation*. Peterborough: English Nature.

Environment Agency. (2001). *Electric fishing Code of Practice*. EAS/6100/4/02. Bristol: Environment Agency.

Environment Agency. (2003). *River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual 2003 version*. Warrington: Environment Agency.

Environment Agency. (2017). *Environment Agency Operational Instruction 118_05 Quality Assurance (AQC, Audit and Ring Test) programme for freshwater macroinvertebrate riverine sample analysis*.

Environment Agency. (2022). *Catchment Data Explorer*. Retrieved from Department for Environment Food & Rural Affairs: [Environment Catchment Planning](#)

Equinor. (2022). *Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Environmental Statement Volume 1 Chapter 20 - Onshore Ecology and Ornithology*.



Froglife. (1999). *Reptile Survey: an introduction to planning, conducting and interpreting surveys for snake and lizard conservation. Froglife Advice sheet 10*. Halesworth.

Gent, T., & Gibson, S. (2003). *Herpetofauna Workers' manual*. Peterborough: Joint Nature Conservation Committee.

Gilbert, G., Gibbons, D., & Evans, J. (1998). *Bird Monitoring Methods: A Manual of Techniques for UK Key Species*. Sandy, Bedfordshire, England.: The Royal Society for the Protection of Birds.

Gillings, S., Wilson, A. M., Conway, G. J., Vickery, J., Fuller, R., Beavan, P., . . . Toms, M. (2008). *Winter Farmland Bird Survey. BTO Research Report No. 494*. Thetford: British Trust for Ornithology.

Greater Norwich Local Plan. (2024). *Document 1 – The Strategy (Adoption Version for Councils, March 2024)*. Retrieved from [Document 1 - The Strategy \(Adoption Version for Councils, March 2024\)](#)

Gurnell, A., England, J., Scott, S., Shuker, L., Foster, I., Downs, P., . . . Jeffries, R. (2021). *A Guide to Assessing River Condition Part of the Rivers and Streams Component of The Biodiversity Net Gain Metric. BM3*. London: Queen Mary University of London.

Henderson, D. M., Orton, P. D., & Watling, R. (1970-2005). *Henderson, D. M., Orton, P. D. & Watling, R. (1970-2005). British Fungus Flora, volumes 1-9*. Edinburgh: Royal Botanic Gardens.

Her Majesty's Stationary Office (HMSO). (1981). *Wildlife and Countryside Act 1981*. Retrieved from Legislation: [Legislation](#)

Her Majesty's Stationary Office (HMSO). (1992). *Protection of Badgers Act 1992*. Retrieved from Legislation: [Legislation](#)

Her Majesty's Stationary Office (HMSO). (1997). *The Hedgerows Regulations 1997*. Retrieved from Legislation.gov.uk: [Legislation](#)



Her Majesty's Stationary Office (HMSO). (2006). *Natural Environment and Rural Communities Act*. HMSO, Norwich. Retrieved from Legislation.gov.uk: [Legislation](#)

Her Majesty's Stationary Office (HMSO). (2017a). *The Conservation of Habitats and Species Regulations*. HMSO, Norwich. Retrieved August 2022, from Legislation.gov.uk: [Legislation](#)

Her Majesty's Stationary Office (HMSO). (2021). *Environment Act 2021*. Retrieved from Legislation.gov.uk: [Legislation](#)

Highways Agency. (2020, March). *Design Manual for Roads and Bridges. LA 108 Biodiversity. Revision 1*. Retrieved from Standards for Highways: [Standards for Highways](#)

Highways England. (2021). *Chapter 8 – Biodiversity: A47 North Tuddenham to Easton Dualling*.

Highways England. (Advice Note HA 207/07). *Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment: Air Quality*.

Holman, C., e. a. (2014). *IAQM Guidance on the assessment of dust from demolition and construction*. London: Institute of Air Quality Management.

Jehle, R. (2000). The Terrestrial Summer Habitat of Radio-tracked Great Crested Newts (*Triturus cristatus*) and Marbled Newts (*T. marmoratus*). *Herpetological Journal* 10, 137-142.

Jehle, R., & Arntzen, J. W. (2000). Post-breeding migrations of newts (*Triturus cristatus* and *T. marmoratus*) with contrasting ecological requirements. *Journal of Zoology*, 251, 297-306.

JNCC. (2010). *Handbook for Phase 1 Habitat Survey – a technique for environmental audit*. Peterborough: Joint Nature Conservation Committee. ISBN 0 86139 636 7.



Joyce, P. a. (2008). Shredder fecal pellets as stores of allochthonous organic matter in streams. *Journal of the North American Benthological Society (JNABS)*, 1868–1880.

Judge, J., Wilson, G., Macarthur, R., McDonald, R., & Delahay, R. (2017). Abundance of badgers (*Meles meles*) in England and Wales. *Scientific Reports*, 7(1), 276. doi: 10.1038/s41598-017-00378-3. PMID: 28325904; PMCID: PMC5428277.

Kerney, M. (1999). *Atlas of the land and freshwater molluscs of Britain and Ireland*. Colchester: Harley Books.

Killeen, I. J. (2003). *Ecology of Desmoulin's Whorl Snail. Conserving Natura 2000 Rivers Ecology Series No, 6*. Peterborough: English Nature.

Knusden, H., & Vesterholt, J. (2008). *Funga Nordica*. Copenhagen: Nordsvamp.

Konrad, P., & Maublanc, A. (1924-1930). *Icones Selectae Fungorum*. Paris: Paul Lechevalier.

Kühner, R. (1935). *Le Genre Galera*. Paris: Paul Lechevalier.

Kühner, R., & Romagnesi, H. (1953). *Flora analytique des Champignons superieurs*. Paris: Mason & Cie.

Lange, J. E. (1935-1940). *Flora Agaricina Danica, volumes 1-5*. Copenhagen: Society for the Advancement of Mycology in Denmark & The Danish Botanical Society.

Legon, N. W., & Henrici, A. (2005). *Checklist of the British & Irish Basidiomycota*. Kew: Royal Botanic Gardens.

Liles, G. (2003). *Otter Breeding Sites, Conservation and Management. Conserving Natura 2000 Rivers Conservation Techniques Series No. 5*. Peterborough: English Nature.

Maas Geesteranus, R. A. (1992). *Mycenas of the Northern Hemisphere, Vols. 1 & 2*. Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen.



Mather-Gratton, Z. (2021, February 22). *The effect of the climate crisis on UK reptile populations*. Retrieved from Froglife: [The Effect of the Climate Crisis on UK Reptil Populations](#)

McGuire, C., & Whitfield, D. (2017). *National Water Vole Database and Mapping Project, PART 1: Project Report 2005-2015*. . Curdridge: Hampshire and Isle of Wight Wildlife Trust.

Moorcroft, M., & Speakman, L. (2015). *Biodiversity Climate Change Impacts Summary Report. Living With Environmental Change*. ISBN 978-0-9928679-6-6. Retrieved from UK Research and Innovation: [Biodiversity Climate Change Impacts](#)

Moser, M. (1967-1983). *Kleine Kryptogamenflora: Die Röhrlinge und Blatterpilze (polyporales, Boletales, Agaricales, Russulales)*. Stuttgart: Gustav Fischer Verlag.

National Atmospheric Emissions Inventory. (2018, May). *Air Quality Pivot Tables*. Retrieved from [National Atmospheric Emissions Inventory](#)

Natural England. (1993, February 4). *Designated Sites View. River Wensum SSSI*. Retrieved from Natural England: [Natural England Designated Sites](#)

Natural England. (2014). *Site Improvement Plan. River Wensum*. Peterborough: Natural England.

Natural England. (2019a). *European Site Conservation Objectives: Supplementary advice on conserving and restoring site features. River Wensum Special Area of Conservation (SAC). Site code: UK0012647*. Peterborough: Natural England.

Natural England. (2022). *European Site Conservation Objectives: Supplementary advice on conserving and restoring site features. River Wensum Special Area of Conservation (SAC) Site Code: UK0012647*. Retrieved from [Natural England Designated Sites](#)



Natural England. (2023). *Priority Habitats Inventory (England)*. Retrieved May 05, 2023, from [Priority Habitats Inventory \(England\)](#)

Natural England. (2023). *The Biodiversity Metric 4.0 (JP039)*. Retrieved May 05, 2023, from [Natural England](#)

Oldham, R. S., Keeble, J., Swan, M. J., & Jeffcote, M. (2000). Evaluating the suitability of habitat for the great crested newt (*Triturus cristatus*). *The Herpetological Journal* 10(4), 143-155.

Orsted. (2018). *Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 3, Chapter 3 – Ecology and Nature Conservation*.

Peay, S. (2002a). A Standardised Monitoring Protocol for White-clawed Crayfish, *Austropotamobius pallipes* in the UK SAC Rivers. Life in UK Rivers Project. Contract LIF 02-11-37. *English Nature*, 58.

Peay, S. (2002b). Monitoring Protocol for White-clawed Crayfish, Field-testing in River Eden Tributaries, Summer 2002. Life in UK Rivers Project. Contract LIF 02-11-37. *English Nature*, 57.

Peay, S. (2003). Monitoring the White-clawed Crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No. 1. *English Nature*, Peterborough.

Perrow, T. &. (2003). *Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4*. Peterborough: English Nature.

Petrovan, S., & Schmidt, B. (2016). Volunteer Conservation Action Data Reveals Large-Scale and Long-Term Negative Population Trends of a Widespread Amphibian, the Common Toad (*Bufo bufo*). *PLoS ONE* 11(10): e0161943. doi:10.1371/journal.pone.0161943, 1-12.

Popper, A. N., & Hastings, M. C. (2009). The effects of human-generated sound on fish. *Integrative Zoology*, 4, 43-52.

Reading, C. (2007). Linking global warming to amphibian declines through its effects on female body condition and survivorship. *Oecologia* [Oecologia](#)



Rodwell, J. S. (2006). *National Vegetation Classification: Users' handbook*. Peterborough: Joint Nature Conservation Committee.

Roper, T. (2010). *Badger (Collins New Naturalist Library, Book 114)*. UK: HarperCollins.

Sainsbury, K. A., Shore, R. F., Schofield, H., Croose, E., Campbell, R. D., & McDonald, R. A. (2019). Recent history, current status, conservation and management of native mammalian carnivore species in Great Britain. *Mammalian Review*, 49: 171-188. [Mammalian Review](#).

Sanderson, N. A., Wilkins, T., Bosanquet, S., & Genney, D. (2018). *Guidelines for the Selection of Biological SSSIs. Part 2: Detailed Guidelines for Habitats and Species Groups. Chapter 13 Lichens and associated microfungi*. . Peterborough: Joint Nature Conservation Committee.

Shawyer, C. R. (2011). Barn Owl *Tyto alba* Survey Methodology and Techniques for use in Ecological Assessment: Developing Best Practice in Survey and Reporting. Winchester: IEEM.

Smith, C. W., Aptroot, A., Coppins, B. J., Fletcher, A., Gilbert, O. L., P.W., J., & Wolseley, P. (2009). *The Lichens of Great Britain and Ireland*. London: British Lichen Society.

Stanbury, A. J., Eaton, M. A., Aebischer, N. J., Balmer, D., Brown, A. F., Douse, A., . . . Win, I. (2021). The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds*. *British Birds*, 723-747.

Standards For Highways. (2022, October). Design Manual for Roads and Bridges. Retrieved from Standards For Highways: [Standards for Highways](#)

Strachan, R., & Moorhouse, T. (2006). *Water Vole Conservation Handbook, Second Edition*. Oxford: Wildlife Conservation Research Unit, University of Oxford.



Taylor, M., & Marchant, J. H. (2011). *The Norfolk Bird Atlas – Summer and Winter Distributions 1999-2007*. Thetford: British Trust for Ornithology.

The Barn Owl Trust. (2012). *Barn Owl Conservation Handbook: A Comprehensive Guide for Ecologists, Surveyors, Land Managers and Ornithologists (Conservation Handbooks)*. Exeter: Pelagic Publishing.

The Council of the European Communities. (1992). Conservation of natural habitats and of wild fauna and flora Council Directive 92/43/EEC. *Official Journal of the European Communities, No L 206, 7-50*.

The European Parliament and The Council of The European Union. (2009, November 30). *Directive 2009/147/EC of the European Parliament and of the Council*. Retrieved from Legislation.gov.uk: [Legislation](#)

UK Habitat Classification. (2020, September). *UK Habitat Classification Basic Edition: Suggested Symbology for Maps*. Retrieved from UK Habitat Classification: [UK Habitat](#)

UKTAG (United Kingdom Technical Advisory Group). (2021). *UKTAG River Assessment Method Benthic Invertebrate Fauna: Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT)*. Retrieved from Water Framework Directive UKTAG: [Invertebrates](#)

University of East Anglia's School of Environment. (2020, October). *Environmental Policy*. Retrieved from Norfolk County Council: [Norfolk County Council Policies and Strategies](#)

Webb, J., Heaver, D., Lott, D., Dean, H., van Breda, J., Curson, J., . . . Foster, G. (2018). *Analytical tool developed by Natural England and the Centre for Ecology & Hydrology to assist invertebrate nature conservation in England*. Retrieved from Pantheon: [Pantheon](#)

WFD-UKTAG. (2014). *UKTAG River Assessment Method Macrophytes and Phytobenthos*. Stirling: Water Framework Directive – United Kingdom Advisory Group.



Woods, R., & Coppins, B. (2012). *A Conservation Evaluation of British Lichens and Lichenicolous Fungi, Species Status No.13*. Peterborough: JNCC.