



THE TRANSPORT AND WORKS ACT 1992
THE TRANSPORT AND WORKS (APPLICATIONS AND OBJECTIONS PROCEDURE) (ENGLAND
AND WALES) RULES 2006
THE TRANSPORT AND WORKS (INQUIRIES PROCEDURE) RULES 2004
ACQUISITION OF LAND ACT 1981
THE COMPULSORY PURCHASE (INQUIRIES PROCEDURE) RULES 2007

GREATER CAMBRIDGE PARTNERSHIP
(ON BEHALF OF CAMBRIDGESHIRE COUNTY COUNCIL)
THE CAMBOURNE TO CAMBRIDGE (PROPOSED ORDER) INQUIRY
Commencing 16th September 2025

Main Proof of Evidence
on
Ecology & Nature Conservation Matters

Dominic M G Woodfield CEcol CEnv MCIEEM
For
Cambridge Past Present and Future
&
Coton Parish Council
(OBJ-251)

THE TRANSPORT AND WORKS ACT 1992
THE TRANSPORT AND WORKS (APPLICATIONS AND OBJECTIONS PROCEDURE) (ENGLAND
AND WALES) RULES 2006
THE TRANSPORT AND WORKS (INQUIRIES PROCEDURE) RULES 2004
ACQUISITION OF LAND ACT 1981
THE COMPULSORY PURCHASE (INQUIRIES PROCEDURE) RULES 2007

GREATER CAMBRIDGE PARTNERSHIP
(ON BEHALF OF CAMBRIDGESHIRE COUNTY COUNCIL)
THE CAMBOURNE TO CAMBRIDGE (PROPOSED ORDER) INQUIRY
Commencing 16th September 2025

Main Proof of Evidence
on
Ecology & Nature Conservation Matters

Dominic M G Woodfield CEcol CEnv MCIEEM
for
Cambridge Past Present and Future
&
Coton Parish Council
(OBJ-251)

Bioscan Ref: E2257/Pr-vf

Inquiry Document Reference	TBC
Author	DW
Date	Final 10/08/25

BIOSCAN (UK) Ltd
The Old Parlour
Little Baldon Farm
Little Baldon
Oxford OX44 9PU

Tel: (01865) 341321
Fax: (01865) 343674
www.bioscanuk.com

CONTENTS

1.	WITNESS BACKGROUND AND QUALIFICATIONS	1
2.	SCOPE AND STRUCTURE OF EVIDENCE	4
3.	BASELINE - MADINGLEY ROAD VERGES AND OTHER HIGHWAY LAND	8
4.	HABITAT LOSSES ARISING FROM THE CPPF SCHEME	15
5.	HABITAT LOSSES ARISING FROM THE GCP SCHEME	22
6.	IMPLICATIONS OF BOTH SCHEMES FOR BARBASTELLE AND OTHER FAUNA	33
7.	GCP's CONSIDERATION OF IN-HIGHWAY ALTERNATIVES	42
8.	NATIONAL AND LOCAL PLANNING POLICY COMPLIANCE	47
9.	OVERALL CONCLUSIONS	57
10.	WITNESS DECLARATION	59

FIGURES

DW1-DW2	Baseline habitat mapping – Madingley Road (CPPF scheme)
DW3-DW4	Post-intervention (post-development) habitat mapping (CPPF scheme)
DW5-DW6	Habitat retention mapping (CPPF scheme)

APPENDICES

Appendix DW1: UKHab Survey Notes and condition assessments – Madingley Road highways land

Appendix DW2: René E. van Dijk et. al. 2025 *Road traffic has a consistent negative impact on a wide range of bird species in different habitats*. Landscape Ecology 40, no.118.

Appendix DW3: Statutory Biodiversity Metric calculation - CPPF Scheme – pdf readout*

Appendix DW4: WSP's Statutory Biodiversity Metric calculation for GCP scheme (as received from GCP 6th June 2025)*

Appendix DW5: BRIG (ed. Ant Maddock) (2008) *UK Biodiversity Action Plan; Priority Habitat Descriptions. Traditional Orchards*. JNCC

Appendix DW6: Note on technical errors in WSP's BNG calculation for GCP scheme

Appendix DW7: GCP Scheme –extrapolated Metric Calculation for off-road section east of St Neots Rd (errors uncorrected)*

Appendix DW8: GCP Scheme –extrapolated Metric Calculation for off-road section east of St Neots Rd (corrected for WSP's tree loss error)*

Appendix DW9: GCP Scheme –extrapolated Metric Calculation for off-road section east of St Neots Rd (corrected for WSP's tree loss error and Traditional Orchard classification/mapping errors)*

*.xslm file copies supplied separately and on request.

1 WITNESS BACKGROUND AND QUALIFICATIONS

- 1.1 My name is Dominic Macsen Geraint Woodfield. I am a professional ecologist and the Managing Director of Bioscan (UK) Limited, a leading ecological consultancy established in 1984. I am also a non-executive director of Biofarm, a company specialising in assisting developers, landowners and planning authorities with the practical delivery of statutory Biodiversity Net Gain.
- 1.2 I hold an honours degree in Environmental Studies with Geography from Manchester Metropolitan University and I am a registered Chartered Ecologist (CEcol), Chartered Environmentalist (CEnv) and a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM).
- 1.3 Following graduation in 1993, and after a short period working for the United States Fish and Wildlife Service, I returned to the UK in 1994 and became a professional ecologist and environmental consultant. I joined the applied ecology consultancy Bioscan in 1998, was made a director around a year later and became the Managing Director in 2008.
- 1.4 Bioscan undertakes a broad range of ecology work covering ecological site appraisal, Environmental Impact Assessment, research, creative conservation, management planning and expert witness work. Clients originate from both the private and public sectors, with some also from the charity sector. Our private sector clients include house builders, commercial property developers, minerals operators, major renewable- and conventional energy suppliers and the construction and transport industry. Public and charity sector clients over the years have included local authorities, Natural England, the RSPB, the National Trust and the Environment Agency.
- 1.5 My technical ecological expertise encompasses a broad range of UK habitats from intertidal to sub-montane communities, rare plant communities and flora and a wide

range of fauna including birds, bats, badgers, herpetofauna, water voles, dormice, otters and some insect groups. I hold, or have held, licences for many of these taxa.

- 1.6 My environmental planning expertise includes past co-ordination of multi-disciplinary EIAs for commercial and residential development projects as well as responsibility for the technical input on ecology for over one hundred and fifty other formal EIA projects and well in excess of a thousand projects overall since 1994. I am therefore closely familiar with the regulatory and good practice requirements of the EIA process, including the workings of the mitigation hierarchy (a matter of particular relevance to this case), and of the role of ecology in planning policy and decision making more generally.
- 1.7 I have presented expert evidence, both for and against the granting of consent, at numerous public inquiries covering a wide range of developments, from large residential schemes, through energy and minerals developments, to Transport and Works Act projects, Nationally Significant Infrastructure Projects and various other projects involving CPO elements. Matters covered in expert evidence have included the full range of statutory and non-statutory designated sites, protected species including bats, badgers, great crested newts and dormice, Habitats Regulations assessments and compliance, ancient woodland, unimproved grasslands, rare invertebrates, peat ecology, carbon sequestration, biodiversity net gain, waxcap fungi, charophytes and protected bird and wind turbine interactions. I have also presented evidence and expert testimony on a number of occasions to the senior courts.
- 1.8 In February 2025, I was asked by Richard Buxton Solicitors, on behalf of Cambridge Past Present and Future (“**CPPF**”) and Coton Parish Council (“**CPC**”), to consider the relative performance, in environmental impact terms, of the guided busway route proposed by Greater Cambridge Partnership (“**GCP**”) as against an ‘in-highway’ alternative being advanced by CPPF/CPC and involving improvements to the existing A1303 Madingley Road between Madingley Mulch Roundabout and the Madingley Road Park and Ride, just east of the M11 junction and overbridge. The latter option is

being advanced by CPPF/CPC as (*inter alia*) a means to avoid the significant land-take, CPO acquisition and related environmental impacts of the GCP scheme, including impacts on important ecological resources and designated wildlife sites such as Coton Orchard. The applicant accepts and it is therefore a matter of common ground that the ecological impacts from the GCP scheme will be significant adverse at up to county level.

1.9 I was subsequently appointed to carry out the necessary surveys and comparative assessment tasks to arrive at a clear and/or determinative position on the comparative ecological impacts of the GCP and CPPF options, and to produce evidence for this inquiry on those matters. This I have subsequently done, and the results are included in this proof.

1.10 The evidence I have prepared and provide for this Inquiry and in this Proof of Evidence is true and has been prepared and given in accordance with the guidance of my professional institute, the Chartered Institute of Ecology and Environmental Management. I confirm that the opinions expressed are my true and professional opinions.

2 SCOPE AND STRUCTURE OF EVIDENCE

2.1 Context, scope and structure of evidence

- 2.1.1 My colleagues Steve Johnstone, Edward Leigh and Louise Hirst collectively address the question of whether the in-highway alternative shown on Civilistix engineering drawings C-001 to C-005 (as appended to Mr Johnstone's proof of evidence) ("**the CPPF scheme**") is deliverable in highways engineering terms, and at least comparable to the application scheme ("**the GCP scheme**") in achieving the desired traffic and transport, carbon saving and related policy objectives.
- 2.1.2 My evidence proceeds from the conclusions arrived at by these witnesses – i.e. that the CPPF scheme is deliverable and either better, or at least comparable, in effectiveness to the GCP scheme as regards such matters.
- 2.1.3 Taking that as a starting point, I focus on the relative performance of the GCP and CPPF schemes from the perspective of environmental impacts, and specifically nature conservation and ecology/biodiversity matters. I do this in the context that it is an accepted and central tenet of sensible and sustainable land-use planning, and central to the application of the 'mitigation hierarchy', that the least environmentally damaging option for delivery of an infrastructure scheme should be adopted, all other things being equal (see e.g. [CD8-01 National Planning Policy Framework \(NPPF\) - updated Feb 2025](#) para 193a)
- 2.1.4 To assist the inquiry on this comparison I have conducted surveys of the baseline ecology conditions on the highways land that would be affected by road-widening and other interventions under the CPPF scheme. This is the land within the A1303 (Madingley Road) highway boundary between Madingley Mulch roundabout in the west and the entrance to the Madingley Road Park and Ride in the east (a distance of just over 3km).

2.1.5 Using that information, I have worked with my colleagues Mr Johnstone and Mr Leigh to explore how delivery of the bus lane and related highways works could be refined or adjusted to minimise vegetation and tree loss within the highway boundary either side of the existing Madingley Road. The outcome of this process is the Civilistix drawings appended to Mr Johnstone's proof of evidence.

2.1.6 The remainder of my proof is structured as follows:

- In **Section 3**, I summarise the baseline ecological conditions on the highways land that would be affected by the CPPF scheme, with further technical detail appended.
- In **Section 4**, I consider the ecological impacts that would occur as a consequence of implementing the CPPF scheme, including via use of quantitative calculations of habitat losses using the Statutory Biodiversity Metric.
- In **Section 5**, I compare those impacts and Statutory Metric outputs to those arising from the GCP scheme (and upon which the Environmental Impact Assessment of that scheme is based) and offer my observations on the comparative performance of the two scheme alternatives.
- In **Section 6**, I consider the comparative risks the two schemes pose to barbastelle bats (and by extension to the Eversden and Wimpole Woods SAC), as well as to other fauna.
- In **Section 7**, I review GCPs contemplation of the ecological performance of an in-highway alternative along Madingley Road and offer comments on the veracity and reliability of the conclusions they have reached.

- In **Section 8**, I consider whether the GCP scheme complies with national and local planning policy on nature conservation, and review the comparative performance of the CPPF scheme against the same policy framework, having particular regard to matters such as the mitigation hierarchy.
- Finally, in **Section 9**, I offer my overall conclusions on why the CPPF route should be preferred on ecology and nature conservation grounds.

2.2 Core documents to have to hand when reading this proof of evidence

2.2.1 To assist with navigation, I have listed below (and embed hyperlinks to) a non-exhaustive list of the main core inquiry documents recommended to have to hand when reading this proof of evidence:

GCP Scheme Plans

- [CD1-12.06](#) Engineering Drawings
- [CD1-12.01](#) Works Plans and Land Plans (Order)
- [CD1-16.04](#) Proposed Site Plans

GCP Scheme EIA

- [CD1-10.01](#) Environmental Statement (ES Main Report) (Chapter 9 – ‘Effects on the natural environment’)
- [CD1-11.05](#) Technical Report 5 – Ecology
- [CD1-11.05 TR5.04](#) Botanical Survey Report (TR5.4)
- [CD1-11.05 TR5.05](#) Bat Activity Report (TR5.5)
- [CD1-11.05 TR5.06](#) Bat Roost Report (TR5.6)
- [CD1-11.05 TR5.10](#) Hedgerow Survey Report (TR5.10)
- [CD1-11.05 TR5.16](#) Ecological Survey Validity Report 2024 (TR5.16)

GCP Scheme EIA addenda

- [CD1-10.06](#) Environmental Statement Addendum, June 2025

- [CD1-11.14.01](#) Technical Report 14 - Arboriculture Report
- [CD1-11.14.02](#) Appendix 14.1 - Coton Orchard Veteran Tree Review
- [CD1-11.14.03](#) Appendix 14.2 - Draft Veteran Tree Mitigation (including Compensation) Strategy
- [CD1-10.07](#) Environment Statement (Addendum 2 and Clarifications) July 2025

GCP Scheme BNG Assessment

- [CD1-11.05 TR5.07](#) Biodiversity Statement and Biodiversity Net Gain Assessment
(Note that the Metric calculation Appendix TR5.7 upon which this document relies was not provided with the TWA application and has had to be obtained separately from the applicant - it is appended at **Appendix DW4** to my proof)
- [CD8-30](#) Department for Environment, Food and Rural Affairs: The Statutory Biodiversity Metric - User Guide 2024

GCP Scheme HRA

- [CD1-11.05 TR5.11](#) Statement to Inform Habitats Regulations Assessment (TR5.11)

GCP Scheme (analysis of alternatives)

- [CD13-03](#) Atkins: Analysis of consultation proposals 2016
- Skanska (02/02/2017): "Cambourne to Cambridge, Better Bus Journeys, A1303 Busway Feasibility"¹
- [CD13-07](#) Mott MacDonald – Technical Note on Cambourne to Cambridge Better Public Transport 2019
- [CD9-31](#) CPPF Alternative - Engineering Assessment, WSP July 2025²

¹ I believe this is not a core inquiry document, but it is accessible via link to the GCP asset library [here](#)

² Note that this document is not an assessment of the CPPF alternative as defined in this evidence and which is as set out in Civilistix drawings C-001 to C-005 appended to Mr Johnstone's proof (i.e. the 'CPPF scheme').

3 CPPF SCHEME - BASELINE

3.1 Surveys carried out

3.1.1 Over three visits spanning May to July 2025, I and colleagues conducted habitat classification and condition surveys of the highways land either side of the A1303 Madingley Road between the western approach to Madingley Mulch Roundabout and the entrance to the Madingley Road Park and Ride, just east of the M11 overbridge. The purpose of these surveys was to classify the habitats that may be affected by the CPPF scheme and establish their baseline value.

3.1.2 My initial survey was conducted on 25 May 2025, and follow-up surveys to ground-truth matters following consideration of a workable engineering design were carried out on 8th and 30th July 2025. On the last of these dates, I also visited Coton Orchard and made a brief visit to the West Cambridge University Campus to investigate apparent errors found in a review of GCP's BNG assessments of these parts of the GCP scheme.

3.1.3 Further detail on the results of the Madingley Road surveys is attached at **Appendix DW1**. I summarise the main points below.

3.2 Habitats and flora

3.2.1 Other than the existing A1303 surfaced carriageway, related highways infrastructure such as periodic signage, traffic islands and bell-mouth accesses, and the extant shared foot/cycleway, the undeveloped highways land between Madingley Mulch roundabout and the Madingley Road park and ride typically comprises linear bands of vegetation ranging from a metre or less of sparsely vegetated road-salt-tolerant communities immediately adjoining the kerb, through a few metres of coarser unkempt grasslands and ruderals or mown swards, to a few metres of shade tolerant

vegetation approaching and extending beneath the canopy of hedgerows or trees that mark the outer margins of the highways land corridor. There are also lengths of seasonal ditch, sections of verge-land adjoining Madingley Wood SSSI that have developed into secondary woodland and occasional free-standing (i.e. non-woodland or non-hedgerow) trees.

3.2.2 In UKHab³ and Biodiversity Net Gain (BNG) terminology, the above vegetation communities fall into the following habitat types listed by their primary and secondary UKHab codes, with the equivalent habitat in BNG terms given in brackets:

- g3c5 *Arrhenatherum* neutral grassland (other neutral grassland)
- g4 modified grassland (modified grassland)
- w1f7 Other lowland mixed deciduous woodland (lowland mixed deciduous woodland and other broadleaved woodland)
- h2a native hedgerow (inc. hedgerow with trees, native hedgerow etc)
- 16 – tall forbs (tall forbs)
- u1b – developed land, sealed surface (developed land, sealed surface)
- u1c – artificial unvegetated, unsealed surface (artificial unvegetated, unsealed surface)
- u1d – suburban mosaic of developed and natural surface (various)
- u1f (81) – sparsely vegetated urban land (ruderal/ephemeral)
- 32/33 – individual (non-woodland, non-hedgerow) trees (rural tree/line of trees)
- 50 – dry or seasonally wet ditch (ditches).

3.2.3 The distribution of each of the above habitats within the highways land is shown on **Figures DW1-DW2. Appendix DW1** provides more detailed descriptions, with an account of the dominant or more notable plant species associated with each of the

³ The UKHab system (UKHab Ltd (2023). UK Habitat Classification Version 2.0 (at <https://www.ukhab.org>)) is now the standard habitat survey and classification system for use in EIA and other forms of formal ecological impact assessment (superseding the Phase 1 methodology that was in use since the 1980s). The UKHab system forms the basis of the habitat classification and scoring categories used in the BNG system and its Statutory Metric, albeit there are some differences between the two. Figures DW1-DW2 map the BNG Habitat equivalents, reflecting the inputs to the Metric at Appendix DW3.

above habitat types and categories, and a summary of the condition assessment results for each.

3.2.4 In general, the habitats present within the highways land are representations of common types of grassland and hedgerow vegetation found in association with trunk road verges up and down the country. Close to the carriageway there is typically a narrow strip of varying width of sparse and often short grassland that is distinctive due to the presence of species tolerant of periodic elevated levels of salt spray (from winter-applied road salt) and sometimes also the effects of compaction and disturbance from vehicle overrun. Of some academic botanical interest in this zone, but of low conservation importance, is the presence of halophytes such as Danish scurvy-grass, narrow-leaved pepperwort, buck's-horn plantain, reflexed saltmarsh grass and grass-leaved orache.

3.2.5 Moving further from the kerb, the bare ground component tends to diminish, and the grassland tends to become taller and thicker, except where regularly mown (such as outside the American Cemetery). These taller, coarse grasslands are of a type near-ubiquitous along road verges in Southern Britain and are characterised by the presence and dominance of robust grass species such as false oat-grass, couch and cock's-foot and typically a paucity of broad-leaved (herb or forb) species, although there are localised spots with more interesting species. In UKHab terms these grasslands vary from mown or grown out representations of 'modified' grassland (e.g. where previous highways works have resulted in reinstatement and active seeding and/or extant or historic levels of Nitrogen deposition have suppressed diversity) through to 'other neutral grasslands' falling within the various subcommunities of NVC⁴ community MG1 *Arrhenatherum* grassland. Locally, there are better quality examples where weak indicators of unimproved grassland such as knapweed, ox-eye daisy and bird's-foot trefoil occur, however this is a common characteristic of the community type and does not change the theme of pretty unremarkable road verge grasslands along this section of the A1303.

⁴ NVC = National Vegetation Classification – after Rodwell, J.S. (ed.) 1991-2000. *British Plant Communities* (Volumes 1-5). Cambridge University Press.

- 3.2.6 Regular mowing, such as outside the American Cemetery and elsewhere in front of residential property boundaries, has locally suppressed or eliminated the taller grasses in favour of species such as perennial rye grass, creeping bent, smooth meadow grass, annual meadow grass and red fescue. Herbs in these swards can attain reasonable frequency, but are generally ubiquitous species such as daisy, creeping buttercup, self-heal and ribwort plantain. One species of more note was however found in the tightly mown swards outside the American Cemetery – this being knotted hedge parsley – a somewhat localised species in Cambridgeshire.
- 3.2.7 Moving still further away from the kerb and/or the foot/cycle pathway, vegetation that has had extended periods without cutting has led to the coarse MG1-type grasslands becoming colonised and then dominated by bramble and/or dewberry combined with tall forbs such as hogweed, stinging nettle, mugwort, cow parsley and occasionally rosebay willowherb. This marks a transition towards more shade-tolerant communities under the canopies of the hedgerows or woodland edge marking the outer highway boundary, where the graminoid component peters out or becomes restricted to shade tolerant grasses such as rough meadow grass and (locally) wood false brome, and where the forb component becomes rather more dominant. Generally, the field layer in these areas is unremarkable with ivy, cow parsley, stinging nettle and hedge garlic typical, and winter heliotrope locally dominant along the southern side. Adjoining Madingley Wood SSSI, secondary woodland extends across the highway verge toward the carriageway and under the canopy cover here there are woodland species such as dog's mercury and giant fescue which have either spread in from the longer established woodland adjacent to the north, or which have survived in soils previously disturbed by past highways works.
- 3.2.8 Scrub in transition to secondary woodland has colonised the highway land in a number of places – generally where elms and/or blackthorn have suckered into the verge from adjacent hedgerows and/or woodland habitats. In the section adjoining

Madingley Wood SSSI, however, there is longer-established canopy cover, comprising a fairly diverse mixture of ash, field maple, hawthorn, elder, blackthorn, buckthorn and elms. The latter includes wych elm plus at least three microspecies from this taxonomically contentious group, including at least one specimen keying out as the eponymous Madingley elm^{5,6}.

3.2.9 At the outer edges of the highway land, the boundary is typically demarcated by trimmed or untrimmed hedgerows with trees, or more locally the fenced/walled boundaries or ornamental hedging of adjacent properties/land-uses. Woody species diversity in the native hedgerows is generally moderate to high (though there are monotypic trimmed yew hedgerows bordering the American Cemetery), and standard trees include very frequent ash (some of which show signs of die-back), oak and a few other species such as horse chestnut, larger-sized individuals of field maple, wych elm, Dutch and Cambridge elm, and odd singletons of walnut and Norway maple.

3.2.10 Overall, the highways land adjoining and encompassing the A1303 between Madingley Mulch roundabout and the Madingley Road P&R is typical of that in the wider locality, and indeed common to that present in the highway land adjoining the St Neots Road west of Madingley Mulch. The most sensitive area is undoubtedly the land adjacent to Madingley Wood SSSI, where the development of secondary woodland contiguous to that site offers an extension of woodland cover and a degree of visual/acoustic and air pollution buffer between the A1303 and the SSSI proper.

⁵ [Eversham, B \(2021\) Identifying British Elms \(Ulmus\) v.2.3.1 July 2021.](#)

⁶ It is a striking feature of the habitat and botanical surveys carried out for GCP, as reported in (e.g. [CD1-11.05 TR5.04](#): Botanical Survey Report and [CD1-11.05 TR5.10](#): Hedgerow Survey Report) and relied upon in the ES, that no attempt is made to differentiate between various microspecies of elm, nor even to recognise the local genetic diversity within that genus, despite this part of Cambridgeshire being a well-known hotspot. It is further striking how few plant species worthy of comment were noted generally, something which (along with startling errors such as records for the North American species *Hordeum brachyantherum* rather than the native *Hordeum secalinum* – see Table TR5-5-5-1 at page 8 of CD1-11.05) I consider points to a lack of rigour and/or expertise being applied to the habitat and botanical surveys, rather than a wholesale absence of anything noteworthy being an accurate representation of the baseline.

3.3 Fauna

3.3.1 Detailed surveys of fauna using the Madingley Road highways land were outside the scope of Bioscan's commission, and of course it is in any event for the proponents of a scheme to carry out suitably thorough and robust surveys and assessments for all relevant taxa, not the responsibility of resource-limited interested parties. Nevertheless, incidental observations of fauna along the highways land corridor between Madingley Mulch roundabout and the Madingley Rd P&R were made during the above surveys, and particular consideration has been given to the potential for affected habitats to be of value for protected or otherwise notable species known from the locality, such as barbastelle bat.

3.3.2 Fauna recorded on the three survey visits were mainly confined to birds, with a range of common species noted⁷, albeit at low density. Traffic noise is a known suppressant of breeding bird density and diversity (see e.g. René E. van Dijk et. al. 2025 at **Appendix DW2**) and therefore the low densities and diversity of species noted in the habitats immediately adjoining the A1303 are not surprising, and I consider them likely representative of the true picture. This is a relevant and important factor when it comes to considering the potential scope for impact arising from minor upgrade of the existing A1303 trunk road as against introducing a wholly new road construction corridor across what is currently farmland, traditional orchard and numerous hedgerows, treelines and other habitats. This issue is returned to later.

3.3.3 Consideration was given to the potential for bat roosts to be present in trees potentially or likely affected by the CPPF scheme, following the Ground Level Tree Assessment (GLTA) method and terminology as outlined in Collins, J. (ed.) (2023)⁸. A

⁷ Chiffchaff, goldcrest, whitethroat, blackcap, blackbird, woodpigeon, long-tailed tit, robin, wren, dunnoek chaffinch, goldfinch, blue tit, house sparrow, jackdaw and great tit all appeared to be holding territory on or overlapping with highway land. A road collision victim (a dead great spotted woodpecker) was also found in May. The most notable species recorded across the three visits was an apparent territory-holding willow warbler, but this was noted from an area of scrub south of Madingley Antenna and remote from the zone of influence of either scheme.

⁸ Collins, J. (ed.) (2023) Bat Surveys for Professional Ecologists: Good Practice Guidelines (4th edition) accessed May 2025 ([link](#))

limited number of trees with features capable of supporting roosting bats were identified: adjustments to the indicative scheme appear likely to secure their retention in all but a very few cases, but a precautionary approach has been taken to this issue. This matter is also returned to later.

3.4 Evaluation

3.4.1 The habitats occupying the verges and other undeveloped highways land along the c3.1km section of the A1303 between Madingley Mulch roundabout and the Madingley Road Park and Ride entrance are generally typical of vegetation at the sides of larger rural and peri-urban roads, both locally and at a wider regional and national scale. At the outer limits and boundaries of this highways land, there is an elevated density of mature trees compared with some of the more open arable farmland to the west and south, and the presence of Madingley Wood SSSI on adjoining land is an important feature and constraint.

3.4.2 The rather limited intrinsic value of the existing roadside habitats will be further affected and, to a greater or lesser extent suppressed, by the close proximity of the existing busy A1303, particularly as regards use by and value for fauna (see again **Appendix DW2**). Beyond that, comparisons of habitat quality to the land affected by the GCP scheme are somewhat hindered as while the stretch of highways land I have surveyed has some plant species of note, it is difficult to contextualise this against the land falling within the GCP scheme, as there is evidence of a lower standard of survey and botanical rigour having been applied in the GCP studies (see footnote 6 above). I return to this matter later in my evidence.

4 HABITAT LOSSES ARISING FROM THE CPPF SCHEME

4.1 The Scheme

4.1.1 The CPPF scheme involves adjustments to carriageway width and alignment within the highways land to accommodate an inbound bus lane and retain and improve the extant active travel provision alongside. It is described in detail in the proofs of evidence of Mr Johnstone and Mr Leigh and shown on the Civilistix engineering drawings C-001 to C-005 appended to Mr Johnstone's proof of evidence.

4.1.2 The CPPF scheme has been designed to make the most use of existing carriageway, foot/cycleway and low-habitat-quality separation verges as a means of minimising landtake, as discussed in detail by Mr Johnstone and Mr Leigh.

4.2 Habitat losses

4.2.1 Figures **DW3-DW4** are the result of plotting the Civilistix drawings onto the existing baseline situation (as shown on **DW1-DW2**) to give the 'post-intervention' situation. From the electronic (QGIS⁹) versions of these drawings is derived the calculation of areas of habitat loss (per standard BNG submission and validation requirements). Figures **DW5-DW6** give a simplified appreciation of the extent of habitat loss associated with the CPPF scheme.

4.2.2 An 'at a glance' summary of the permanent land-take and associated habitat losses calculated to arise from implementation of the CPPF scheme is given at **Table 1** below. Excluding loss/re-use of existing unvegetated (i.e. paved/tarmac) surfaces, habitat losses are limited to just under a hectare in total of land adjoining the current A1303 carriageway, this being mostly species-poor grassland verge. This is made achievable via limited widening and re-alignment of the existing road surface

⁹ QGIS version 3.40.9 'Bratislava' Long Term Release (LTR).

and shared foot/cyclepath and dispensing with 'separation verges' to accommodate the bus lane 'in-highway', as explained by Mr Johnstone and Mr Leigh.

Table 1: Permanent losses of habitat predicted to arise from implementation of CPPF scheme

Habitat Type	Area/No. Lost	%*
Modified grassland	0.25ha	36.4%
Other neutral grassland	0.51ha	46.9%
Tall forbs	0.16ha	16.9%
Lowland mixed deciduous woodland [#]	0.03ha	4.21%
Other woodland; broadleaved	0.005ha	3.99%
Non-woodland trees	12 [^]	Est. <1.5%
TOTAL	0.96ha	c.12.5%

*i.e. percentage of the total of this habitat type falling within the highways land between Madingley Mulch roundabout and Madingley Road Park and Ride.

[#] Lowland mixed deciduous woodland has been used as a precautionary default and therefore it includes some low-value scrub-woodland. The majority of this loss figure actually relates to an area of young, scrubby secondary woodland and plantation on the southern side of the Madingley Mulch roundabout. Much of the remainder relates to localised requirements to trim back canopy rather than involving actual loss of trees.

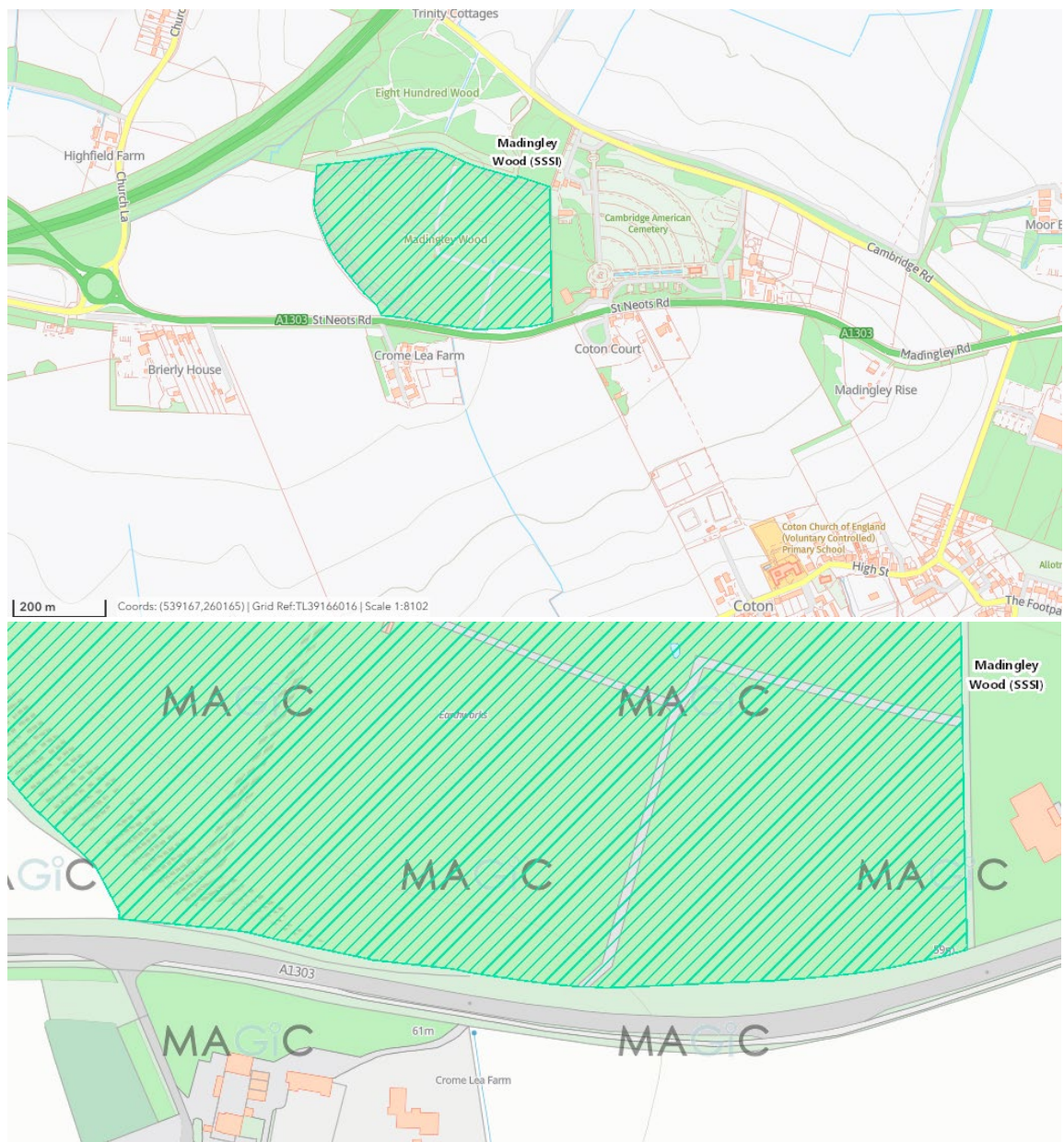
[^] Comprising one small (i.e. <30cm dbh), 5 medium (30-60cm dbh) and 6 large (>60cm dbh) trees. No ancient or veteran trees affected.

4.2.3 An equivalent table of habitat losses for the off-road busway section of the GCP scheme is provided in Section 5, but for an immediate appreciation, the equivalent land-take (not including existing hard surface) required in order to deliver the offroad section of the GCP scheme from St Neots Road to Grange Road is 6.68ha. This is approaching **six times the landtake** required by the CPPF scheme. Note that this figure does not include the additional CPO landtake required for drainage basins, embankments and other earthworks with the GCP scheme: these will be much more significant in size and area than with the CPPF scheme due to the need for new bridging structures, related earthworks, bat 'hop-overs' and the introduction of a far greater area of new impermeable surface.

4.3 Effect on Madingley Wood SSSI

4.3.1 A key driver for the CPPF scheme design was avoiding the scope for direct or indirect impacts on Madingley Wood SSSI, its buffer of non-SSSI woodland vegetation occupying the verge to the south of the SSSI boundary, and its population of barbastelle bats. This area of key importance is shown at **Image 1** below:

Image 1: Upper panel: screengrab from Magic showing location of Madingley Wood SSSI (green hatching) relative to the A1303. Lower panel: close-up of the SSSI boundary relative to the adjoining highways land.



4.3.2 As is evident from Figures **DW3-DW6** and from the Civilistix drawings appended to Mr Johnstone's proof, the CPPF scheme avoids any direct impact on the SSSI and also avoids any significant impact on its buffer by avoiding landtake from the northern verge of the A1303 where it runs past Madingley Wood. The proposed bus lane and active travel path will in this section be accommodated by shifting the carriageway slightly southwards ensuring no encroachment of either carriageway or busway closer to the SSSI boundary than the present road. Some very slight and localised trimming back of overhanging woody vegetation (which in places currently extends right to the carriageway edge) may be required locally to accommodate the active travel path (e.g. as shown by **Image 2** below), however any landtake here affects existing narrow grassed verge oversailed by canopy, rather than woodland *per se*.

Image 2: Madingley Road looking east at the approach to the American Cemetery frontage showing grassed verge oversailed by woodland to the left. The yellow line gives an indication of where the northern edge of the foot/cycle path would sit at this location (for more detail see the Civilistix drawings appended to Mr Johnstone's proof of evidence)



- 4.3.3 The current roadside habitat edge here is compromised in value by its immediate proximity to existing traffic, to the extent that any limited trimming back can be safely assumed to be inconsequential. I am satisfied that it would not result in any tree loss – indeed it would fall well within the parameters of existing, standard highway maintenance activities. To the extent that any trimming back *at all* might be argued to diminish (even if only locally and very marginally) the width of the existing buffer to the SSSI, any such effect is in my view *de minimis*, would not impact on the function as a buffer and again falls within the scope of highways maintenance activities that will occur periodically in any event. In fact the insertion of both the foot/cycleway and the bus lane, will have the effect of moving the much more significant and impactful traffic volumes, and related noise, spray, vibration, emissions, collision hazard and lighting effects associated with the A1303 slightly further (a few metres) away from the SSSI than at present, effectively increasing the width of the buffer to the designated site from the vast majority of Madingley Road traffic.
- 4.3.4 Weighing all these factors into account, I assess the indirect effect of the CPPF scheme on Madingley Wood SSSI and its designated interest features will be at worst neutral (no effect) and potentially even slight net beneficial.
- 4.3.5 The consequence of this southward shift to avoid the SSSI is that the re-aligned carriageway will encroach within the root protection zones (RPZs) of some eleven ash trees located along the box-trimmed hedgerow to the south of the carriageway (see Civilistix drawing C-001 appended to Mr Johnstone’s proof of evidence). The RPZs of these trees are to a greater or lesser extent affected by the existing carriageway, however I have made the precautionary assumption that five of the eleven will not be able to be retained, even though methods such as no-dig construction and crown reduction may ultimately enable a proportion of even these to be kept. None of these trees have significant bat roosting potential¹⁰ and their

¹⁰ A proportion show signs of ash dieback, which may in time generate features suitable for bat roosting

loss would not result in any severance of the linear hedgerow and tree belts to the south of the road. This is relevant to the consideration of potential impacts on bats, and in particular the scope for impact on barbastelle bats (which are not a cited interest feature of the Madingley Wood SSSI but are considered functionally linked to Eversden and Wimpole Woods SSSI and SAC). This matter is covered in section 6 of my evidence.

4.4 BNG calculation

- 4.4.1 The habitat loss figures in **Table 1** above have been entered (along with calibrating variables such as the habitat condition assessments in **Appendix DW1**), into the BNG Metric Calculator tool, with the outputs appended at **Appendix DW3**.
- 4.4.2 In quantitative terms, using the Statutory Biodiversity Metric, the CPPF scheme will result in a net loss of 5.96 area-based Habitat Units, in the absence of any compensatory enhancement or habitat creation. No hedgerow or watercourse units will be lost, albeit some very localised and minor diminution of hedgerow ‘condition’ is possible in a few locations where more severe cutting back may be required (e.g. close to Madingley Mulch roundabout). Even allowing for a substantial margin of latitude for the requirements of detailed design, this is clearly a very much-reduced level of impact and imposes a much lower mitigation and compensation burden than the GCP scheme, as is discussed in more detail in the next section of my evidence.

4.5 Summary of impacts

- 4.5.1 The CPPF scheme would involve very modest losses of generally low-grade roadside habitats that are ubiquitous along both the local and wider road network, and which have their value already suppressed by the proximity of the busy A1303, with its associated impacts from NOx emissions, particulates and salt spray. How these losses compare with those occasioned by the equivalent parts of the GCP scheme is

dealt with in section 5 of my evidence. The implications for fauna are discussed in section 6.

5 HABITAT LOSSES ARISING FROM THE GCP SCHEME

5.1 Summary description of the relevant parts of the GCP Scheme

5.1.1 The GCP scheme is as described in the Environmental Statement Main Report Chapter 3 ([CD1-10.01](#)) and as set out in other submission material, and in the various drawings listed under CD1-12 (e.g. [CD1-12.06](#)). No alternative to the western section of the route from Cambourne to the stretch of St Neots Road east of Hardwick is being advanced by CPPF, and I do not therefore consider this western part of the route in my evidence. The CPPF scheme is instead being presented as an alternative to the 'off-road' section of the GCP scheme, which diverges from St Neots Road west of its junction with Long Road, and then runs southeast and then east across farmland, through Coton Orchard and across the M11 before rejoining the local highway network at Charles Babbage Road. It then encompasses a further off-road section before terminating at Grange Road.

5.2 Impacts of the GCP scheme on Coton Orchard CWS and other non-statutory sites

5.2.1 Four non-statutory designated sites are located within the proposed Order Limits and will be directly impacted by the GCP scheme, namely Coton Orchard and the Coton Path hedgerow (both County Wildlife Sites), and two City Wildlife Sites; 'Scrub east of the M11 verge' and 'Bin Brook'.

5.2.2 The Environmental Statement Main Report Chapter 8 ([CD1-10.01](#) para 8.3.7) states that *"due to the extent of habitat loss within the Coton Orchard County Wildlife Site, the effect on this non-statutory designated site is considered to be significant at a county scale"*.

5.2.3 I do not disagree with this overall assessment, however I do have significant concerns about how the Coton Orchard has been classified and valued quantitatively

in GCP's BNG assessment, and how the true magnitude of impact has been masked and suppressed in other areas of the submission material by an erroneous approach taken to scoring the habitats and tree loss in this area.

5.2.4 The ES Main Report ([CD1-10.01](#)) correctly references (at footnote 81 on page 103) the relevant text for determining the extent of Coton Orchard that qualifies as Priority 'Traditional Orchard' habitat. This is the 2008 document *UK Biodiversity Action Plan Priority Habitat Descriptions: Traditional Orchards* which I have attached in full at **Appendix DW5**. The grey shaded box on the same page of the ES Main Report provides the rationale for why GCP does not consider most of the orchard, nor the area mapped as Priority Habitat on Magic, to qualify as the Priority Habitat type, albeit I note that the applicant appears to take a somewhat contradictory and in any event non-precautionary approach in stating on the one hand "*its status as a traditional orchard (and therefore priority habitat) is unclear*" (ES ([CD1-10.01](#) p103) and then on the other hand mapping and scoring a mere 0.52ha of the c2.5ha area (around one fifth) of the orchard within the proposed order limits as the Priority Habitat type in its BNG calculation.

5.2.5 In my opinion, and with specific reference to the detailed description in **Appendix DW5**, there is no scientific or other basis not to classify most of this c2.5ha as the Priority Habitat, particularly as a) any intensive management practices have long since ceased and b) there is recognition by the applicant that "*the site fulfils many of the ecological niches of a traditional orchard*" (ES [CD1-10.01](#) p103). There may have been a period of intensive management of the field layer in the past, but that is certainly not the case now, nor has it been recently. In the face of the available evidence and having visited the site to attempt to verify its BNG input score, it is clear in my mind that the applicant's assessment significantly suppresses the true value and BNG score of this habitat. By reference to **Appendix DW5** and the key determinative criteria contained within it, this is an area of land with a documented history of use as an orchard since 1922, with an abundance and varied age structure of mature, overmature and younger fruit trees (rather than a preponderance of

intensively pruned, even-aged, dwarf varieties). It is not intensively managed, with the trees interspersed with neutral grassland managed on a low-intensity regime (as is recognised by the applicant), and it contains numerous standing and fallen deadwood features associated with higher quality representations of the Priority Habitat. On any rational reading of the JNCC description the majority of this c.2.5ha area qualifies as the Priority Habitat type.

5.2.6 There are grounds for argument in my view in small areas where fruit trees are presently absent and in somewhat larger areas where management has lapsed and pre-existing orchard structure and trees have been enveloped by self-sown or suckering scrub. The latter applies to parts of this area towards the east, although it should be noted that mature fruit trees in orchard rows are still readily discernible within this habitat matrix, and that this form of scrub has high value for nesting birds and contributes to the mosaic of higher value habitats in this area, rather than detracts from it. It will be noted that the JNCC description (**Appendix DW5**) allows for elements of scrub due to neglect to be included within areas subject to the Priority Habitat definition. A technical note and accompanying plans and photos at **Appendix DW6** consider this issue further and provide further evidence as to why in my view the area of the orchard that should be considered as Priority Habitat/Habitat of Principal Importance is several times larger than allowed for by GCP.

5.2.7 In terms of the three other designated sites, para 8.3.7 of the ES Main Report [CD1-10.01](#) goes on to suggest that “*There will be no significant effects on the other three [designated, non-statutory] sites*” (i.e. Coton Path Hedgerow County Wildlife Site, and Scrub East of the M11 Verge and Bin Brook (both city wildlife sites)).

5.2.8 I disagree. Paras 8.3.8 and 8.3.9 of the ES Main Report specify that “*a little under 5% of the Coton Path hedgerow*” and “*approximately 0.4ha of the M11 scrub*” (from a total site area of 2.3ha – i.e. 17.4%) will be removed due to the GCP scheme. The principle of a 1% loss threshold for significance, a long-established tenet in EIA and

Habitats Regulations Assessment, is relevant here, and this significance threshold is substantially exceeded in both these cases.

5.2.9 It is suggested in the ES Main Report that these substantial losses of habitat from these two designated sites should not be regarded as of importance on the basis that “*no rare or notable plant species were recorded in the affected part*”, and because compensation is proposed ([CD1-10.01](#) paras 8.3.8-8.3.10). In my view this quantum of loss of a designated site is significant notwithstanding the particular plant species on the site and regardless of the fact that compensation is proposed¹¹. One would not, for example, consider a 5% or 17.4% loss of a SSSI as non-significant. In my view such a significant quantum of loss clearly engages relevant national and local policy that seeks to protect such sites from harm (as discussed further in Section 8 of this proof).

5.2.10 Having not visited or surveyed these other non-statutory designated sites, I am not in a position to go further and either dispute or verify the strength of the applicant’s claim that the affected parts harbour no scarce or rare plant species, which appears to be the foundation for the applicant’s contention that such losses amount to ‘no significant effect’. However, I believe it is relevant to re-state here my concerns about the adequacy of the habitat and botanical survey information underpinning the ES more generally, and as exemplified by the errors noted in footnote 6 above, and the applicant’s incorrect approach to classification of Priority Habitat at Coton Orchard as detailed in **Appendix DW6**. Such factors diminish my confidence in the robustness of the statements about the significance of impact at these three locations. Also relevant is the question of whether BNG method has been applied properly in the applicant’s assessments, which I discuss below.

¹¹ To be given a non-statutory nature conservation designation, these sites will have been through a selection process presided over by an expert panel and defined by set criteria and guidelines, which may (for example) relate to fauna not flora. Such sites have also typically been through the Local Plan adoption process. See (e.g.) <https://www.cambridgeshire.gov.uk/residents/libraries-leisure-culture/biodiversity-and-greenspaces/nature-conservation-sites>

5.3 GCP's BNG calculation

5.3.1 The applicant's BNG calculation for the scheme (i.e. the completed metric calculation tool) was not submitted with the TWA application. This is despite the obligation to do so for reasons of transparency, as set out in relevant planning practice guidance¹², and as the applicant itself recognises as a requirement at para 2.1.2 of its Biodiversity Statement and BNG Assessment ([CD1-11.05 TR5.07](#)). On realising in late May 2025 that the calculation was not appended to the BNG Assessment or otherwise available in the submission information, I asked CPPF to request it direct from the applicant. Subsequent correspondence between CPPF and GCP suggested a reluctance on the part of GCP to release it, and then a further short delay ensued due to WSP reportedly needing to 'format' the XLS file. It was finally received by CPPF on 6th June and by myself the following Monday on 9th June¹³. A pdf readout is attached at **Appendix DW4**.

5.3.2 The calculation provided by GCP relates to the GCP scheme in its entirety, and therefore for the purposes of comparison with any in-highway alternative along Madingley Road, an exercise of disaggregating those elements of the calculation which concern the section of GCP's scheme between St Neots Road and Grange Road from the remainder, was necessary. The result of this extrapolation is presented at **Appendix DW7**. The process exposed a number of methodological errors and omissions, all of which have the effect of significantly suppressing the baseline value of the affected habitats. It was further noted that the calculation as a whole is based on very optimistic to the point of questionable assumptions about the future condition of the habitats likely to develop alongside the GCP scheme.

¹² Department for Levelling Up, Housing and Communities, 2024. Planning Practice Guidance on Biodiversity Net Gain. Available at: <https://www.gov.uk/guidance/biodiversity-net-gain#biodiversity-net-gain-submitting-a-planning-application>. Published 14 February 2024.

¹³ GCP emphasised in covering correspondence that the BNG calculation was in draft form, notwithstanding that no such qualifier is applied to the statements within CD1-11.05 TR5.07 (for example in the Executive Summary where it is stated that "*The CtoC Scheme achieves, within the Scheme boundaries, a 4.73% net gain in Area Habitat Biodiversity Units (AHBUs) and a -15.15% net loss in Hedgerow Biodiversity Units (HBU)*").

- 5.3.3 These errors are discussed further in **Appendix DW6**, but perhaps the most significant in terms of their effect on the GCP scheme's impact score are the failure to classify the true extent of Traditional Orchard Priority Habitat at Coton Orchard (as discussed above) compounded by a failure to apply the appropriate methodology around calculating tree-loss.
- 5.3.4 On the latter, the Statutory Biodiversity Metric - User Guide 2024 [CD8-30](#)¹⁴ clearly states that medium or larger trees in hedgerows, lines of trees and in traditional orchard habitats that will be removed due to development should be counted in the baseline as individual trees, and their loss factored in to the impact calculation. Other than for the six trees in Coton Orchard which the applicant now accepts as veteran, this has not been done in the applicant's BNG assessment. The effect of this omission on the applicant's BNG calculation is profound. **Appendices DW8** and **DW9** show the effect, respectively, of correction of the applicant's BNG tree-loss inputs, and correction of both tree loss and habitat mapping for the Coton Orchard part of the Order Limits. Together these corrections more than double the negative impact score of this part of the GCP scheme from minus 20.06 Habitat Units to minus 51.71 Habitat Units. **Appendix DW6** also highlights other significant omissions noted for other parts of the site, correction of which will further worsen the applicant's output BNG score.
- 5.3.5 I conclude that the applicant's metric calculation is so infected with error as to be rendered completely unreliable and potentially highly misleading. The margins of possible or likely error are large enough to bring into renewed question a) the ability of the GCP scheme to achieve 10% net gain (as required by statute) or 20% net gain (as required by local policy); b) the potential cost to the public purse of doing so and c) the ecological realism and practicality of delivering the enhancements relied upon to achieve a net positive end score.

¹⁴ [CD8-30](#) see p55 under the heading "Recording baseline trees within hedgerows and lines of trees" and p56 under the heading "Recording baseline trees within orchards and wood pasture and parkland".

5.3.6 I find myself ultimately unconvinced about the ability of the scheme to achieve the local and national statutory and policy objectives for BNG compliance without a very substantial uplift in off-site compensation – something for which there is no obvious evidence within the submission material to indicate this has been looked into or indeed costed for.

5.3.7 If, notwithstanding the above, one elects to still take the applicant's BNG calculation non-critically and at face value, there is still a need to extrapolate from it to generate a directly comparable metric calculation for the part of the route that would become unnecessary in the event the CPPF scheme were taken forward – i.e. from the point at which the GCP scheme leaves St Neots Rd to the point at which it meets Grange Road. This exercise generates the calculation at **Appendix DW7** and the quantified schedule of impacts set out at **Table 2** below:

Table 2: Permanent losses of habitat for GCP off-road scheme eastwards from divergence from St Neots Rd (extrapolated from uncorrected GCP BNG calculation)

Habitat Type	Area/No. Lost	% of total
Cereal crops	3.57ha	14.64%
Modified grassland	0.53ha	26.14%
Other neutral grassland	1.28ha	11.70%
Traditional orchards	0.13ha	25.08%
Hawthorn scrub	0.04ha	21.09%
Mixed scrub	0.10ha	24.56%
Ruderal/Ephemeral	0.05ha	10.89%
Tall forbs	0.05ha	22.64%
Vegetated garden	0ha	0%
Lowland mixed deciduous woodland	0.11ha	4.81%
Other woodland; broadleaved	0.10ha	29.74%
Other woodland; mixed	0ha	0%
Non-woodland trees	>500 [#]	Est. >75%
TOTAL HABITAT LOSS – GCP	5.97ha	c.14.22%*

SCHEME		
(TOTAL HABITAT LOSS – CPPF SCHEME (See Table 1))	(0.96ha)	(c.12.5%^)

#The ES Main Report CD1-10.01 p103 states that it has been assumed that all 490 trees mapped as within the Order Limits within Coton Orchard would be lost. Other non-woodland losses over and above this are estimated from aerials etc.

*i.e. of the total area within the proposed Order Limits east of the point where the scheme leaves St Neots Rd. NB this figure does not allow for enabling works, earthworks, drainage and other ancillary impacts/losses.

^ i.e. of the total area within the highway boundary from Madingley Mulch roundabout to the entrance to Madingley Rd P&R. NB this figure also does not allow for enabling works, earthworks, drainage and other ancillary impacts/losses.

5.3.8 The habitat area losses in **Table 2** above translate to an impact score of -20.06 Habitat Units with the GCP scheme, compared to -3.51 Habitat Units with the CPPF scheme. These figures exclude individual non-woodland tree loss which will clearly be orders of magnitude higher with the GCP scheme (over 500 non-woodland trees lost with the GCP scheme versus around 12 with the CPPF scheme). The difference will be higher still in terms of absolute (i.e. total) tree loss (i.e. including woodland tree loss).

5.3.9 Thus, **Table 2** shows that even if one disregards the clear methodological errors and other causes for doubt over the precision and reliability of GCP's BNG metric calculation, the CPPF scheme performs around five times better by this measure in terms of reduced ecological impact. As discussed at 5.3.4 above, and demonstrated by **Appendix DW6**, if the losses of trees and the other most obvious methodological and habitat classification errors in GCP's BNG metric calculation are included, the difference becomes even more stark, with only a slight uplift of impact score with the CPPF scheme to minus 5.96 Habitat Units including tree loss compared with at least a doubling of the negative impact score of this part of the GCP scheme from minus 20.06 Habitat Units to minus 51.71 Habitat Units including tree loss and correction of the classification of Coton Orchard. By this measure the CPPF scheme performs around nine times better (i.e. has around nine times less ecological impact).

5.4 Summary

- 5.4.1 Precise comparison of the BNG metric calculation for the CPPF alternative scheme against that for the GCP scheme is complicated by significant methodological errors and omissions in GCPs BNG calculation and inconsistencies between their BNG calculation and what is stated in the ES (e.g. as regards tree loss). It is nevertheless clear on any analysis and indeed on GCP's own evidence that the GCP scheme performs significantly worse by this measure of environmental impact than the CPPF scheme.
- 5.4.2 A calculation based on more thorough survey and a fully corrected and properly applied habitat classification methodology would return a still worse metric output figure for the GCP scheme. Indeed, I would fully expect it to return a figure showing a biodiversity loss figure exceeding ten times that of the CPPF scheme and (by extension) imposing a much higher offset/compensation burden than has hitherto been assumed by the applicant.
- 5.4.3 For the above reasons I question whether GCP's confidence around future BNG compliance through off-site compensation delivery (as set out in [CD1-11.05 TR5.07](#) Biodiversity Statement and Biodiversity Net Gain Assessment) is well founded. Correction of the errors discussed above will substantially elevate the costs of delivering appropriate and policy/regulatory compliant off-site BNG compensation in the course of constructing the scheme, and it would appear that these costs are likely to have been significantly underestimated by GCP.
- 5.4.4 Overall, and from both an expert subjective assessment basis (taking into account impacts on Priority Habitats and Species and designated sites), and from an objective quantified basis (using the statutory Biodiversity Metric to 'measure' impacts), there can be no doubt that the in-highway scheme promoted by CPPF performs far better in terms of minimising habitat loss, far better on biodiversity impact generally and will therefore be much less costly to compensate.

5.4.5 This is in fact no more than common sense given that the CPPF scheme uses modifications to the existing A-road and thereby requires far less landtake than the GCP scheme which carves a wholly new roadway through undeveloped farmland, field boundaries, woodland belts, other intrinsically high value habitats and indeed through designated wildlife sites.

5.4.6 I recognise of course that the CPPF scheme remains subject to detailed design and that this process will determine the need for additional localised temporary works, and any earthworks and drainage improvements required in order to deliver it. However, I understand (from the evidence given by Mr Johnstone and Mr Leigh) that the totality of these would remain minor in nature due (for example) to the fact that there will be only a modest expansion of existing hard surface over the present situation. Any extra run-off can be dealt with via on-line storage below the new cycleway, thus requiring no additional volumes of surface water to be discharged into the existing water courses. By comparison, the introduction of new expansive areas of impermeable surface into what is presently farmland will necessitate significant surface water management infrastructure with the GCP scheme, as is evident from the GCP scheme drawings. The comparisons provided in **Table 1** and **Table 2** above disregard earthworks and other such enabling works for both schemes, however a glance at the application drawings affords a ready appreciation that those attendant with the GCP scheme will necessarily be of larger scale than the CPPF scheme. Factoring in earthworks, drainage and other matters is therefore merely likely to widen the gap between the two schemes in terms of biodiversity impact.

5.4.7 There is clearly a wide gulf between the CPPF scheme and the GCP scheme in terms of the magnitude and significance of habitat losses. This gulf remains whichever one of several assessment approaches one cares to apply, but in terms of quantitative habitat loss using the BNG system, the GCP scheme can be regarded conservatively as between five and ten times more harmful than the CPPF scheme. I am confident that this gulf would remain or even widen at the detailed stage – i.e. taking into

account the potential need for additional temporary and preparatory works. It is also relevant of course that whilst the GCP scheme is assumed to be further advanced in design terms, there will inevitably be changes to that also at the detailed stage, as allowed for in the requested CPO landtake.

6 IMPLICATIONS OF BOTH SCHEMES FOR BARBASTELLE AND OTHER FAUNA

6.1 Barbastelle

6.1.1 Perhaps the most important single species requiring consideration in any assessment of the comparative performance of the CPPF and GCP schemes is the barbastelle bat, which is known to have maternity (breeding) roosts in Madingley Wood. Bats from this roost (and potentially others locally) utilise the local landscape crossed by both route options. This barbastelle population is considered by Natural England as highly likely to be functionally linked to the population which underpins the Eversden and Wimpole Woods SAC, some 7.5km to the south-west, and the scope for likely significant and/or adverse effects on that site via such functional linkage is therefore an important material consideration for decision-makers, requiring assessment under the Conservation of Habitats and Species Regulations 2017 (as amended).

6.1.2 Concerns over the scope for the GCP scheme to impact on this species, and by extension the Eversden and Wimpole Woods SAC, were first raised by Natural England during the EIA scoping stage in 2022 and have been the subject of further comment and engagement between GCP and NE since that time. A chronology of that engagement and the NE comments it has solicited is provided at section 4.2 of [CD1-11.05 TR5.11](#) (Statement to Inform Habitats Regulations Assessment). I understand the position at the time of writing to remain that Natural England (and others) remain concerned about the scope for impacts on barbastelle bats to arise from the GCP scheme, and concerned about the likely adequacy and efficacy of the mitigation measures that are proposed by GCP to combat risks of significant effects arising through fragmentation effects, including within the core sustenance zone around Madingley Wood. This is reflected in comments made by the statutory authority most recently in January 2025 ([CD2 REP-11](#)), extracts of which are reproduced below:

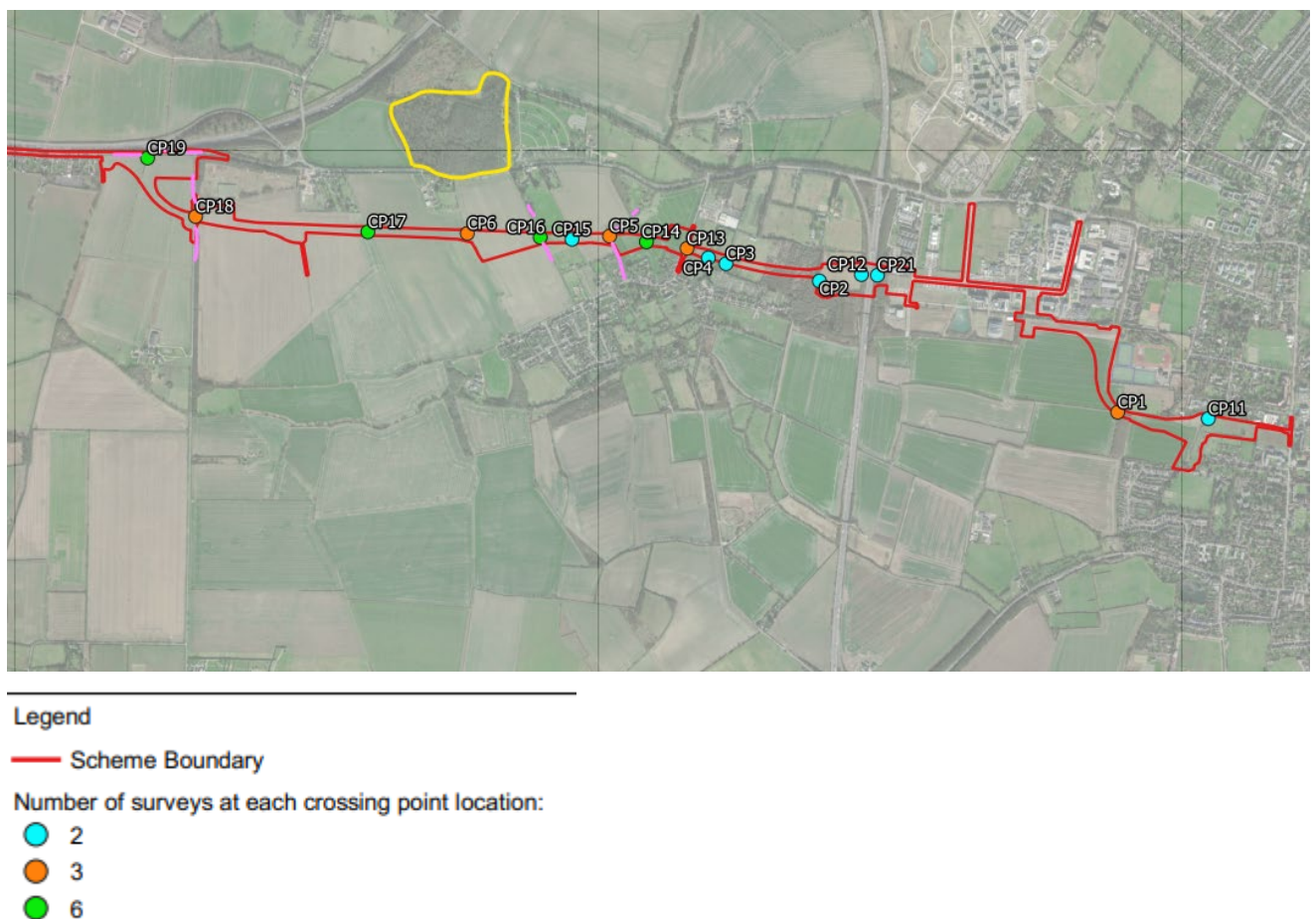
“Natural England’s concerns are primarily around barbastelle bats Barbastella barbastellus - the loss of potentially important foraging habitat and food sources, maintaining connectivity of bat habitat within the wider landscape and direct mortality of bats (i.e. hit by buses or swept into their backdraught). This representation covers our initial observations, but we may add to these should a public inquiry be called. We will, however, limit any additional points to those associated with bats....

...This landscape is particularly important for this species, as it is within the 10km Impact Risk Zone (IRZ) of Eversden and Wimpole Woods Special Area of Conservation (SAC). The proposal is therefore subject to the Habitats Regulations Assessment (HRA) process. A known maternity roost is also located in Madingley Wood Site of Special Scientific Interest (SSSI), close to the route’s red line boundary. Other colonies are also located nearby, but our present comments mainly focus on this population as it is on the opposite side of the proposed busway to the SAC and therefore most at risk of severance. The genetic health of one barbastelle colony is dependent on the genetic health of the colonies around it. As the Madingley Wood population is almost definitely functionally linked to the Eversden and Wimpole Wood SAC population, given the proximity and likelihood of shared autumn swarming sites (at currently unknown locations), the health and survival of the Madingley Wood population is therefore important for maintaining genetic diversity to support the SAC population.” (Natural England [CD2 REP-11](#))

- 6.1.3 The combined survey information on the use of the local landscape by barbastelle is patchy, however surveys in 2020 and 2021 carried out for GCP and reported in [CD1-11.05 TR5.05](#) Bat Activity Report (para 1.2.3) “...identified high levels of Barbastella barbastellus at numerous locations along the survey area, with key areas identified [including]... A hedgerow south of Madingley Wood SSSI [and] “...A hedgerow south of Cambridge University Sports Ground in the east of the survey area leading to a conclusion that a roost site was present within close proximity to the Scheme”

6.1.4 Further work by WSP in 2022 found that *“four features; CP5, CP16, CP18, CP19, provided commuting habitat for Barbastelle which all recorded a peak of one commuting Barbastelle in any one survey.”* (para 5.1.2). The locations of these four crossing points relative to the known roost site at Madingley Wood SSSI are shown on the screengrab from that report reproduced at **Image 3** below:

Image 3: Annotated screengrab extract from CD1-11.05 TR5.05 (Bat Activity Report) showing crossing point locations referred to and number of surveys at each. Yellow=Madingley Wood. Magenta=barbastelle crossing points confirmed in GCP surveys.



6.1.5 The accumulated survey work on this species conveys a sense of barbastelle dispersal fanning out from and returning to Madingley Wood along field boundary vegetation and via scattered and interlinked woodland pockets. Significant loss or other impacts on these features (by whichever scheme) could clearly impinge on the species' ease of mobility in the local landscape, including (importantly) that of

juvenile bats making their first forays close to the natal roost within a 'juvenile sustenance zone'.

6.1.6 Natural England's concerns about the scope for impact on this species are thus important and relevant to both the GCP scheme and to the CPPF scheme, both of which would involve land-use changes and habitat loss within the landscape around Madingley Wood.

6.1.7 It is notable that NE appear particularly focused on the potential for 'severance' impacts, such as can occur when linear landscape features are bisected and fragmented by a corridor of infrastructure works. On this issue it will readily be appreciated that a scheme which involves perpendicular severance of multiple field boundaries and other linear features known or likely to be used habitually as navigational aids for commuting and foraging bats, carries an inherently higher risk of significant adverse effects than a scheme which follows an existing highway, runs along the line of and parallel to existing linear features, involves minimal or no loss from them and which does not involve breaking their continuity at any point.

6.1.8 The CPPF scheme does the latter, requiring only minor-scale habitat losses alongside an extant busy highway corridor, rather than construction of a whole new corridor across otherwise undeveloped farmland, through multiple field boundaries and across higher value habitats such as the Priority Habitat (Habitat of Principal Importance) complex at Coton Orchard.

6.1.9 Furthermore, with the CPPF scheme any elevated risks to barbastelle bats (and indeed other fauna) from traffic collision, backdraught, lighting, noise, air pollution and spray are confined within the envelope of an existing and long-established zone of influence from such effects around the existing A1303. This stands in complete contrast to the introduction of such potential impact sources as wholly new factors into a landscape where they do not otherwise exist, which is an inevitable consequence of the GCP scheme.

6.1.10 The seriousness of these elevated severance risks is clearly recognised by GCP, and an attempt to respond to them is proposed in the commitment to mitigation in the form of bat ‘hop-overs’ at eight locations, including the crossing points set out at [CD1-10.02 Appendix ES1 - Mitigation Register](#). However, there is a stark absence of proven efficacy with such forms of mitigation¹⁵ and they cannot be seen as obviating the risk of significant negative effects to barbastelle. I note that Natural England also continue to have fundamental concerns about the basic design that is proposed (see NE comments on crossing point mitigation at p3 of [CD2 REP-11](#)). This merely underlines that such mitigation is very clearly subordinate to avoiding or minimising those risks in the first place.

6.1.11 The likely significant added costs involved in the implementation and monitoring of such mitigation (which is stated to potentially involve earthworks as well as planting), the significant uncertainties around whether it will be effective in providing any meaningful amelioration of effects, and the risk of adverse effects on barbastelle and potentially the Eversden and Wimpole Woods SAC if ineffective, are concerns that, in my view, simply do not arise with the CPPF scheme. While the CPPF scheme will necessitate some localised cutting back of hedgerow vegetation, some localised crown lifting and the loss of a very limited number of trees along Madingley Road (though none within the SSSI buffer referred to by NE), I consider that the totality of such impacts would still not amount to any severance effect such that might necessitate a mitigation response. Nor would it give rise to foraging habitat losses of anything close to the same magnitude as the GCP scheme.

6.1.12 Consequently, despite the CPPF scheme involving highways works in physically closer proximity to the known barbastelle roost site at Madingley Wood than the GCP scheme, I consider this factor to be greatly outweighed in importance by the CPPF

¹⁵ See for example the accumulated evidence in Berthinussen, A., Richardson O.C. and Altringham J.D. (2021) Bat Conservation: Global Evidence for the Effects of Interventions. Conservation Evidence Series Synopses. University of Cambridge, Cambridge, UK. (link [here](#))

scheme offering a far lower magnitude of overall change to the local landscape used by barbastelle and a consequent lower level of overall risk to that species and by extension to the SAC. It is also relevant that the CPPF scheme would not involve any impacts in the locality of the Cambridge University Sports Ground, which surveys for GCP in 2020-2021 reported as a further hotspot of barbastelle activity (potentially indicative of another roost site), and where habitat loss impacts to linear features likely to be of importance for foraging and/or commuting again appear to have been omitted or underplayed in GCPs assessments¹⁶.

6.1.13 **Table 3** below provides a comparison of the risk factors for barbastelle for each of the two alternative schemes, drawing on the concerns raised by Natural England in their January 2025 consultation response:

Table 3: Comparison of risks/threats to barbastelle bat:

Impact/risk of concern to NE	GCP scheme	CPPF scheme
Direct loss of foraging habitat and food sources	Loss of significant quantum of habitat, including severance of linear landscape features known or likely to be of value for commuting and/or foraging, and loss of habitats likely to generate significant invertebrate biomass such as at Coton Orchard.	Limited and inconsequential habitat loss compared with the GCP scheme.
Indirect loss of foraging habitat and food sources (e.g. via lighting, landscape changes)	Severance of commuting and foraging routes a concern, against which mitigation ("hop overs") has been proposed but which is of a type that remains unproven and adds to project expense. Lighting, noise/vibration, collision risk and other factors represent high magnitude change in otherwise undeveloped farmland and could impact on foraging patterns and	No substantive landscape change. Any effects from lighting etc will arise within the envelope/zone of influence of existing effects and therefore be low or negligible in magnitude compared to their introduction into previously

¹⁶ For example, undeveloped areas of grassland and ruderal within the West Cambridge University Campus have been mapped as developed land and it appears that no loss of watercourse units has been factored in where the GCP scheme crosses a well vegetated watercourse immediately to the south of here between the West Cambridge University Campus and West Fields. See **Appendix DW6**.

Impact/risk of concern to NE	GCP scheme	CPPF scheme
	access to foraging areas. Some limited scale habitat diversification may be associated with scheme planting and features such as balancing ponds (e.g. where on arable land)	undisturbed land.
Impact on landscape scale connectivity and known commuting routes	Several linear landscape features known to be used by barbastelle will be severed.	Works occur in alignment with linear landscape features and while some effects may arise from cutting back, no overall loss or severance is entailed.
Risk of direct mortality (collision/backdraught)	Introduction of this hazard into otherwise undeveloped farmland represents high magnitude change and significantly increased risk.	Any uplift in risk will arise within the envelope/zone of influence of existing effects and therefore be low or negligible in magnitude compared to introduction into previously undisturbed land.
Significant land-use change in roost sustenance zone	Severance of commuting and foraging routes a concern, against which mitigation ("hop overs") has been proposed but which is of a type that remains unproven and adds to project expense. Lighting, noise/vibration, collision risk and other factors represent high magnitude change in otherwise undeveloped farmland south of Madingley Wood and could impact on foraging patterns and access to foraging areas. Some limited scale habitat diversification may be associated with scheme planting and features such as balancing ponds (e.g. where on arable land)	No substantive landscape change. Any effects from lighting etc will arise within the envelope/zone of influence of existing effects and therefore be low or negligible in magnitude compared to introduction into previously undisturbed land.
Overall/cumulative risks	Significant risk to the species, and NE is not satisfied that the applicant's shadow HRA (TR5.11) is robust enough to provide sufficient certainty of no adverse effect on the integrity of Eversden and Wimpole Woods SAC	On all counts lower than the GCP scheme and thus presenting lower risk of LSE and AEOI on the Eversden and Wimpole Woods Special Area of Conservation (SAC). Added

Impact/risk of concern to NE	GCP scheme	CPPF scheme
	(CD2 REP-11)	compunction to take lower risk alternative.

6.1.14 For all of the above reasons, in my opinion the CPPF scheme should also be preferred on the basis of its lower inherent risk to barbastelle. This weighs further in favour of the CPPF scheme over and above its far superior performance in BNG terms, its lower impact on designated sites and its lower impact on Priority Habitats.

6.2 Other fauna

6.2.1 In respect of other bat species, much the same considerations apply as to barbastelle, and I readily reach the same conclusions – i.e. that the CPPF scheme presents a lower overall level of risk to local bat populations generally. The comparative position as regards risk to potential tree roosts is difficult to determine with confidence due to the aforementioned issues with GCP’s approach to assessment and the resultant ‘undercounting’ of tree loss. However, it is noted that the ES Main Report states that *“some 35 trees that are suitable for use by roosting bats that [sic] will be felled”* ([CD1-10.01](#) para 8.3.24) which is in any event a substantially higher number than with the CPPF scheme.

6.2.2 Clearly any trees with bat roosting potential that upon detailed design prove unable to be retained under the CPPF scheme would require further survey and assessment to determine whether roosts are actually present and if so, to determine the appropriate licensed mitigation. Precisely the same applies, of course, to the detailed design process for the GCP scheme, as recognised at para 8.3.24 of the ES Main Report, albeit a far larger number of trees with bat roosting potential appear to be implicated with the GCP scheme.

6.2.3 In respect of all other fauna, the comments previously made also provide a sound basis for concluding that the CPPF scheme offers lower scope for impact. The GCP

scheme involves the introduction of a new linear corridor of built form, major construction and earthworks across a farmed landscape. These works will sever linear boundaries, involve significant losses of designated wildlife sites and Priority Habitat, and introduce new and permanent impact sources from risk of collision, noise, lighting, air pollution and other factors into parts of the local landscape where they are currently absent. This introduces an inherently higher scope for significant adverse effects than the CPPF scheme which, by contrast, is centred on limited-scale expansion of an existing highway, which follows the line of existing linear landscape features, involves minimal landtake from them and which does not involve breaking their continuity at any point. In involving only minor-scale improvements to an extant busy highway corridor, the CPPF scheme introduces at worst a minor uplift and at best a near-neutral change to prevailing noise, vibration, air quality and lighting effects within an existing zone of influence from such effects. By contrast, the GCP scheme involves a much higher magnitude of change due to introducing these potential impacts as wholly new factors into a landscape where they do not currently or otherwise exist.

7 GCP's CONSIDERATION OF IN-HIGHWAY ALTERNATIVES

7.1 GCP's position on Madingley Road options

7.1.1 Core document [CD9-31](#) is a recent (July 2025) report by WSP for GCP which considers the *"engineering feasibility of an alternative public transport scheme proposed by Cambridge Past, Present and Future (CPPF) in their objection to the Cambourne to Cambridge (CtoC) guided busway"* (Executive Summary, p6).

7.1.2 It should be noted that this document does **not** consider the CPPF scheme upon which my evidence is based, and which is as shown in the Civilistix drawings attached to Mr Johnstone's proof. To the extent that any of the engineering points made in [CD9-31](#) remain relevant to the CPPF scheme, I leave Mr Johnstone and/or Mr Leigh to respond to them. I deal here solely with the claim made within [CD9-31](#) that *"the Madingley Road options are far from environmentally benign, with potential impacts to some of the most highly protected heritage and ecological categories of designation in the UK, and/or for the property and amenity of people living along the southern boundary of this road. These are considered to make this proposal no better and potentially inferior in environmental terms to that proposed under the TWA Order application"* (para 3.10.10).

7.1.3 It will be noted, firstly, how this conclusion differs very substantially from the results of the comparative impact assessment exercises discussed in previous sections of my proof, and also how it is not based on an equivalent level of consideration¹⁷. Those results show that the CPPF scheme is in fact far superior to that proposed under the TWA Order application, as regards impact on ecology and designated sites.

7.1.4 Secondly, I note that the conclusion that an in-highway option along the Madingley Road cannot be delivered without unacceptable impacts on Madingley Wood SSSI, is not new. Indeed, WSP claim ([CD9-31](#), para 1.2.3) that *"an on-line inbound bus lane"*

¹⁷ I am not aware, for example, of any substantive habitat or species survey work along this stretch of the Madingley Road having been done by GCP.

[including an in-highway bus priority scheme on Madingley Road] “...was assessed comprehensively in the various Options Appraisal Reports (OAR)...”. Supporting those reports are a series of reviews and reports which included, amongst other things, some consideration of the potential environmental effects of such an alternative, in particular the scope for impacts on Madingley Wood SSSI.

- 7.1.5 I have considered this collective evidence, including the previous assessments (which were carried out for GCP variously by Atkins, Skanska and WSP) and I do not agree that they should be regarded as ‘comprehensive’ (as is being claimed) and/or reliable as regards the identification and relative weighting of environmental effects against the GCP favoured option. I explain why below.

7.2 Background to GCP position on Madingley Road option

- 7.2.1 At para 3.10.1 (p52) of [CD9-31](#), GCP cite concerns raised by Natural England about the risk to Madingley Wood SSSI in early consultation correspondence from 2018 (para 3.10.1 and Appendix D p68 of [CD9-31](#)).
- 7.2.2 As Appendix D of [CD9-31](#) shows, Natural England did indeed raise this concern in 2018 (and subsequently). They stated, inter alia, that “*Natural England will not support any project likely to have an adverse impact on this designated site or buffering habitat*” (p.69 3rd para). However, they also remarked that sufficient detail was not available for them to be able to provide any detailed comments or advice, nor make any judgment regarding the likely impact on Madingley Wood SSSI. Self-evidently this lack of detail will also have prevented them from being able to determine (amongst other things) whether the impacts on the SSSI and its buffer could be avoided by design (Appendix D p68 of [CD9-31](#)). Natural England understandably relies upon development applicants to consider and evidence such matters.

7.2.3 The decision to permanently set aside a Madingley Road option appears to have been taken by GCP a little later, in the wake of a 'Quick Wins' review by Mott Macdonald in 2019 and as reported in [CD13-07](#) (Mott MacDonald – Technical Note on Cambourne to Cambridge Better Public Transport 2019).

7.2.4 The Mott McDonald Technical Note considers a Route Option involving Madingley Road as part of an *“evaluation of any ‘quick win’ interventions along the worst site of congestion, from Madingley Mulch Roundabout to Grange Road”*. Figure 2 of this document (page 5 of [CD13-07](#)) provides a sketch plan of an option for an inbound public transport lane to be added to the north of Madingley Road. The drawing shows landtake from the Madingley Wood SSSI on the approach to the American Cemetery from the west. This landtake is annotated as *‘Earthworks and working space impact SSSI’*. However, this drawing shows the bus lane simply added to the extant northern carriageway without any carriageway realignment away from the SSSI (as forms part of the CCPF scheme). I also note that the earthworks (coloured green) do not actually extend over the SSSI boundary, only the pink ‘working area’.

7.2.5 The assumption that land-take from the SSSI and its buffer vegetation would be required is reflected under ‘Discounted Options’ at para 3.4.1 of this Technical Note (page 4 of [CD13-07](#)), which states the following:

“The in-bound public transport lane that was part of the On-road options consulted in 2017 / 2018 is not being proposed as a ‘quick win’ as it stretches from Madingley Mulch roundabout up to the M11 junction and a significant proportion of the work would require earthworks or working areas that fall outside of the highway boundary. This would have a large impact upon existing vegetation that runs alongside the A1307, including that which forms part of Madingley Wood, a site of Special Scientific Interest (SSSI)”.

7.2.6 The Technical Note [CD13-07](#) goes on to state that *“Following discussion with the Local Liaison Forum Technical Group, it was questioned whether the alignment [in*

the area of Madingley Wood SSSI] could be revised to provide a more comprehensive on-line scheme whilst avoiding taking land from the SSSI and American Cemetery, by shifting the route to the south. The alignment could be changed to accommodate this and it would likely reduce the impact on the SSSI and Cemetery. However, it would also require significant landtake and tree removal from residential properties opposite the American Cemetery and would still be considered as having an impact on the setting of the cemetery itself because of the road widening to provide the additional lane. As such it would still not be considered a “quick win”.

7.2.7 The Mott McDonald note ultimately concludes that *“Due to the limited amount of space available along the corridor, there is not considered to be a significant range of available “quick win” schemes that could be implemented along this section of road without the need for the purchase of private land, negotiation of 3rd party land, or impacting on vegetation and other significant features such as the American Cemetery or the SSSI”*

7.2.8 I note that the conclusion much more recently reached by WSP in July 2025 is very similar. However, the Civilistix drawings, considered together with the evidence of Mr Johnstone and Mr Leigh, offer a design that is a) deliverable without any direct impact on the SSSI, b) deliverable without any substantive impact on buffer vegetation south of the SSSI, and c) will not result in *“significant landtake and tree removal from residential properties opposite the American Cemetery”*. Furthermore, the CPPF scheme involves substantially lower risk to the barbastelle bat population associated with the SSSI (and obviates any requirement for the expensive and dubiously effective ‘hop-over’ mitigation attendant with the GCP scheme) and avoids a suite of significant negative impacts to non-statutory designated sites, Habitats of Principal Importance and a host of fragmentation and urbanisation effects which are likely to have significant consequences for a broad range of other protected and notable fauna.

7.2.9 Therefore, while the evidence I have reviewed shows that GCP has at points considered an in-highway scheme along Madingley Road, it also shows that it has not done so to the level of detail required to determine if the risk of direct or indirect impacts on the Madingley Wood SSSI and other relevant environmental constraints can be avoided, designed-out or otherwise made acceptable. When coupled together with a flawed assessment of the GCP-favoured off-road route which has the result of downplaying the environmental impacts of that option (as discussed earlier in my proof), it is clear to me that the optioneering process followed by GCP has been flawed and has likely led to misdirection. This might have been inconsequential if the two schemes performed similarly in environmental impact terms, but as I have already demonstrated, the reality is that the GCP scheme is up to an order of magnitude more damaging to biodiversity than the CPPF scheme, and therefore there are weighty moral and policy compunctions to seek the less harmful of the two options.

8 NATIONAL AND LOCAL PLANNING POLICY COMPLIANCE

8.1 The mitigation hierarchy and its relevance to the question of policy compliance

8.1.1 The mitigation hierarchy is an established tenet of land-use planning in England, enshrined within the National Planning Policy Framework (CD [8-01](#)) and recognisable as a consistent thread running through the suite of policies and good practice guidance on the sustainable use of natural resources and related decision-making. Self-evidently, the more finite, fragile or effectively irreplaceable a resource is, the greater the compunction to apply the mitigation hierarchy to it. It operates as a sequential test, requiring the consideration of opportunities firstly to avoid negative environmental impacts/harms, then reduce (mitigate) them if unavoidable and (only as a last resort) compensate for them (e.g. via offsetting).

8.1.2 It is further relevant to note here that whilst following the mitigation hierarchy is intended to be a policy-driven guiding principle for all bodies involved in development or other forms of land-use change, the compunction to do so is particularly acute when it comes to public bodies, such as the partner local authorities of the GCP, and indeed the decision-maker in this case. This is due to the additional statutory obligations and duties such bodies are subject to, including (*inter alia*) a general duty to “*conserve and enhance biodiversity*” in the exercise of their functions (s.40 NERC Act¹⁸, as amended by s.102 Environment Act 2021 [[CD5-14](#)]). That duty gains added and more specific traction when involving habitats or species listed at Section 41 of the Natural Environment and Rural Communities Act (i.e. Habitats of Principal Importance and Species of Principal Importance to the conservation of biodiversity) – otherwise known as Priority Habitats or Priority Species.

¹⁸ <https://www.legislation.gov.uk/ukpga/2006/16/contents>

8.2 Has the mitigation hierarchy been duly and properly applied by GCP?

8.2.1 Given the above, it is firstly relevant to ask the question as to whether adequate regard has been had to date by GCP to the mitigation hierarchy in the process of optioneering and ultimately settling upon a preferred route for the busway.

8.2.2 Taking account of the evidence discussed in Section 7 of my proof, it appears to me that at some point in the process GCP prematurely concluded or otherwise pre-determined that significant impacts on Madingley Wood SSSI could not be avoided with an in-highway option using the extant A1303. Marrying that conclusion to NE's concerns about the SSSI and attendant threat of objection (as articulated early in the consultation process) they appear to have decided that this not only struck out the Madingley Road in-highway option, but also provided a level of headroom in impact magnitude within which the county-significant adverse impacts to Coton Orchard, to other LWS, to Priority Habitats and Priority Species and potentially even to the Eversden and Wimpole Woods SAC could be determined as unavoidable and thus acceptable in policy terms.

8.2.3 I believe this to be a fundamentally misguided conclusion. Mr Johnstone's and Mr Leigh's evidence sets out how a design can be accommodated within the highways land along Madingley Road that wholly avoids direct impacts to Madingley Wood SSSI, and either eliminates any scope for adverse effects to the buffer zone of vegetation on highways land, or reduces them to negligible and well within the scope allowed for by standard highways maintenance in any event. Impacts on the buffer from noise, salt spray and air pollution can also be ameliorated to slightly better than neutral by pushing road traffic fractionally further to the south and away from the SSSI. At the same time, potentially significant severance and fragmentation impacts on landscape features utilised by rare barbastelle bats from roosts based in the SSSI (and potentially at least one other) can be wholly avoided, obviating the need for expensive and unproven mitigation in the form of 'hop-overs'. Lastly, direct and significant adverse impacts on a number of non-statutory designated sites,

Habitats of Principal Importance and other important ecological receptors can also be avoided. Cumulatively, these factors weigh heavily in favour of the CPPF scheme.

8.3 Compliance with national planning policy on nature conservation

8.3.1 The potential impacts of the CPPF and GCP schemes on important ecological receptors engage with Paras 187 and 193 of the National Planning Policy Framework (NPPF), and potentially also para 195.

8.3.2 NPPF Para 187 encompasses several limbs, of which (a) and (d) are relevant. These read as follows:

NPPF 187: "Planning policies and decisions should contribute to and enhance the natural and local environment by:

a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);

...

d) minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures and incorporating features which support priority or threatened species such as swifts, bats and hedgehogs."

8.3.3 In respect of NPPF 187(a), the GCP scheme has been determined to present sufficient risk to barbastelle bats to merit mitigation proposals, and because these bats are considered by Natural England to be part of a local population that is functionally linked to the statutory Eversden and Wimpole Woods Special Area of Conservation (SAC), a Habitats Regulations Assessment is also required. As confirmed in [CD2 REP-11](#), Natural England consider that the GCP scheme will give rise to a Likely Significant Effect (LSE) on the Eversden and Wimpole Woods SAC, and

furthermore that the applicant's shadow appropriate assessment ([CD1-11.05](#) TR5.11 Statement to Inform Habitats Regulations Assessment), which takes account of proposed mitigation measures, *"is not robust enough to provide sufficient certainty of no adverse effect on the integrity of Eversden and Wimpole Woods SAC"* (see page 2, para 6 of [CD2 REP-11](#)). They continue to have concerns over mitigation design and efficacy.

8.3.4 By contrast, and for the reasons set out earlier in my proof (particularly Section 6), I consider that the CPPF scheme poses negligible or no risk to local barbastelle bat populations, being centred on works to an existing busy highway rather than new road construction across a significant area of undeveloped land used by this species. Indeed, I (as an experienced HRA practitioner) am confident that the CPPF scheme would readily return a No Likely Significant Effects (NLSE) conclusion in any HRA screening process.

8.3.5 The other relevant statutory site is the Madingley Wood SSSI. The applicant suggests that any alternative to the GCP scheme based on in-highway works to Madingley Road would be unable to avoid adverse direct or indirect impacts on this SSSI. Based on the scheme drawings and the evidence of Mr Johnstone and Mr Leigh, I believe that the CPPF scheme is demonstrative that this suggestion is not robust. Direct effects on the SSSI itself can be readily and wholly avoided, and any necessary trimming back of the outer edge of buffer vegetation on the highways land south of the SSSI will be negligible and within the range of existing periodic highways maintenance activities. For such reasons I am confident that there will be no direct effect on the SSSI at all, and no indirect effect of sufficient magnitude to be classed as adverse. Indeed, there may even be fractional benefits to the function of the SSSI buffer from the CPPF scheme, as discussed at para 4.3.3 of my proof. Consequently, I believe that the specific cited interest features of the SSSI¹⁹ would be protected with either scheme.

¹⁹ i.e. ancient woodland and related flora. Note that the SSSI's population of rare barbastelle bats is not strictly speaking a designated interest feature of the SSSI.

8.3.6 In respect of 187 (d), as discussed in Sections 3-6 of my evidence the GCP scheme is substantially more harmful to biodiversity than the CPPF scheme. The CPPF scheme therefore stands as evidence of a failure to seek to minimise biodiversity impacts. In terms of providing net gains, the applicant's BNG assessment is infected by significant methodological and factual errors which have the effect of significantly underplaying the measurable impact score (using the Statutory Biodiversity Metric). The applicant contends that both the Statutory 10% net gain target, and the local policy-backed 20% net gain target, are achievable, but this is based on a demonstrably flawed BNG assessment and calculation, and a substantially greater amount of off-site compensation will be required to achieve either target than has been assumed. Off-site compensation is subject to land availability, suitability (including for the purposes of meeting BNG trading rules and delivering coherent ecological networks) and commercial pricing structures. There is no evidence that these matters have been accounted for in the applicant's costings or costs-benefits analyses. Such factors mean that uncertainties surround the question of whether, and how, the GCP scheme can achieve a 10% or 20% net gain. By contrast, the position as regards the CPPF scheme is rendered far more certain by simple virtue of the very modest off-site compensation requirement that would be necessary to compensate the much smaller losses of lower distinctiveness habitat from the scheme and deliver a 10% or 20% net gain.

8.3.7 NPPF Para 193 sets out four principles (a-d), three of which are engaged. The first of these, Para 193(a), states:

NPPF 193(a) "if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused."

8.3.8 Firstly, there is no debate that the GCP scheme will result in significant impacts. The applicant accepts that there will be adverse ecological impacts significant at county

level as a consequence of substantial landtake from four non-statutory designated sites, substantial losses of Priority Habitat (including six veteran trees accepted by the applicant to fall within the scope of the Biodiversity Gain Requirements (Irreplaceable Habitat) Regulations 2024²⁰), and a substantial risk of impacts on protected species, including a local population of barbastelle bats that is regarded by Natural England as functionally linked to the population underpinning the Eversden and Wimpole Woods SAC. These factors provide compelling reasons to follow the sequential hierarchy set out in Para 193(a) and explore whether such significant effects can be avoided. While there has been some consideration of alternatives by GCP, I believe that there has been a failure to fully engage with this sequential process and GCP has misdirected itself as to the question of whether there are less damaging alternatives that should be pursued. As demonstrated in previous sections of this proof, the CPPF scheme represents a very significantly less harmful alternative to the GCP scheme. The applicant's failure to elucidate this through the process of optioneering and in its consideration of alternatives represents, in my view, a failure to apply the mitigation hierarchy and consequently a failure to comply with NPPF Para 193(a).

8.3.9 NPPF Para 193(b) is relevant here due to the presence of the Madingley Wood SSSI. It states:

NPPF 193(b): "development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. 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"

²⁰ <https://www.legislation.gov.uk/uksi/2024/48/contents/made>

8.3.10 The applicant seeks to justify the significant ecological harms attendant with the GCP scheme by suggesting that any alternative based on in-highway works to Madingley Road would be unable to avoid adverse direct or indirect impacts on Madingley Wood SSSI. Based on the CPPF scheme drawings and the evidence of Mr Johnstone and Mr Leigh, I believe that this suggestion is not robust. Direct effects on the SSSI itself can be readily and wholly avoided, and any necessary trimming back of buffer vegetation on the highways land south of the SSSI will be negligible, and within the range of existing periodic highways maintenance activities. For such reasons I am confident that there will be no direct effect on the SSSI, and no indirect effect sufficient to be classed as adverse. Indeed, there may even be fractional benefits to the function of the SSSI buffer from the CPPF scheme, as discussed at para 4.3.3 of my proof.

8.3.11 NPPF Para 193(c) concerns irreplaceable habitats:

NPPF 193(c): “development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons and a suitable compensation strategy exists”.*

**wholly exceptional reasons are defined in a footnote to this para as “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”*

8.3.12 The CPPF scheme involves no loss or deterioration of irreplaceable habitat. By contrast, the GCP scheme involves the loss of ‘veteran trees’, as named in Para 193(c) and as listed in the schedule to the Biodiversity Gain Requirements (Irreplaceable Habitat) Regulations 2024. The ‘wholly exceptional reasons’ clause therefore applies to the GCP scheme and, in my opinion, the existence of a workable and far less ecologically damaging alternative in the form of the CPPF scheme means

that the GCP scheme clearly fails to meet the exception test and comply with this policy.

8.3.13 NPPF Para 195 disapplies the presumption in favour of sustainable development in circumstances where a plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects). It is relevant here that, as confirmed in [CD2 REP-11](#), Natural England consider that the GCP scheme will give rise to a Likely Significant Effect (LSE) on the Eversden and Wimpole Woods habitats site (SAC), triggering a requirement for appropriate assessment. NE further consider that the applicant's shadow appropriate assessment ([CD1-11.05](#) TR5.11 Statement to Inform Habitats Regulations Assessment) *"is not robust enough to provide sufficient certainty of no adverse effect on the integrity of Eversden and Wimpole Woods SAC"* (see page 2, para 6 of [CD2 REP-11](#)). The tilted balance enshrined within NPPF 195 should not therefore be considered to apply to the GCP scheme.

8.4 Compliance with relevant local planning policy on nature conservation

8.4.1 Given the misalignment of the GCP scheme with national policy, as set out at 8.3 above, I deal more briefly with adopted local planning policy by means of **Table 4** below. Both the GCP scheme and the CPPF scheme cross the administrative boundary between South Cambridgeshire and Cambridge City, and therefore relevant policies from both are engaged:

Table 4 – Compliance with adopted local planning policy

LP Policy	GCP Scheme	CPPF Scheme
Cambridge Local Plan 2018 CD6-01		
Policy 69: Protection of sites of biodiversity and geodiversity Importance (pp201-203).	Risk to Eversden and Wimpole Woods SAC unresolved – NE maintain concerns. Directly affects and damages an additional 4no non-statutory	No substantive risk to Eversden and Wimpole Woods SAC due to nature of scheme. Involves works physically closer to Madingley Wood SSSI than GCP scheme, but

	designated sites of county or city-wide importance. Exceptional circumstances test not met as CPPF scheme represents much less harmful alternative.	direct or adverse indirect effects not likely to arise due to scheme design. No impact on any non-statutory designated site.
Policy 70: Protection of priority species and habitats (pp203-205)	<p>Involves significant losses of Priority Habitat (and also statutory Irreplaceable Habitat) which is avoidable via CPPF scheme and therefore fails sequential test enshrined within the policy.</p> <p>Risks significant harm to barbastelle bats (Priority Species) and is reliant on unproven mitigation which NE does not consider sufficient to rule out adverse effects on local populations of this species.</p> <p>Scheme is intrinsically more impactful for Priority Species due to route crossing undeveloped farmland rather than being delivered via highways works within the zone of influence of the existing A1303.</p>	<p>Avoids significant loss of any Priority Habitat, and wholly avoids significant loss of Traditional Orchard Priority Habitat. Some hedgerows may need cutting back but there will be no losses in contrast to GCP scheme.</p> <p>Negligible scope for adverse effect on barbastelle bats due to much more limited landtake and tree/hedgerow loss.</p> <p>Other species impacts limited due to scheme focus on upgrade to existing road.</p>
South Cambridgeshire Local Plan 2018 CD6-02		
NH/4 (Biodiversity) (internal pp115-116)	<p>Involves significant losses of Priority Habitat (and also statutory Irreplaceable Habitat) which is avoidable via CPPF scheme and therefore fails sequential test enshrined within the policy.</p> <p>Risks significant harm to barbastelle bats (Priority Species) and is reliant on</p>	<p>Avoids significant loss of any Priority Habitat, and wholly avoids significant loss of Traditional Orchard Priority Habitat. Some hedgerows may need cutting back but there will be no losses in contrast to GCP scheme.</p> <p>Negligible scope for adverse effect on barbastelle bats due to</p>

	<p>unproven mitigation which NE does not consider sufficient to rule out adverse effects on local populations of this species.</p> <p>Scheme is intrinsically more impactful for Priority Species and Habitats due to route crossing undeveloped farmland rather than being delivered via highways works within the zone of influence of the existing A1303.</p>	<p>much more limited landtake and tree/hedgerow loss.</p> <p>Other species impacts limited due to scheme focus on upgrade to existing road.</p>
NH/5 (Sites of Biodiversity or Geological Importance) (internal pages 117-119)	<p>Risk to Eversden and Wimpole Woods SAC unresolved – NE maintain concerns.</p> <p>Directly affects and damages an additional 4no non-statutory designated sites of county or city-wide importance.</p> <p>Exceptional circumstances test not met as CPPF scheme represents much less harmful alternative.</p>	<p>No substantive risk to Eversden and Wimpole Woods SAC due to nature of scheme.</p> <p>Involves works physically closer to Madingley Wood SSSI than GCP scheme, but direct or adverse indirect effects not likely to arise due to scheme design.</p> <p>No impact on any non-statutory designated site.</p>

8.4.2 In terms of emerging policy, the Greater Cambridge Local Plan ([CD6-04](#)) is at an early stage, however nascent policy BG/BG (pp168-171) is relevant in that the clear direction is to maintain the 20% target for BNG in the Greater Cambridge area and to maintain the presumption against permitting development proposals adversely affecting sites of biodiversity importance subject to an overriding public benefit/importance exceptions test. The comments made above at **Table 4** therefore relate equally to the current form and direction of emerging Local Policy on biodiversity and again strongly weigh in favour of the CPPF scheme.

9 OVERALL CONCLUSIONS

- 9.1 GCP accepts that its preferred scheme, involving (*inter alia*) unresolved risks of adverse effect on the integrity of the Eversden and Wimpole Woods SAC, direct impacts (landtake) from four non-statutory designated sites and substantial losses of Priority Habitat, including 'irreplaceable' veteran trees, will result in adverse impacts on biodiversity that are significant at up to county level. These impacts create clear conflicts with national and local planning policy that can only be overcome in exceptional circumstances. GCP's case that the scheme meets these policy and public interest tests hinges on an assertion that such impacts are unavoidable if the congestion-easing and other benefits of the scheme are to be realised.
- 9.2 As my colleagues' and my own evidence demonstrates, this assertion is at best highly challengeable. The CPPF scheme, involving limited-scale in-highway works along the A1303 Madingley Road would obviate the need for the proposed off-road section of the CtoC route east of St Neots Road, and thus represents an evidently deliverable and workable alternative that is at least comparable in terms of traffic and transport benefits, but has the weighty advantage of giving rise to vastly lesser ecological impact.
- 9.3 While GCP have at times considered the principle of an in-highway option along Madingley Road, I consider that the CPPF scheme demonstrates that such consideration has been insufficient, and in any event short of what is necessary for GCP to be able to advance a case that their preferred option (the GCP scheme) accords with the mitigation hierarchy. By extension this puts the GCP scheme out of alignment with national and local policy and inconsistent with sensible and sustainable decision-making.
- 9.4 I have also found GCPs assessment of ecological impacts to be flawed due to significant methodological failure, omission and error. As a consequence of these

flaws, the true ecological impact of the GCP scheme has, in my opinion, been underplayed in the submitted EIA and related assessments.

- 9.5 If the Order were not made, this would afford GCP the opportunity to revisit less ecologically harmful alternatives in a more applied and meaningful way, such that the intended transport benefits behind the scheme can be delivered to a higher standard of environmental responsibility.

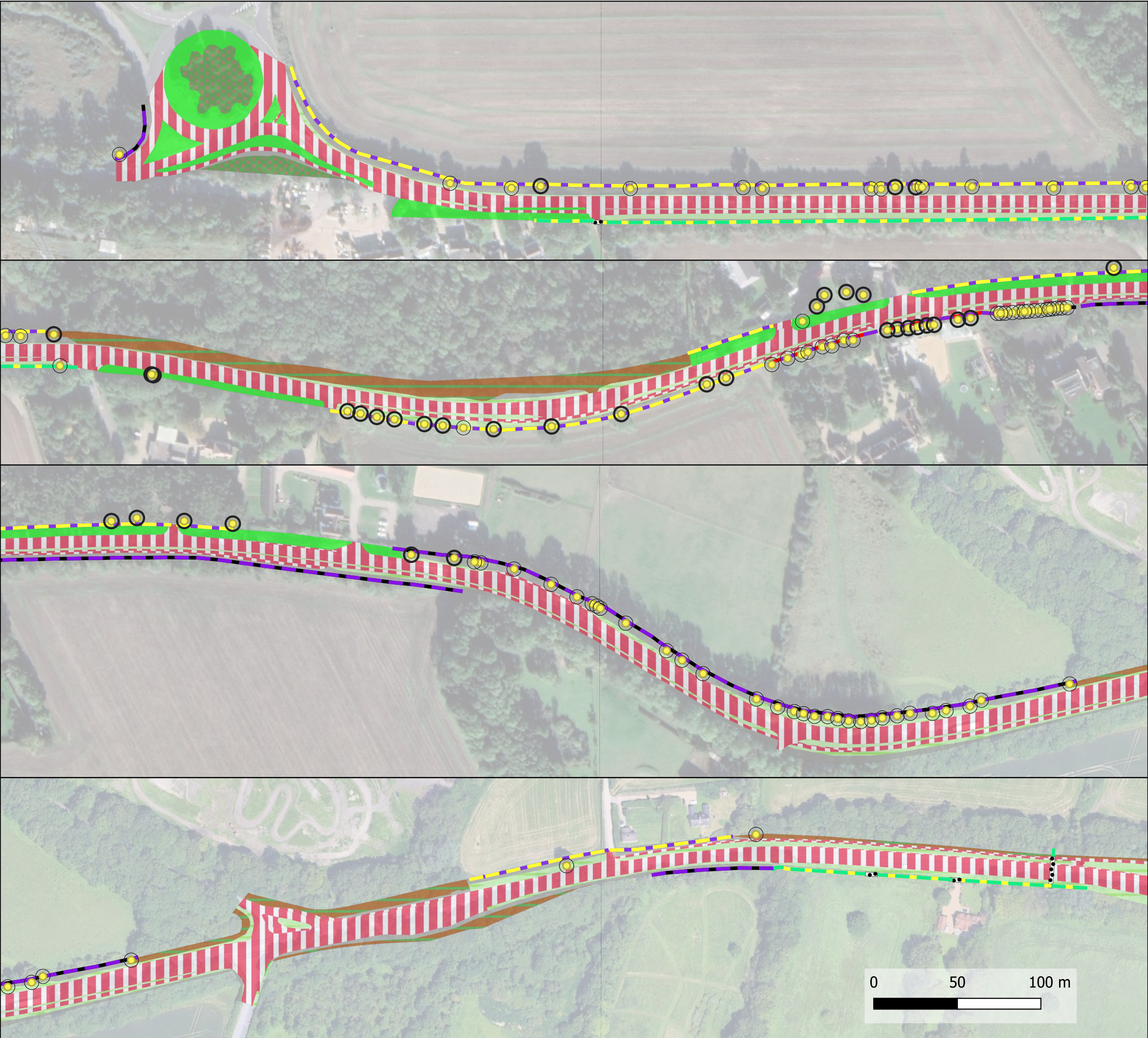
10 WITNESS DECLARATION

10.1 This proof of evidence includes all facts which I regard as being relevant to the opinions that I have expressed and that the inquiry's attention has been drawn to any matter which would affect the validity of that opinion.

10.2 I believe the facts that I have stated in this proof of evidence are true and that the opinions expressed are correct.

10.3 I understand my duty to the inquiry to help it with matters within my expertise and have complied with that duty.

FIGURES



Key

- Developed land; sealed surface
- Lowland mixed deciduous woodland
- Modified grassland
- Other neutral grassland
- Other woodland; broadleaved
- Tall forbs
- Non-native and ornamental hedgerow
- Ecologically valuable line of trees
- Ecologically valuable line of trees - associated with bank or ditch
- Native hedgerow
- Native hedgerow with trees
- Species-rich native hedgerow with trees
- Species-rich native hedgerow with trees - associated with bank or ditch
- Culvert
- Ditches
- Large rural tree
- Medium rural tree
- Small rural tree

Title
Baseline Habitats Map

Project
CtoC Busway

Client
CPPF/CPC

Drawing No. Revision Project No.
Figure DW1 - E2257

Drawn Checked Date
CT & OB DW August 2025

Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU

+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com



Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491



Key

- Developed land; sealed surface
- Lowland mixed deciduous woodland
- Modified grassland
- Other neutral grassland
- Other woodland; broadleaved
- Tall forbs
- Non-native and ornamental hedgerow
- Ecologically valuable line of trees
- Ecologically valuable line of trees - associated with bank or ditch
- Native hedgerow
- Native hedgerow with trees
- Species-rich native hedgerow with trees
- Species-rich native hedgerow with trees - associated with bank or ditch
- Culvert
- Ditches
- Large rural tree
- Medium rural tree
- Small rural tree

Title Baseline Habitats Map East		
Project CtoC Busway	Client CPPF/CPC	
Drawing No. Figure DW2 -	Revision 	Project No. E2257
Drawn CT & OB	Checked DW	Date August 2025

Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU

+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com



Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491



Key

- Developed land; sealed surface
- Lowland mixed deciduous woodland
- Modified grassland
- Other neutral grassland
- Other woodland; broadleaved
- Tall forbs
- Non-native and ornamental hedgerow
- Ecologically valuable line of trees
- Ecologically valuable line of trees - associated with bank or ditch
- Native hedgerow
- Native hedgerow with trees
- Species-rich native hedgerow with trees
- Species-rich native hedgerow with trees - associated with bank or ditch
- Culvert
- Ditches
- Large rural tree
- Medium rural tree
- Small rural tree
- Lost rural tree

Title Proposed Habitats Map		
Project CtoC Busway	Client CPPF/CPC	
Drawing No. Figure DW3 -	Revision 	Project No. E2257
Drawn CT & OB	Checked DW	Date August 2025

Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU

+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com



Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491



Key

- Developed land; sealed surface
- Lowland mixed deciduous woodland
- Modified grassland
- Other neutral grassland
- Other woodland; broadleaved
- Tall forbs
- Non-native and ornamental hedgerow
- Ecologically valuable line of trees
- Ecologically valuable line of trees - associated with bank or ditch
- Native hedgerow
- Native hedgerow with trees
- Species-rich native hedgerow with trees
- Species-rich native hedgerow with trees - associated with bank or ditch
- Culvert
- Ditches
- Large rural tree
- Medium rural tree
- Small rural tree
- Lost rural tree



Title
Proposed Habitats Map East

Project
CtoC Busway

Client
CPPF/CPC

Drawing No. Revision Project No.
Figure DW4 - E2257

Drawn Checked Date
CT & OB DW August 2025

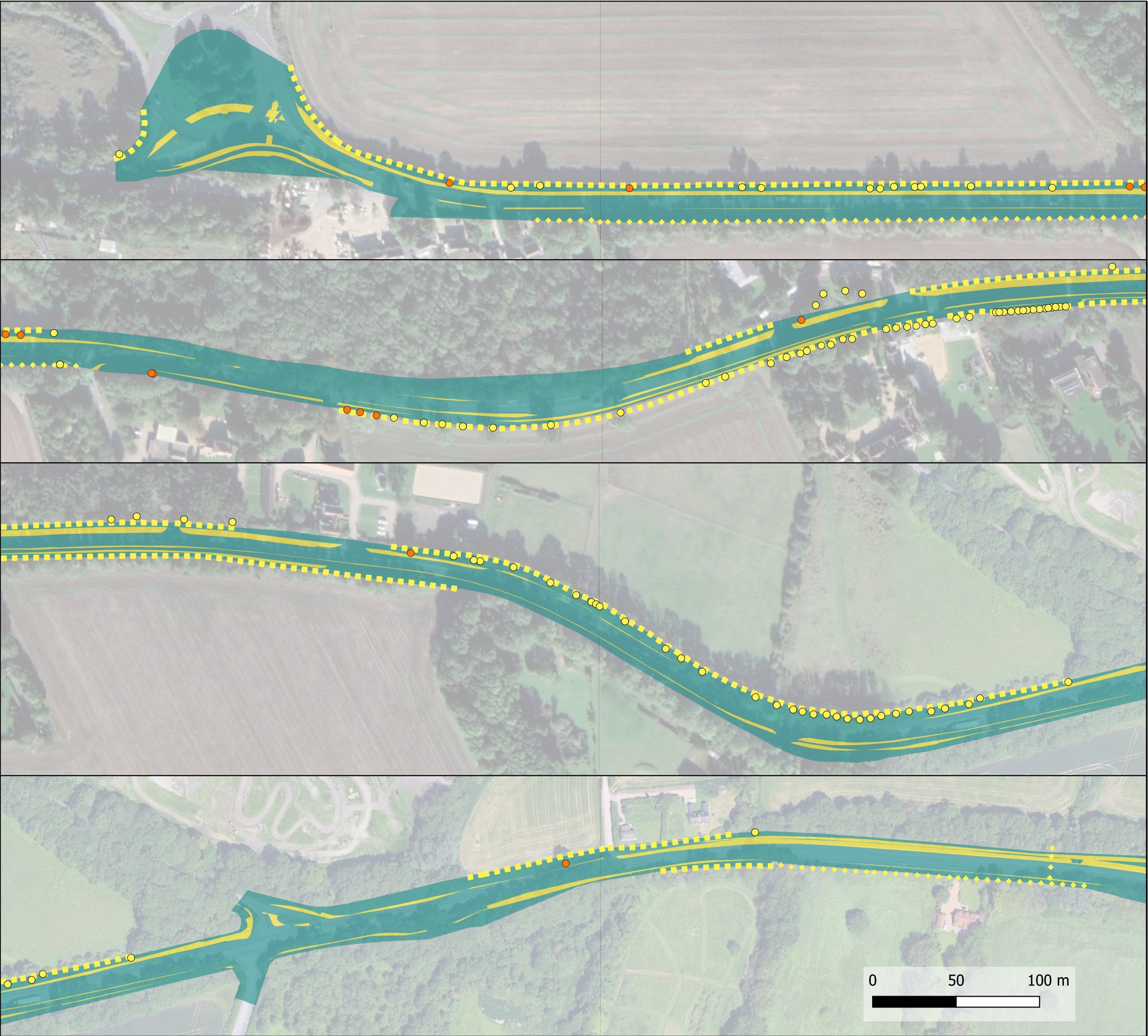
Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU

+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com



Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491



Key

Habitat Retention

- Retained
- Lost

Watercourse Retention

- Retained

Hedgerow Retention

- Retained

Individual tree Retention

- Retained
- Assumed lost



Title
Habitat Retention Map

Project	Client
CtoC Busway	CPPF/CPC

Drawing No.	Revision	Project No.
Figure DW5 -		E2257

Drawn	Checked	Date
CT & OB	DW	August 2025

Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU

+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com



Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491



Key

Habitat Retention

- Retained
- Lost

Hedgerow Retention

- Retained

Watercourse Retention

- Retained

Individual tree Retention

- Retained
- Proposed Lost

Title

Habitat Retention Map East

Project

CtoC Busway

Client

CPPF/CPC

Drawing No.

Figure DW6 -

Revision

Project No.

E2257

Drawn

CT & OB

Checked

DW

Date

August 2025

Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU

+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com



Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491

APPENDIX DW1

Appendix DW1 – Madingley Road Habitat Descriptions and Condition Assessments

1. UKHab surveys and condition assessments conducted by Dominic Woodfield. 25th May, 8th July and 30th July 2025.
2. The following habitat types are present within the highway land along Madingley Road between Madingley Mulch Roundabout and the start of the extant bus lane just west of the M11 overbridge and interchange. They are listed by their primary and secondary UKHab codes, with the equivalent habitat in BNG terms in brackets:
 - g3c5 *Arrhenatherum* neutral grassland (other neutral grassland)
 - g4 modified grassland (modified grassland)
 - w1f7 Other lowland mixed deciduous woodland (lowland mixed deciduous woodland and other broadleaved woodland)
 - h2a native hedgerow (inc. hedgerow with trees, native hedgerow etc)
 - 16 – tall forbs (tall forbs)
 - u1b – developed land, sealed surface (developed land, sealed surface)
 - u1c – artificial unvegetated, unsealed surface (artificial unvegetated, unsealed surface)
 - u1d – suburban mosaic of developed and natural surface (various)
 - u1f (81) – sparsely vegetated urban land (ruderal/ephemeral)
 - 32/33 – individual (non-woodland, non-hedgerow) trees (rural tree/line of trees)
 - 50 – dry or seasonally wet ditch (ditches).

The BNG equivalents of the UKHab categories above are mapped on **Figures DW1-DW2** and each habitat type is described in further detail below, with an account of the dominant constituent plant species, and attention drawn to any more unusual or notable species recorded.

g3c5 Arrhenatherum neutral grassland (other neutral grassland)

Tall and essentially unmanaged grassland habitat dominates the broader unshaded verges of Madingley Road other than where replaced by hard surfaces (such as at junctions and accessways) or modified by mowing, overseeding and fertilisation (where it is described as modified grassland below). It typically occupies a linear zone in the mid-ground between the outer edges of the highway boundary and the carriageway itself. It grades outwards towards adjoining hedges and woodland via a narrow strip of tall forb habitat and/or a narrow strip dominated by bramble or dewberry, and inwards towards the carriageway via a narrow fringe of more sparsely vegetated kerb-side verge

where salt spray and factors such as more frequent cutting and occasional overrun of vehicles have created a community of low-growing salt-tolerant species.

The tall and robust grass false oat *Arrhenatherum elatius* is typically the dominant graminoid species, though often it is co-dominant with cock's-foot *Dactylis glomerata* and sometimes replaced by couch *Elytrigia repens*. This pattern is typical for generally unmanaged road verges on circumneutral soils. Other grass species that are frequent to locally abundant include rough meadow grass *Poa trivialis*, creeping bent *Agrostis stolonifera*, soft brome *Bromus hordaceus* and sterile brome *Anisantha sterilis*. In the poorer examples, herb species may be restricted to cow parsley *Anthriscus sylvestris*, broad-leaved dock *Rumex obtusifolius*, hogweed *Heracleum sphondylium*, creeping thistle *Cirsium arvense*, mugwort *Artemisia vulgaris* and stinging nettle *Urtica dioica* with some bramble *Rubus fruticosus* agg. or dewberry *Rubus caesius*. Localised examples have a range of finer herbs such as stone parsley *Sison amomum*, hedge bedstraw *Galium mollugo*, knapweed *Centaurea nigra* and ox-eye daisy *Leucanthemum vulgare*.

Habitat falling within the category u1f (81) – sparsely vegetated urban land (ruderal/ephemeral) occur as a narrow (generally <0.5m) fringe of salt-spray influenced verge immediately adjoining the carriageway. The vegetation here is often sparse and low growing (though some taller species can occur, such as perennial sow thistle *Sonchus arvensis*) and the community is also distinctive by the abundance of low-growing rosette forming or otherwise creeping species, and by the presence of halophytes tolerant of road salt spray. Characteristic species of this habitat include perennial rye grass, buck's-horn plantain *Plantago coronopus*, procumbent pearlwort *Sagina procumbens*, annual meadow grass, reflexed saltmarsh grass *Puccinellia distans*, grass-leaved orache *Atriplex littoralis*, common orache *Atriplex patula*, Danish scurvy grass *Cochlearia danica*, and (locally) narrow leaved pepperwort *Lepidium heterophyllum*. These communities would fall into 'ruderal ephemeral' under the BNG regime which is a lower distinctiveness habitat, however due to their small size and fluctuating nature they have been included within 'other neutral grassland' for precautionary reasons.

Condition assessment:

All g3c5/other neutral grassland habitat polygons were assessed against the criteria to fall within the "poor" condition category largely due to failures against structure and species diversity criteria.

w1f7 Other lowland mixed deciduous woodland (lowland mixed deciduous woodland and other broadleaved woodland)

Self-sown woodland expands into the highways land at several locations along the relevant stretch of Madingley Road. Most extensively, and significantly, it occurs south

of (and as an unbroken woodland extension to) the Madingley Wood SSSI, albeit on land that has clearly been disturbed in the past (including during highways works related to Madingley Road). There is therefore no ancient woodland within the highway boundary.

The strip of woodland south of the SSSI at Madingley Wood is a closed canopy stand of comprised mainly of established and quite large field maple *Acer campestre* and both smooth-leaved and rough-leaved elms (including at least three microspecies from this taxonomically contentious group, including at least one specimen keying out as the claimed site-specific native *Ulmus madingleyensis*¹. There are also smaller amounts of ash *Fraxinus excelsior*, buckthorn *Rhamnus catharticus*, hawthorn *Crataegus monogyga* and even horse chestnut *Aesculus hippocastanum*. The understorey is variously quite open or consists of mid-height elms with a little blackthorn *Prunus spinosa*, hawthorn *Crataegus monogyna* and elder *Sambucus nigra*.

The ground flora varies from sparse shaded-out examples of road verge on the higher ground and made slopes of the highway shoulders, to stands of wood false brome *Brachypodium sylvaticum*, hedge garlic *Alliaria petiolata* and dog's mercury *Mercurialis perennis* on the lower ground at the northern highway boundary and adjoining the SSSI. Other species noted on this lower ground included ivy *Hedera helix*, giant fescue *Schedonorus giganteus*, lords and ladies *Arum maculatum* and dewberry.

Away from Madingley Wood, smaller representations of secondary woodland of similar quality encroach into the highways boundary in a number of locations. Their species composition is generally similar to that described above, with ash and elm often dominant, and field maple locally prominent, however they typically have a more depauperate ground flora/field layer.

Poorer quality representations of woodland falling within the 'other broadleaved woodland' category are mapped in a few places, such as occupying land in the central part of the Madingley Much roundabout. This is derived from fairly recent plantation and the trees are not yet fully mature, but as they are in all instances >5m tall, have occluded the space between them and now overshadow and thereby strongly influence the herb and grass communities beneath, they have been classified and mapped as woodland (albeit of poor condition). The constituent species at this location include field maple, cherry plum *Prunus laurocerasus*, beech *Fagus sylvatica*, hornbeam *Carpinus betulus*, sycamore *Acer pseudoplatanus* hazel *Corylus avellana* and damson *Prunus domestica*.

Most of the woodland achieves moderate condition, with some poor against the relevant criteria.

¹ <https://www.wildlifebcn.org/sites/default/files/2021-07/Complete%20key%20to%20native%20and%20naturalised%20elms.pdf>

h2a native hedgerow (inc native hedgerow with trees, species-rich hedgerow with trees, native hedgerow, species-rich hedgerow with trees associated with a bank or ditch, ecologically valuable line of trees)

Where not part of adjoining woodland, or demarcated by the walls, fences or ornamental hedging of residential or institutional property boundaries, the outer boundaries of the highways land are in all instances demarcated by hedgerows. These vary from grown out features with a significant complement of mature trees, to more regularly trimmed examples, where standard trees are intermittent at best. Woody species complement and diversity varies from fairly low (3-5 species per 30m) to good (consistently >5m per 30m). The latter examples will typically qualify as Important hedgerows under the 1987 Hedgerows Regulations due to a combination of this and other qualifying features.

The dominant or most common constituents of the hedgerows along the route are listed in declining order of frequency as follows: hawthorn, blackthorn, elm, field maple, ash, spindle, dog rose, wild privet, oak, hazel, buckthorn, elder, damson, sycamore, field rose. In terms of field layer beneath these features, this generally contains a reasonable complement of woodland species such as bramble, dewberry, cleavers *Galium aparine*, rough meadow grass, lords and ladies, wood dock *Rumex sanguineum*, hedge garlic, black bryony *Tamus communis*, ivy, wood false brome and locally dog's mercury.

All hedgerows were adjudged to achieve 'moderate' condition.

g4 modified grassland (modified grassland)

This type of grassland occurs in several defined locations along the route. Most extensively, it occurs on the close-mown verges outside the entrance to the American Cemetery, with other localised examples outside Mill Farm and in the narrow strip of grassland between the cycleway and road carriageway, where there has evidently been comparatively recent disturbance and re-seeding.

To a greater or lesser extent the community is characterised by perennial rye-grass *Lolium perenne* and white clover *Trifolium repens*, but species diversity can be much higher, with annual meadow grass *Poa annua*, couch, smooth meadow grass *Poa pratensis* and red fescue *Festuca rubra* and an array of low-growing or rosette-forming herbs such as dandelion *Taraxacum officinale* agg. daisy *Bellis perennis*, smooth hawk's-beard *Crepis capillaris*, common mallow *Malva sylvestris*, greater plantain *Plantago major* and very locally knapweed and bird's-foot trefoil *Lotus corniculatus*. Of most note was the presence of several stations of knotted hedge parsley *Torilis nodosa* in this habitat (outside the American Cemetery).

Condition assessment:

All modified grassland polygons were adjudged to be of moderate condition, with slightly elevated herb diversity lifting them out of 'poor'.

16- tall forbs

This habitat occurs mainly as a narrow, linear transitional structural component between MG1 type coarse grassland, and hedgerows or woodland albeit sometimes this transition is truncated (e.g. where woodland or hedgerows are closer to the road). Often it includes elements of bramble/dewberry scrub, but the latter are not dominant. Typical constituents include mugwort, hogweed, stinging nettle, cleavers and cow parsley. Also mapped as this habitat are extensive areas of winter heliotrope *Petasites fragrans* which dominate sections of shaded and locally damp southern verge and ditch (qv) banks.

All examples of this habitat were adjudged to be in 'moderate' condition.

u1b – developed land, sealed surface, u1c – artificial unvegetated, unsealed surface.

These two habitats are dealt with together as they are essentially unvegetated and low scoring artificial surfaces, comprising the surfaced carriageway, kerbs, footways, bellmouths and other features associated with the road itself, and with surfaced laybys, footways and cycleways.

There are no condition assessment criteria for these habitats.

32/33 – individual (non-woodland, non-hedgerow) trees (rural trees)

In addition to a few free-standing (i.e. non-woodland or non-hedgerow) trees, in accordance with BNG rules any medium or larger sized hedgerow trees likely to be removed by the scheme have been subject to independent condition assessment. The majority of trees likely to be affected are ash, some of which show signs of dieback, but there are also a number of larger field maple and one or two oak. All were assessed to be in moderate condition, and no veteran or ancient trees fell were present within this group.

50 – dry or seasonally wet ditch (ditches).

Intermittent lengths of seasonal ditch occur along the southern side of the Madingley Road. Generally these have little in the way of macrophyte vegetation and contain a continuation of the adjoining other neutral grassland, with wetland species such as greater willowherb *Epilobium hirsutum* and an increased abundance of creeping buttercup marking the transition onto seasonally inundated and damper soils. Winter heliotrope is a feature locally. The condition of all of these features was assessed as 'poor'.

APPENDIX DW2



Road traffic has a consistent negative impact on breeding density of a wide range of bird species in different habitats

René E. van Dijk · Toine Morel ·
Karen Zwerver · Paul van Els · Ruud P. B. Foppen

Received: 29 November 2024 / Accepted: 11 April 2025 / Published online: 11 June 2025
© The Author(s) 2025

Abstract

Context Road traffic has a major impact on the environment and numerous studies have shown how various species respond to road traffic. However, a clear picture based on large-scale studies of how complete species communities in different environments are affected by road traffic is lacking.

Objectives We assessed the distance within which road traffic negatively impacts breeding bird densities and the extent to which effect distances differ between

species and habitats. We also tested how traffic intensity is associated with effect distances.

Methods We used a large dataset from protocolled breeding bird surveys of > 140,000 territories of complete breeding bird communities within 1500 m from motorways across the Netherlands. We examined effect distances of road traffic on breeding density of individual species, for various ecological species groups and for all species together. Finally, we tested how road traffic intensity influences effect distances.

Results Road traffic had a consistent negative effect on territory densities up to approximately 650 m distance from the road for different species and ecological species groups. Within road-effect zones, densities of breeding birds were significantly lower (on average 25%) than at greater distances from the road. Effect distances were positively associated with traffic intensity in various ecological species groups.

Conclusions These findings that road traffic negatively affects breeding densities in a consistent manner across species and that this effect is exacerbated by traffic intensity will allow policymakers to predict and assess the quantitative impact of road traffic with a given traffic intensity on breeding bird populations.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10980-025-02100-5>.

R. E. van Dijk (✉)
Sweco Netherlands, De Holle Bilt 22, 3732 HM De Bilt,
The Netherlands
e-mail: vandijkre@yahoo.co.uk

R. E. van Dijk
Geonius, Voorveste 7, 3992 DC Houten, The Netherlands

T. Morel · K. Zwerver
Rijkswaterstaat Water, Transport and Environment,
Postbus 2232, 3500 GE Utrecht, The Netherlands

P. van Els · R. P. B. Foppen
Sovon Dutch Centre for Field Ornithology, Toernooiveld
1, 6525 ED Nijmegen, The Netherlands

R. P. B. Foppen
Radboud University, Heyendaalseweg 135,
6525 AJ Nijmegen, The Netherlands

Keywords Road exposure · Birds · Disturbance · Effect distance · Dose–effect relationship · Road ecology

Introduction

Roads and road traffic are a major source of disturbance of the natural world (Forman and Alexander 1998; Forman 2003; Fahrig and Rytwinski 2009; van der Ree et al. 2015). Various factors associated with road traffic influence the abundance and composition of animal and plant communities. The presence of roads and their use by traffic cause fragmentation of natural habitats, increased risk of wildlife-vehicle collisions, noise and light pollution, optical disturbance, the spread of invasive species, and pollution through the deposition of toxic heavy metals and nutrients (Spellerberg 1998; Kociolek et al. 2011; Sanderfoot and Holloway 2017). These effects may lead to, among others, genetic impoverishment, physiological stress, reduced availability of food and suitable habitat, interference with communication, reduced survival and reproduction and ultimately reduced abundance and diversity of animals and altered species compositions near busy roads compared with locations further away from roads (van der Zande et al. 1980; Keller and Largiadèr, 2003; Palomino and Carrascal 2007; Eigenbrod et al. 2009; Slabbekoorn 2013; Sijtsma et al. 2020; Cooke et al. 2020a; Kroeger et al. 2022).

The topic of how roads and associated traffic impact ecology and the road-effect zone ('road ecology'; Forman 2003) is therefore of increasing conservation concern and has drawn the attention of researchers and policymakers for decades (Barber et al. 2010; Benítez-López et al. 2010; Gaston et al. 2017; Cooke et al. 2020a). Most studies have focused on the impact of traffic, such as effects of disturbance caused by noise, visual effects or vibrations, road victims or the effects of exhaust gases generated by cars. In general, there is substantial evidence that road traffic impacts bird populations, often represented as lower densities of breeding populations along roads. A clear picture of how such impacts caused by the different factors associated with traffic may differ between species and environments is still lacking. This is because of the complexity of the integrated effect of the various factors involved, which may all affect birds in different but often overlapping ways. Dose values of noise and visual effects, for example, decrease exponentially with distance from the road, so that dose values are well above background levels within the first few hundred metres from the

road. The negative impact of road collisions is also expected to only affect bird populations in zones near the road (Reijnen and Foppen 2006). While some authors consider collision risk the key factor driving changes (Summers et al. 2011) and others suggest that it is disturbance caused by noise (Parris and Schneider 2008; Ware et al. 2015), because of such stacking of effects close to the road, it is difficult to establish which factor should be considered the most important.

Several previous authors have considered the impact of traffic on different species and species compositions and in various habitats (Reijnen et al. 1997; Garniel et al. 2007; Fahrig and Rytwinski 2009; Benítez-López et al. 2010). These studies revealed obvious differences between species in terms of the effects caused by road traffic, likely because species are not equally sensitive to disturbance caused by the different factors associated with road traffic (Fahrig and Rytwinski 2009; Ortega 2012). For example, bird species for which vocal communication is important and that communicate at frequencies that overlap with the frequency of traffic noise are more likely to be affected by road traffic noise than are species for which vocal communication is less important (Rheindt 2003; Goodwin and Shriver 2011; Halfwerk et al. 2011a, 2011b; Ortega 2012). Sound permeability and visual effects also differ between environments. The presence of trees, for example, can block visual effects, while a soft forest floor may absorb sound of certain frequencies. In contrast, visual effects are more likely to propagate over greater distances in open areas, and sound may be reflected and amplified from smooth or hard soil surfaces. The impact of road traffic also depends on the existing level of background effects, such as background noise, and the extent to which animals are habituated or able to adapt to it (Blumstein 2013; Vincze et al. 2016; Ramellini et al. 2024). Consequently, the impact of traffic depends on the environment and may, for example, differ between urban and rural landscapes or depend on the quality of the habitat and/or availability of alternative habitats (Reijnen and Foppen 1995). This makes an accurate assessment of the effects caused by traffic complex.

Largescale studies assessing effects of traffic on species communities in different environments are therefore required. In addition to how the presence of roads may influence the distribution of birds (Cooke

et al. 2020c), insight into how species from different environments may be affected by traffic and how traffic volumes may influence effects caused by road traffic provides crucial information for assessing and mitigating the impact of road traffic on birds. In this study, we used an extensive dataset containing information on the locations of more than 140,000 breeding bird territories near motorways from protocolled bird monitoring surveys throughout the Netherlands collected between 1984 and 2021. We used this dataset to analyse the pattern of breeding densities in relation to the distance of a road and assess over which distances effects on breeding birds occur for different species and species groups in different habitats.

First, we expected the impact of traffic to lead to decreased densities of breeding birds near roads. The density of breeding birds should therefore increase with increasing distance from the road. We expected this effect to be stronger closer to roads than at a greater distance from the road. Second, we expected the effect curves with distance from the road to be similar for different species of birds, but the extent of the effect to differ between species and species groups in different habitats. We tested this prediction by investigating effect distances and effect sizes for different species and ecological species groups. Finally, we also expected the extent of the effect to be positively associated with traffic intensity. We investigated this dose–effect relationship by examining whether effect distances are predicted by road traffic intensity. The results from this study may be used to assess the effects of motorway traffic on a wide array of breeding birds. The results will help predict how effects are associated with traffic intensity and how adjustments to existing roads leading to altered traffic intensity may affect the impact on breeding birds.

Methods

Data collection – breeding bird surveys

Information on the location of territories used in the analyses was collected between 1984 and 2021 using protocolled bird surveys within survey plots of the national breeding bird monitoring project BMP (www.sovon.nl/bmp). With this long-term monitoring project annual changes in numbers are obtained for nearly all species of breeding birds in

the Netherlands, excluding colonial nesting birds (Vergeer et al. 2016). From this extensive long-term nationwide survey, data were selected on the basis of various characteristics. We selected survey plots adjacent to major roads (motorways). We restricted the analyses to territories within a distance of 1500 m from the motorway network in the Netherlands. Earlier studies have indicated that effect distances are unlikely to exceed 1000 m from the road (Reijnen et al. 1997; Palomino and Carrascal 2007; Benítez-López et al. 2010; Cooke et al. 2020a, b, c). A cut-off distance of 1500 m is thus likely to be conservative while also allowing the calculation of breeding densities in a control situation without the effect of road traffic. The motorway network used in this study concerned the motorways managed by Rijkswaterstaat, the executive agency of the Dutch Ministry of Infrastructure and Water Management. The first 25 m from the roadside were excluded from the analyses, because this area usually comprises a road verge, ditch or a parallel minor road not representative of the survey plots within the landscape bordering the motorway. Only survey plots between 20 and 75 ha in size were included in our analyses. Larger plots often comprise more heterogeneous habitats, while only survey plots composed of a relatively homogeneous landscape were included in our analyses. The composition of survey plots was assessed using aerial photographs in ArcGIS (Esri ArcGIS Pro v. 3.1.0, 2023). Survey plots comprising a mosaic of different habitats, such as a combination of forests, grasslands, open water and/or marshes, were excluded. This was done because of the difficulty in assessing the effect of traffic on territory density over distance from the road when species communities are associated with different types of habitats forming a mosaic within the landscape. Additionally, the propagation of noise and optical effects differ across habitats. This means that effects in mosaic landscapes are not directly comparable to those in more homogeneous landscapes. A total of 18 survey plots were excluded for this reason. The survey plots were also visually assessed for the presence of other potential sources of disturbance, such as built-up areas or other, minor, roads using aerial photographs. Survey plots with such additional sources of human-induced disturbance, caused by noise, light or presence of human activities, including survey plots within an urban environment, were excluded. Survey plots included in the analyses therefore contained

relatively few sources of disturbance other than road traffic. This means that for each plot, the presence of a motorway was considered to be the most prominent disturbing feature that may negatively affect the density of breeding birds. Survey plots within 1500 m of another motorway and/or within 1000 m of a provincial road were also excluded to avoid cumulative

effects caused by road traffic from multiple roads. This selection resulted in a total of 414 survey plots distributed across the Netherlands, containing 146,110 territories of 136 bird species (Fig. 1; Online Resource 1) to be included in our analyses. Of the 414 survey plots included in the analyses, 137 were at least partly located within the first 100 m from the



Fig. 1 Locations of the survey plots (in red) and the Dutch motorway network (black lines) (Esri ArcGIS Pro, 2023)

roadside, 91 within the first 500 m and 186 between 500 and 1500 m from the road.

Data collection – traffic intensity

Data on the intensity of road traffic on Dutch motorways in each year were collected between 2012 and 2021 by Rijkswaterstaat and registered in the open access database INWEVA ('INtensiteit WEgVAkken', Rijkswaterstaat). Before 2012, no comparable data on traffic intensity were available. All analyses concerning traffic intensity were therefore based only on data collected between 2012 and 2021. Data on breeding densities from before 2012 were excluded from these analyses.

Road traffic intensities for the INWEVA database are measured at approximately 4000 road sections and estimated for the remaining road sections. The intensities comprise the total number of motor vehicles (mv) per 24 h and are averaged per year for each road section. The average traffic intensity per 24 h of all types of road traffic on working days was used. The breeding density data from each survey plot were matched with the traffic intensity data from the nearest road section. This was done separately for each year in which the number of breeding territories was counted, so that the breeding density in a given year was associated with the traffic intensity on the nearest road section in that year.

Data analysis

Analyses were performed separately at the level of species, ecological species group, species for which vocal communication is or is less important, and for all species combined. Species were divided into ecological species groups based on the typical habitat of each species to obtain eight ecological groups (Online Resource 1). First, for each of these levels of analysis, we assessed the effect distance and effect size of road traffic on breeding bird density. The response variable in these analyses was the territory density per 50 m distance contour, measured perpendicularly from the edge of the motorway. To test whether territory density is predicted by distance from the road we used a segmented regression model (Muggeo 2003, 2017) with the log-transformed territory density per 50 m distance contour as the response variable, distance from the road as the predictor variable and year,

species name and survey plot ID as factors. The segmented linear regression model provides a threshold, or breakpoint, that corresponds to the effect distance within which a measurable effect caused by road traffic on the density of breeding birds can be identified. The segmented regression model obtains the relation between dependent and independent variables by linear regression within intervals into which the relation is partitioned. It estimates the breakpoint by comparing, using an iterative process, the regression slopes on either side of the breakpoint and tests if the slopes differ significantly using Davies' test (Muggeo 2003, 2017). To assess if the models' assumption of normality of residuals was met, we used histograms and normal QQ plots of the models' residuals. The models' assumptions of the regression-based models were met for all results presented in this paper.

Next, we examined dose–effect relationships. For these analyses, we divided our dataset into categories depending on the traffic intensity measured near the survey plots. The data were categorised to be able to calculate effect distances for each category since the effect distance is a calculated outcome of the segmented model and not a response variable related to traffic intensity. We used categories of 25,000 mv per 24 h (Table 1). These categories were chosen aiming at a sufficiently large sample size to confidently calculate effect distances and sufficient variation in traffic intensity categories. Using smaller categories of 10,000 or 20,000 mv per 24 h resulted in the same pattern but with a more fluctuating relationship between the effect distance and traffic intensity. Using categories of 25,000 mv per 24 h resulted in eight categories ranging from 3200–25,000 mv per 24 h to 125,000–150,000 mv per 24 h. The sample size for the only six survey plots with a traffic

Table 1 The number of territories and the total number of survey plots included in the analyses of dose–effect relationships

Category of traffic intensity (mv per 24 h)	Territories	Total number of survey plots
3200–25,000	17,040	81
25,000–50,000	17,242	82
50,000–75,000	15,972	78
75,000–100,000	16,715	56
100,000–125,000	4261	21
125,000–150,000	6027	14

intensity > 150,000 mv per 24 h was too small to confidently calculate effect distances. Survey plots near roads with a traffic intensity > 150,000 mv per 24 h were therefore excluded from these analyses. The median traffic intensity measured was 46,500 mv per 24 h.

For each category we calculated the effect distance using the segmented regression models described above. Using a regression analysis, the calculated effect distances were subsequently analysed as a function of traffic intensity to obtain a (log-linear) relationship describing the association of the effect distance with traffic intensity. We were unable to perform regressions between traffic intensity and effect distance in a similar manner for each ecological species group separately because of insufficient data. To test the effect of traffic intensity on the effect distance for each ecological species group, we divided the dataset for the ecological species groups into two categories only: survey plots near roads with a traffic intensity < 75,000 mv per 24 h and those with > 75,000 mv per 24 h. A traffic intensity of 75,000 mv per 24 h was chosen as a cut-off point between low and high traffic intensity, because the largest increase in effect distance with increasing traffic intensity appears to take place up to approximately 75,000 mv per 24 h (see Fig. 4).

Statistical analyses were conducted using R, version 4.4.0 (R Core Team 2024), using the 'segmented' (Muggeo 2003, 2017) package.

Results

We tested whether territory density is predicted by distance from the motorway for territories of individual species, per 'species group' (ecological species group and species for which vocal communication is important and species for which vocal communication is less important) and for all bird species combined.

Individual species

First, we calculated the effect distance and effect sizes for 136 individual species (Online Resource 2). Although there appears to be some variation between species in terms of effect distance, the effect distances between species within ecological species groups are largely consistent. The mean effect distance for

those species for which breeding density significantly increased with distance from the road up to a threshold was 656 ± 197 m (mean $\pm$ SD; the effect distance). This was true for 65 out of 136 species (mean n per species = 1149). For 8 ecologically and taxonomically different species we found a negative relationship with distance from the road (mean n per species = 820) and for 63 species no significant effect distance could be identified, often due to limited sample sizes per species (mean n per species = 221). For the typical meadow birds Northern Lapwing, Black-tailed Godwit, Common Redshank and Meadow Pipit the calculated effect distances appeared to be a model artifact caused by a decline in territory density after the effect distance. When the distance from the road is maximised at 1000 m in the analyses for these species, effect distances of 568 ± 294 m, 500 ± 82 m, 900 ± 23 m, and 601 ± 55 m, respectively, are found for these species of meadow birds ($P < 0.001$). Therefore, despite some interspecific variation, the pattern of increasing density with distance from the road up to the effect distance is similar, and statistically significant, for many different species (Online Resource 2).

We also calculated the territory density within and outside the effect distance for all species for which density significantly increased with distance (Online Resource 2). The mean territory density within the effect distance was 0.48 ± 0.13 SD territories per ha and, on average, 25% lower than that outside the effect distance (0.64 ± 0.16).

Ecological species groups

Similar to the results for individual species, for ecological species groups we found that for all groups territory density of breeding birds increased up to a certain threshold, after which density no longer changed significantly with the distance from the motorway. For ecological species groups, the effect distances of effects of road traffic on breeding bird density vary between 540 m for shrubland species and 650 m for forest birds (Table 2a; Fig. 2). Effect distances therefore appear to be consistent across the different species groups. The ecological species groups 'coast', 'pioneer vegetation' and 'streams' are excluded here because of the small sample sizes ($n = 709$, $n = 204$ and $n = 126$, respectively), the number of species in each group (3, 3 and 2, respectively) and the uneven

Table 2 Effect distances and effect sizes (expressed as an increase in density per 100 m stretch from the road) for (a) ecological species groups and (b) species for which vocal communication is important and species for which vocal communication is less important

(a)				
Ecological species group	Effect distance $\pm$ SE (m)	Effect size (per 100 m)	P	n
Forest	650 $\pm$ 15	0.045 $\pm$ 0.003	< 0.001	43,661
Marsh	547 $\pm$ 17	0.084 $\pm$ 0.005	< 0.001	26,095
Agricultural	600 $\pm$ 31	0.049 $\pm$ 0.005	< 0.001	15,091
Shrubland	540 $\pm$ 31	0.041 $\pm$ 0.009	< 0.001	6858
Heathland	600 $\pm$ 43	0.112 $\pm$ 0.015	< 0.001	2662
(b)				
Vocal communication	Effect distance $\pm$ SE (m)	Effect size (per 100 m)	P	n
Important	577 $\pm$ 13	0.056 $\pm$ 0.003	< 0.001	67,403
Less important	552 $\pm$ 13	0.073 $\pm$ 0.004	< 0.001	28,097

n is the number of calculated territory densities per distance contour

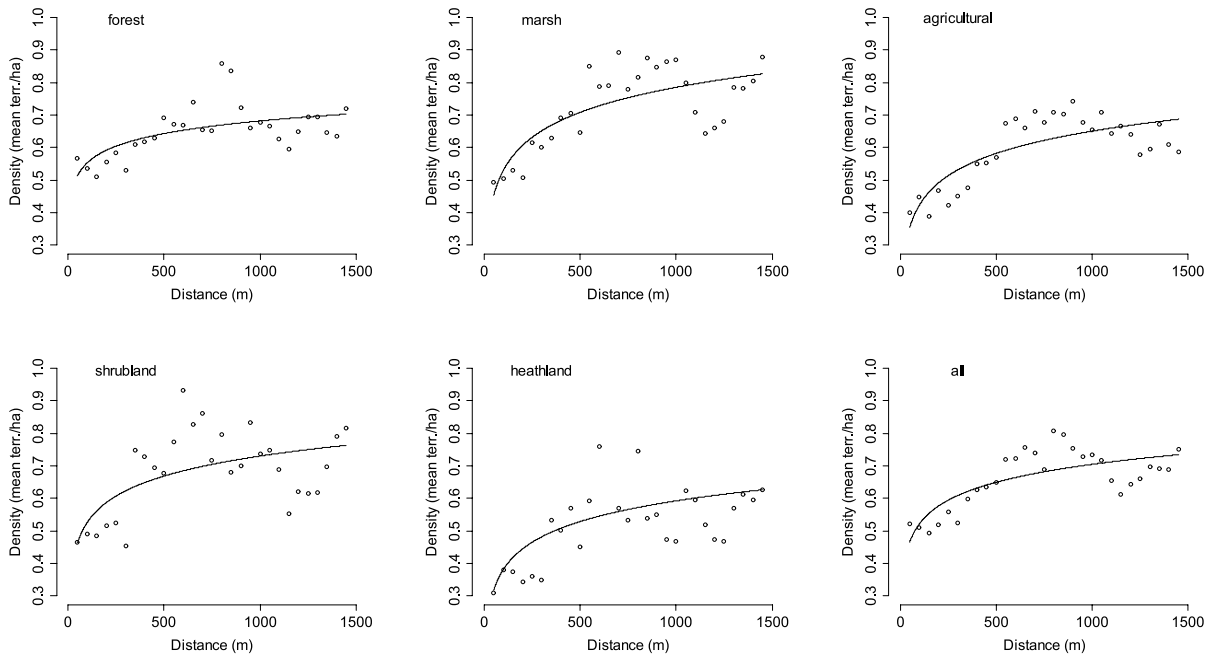


Fig. 2 Association between mean territory density per ha for each 50 m distance contour and the distance from the motorway for territories of breeding birds in each of the five ecological species groups from Table 2a and for all species together.

The continuous lines represent the fitted line for the linear regression of territory density over distance from the road; the dashed line the standard error

number of species within each group. Effect distances for these three groups could therefore not be identified confidently. We also found no clear difference in

effect distance between species for which vocal communication is important and those for which vocal communication is less important (Table 2b).

All species combined

For all species together, the mean effect distance was 570 m (± 9 SE, $P < 0.001$, $n = 95,500$; Fig. 3). The effect size, expressed as an increase in density per 100 m distance from the road, is 0.061 ± 0.002 territories per ha, which translates to a mean increase in territory density of approximately 11% per 100 m. The mean territory density per ha within 570 m was 0.58 ± 0.62 (SD) territories per ha. Outside the effect distance the mean territory density was 26% higher, namely 0.73 ± 0.85 (SD) territories per ha.

In sum, for individual species, ecological species groups and for all species combined, we found that territory density is positively associated with distance from the motorway following a log-linear relationship and increased to a certain threshold (the effect distance), after which the density no longer changed significantly with increasing distance from the motorway.

Dose–response relationship

We found a positive association between traffic intensity and effect distance on breeding birds. This finding indicates that, when all species are considered, the impact of road traffic on breeding birds increases when the traffic intensity increases (log-linear regression; intercept $\pm$ SE = -2657.68 ± 1080.38 , model effect estimate $\pm$ SE = 298.61 , $P = 0.036$, $r^2 = 0.707$, $n = 6$; Table 3, Fig. 4).

When we divided the dataset into two categories of high (i.e., $> 75,000$ mv per 24 h) and low ($< 75,000$ mv per 24 h) traffic intensity, we also found that the effect distance was generally greater near roads with high traffic intensity, except for shrubland birds (Fig. 5). For all birds combined, for example, the effect distance near roads with a low traffic intensity ($n = 23,605$) was 414 m smaller than near roads with a high traffic intensity ($n = 28,901$). The ecological species groups ‘coast’, ‘pioneer vegetation’ and ‘streams’ are excluded here because of the small sample sizes

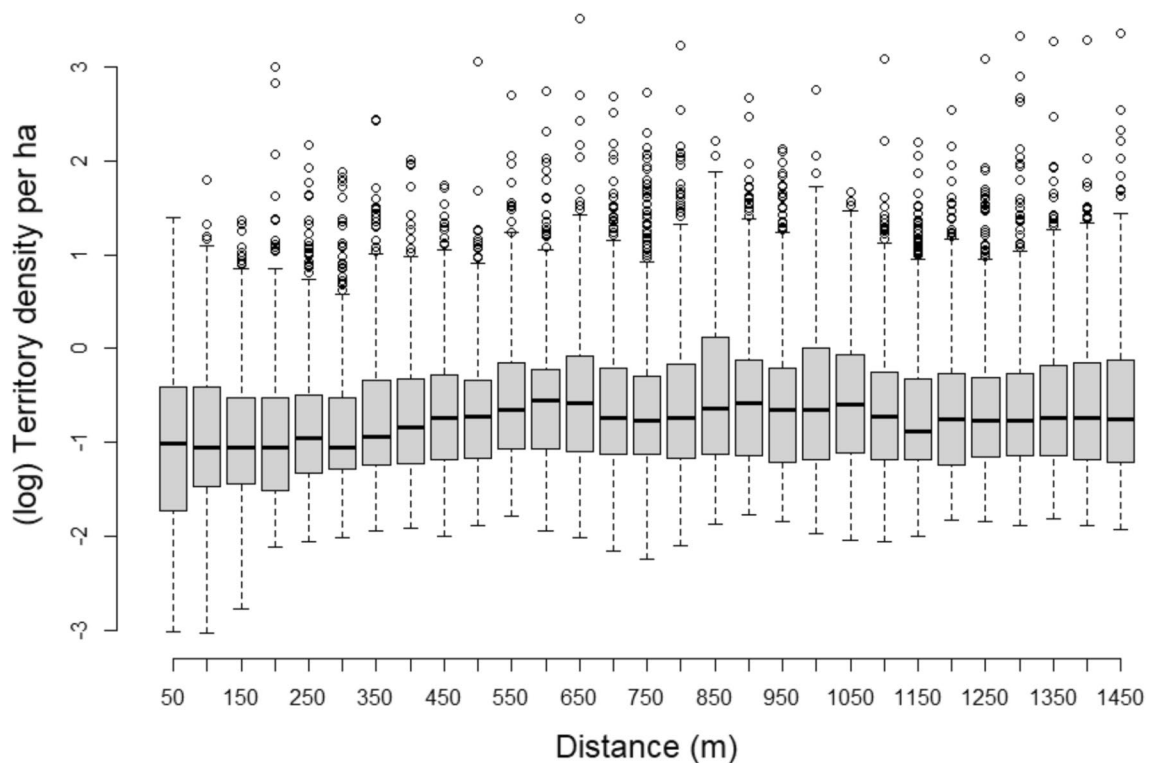


Fig. 3 Association between (log) territory density per ha for each 50 m distance contour and the distance from the motorway for territories of all species ($n = 95,500$). Boxplots rep-

resent the interquartile range (box), the median (black line inside the box), other values within the $1.5 \times$ interquartile range (dashed line) and outliers (open circles)

Table 3 Effect distance per category of traffic intensity for all species

Traffic intensity (mv/24 h)	Effect distance $\pm$ SE	n
3200–25,000	422 $\pm$ 32	11,536
25,000–50,000	492 $\pm$ 16	12,069
50,000–75,000	550 $\pm$ 34	10,447
75,000–100,000	999 $\pm$ 17	10,237
100,000–125,000	850 $\pm$ 21	2865
125,000–150,000	849 $\pm$ 114	3936

n = number of calculated densities per 50 m distance contour

and number of species in each group. Therefore, no significant effect distance could be identified for these groups near roads with a low and/or high traffic intensity.

Discussion

The extent to which birds are affected by road traffic, what causes disturbance and how it may affect populations of different species remain important questions within the field of road ecology. It has important consequences for environmental impact studies related to the construction and redevelopment

Fig. 4 Linear regression of the effect distance in response to traffic intensity on motorways in the Netherlands. The effect distance indicates the distance from the roadside to which the territory density is (negatively) associated with road traffic. The continuous line represents the fitted line for the linear regression of effect distance over traffic intensity; the dashed line the standard error

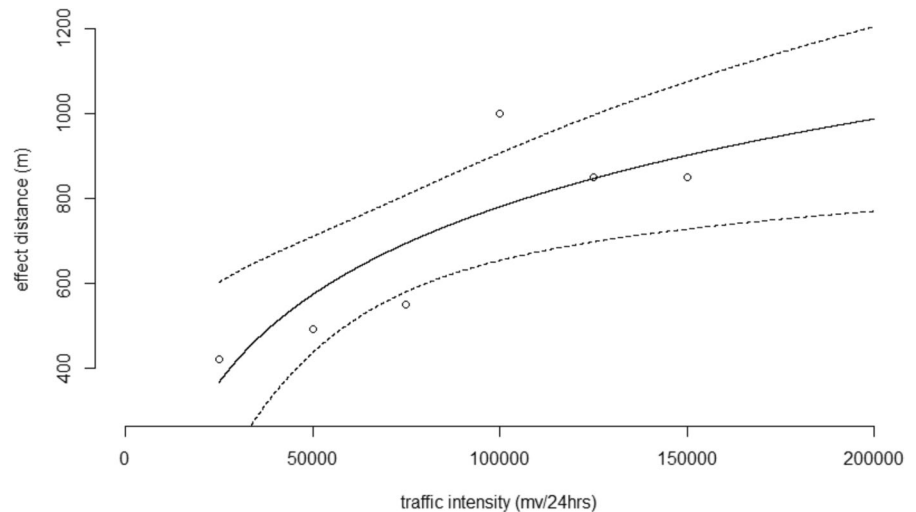
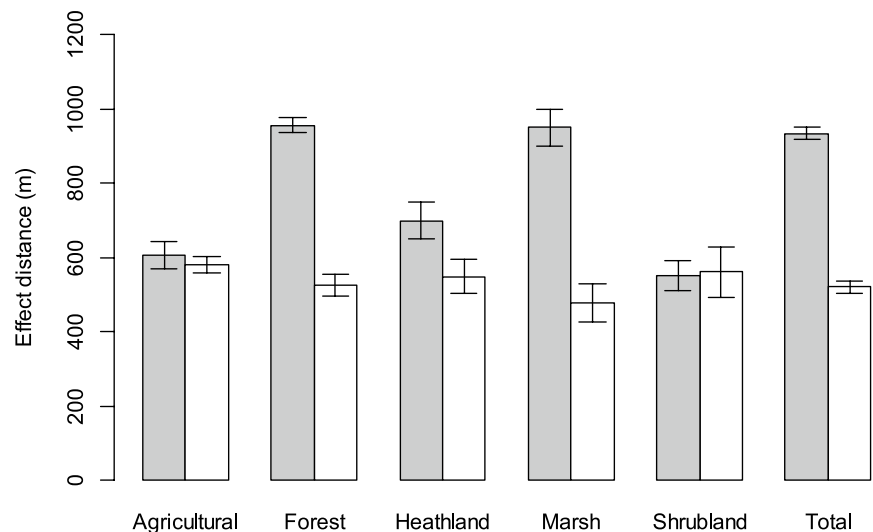


Fig. 5 Effect distances $\pm$ SE per ecological species group and for all species combines ('Total') near roads with high (> 75,000 mv per 24 h; grey bars) and low (< 75,000 mv per 24 h; white bars) traffic intensities



of roads. On the basis of a large dataset of breeding bird surveys near motorways in the Netherlands, we show that the density of breeding birds is lower near motorways and that the density increases with distance from motorways. We show that this effect is generally measurable up to a distance of approximately 550–650 m from the roadside (the effect distance), but may extend further depending on, for example, traffic volumes. The consistency of these distances across various species groups and the fact that a large proportion of the breeding bird community in the Netherlands shows negative impacts on the species level illustrates the extent of the effect on breeding birds caused by motorway traffic. Within the effect distance, the territory density is on average across species 25% lower than at a greater distance from the road. Importantly, we found that despite some variation between species, the negative effects of motorways and motorway traffic on breeding densities are broadly consistent across many ecologically and taxonomically different species. Finally, we found that the effect distance is positively related to traffic intensity. Near roads with greater traffic intensities, the area over which breeding densities are negatively affected by road traffic is larger than near roads with less traffic. This dose–effect relationship was again found for several, ecologically diverse species groups. The overall effect on population size is thus determined by a lowered density of breeding territories over larger threshold values near roads with relatively high traffic intensities.

In line with previous studies, we found that breeding densities are significantly lower near roads, especially within the first 500 m and up to approximately 1 km and that the extent of the effect is influenced by traffic intensity (Forman et al. 2002; Reijnen and Foppen 2006; Benítez-López et al. 2010; Polak et al. 2013). The differences between species may be explained by a wide range of factors, including the likelihood of birds being near or crossing a road (*cf.* collision risk), their dependence on vocal communication (*cf.* risk of acoustic masking or distraction) or their sensitivity to pollutants, which may cause a decline in habitat quality (Nijsen et al. 2017; Stevens et al. 2018; Senzaki et al. 2020). Also the habitat in which species occur may influence the negative impact of road traffic, because the habitat composition partly determines the propagation of, for example, sound and light. The type

of habitat also determines which species occur in a given location and their tolerance to pollution or disturbance. Species in pristine, undisturbed areas may be more affected by increasing disturbance than species that are used to human pressures (Radford et al. 2005; Kroeger et al. 2022). In addition to the habitat within which species occur, the extent to which a species may habituate to disturbances caused by road traffic could therefore influence the effects of traffic on breeding densities. Differences between species thus depend on the extent to which a species may be impacted by, for example, its vulnerability to disturbance by sound and light and/or vulnerability to the impact of collision. Species for which vocal communication is important may be disturbed by traffic noise, especially those, including non-passerines, that communicate at frequencies that overlap with traffic noise (Reijnen and Foppen 2006; Slabbekoorn and Ripmeester 2008; Goodwin and Shriver 2011; Ortega 2012; Francis and Barber 2013). Although some birds may exhibit behavioural plasticity and adapt their songs to ambient noise, anthropogenic noise often has a particular negative effect on species that rely on vocal communication for mate attraction and territorial conflicts (Halfwerk et al. 2011a, b; Slabbekoorn 2013). If disturbance caused by traffic noise is a key factor influencing breeding densities near roads, one would therefore expect species relying on vocal communication to exhibit a clearer response than species for which vocal communication is less important.

Based on the above, one would expect species to differ in their response to road traffic. Indeed, we found that while the majority of species exhibited a negative impact of road traffic on breeding densities, eight species showed a positive association, and for 63 species, we found no significant relationship with road traffic. This aligns with previous studies that have reported a predominantly negative association between bird breeding densities and the presence of roads, while some species appear to show a positive association with roads (e.g. Cooke et al. 2020c; Ascensão et al. 2022). Although some consistency between studies exists regarding which species or species traits are positively or negatively associated with roads, no clear pattern has emerged (Cooke et al. 2020c). For example, Ascensão et al. (2022) found that urban-dwelling species and those with high fecundity were positively associated with road encroachment, whereas ground-nesting species were

negatively related with the presence of roads. However, our findings did not reveal a similar pattern. The eight species in our study exhibiting a positive relation with road traffic, as well as those that exhibited a negative or no association with road traffic, were diverse. The difference in results of our study compared to those by Cooke et al. (2020c) and Ascensão et al. (2022) probably reflects the difference in study design. Our study primarily focuses on the effects of traffic on heavily used motorways, whereas studies like Cooke et al. (2020c) and Ascensão et al. (2022) examine the broader impact of road encroachment, including the presence and density of roads themselves. Moreover, we found that the negative effect of road traffic on breeding bird density was broadly consistent across species and habitats. Similarly, we observed a comparable effect distance and effect size for both species that rely on vocal communication and those for which vocal communication is less critical. Although this may partly be explained by the fact that we did not conduct these analyses for species in different habitats or control for the frequency at which species communicate and may experience interference from traffic noise, this result suggests that multiple factors are likely to interact to generate an effect of traffic on breeding densities, also for species for which vocal communication is important.

A frequently heard criticism on roadside studies refers to biased detectability of birds near roads by observers. This could have influenced the calculated effects of road traffic on breeding densities. Different behaviour of birds near roads might cause reduced detectability. Birds, for example, may sing earlier to avoid interference with traffic noise or birds closer to roads may be warier due to collision risk or a reduced ability to detect predators. They may also become easier to detect when they forage near the roadside or use roadside structures for perches. Interference of traffic noise with bird song may make it more difficult to distinguish bird song, whereas birds near roads may also sing at higher frequencies in response to traffic noise, which might, positively or negatively, influence their detectability (Cooke et al. 2020b; Koper et al. 2016). Changes in (vocal) behaviour in response to traffic noise are likely to be costly and might thus also lead to lower densities near roads (Rheindt 2003). For example, if birds sing earlier near roads to avoid peak traffic or

sing at a higher frequency to avoid acoustic interference, this may lead to reduced detectability, but also to lower densities. In that case, the effect size might be influenced, but the overall pattern of an effect of road traffic would not be influenced. The effects of biased detectability might, however, result in an under- or overestimation of territory densities nearer to roads (Cooke et al. 2020b). Although attempts have been made to estimate the effects of biased detectability, most notably by Cooke et al. (2020b), the effects of biased detectability near major roads remain uncertain and are therefore difficult to control for. Cooke et al. (2020b) reported that, of the 51 species investigated, the detectability of 36 species was significantly associated with road exposure, with both positive and negative associations for different species. Among the 51 species, only six, however, showed a significant association with major roads, only half of which were negative. The latter is likely due to the limited number of observations near major roads. Because of potential under- or overestimation of the densities near roads, the real effect size, *i.e.*, the slope of the relationship between distance from the road and territory density, might be smaller or greater than those reported here. We argue, however, that it is unlikely that biased detectability has influenced our (main) results on effect distances. At the threshold of several hundreds of meters away from the road, biased detectability is unlikely. Therefore, the threshold (the 'effect distance') will not significantly be influenced by it. Additionally, other studies also provide clues as to why such biased detectability is unlikely to have a large impact on observed densities. Survey results of bird communities in a study by Rheindt (2003) were not significantly different between working days and weekend surveys, when traffic noise is relatively low, and were not affected when potentially noise-biased data were disregarded. Moreover, differences in densities between species and species groups are likely to be much greater than apparent variability in abundance caused by a potential detectability bias (Tella et al. 2021), whereas traffic noise is also likely to be less influential on the detectability of species than the type of habitat (Lituma and Buehler 2016). Overall, we acknowledge that biased detectability might have influenced our results, but we expect this effect to

be limited and not to have significantly influenced the effect distances presented here.

Dose–response

Previous studies on the effects of traffic intensity on bird populations near roads provide ambiguous results, with some highlighting an increased negative effect with increasing traffic intensity (Reijnen and Foppen 1994; Forman et al. 2002; Rheindt 2003), while others find no effect (Peris and Pescador 2004; Benítez-López et al. 2010). In contrast to the meta-analysis by Benítez-López et al. (2010), for example, who found effects of up to a distance of 1 km, but no effect of traffic intensity, we found a significant effect of traffic intensity on effect distances on the basis of territory density of breeding birds. Using an analysis of all species together, we found that the effect distance increased log-linearly with increasing traffic intensity. We also found that for several distinct species groups, the effect distance was greater near roads with high traffic intensity than near roads with lower traffic intensity. This difference appeared to be greatest in forests and marshes, which might be explained by these habitat types being characterised by relatively low human impact compared to more open landscapes (Kroeger et al. 2022). An increased level of disturbance might then cause a relatively large negative impact. Kroeger et al. (2022) similarly showed that effects of roads on bird richness were more negative in landscapes with higher tree cover.

Besides a negative impact at the species level, road traffic may also cause other effects than an impact on breeding densities. The composition of the population, for example, may also be impacted. Younger, inexperienced birds, for instance, tend to occupy lower-quality territories closer to roads than older, more experienced birds do (Foppen and Reijnen 1994). This effect of disturbance by road traffic on demographic composition may not necessarily translate into a noticeable effect on breeding density. Additionally, whether territory density comprises the best estimate of the effects of road traffic on breeding birds is debatable. For example, effects could also be expressed as a behavioural response or could primarily result in reduced breeding success. However, several studies have shown a relationship between traffic and territory densities of breeding birds (for example, Reijnen et al. 1996; Garniel et al. 2007; Summers

et al. 2011; Cooke et al. 2020c, 2020a). The effects of road traffic on vital life history parameters, such as negative effects on breeding success, are likely also reflected in effects on breeding density.

A limitation of our study is that not all species could be analysed because of the lack of sufficient data. Among these are rare species, of high relevance to nature conservation, that are clearly underrepresented. However, given the high proportion of analysed species for which we found an effect, we believe that these results also hold for the rare and scarce species outside the scope of this study.

With an increase in effect distance, the density of breeding territories within the effect distance will also be reduced. On average, for all species together, the breeding density was 25% lower within the effect distance as compared to undisturbed areas, and increased by 11% per 100 m distance from the roadside. These effects decrease in magnitude with distance from the road. When is an increase in traffic intensity relevant? Clearly the results show a log-linear relationship which tells us that an increase in traffic intensity of, for instance, 5000 motor vehicles per 24 h has more impact for a road that previously had a relatively low traffic intensity than a very busy road. However, even a relatively small increase in effect distance could be very meaningful if it concerns long stretches of road. For example, an increase of 5000 motor vehicles per 24 h on a road which currently has a traffic intensity of 50,000 motor vehicles per 24 h, results in an expected increase in the effect distance of approximately ‘only’ 29 m. Over a stretch of 10 km road this would lead to an increase of ‘affected habitats’ with lowered densities of 58 ha.

In summary, we found that: (1) a wide range of bird species exhibit reduced breeding densities near roads, (2) the negative impact of road traffic on breeding densities extends over a similar distance across species and habitats, and (3) this effect is intensified by higher traffic intensity. These results highlight the significant, large-scale negative impact of road traffic on bird populations. The results will help policymakers predict the distance over which different species may be affected by road traffic and assess the impact of increased traffic intensity—for example, due to modifications to existing roads or projects that lead to higher traffic flows. The additional area that is negatively impacted by an increased traffic intensity can be quantified using the results presented here.

Additionally, the results may guide the implementation of mitigation measures to reduce the impact of road traffic, such as quieter road surfaces, reduced speed limits, noise barriers or sunken road construction in the landscape. However, the effectiveness of such mitigation measures requires further research. Future studies should also focus on disentangling the effects of the various factors associated with road traffic that negatively impact birds. This may improve our understanding of how the consistent patterns of negative effects emerge across species and help identify the most effective mitigation strategies.

Acknowledgements The research leading to the results presented here was conducted in the period from 2018 to 2024 to revise and update the methodology to assess the disturbance of breeding birds caused by road traffic as commissioned by Rijkswaterstaat Water, Transport and Environment. The research was funded by Rijkswaterstaat. We are grateful to Sovon Dutch Centre for Field Ornithology and especially Henk Sierdsema for providing the BMP data. We thank the members of the advisory board of Rijkswaterstaat for their helpful comments and feedback on the research findings and Willem Fenten (Sweco) for the GIS analyses.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analyses were performed by REvD. The first draft of the manuscript was written by REvD and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding The research was funded by Rijkswaterstaat.

Data availability The datasets analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use,

you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

- Ascensão F, D'Amico M, Revilla E, Pereira HM (2022) Road encroachment mediates species occupancy, trait filtering and dissimilarity of passerine communities. *Biol Conserv* 270:109590
- Barber JR, Crooks KR, Frisrup KM (2010) The costs of chronic noise exposure for terrestrial organisms. *Trends Ecol Evol* 25:180–189
- Benítez-López A, Alkemade R, Verweij PA (2010) The impacts of roads and other infrastructure on mammal and bird populations: a meta-analysis. *Biol Conserv* 143:1307–1316
- Blumstein DT (2013) Attention, habituation, and antipredator behaviour: implications for urban birds. In: Gil D, Brumm H (eds) *Avian urban ecology*. Oxford University Press, Oxford
- Cooke SC, Balmford A, Donald PF, Newson SE, Johnston A (2020a) Roads as a contributor to landscape-scale variation in bird communities. *Nat Commun* 11:3125
- Cooke SC, Balmford A, Johnston A, Massimino D, Newson SE, Donald PF (2020b) Road exposure and the detectability of birds in field surveys. *Ibis* 162:885–901
- Cooke SC, Balmford A, Johnston A, Newson SE, Donald PF (2020c) Variation in abundances of common bird species associated with roads. *J Appl Ecol* 57:1271–1282
- Eigenbrod F, Hecnar SJ, Fahrig L (2009) Quantifying the road-effect zone. *Ecol Soc* 14:18
- Esri (2023) ArcGIS Pro. Version 3.1.0, 2023. Environmental Systems Research Institute, Redlands, CA. <https://www.esri.com>
- Fahrig L, Rytwinski T (2009) Effects of roads on animal abundance. *Ecol Soc* 14:20
- Foppen R, Reijnen R (1994) The effects of car traffic on breeding bird populations in woodland. II. Breeding dispersal of male willow warblers (*Phylloscopus trochilus*) in relation to the proximity of a highway. *J Appl Ecol* 31:95–101
- Forman RTT (2003) *Road ecology: science and solutions*. Island Press, Washington, DC
- Forman RTT, Alexander LE (1998) Roads and their major ecological effects. *Annu Rev Ecol Syst* 29:207–231
- Forman RTT, Reineking B, Hersperger AM (2002) Road traffic and nearby grassland bird patterns in a suburbanizing landscape. *Environ Manag* 29:782–800
- Francis CD, Barber JR (2013) A framework for understanding noise impacts on wildlife: an urgent conservation priority. *Front Ecol Environ* 11:305–313
- Garniel A, Daunicht WD, Mierwald U, Ojowski U, (2007) *Vögel und Verkehrslärm. Quantifizierung und Bewältigung entscheidungserheblicher Auswirkungen von Verkehrslärm auf die Avifauna*. Bonn, Kiel.
- Gaston KJ, Davies TW, Nedelec SL, Holt LA (2017) Impacts of artificial light at night on biological timings. *Ann Rev Ecol Evol Syst*. <https://doi.org/10.1146/annurev-ecolsys-110316-022745>

- Goodwin SE, Shriver WG (2011) Effects of traffic noise on occupancy patterns of forest birds. *Conserv Biol* 25:406–411
- Halfwerk W, Bot S, Buix J, van der Velde M, Komdeur J, ten Cate C, Slabbekoorn H (2011a) Low-frequency songs lose their potency in noisy urban conditions. *Proc Natl Acad Sci USA* 108:14549
- Halfwerk W, Holleman LJM, Lessells CM, Slabbekoorn H (2011b) Negative impact of traffic noise on avian reproductive success. *J Appl Ecol* 48:210–219
- Keller I, Largiadèr CR (2003) Recent habitat fragmentation caused by major roads leads to reduction of gene flow and loss of genetic variability in ground beetles. *Proc R Soc Lond B Biol Sci* 270:417–423
- Kociolek AV, Clevenger AP, Clair CC, Proppe DS (2011) Effects of road networks on bird populations. *Conserv Biol* 25:241–249
- Koper N, Leston L, Baker TM, Curry C, Rosa P (2016) Effects of ambient noise on detectability and localization of avian songs and tones by observers in grasslands. *Ecol Evol* 6:245–255
- Kroeger SB, Hanslin HM, Lennartsson T, D'Amico M, Kollmann J, Fischer C, Albertsen E, Speed JDM (2022) Impacts of roads on bird species richness: a meta-analysis considering road types, habitats and feeding guilds. *Sci Total Environ* 812:151478
- Lituma CM, Buehler DA (2016) Minimal bias in surveys of grassland birds from roadsides. *Condor* 118:715–727
- Muggeo VMR (2003) Estimating regression models with unknown break-points. *Stat Med* 22:3055–3071
- Muggeo VMR (2017) Interval estimation for the breakpoint in segmented regression: a smoothed score-based approach. *Aust N Z J Stat* 59:311–322
- Nijssen ME, WallisDeVries MF, Siepel H (2017) Pathways for the effects of increased nitrogen deposition on fauna. *Nitrogen Depos Impacts Biodivers Terr Ecosyst Mech Perspect* 212:423–431
- Ortega CP (2012) Effects of noise pollution on birds: a brief review of our knowledge. *Ornithol Monogr* 74:6–22
- Palomino D, Carrascal LM (2007) Threshold distances to nearby cities and roads influence the bird community of a mosaic landscape. *Biol Conserv* 140:100–109
- Parris KM, Schneider A (2008) Impacts of traffic noise and traffic volume on birds of roadside habitats. *Ecol Soc* 14:29
- Peris SJ, Pescador M (2004) Effects of traffic noise on passerine populations in Mediterranean wooded pastures. *Appl Acoust* 65:357–366
- Polak M, Wiącek J, Kucharczyk M, Orzechowski R (2013) The effect of road traffic on a breeding community of woodland birds. *Eur J for Res* 132:931–941
- R Core Team (2024) R: a language and environment for statistical computing. R Core Team
- Radford JQ, Bennett AF, Cheers GJ (2005) Landscape-level thresholds of habitat cover for woodland-dependent birds. *Biol Conserv* 124:317–337
- Ramellini S, Lapadula S, Bonomelli L, Sciandra D, Falaschi M (2024) Effects of human disturbance on detectability of non-breeding birds in urban green areas. *Glob Ecol Conserv* 51:e02873
- Reijnen R, Foppen R (1994) The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for Willow Warblers (*Phylloscopus trochilus*) breeding close to a highway. *J Appl Ecol* 31:85–94
- Reijnen R, Foppen R (1995) The effects of car traffic on breeding bird populations in woodland. IV. Influence of population size on the reduction of density close to a highway. *J Appl Ecol* 32:481–491
- Reijnen R, Foppen R (2006) Chapter 12: Impact of road traffic on breeding bird populations. In: Davenport J, Davenport JL (eds) *The ecology of transportation: managing mobility for the environment*. Springer, The Netherlands
- Reijnen R, Foppen R, Meeuwssen H (1996) The effects of traffic on the density of breeding birds in Dutch agricultural grasslands. *Biol Conserv* 75:255–260
- Reijnen R, Foppen R, Veenbaas G (1997) Disturbance by traffic of breeding birds: evaluation of the effect and considerations in planning and managing road corridors. *Biodivers Conserv* 6:567–581
- Rheindt FE (2003) The impact of roads on birds: does song frequency play a role in determining susceptibility to noise pollution? *J Für Ornithol* 144:295–306
- Sanderfoot OV, Holloway T (2017) Air pollution impacts on avian species via inhalation exposure and associated outcomes. *Environ Res Lett* 12:083002
- Senzaki M, Barber JR, Phillips JN, Carter NH, Cooper CB, Ditmer MA, Fristrup KM, McClure CJW, Mennitt DJ, Tyrrell LP, Vukomanovic J, Wilson AA, Francis CD (2020) Sensory pollutants alter bird phenology and fitness across a continent. *Nature* 587:605–609
- Sijsma FJ, van der Veen E, van Hinsberg A, Pouwels R, Bekker R, van Dijk RE, Grutters M, Klaassen R, Krijn M, Mouissie M, Wymenga E (2020) Ecological impact and cost-effectiveness of wildlife crossings in a highly fragmented landscape: a multi-method approach. *Landsc Ecol* 35:1701–1720
- Slabbekoorn H (2013) Songs of the city: noise-dependent spectral plasticity in the acoustic phenotype of urban birds. *Spec Issue Behav Plast Evol* 85:1089–1099
- Slabbekoorn H, Ripmeester EAP (2008) Birdsong and anthropogenic noise: implications and applications for conservation. *Mol Ecol* 17:72–83
- Spellerberg I (1998) Ecological effects of roads and traffic: a literature review. *Glob Ecol Biogeogr Lett* 7:317–333
- Stevens CJ, David TI, Storkey J (2018) Atmospheric nitrogen deposition in terrestrial ecosystems: its impact on plant communities and consequences across trophic levels. *Funct Ecol* 32:1757–1769
- Summers PD, Cunnington GM, Fahrig L (2011) Are the negative effects of roads on breeding birds caused by traffic noise? *J Appl Ecol* 48:1527–1534
- Tella JL, Romero-Vidal P, Dénes FV, Hiraldo F, Toledo B, Rossetto F, Blanco G, Hernández-Brito D, Pacífico E, Díaz-Luque JA, Rojas A, Bermúdez-Cavero A, Luna Á, Barbosa JM, Carrete M (2021) Roadside car surveys: methodological constraints and solutions for estimating parrot abundances across the world. *Diversity*. <https://doi.org/10.3390/d13070300>
- van der Ree R, Smith DJ, Grilo C (2015) *Handbook of road ecology*. Wiley, Hoboken

- van der Zande AN, ter Keurs WJ, van der Weijden WJ (1980) The impact of roads on the densities of four bird species in an open field habitat—evidence of a long-distance effect. *Biol Conserv* 18:299–321
- Vergeer J-W, van Dijk A, Boele A, van Bruggen J, Hustings F (2016) Handleiding Sovon broedvogelonderzoek: broedvogel Monitoring Project en Kolonievogels. Sovon Vogelonderzoek Nederland, Nijmegen
- Vincze E, Papp S, Preiszner B, Seress G, Bókony V, Liker A (2016) Habituation to human disturbance is faster in urban than rural house sparrows. *Behav Ecol* 27:1304–1313
- Ware HE, McClure CJW, Carlisle JD, Barber JR (2015) A phantom road experiment reveals traffic noise is an invisible source of habitat degradation. *Proc Natl Acad Sci USA* 112:12105–12109

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

APPENDIX DW3

Appendix DW3: CPPF Scheme – pdf readout of Statutory Biodiversity Metric calculation (Bioscan)

Headline Results		Return to results menu		
Scroll down for final results ▲				
On-site baseline	Area habitat units	24.00		
	Hedgerow units	19.30		
	Watercourse units	1.77		
On-site post-intervention (Including habitat retention, creation & enhancement)	Area habitat units	18.04		
	Hedgerow units	19.30		
	Watercourse units	1.77		
On-site net change (units & percentage)	Area habitat units	-5.96	-24.82%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
		On-site net gain is less than target set ▲		
		On-site net gain is less than target set ▲		
		On-site net gain is less than target set ▲		
Off-site baseline	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site post-intervention (Including habitat retention, creation & enhancement)	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site net change (units & percentage)	Area habitat units	0.00	0.00%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
Combined net unit change (Including all on-site & off-site habitat retention, creation & enhancement)	Area habitat units	-5.96		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Spatial risk multiplier (SRM) deductions	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
FINAL RESULTS				
Total net unit change (Including all on-site & off-site habitat retention, creation & enhancement)	Area habitat units	-5.96		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Total net % change (Including all on-site & off-site habitat retention, creation & enhancement)	Area habitat units	-24.82%	Total net gain achieved is less than target set ▲	
	Hedgerow units	0.00%	Total net gain achieved is less than target set ▲	
	Watercourse units	0.00%	Total net gain achieved is less than target set ▲	
Trading rules satisfied?		No - Check Trading Summaries ▲		
Unit Type	Target	Baseline Units	Units Required	Unit Deficit
Area habitat units	10.00%	24.00	26.39	8.36
Hedgerow units	10.00%	19.30	21.23	1.93
Watercourse units	10.00%	1.77	1.94	0.18
Input errors/rule breaks present in metric ▲				

Project Name: Map Reference:

A-1 On-Site Habitat Baseline

Area habitat summary	
Total Net Unit Change	-5.96
Total Net % Change	-24.82%
Trading Rules Satisfied	No - check trading summaries ▲

Condense / Show Columns

Condense / Show Rows

Main Menu

Ref	Existing area habitats				Distinctiveness	Condition	Strategic significance	Required Action to Meet Trading Rules	Ecological baseline
	Broad Habitat	Habitat Type	Irreplaceable habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance		Total habitat units
1	Grassland	Modified grassland	No	0.6804	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	2.72
2	Grassland	Other neutral grassland	No	1.0919	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	4.37
3	Sparsely vegetated land	Tall forbs	No	0.9246	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	3.70
4	Urban	Developed land; sealed surface	No	4.0687	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Compensation Not Required	0.00
5	Woodland and forest	Lowland mixed deciduous woodland	No	0.3828	High	Moderate	Formally identified in local strategy	Same habitat required =	5.28
6	Woodland and forest	Lowland mixed deciduous woodland	No	0.3293	High	Moderate	Formally identified in local strategy	Same habitat required =	4.54
7	Woodland and forest	Other woodland; broadleaved	No	0.0571	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	0.46
8	Woodland and forest	Other woodland; broadleaved	No	0.1202	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	0.48
9	Individual trees	Rural tree	No	0.305362806	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	2.44
10									
11									
12									
13									
14									
Total habitat area				7.96					24.00

Area retained	Area enhanced	Baseline units retained	Baseline units enhanced	Area habitat lost	Units lost
0.4325	0	1.73	0.00	0.25	0.99
0.5801	0	2.32	0.00	0.51	2.05
0.768	0	3.07	0.00	0.16	0.63
3.8599	0	0.00	0.00	0.21	0.00
0.3507	0	4.84	0.00	0.03	0.44
0.3244	0	4.48	0.00	0.00	0.07
0.0571	0	0.46	0.00	0.00	0.00
0.1154	0	0.46	0.00	0.00	0.02
		0.00	0.00	0.31	2.44
6.49	0.00	17.36	0.00	1.47	6.64

Main Menu

Protection habitats						
Temporal multiplier		Difficulty	Habitat units delivered	Comments		
Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation		User comments	Planning authority comments	Habitat reference number
Standard time to target condition applied	4	Low	0.23			
Standard time to target condition applied	2	Low	0.45			
Standard time to target condition applied	0	Low	0.00			
Standard time to target condition applied	0	Low	0.00			
			0.68			

Project Name:

Map Reference:

A-3 On-Site Habitat Enhancement

Condense / Show Columns

Condense / Show

Main Menu

Area habitat summary	
Total Net Unit Change	-5.96
Total Net % Change	-24.82%
Trading Rules Satisfied	No - check trading summaries ▲

Baseline habitats		Proposed Habitat (Broad habitat pre-populated but can be overridden)		Post intervention habitats	
Baseline habitats		Proposed Habitat (Broad habitat pre-populated but can be overridden)		Change in distinctiveness and condition	
Baseline ref	Baseline habitat	Proposed Broad Habitat	Proposed habitat	Distinctiveness change	Condition change
					Total habitat area

Habitat Distinctiveness and Condition						
Area (hectares)	Distinctiveness	Condition	Strategic significance	Temporal risk multiplier		Difficulty risk multipliers
			Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of enhancement
0.00						

Project Name:

Map Reference:

B-1 On-Site Hedge Baseline

Condense / Show Columns

Condense / Show Rows

Main Menu

Hedgerow summary	
Total Net Unit Change	0.00
Total Net % Change	0.00%
Trading Rules Satisfied	Yes ✓

Ref	Existing hedgerow habitats			Distinctiveness	Condition	Strategic significance	Required Action to Meet Trading Rules	Ecological baseline Total hedgerow units						
	Hedge number	Habitat type	Length (km)	Distinctiveness	Condition	Strategic significance			Length retained	Length enhanced	Units retained	Units enhanced	Length lost	Units lost
1		Species-rich native hedgerow with trees	0.069	High	Moderate	Area/compensation not in local strategy/ no local strategy	Like for like or better	0.83	0.069	0	0.83	0.00	0.00	0.00
2		Native hedgerow	0.01	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness band or better	0.04	0.01	0	0.04	0.00	0.00	0.00
3		Species-rich native hedgerow with trees	0.036	High	Moderate	Area/compensation not in local strategy/ no local strategy	Like for like or better	0.43	0.036	0	0.43	0.00	0.00	0.00
4		Native hedgerow	0.073	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness band or better	0.29	0.073	0	0.29	0.00	0.00	0.00
5		Native hedgerow	0.051	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness band or better	0.20	0.051	0	0.20	0.00	0.00	0.00
6		Native hedgerow	0.003	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness band or better	0.01	0.003	0	0.01	0.00	0.00	0.00
7		Native hedgerow	0.472	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness band or better	1.89	0.472	0	1.89	0.00	0.00	0.00
8		Native hedgerow with trees	0.029	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness band or better	0.23	0.029	0	0.23	0.00	0.00	0.00
9		Species-rich native hedgerow with trees	0.055	High	Moderate	Area/compensation not in local strategy/ no local strategy	Like for like or better	0.66	0.055	0	0.66	0.00	0.00	0.00
10		Species-rich native hedgerow with trees	0.13	High	Moderate	Formally identified in local strategy	Like for like or better	1.79	0.13	0	1.79	0.00	0.00	0.00
11		Species-rich native hedgerow with trees	0.056	High	Moderate	Formally identified in local strategy	Like for like or better	0.77	0.056	0	0.77	0.00	0.00	0.00
12		Species-rich native hedgerow with trees	0.122	High	Moderate	Formally identified in local strategy	Like for like or better	1.68	0.122	0	1.68	0.00	0.00	0.00
13		Native hedgerow	0.227	Low	Moderate	Formally identified in local strategy	Same distinctiveness band or better	1.04	0.227	0	1.04	0.00	0.00	0.00
14		Native hedgerow	0.052	Low	Moderate	Formally identified in local strategy	Same distinctiveness band or better	0.24	0.052	0	0.24	0.00	0.00	0.00
15		Native hedgerow	0.032	Low	Moderate	Formally identified in local strategy	Same distinctiveness band or better	0.15	0.032	0	0.15	0.00	0.00	0.00
16		Native hedgerow	0.072	Low	Moderate	Formally identified in local strategy	Same distinctiveness band or better	0.33	0.072	0	0.33	0.00	0.00	0.00
17		Species-rich native hedgerow with trees - associated with bank or ditch	0.071	V.High	Moderate	Formally identified in local strategy	Like for like	1.31	0.071	0	1.31	0.00	0.00	0.00
18		Species-rich native hedgerow with trees - associated with bank or ditch	0.301	V.High	Moderate	Formally identified in local strategy	Like for like	5.54	0.301	0	5.54	0.00	0.00	0.00
19		Non-native and ornamental hedgerow	0.032	V.Low	Poor	Formally identified in local strategy	Same distinctiveness band or better	0.04	0.032	0	0.04	0.00	0.00	0.00
20		Non-native and ornamental hedgerow	0.065	V.Low	Poor	Formally identified in local strategy	Same distinctiveness band or better	0.07	0.065	0	0.07	0.00	0.00	0.00
21		Ecologically valuable line of trees	0.048	Medium	Moderate	Formally identified in local strategy	Same distinctiveness band or better	0.44	0.048	0	0.44	0.00	0.00	0.00
22		Non-native and ornamental hedgerow	0.028	V.Low	Poor	Formally identified in local strategy	Same distinctiveness band or better	0.03	0.028	0	0.03	0.00	0.00	0.00
23		Native hedgerow	0.264	Low	Moderate	Formally identified in local strategy	Same distinctiveness band or better	1.21	0.264	0	1.21	0.00	0.00	0.00
24		Species-rich native hedgerow with trees	0.004	High	Moderate	Formally identified in local strategy	Like for like or better	0.06	0.004	0	0.06	0.00	0.00	0.00
25														
26														
27														
28														
29														
			2.30					19.30	2.30	0.00	19.30	0.00	0.00	0.00

Project Name:

Map Reference:

B-2 On-Site Hedge Creation

Condense / Show Columns

Condense / Show Rows

Main Menu

Hedgerow summary	
Total Net Unit Change	0.00
Total Net % Change	0.00%
Trading Rules Satisfied	Yes ✓

		Proposed habitats		Distinctiveness	Condition	Strategic significance	Temporal multiplier		Difficulty risk multipliers	Hedge units delivered
Ref	New hedge number	Habitat type	Length (km)	Distinctiveness	Condition	Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation	
1										
2										
3										
4										
5										
			0.00							0.00

Project Name:

Map Reference:

B-3 On-Site Hedge Enhancement

Condense / Show Columns

Condense / Show

Main Menu

Hedgerow summary	
Total Net Unit Change	0.00
Total Net % Change	0.00%
Trading Rules Satisfied	Yes ✓

		Post intervention habitats										Hedge units delivered
Baseline Habitats		Proposed habitat	Change in distinctiveness and condition		Length (km)	Distinctiveness	Condition	Strategic significance	Temporal multiplier		Difficulty risk multipliers	
Baseline ref	Baseline habitat		Distinctiveness movement	Condition movement		Distinctiveness	Condition	Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of enhancement	
					0.00							0.00

Project Name:	Map Reference:
C-1 On-Site WaterC' Baseline	

Watercourse summary	
Total Net Unit Change	0.00
Total Net % Change	0.00%
Trading Rules Satisfied	Yes ✓

Condense / Show Columns

Condense / Show Rows

Main Menu

Existing watercourse type			Distinctiveness	Condition	Strategic significance	Watercourse encroachment	Riparian encroachment	Required Action to Meet Trading Rules	Ecological baseline						
Ref	Watercourse type	Length (km)	Distinctiveness	Condition	Strategic significance	Extent of encroachment	Extent of encroachment for both banks		Total watercourse units	Length retained	Length enhanced	Units retained	Units enhanced	Length Lost	Units Lost
1	Ditches	0.36	Medium	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Same habitat required =	1.08	0.36	0	1.08	0.00	0.00	
2	Culvert	0.005	Low	Poor	Area/compensation not in local strategy/ no local strategy	N/A - Culvert	N/A - Culvert	Better distinctiveness habitat required	0.01	0.005	0	0.01	0.00	0.00	
3	Ditches	0.034	Medium	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Same habitat required =	0.10	0.034	0	0.10	0.00	0.00	
4	Ditches	0.005	Medium	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Same habitat required =	0.02	0.005	0	0.02	0.00	0.00	
5	Culvert	0.016	Low	Poor	Area/compensation not in local strategy/ no local strategy	N/A - Culvert	N/A - Culvert	Better distinctiveness habitat required	0.02	0.016	0	0.02	0.00	0.00	
6	Ditches	0.076	Medium	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Same habitat required =	0.23	0.076	0	0.23	0.00	0.00	
7	Culvert	0.005	Low	Poor	Area/compensation not in local strategy/ no local strategy	N/A - Culvert	N/A - Culvert	Better distinctiveness habitat required	0.01	0.005	0	0.01	0.00	0.00	
8	Ditches	0.045	Medium	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Same habitat required =	0.14	0.045	0	0.14	0.00	0.00	
9	Ditches	0.057	Medium	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Same habitat required =	0.17	0.057	0	0.17	0.00	0.00	
10	Culvert	0.005	Low	Poor	Area/compensation not in local strategy/ no local strategy	No Encroachment	Major/Major	Better distinctiveness habitat required		0.005	0			0.00	
11															
12															
13															
14															
15															
		0.61							1.77	0.61	0.00	1.77	0.00	0.00	0.00

Project Name:	Map Reference:
C-2 On-Site WaterC' Creation	

Condense / Show ColumnsCondense / Show Rows

[Main Menu](#)

Watercourse summary	
Total Net Unit Change	0.00
Total Net % Change	0.00%
Trading Rules Satisfied	Yes ✓

[illegible]

Project Name:	Map Reference:
C-3 On-Site WaterC' Enhancemen	

Condense / Show ColumnsCondens[Main Menu](#)

Watercourse summary	
Total Net Unit Change	0.00
Total Net % Change	0.00%
Trading Rules Satisfied	Yes ✓

[illegible]

APPENDIX DW4

Appendix DW4: GCP Scheme - pdf readout of Statutory Biodiversity Metric calculation (WSP, as received from GCP 6th June 2025) (whole GCP scheme)

Cambourne to Cambridge

Return to results menu

Headline Results

Scroll down for final results ▲

On-site baseline	Habitat units	235.28		
	Hedgerow units	36.04		
	Watercourse units	0.00		
On-site post-intervention <small>(Including habitat retention, creation & enhancement)</small>	Habitat units	246.40		
	Hedgerow units	30.58		
	Watercourse units	0.00		
On-site net change <small>(units & percentage)</small>	Habitat units	11.12	4.73%	On-site net gain is less than target set ▲
	Hedgerow units	-5.46	-15.15%	On-site net gain is less than target set ▲
	Watercourse units	0.00	0.00%	
Off-site baseline	Habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site post-intervention <small>(Including habitat retention, creation & enhancement)</small>	Habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site net change <small>(units & percentage)</small>	Habitat units	0.00	0.00%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
Combined net unit change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Habitat units	11.12		
	Hedgerow units	-5.46		
	Watercourse units	0.00		
Spatial risk multiplier (SRM) deductions	Habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
FINAL RESULTS				
Total net unit change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Habitat units	11.12		
	Hedgerow units	-5.46		
	Watercourse units	0.00		
Total net % change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Habitat units	4.73%	Total net gain achieved is less than target set ▲	
	Hedgerow units	-15.15%	Total net gain achieved is less than target set ▲	
	Watercourse units	0.00%		
Trading rules satisfied?	No - Check Trading Summaries ▲			
Unacceptable loss of irreplaceable habitat recorded - no bespoke compensation for losses has been agreed ▲				
Unit Type	Target	Baseline Units	Units Required	Unit Deficit
Habitat units	10.00%	235.28	258.81	12.41
Hedgerow units	10.00%	36.04	39.64	9.06
Watercourse units	10.00%	0.00	0.00	0.00
				No additional watercourse units required to meet target ✓
Input errors/rule breaks present in metric ▲				

Project Name: Cambourne to Cambridge Map Reference:
A-1 On-Site Habitat Baseline

Condense / Show Columns

Condense / Show Rows

Main Menu

Area habitat summary	
Total Net Unit Change	11.12
Total Net % Change	4.11%
Trading Rules Satisfied	No - check trading summaries ▲

Ref	Existing area habitats				Distinctiveness	Condition	Strategic significance	Required Action to Meet Trading Rules	Ecological baseline
	Broad Habitat	Habitat Type	Irreplaceable habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance		Total habitat units
1	Grassland	Other neutral grassland	No	1.489	Medium	Good	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	17.87
2	Grassland	Other neutral grassland	No	2.245	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	17.96
3	Grassland	Other neutral grassland	No	7.431	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	29.72
4	Urban	Artificial unvegetated, sealed surface	No	0.063	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Compensation Not Required	0.00
5	Cropland	Cereal crops	No	42.976	Low	Condition Assessment N/A	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	85.95
6	Heathland and shrub	Hawthorn scrub	No	0.121	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	0.48
7	Urban	Developed land; sealed surface	No	10.684	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Compensation Not Required	0.00
8	Woodland and forest	Lowland mixed deciduous woodland	No	0.528	High	Good	Formally identified in local strategy	Same habitat required =	10.93
9	Woodland and forest	Lowland mixed deciduous woodland	No	1.251	High	Moderate	Formally identified in local strategy	Same habitat required =	17.28
10	Woodland and forest	Lowland mixed deciduous woodland	No	0.02	High	Poor	Formally identified in local strategy	Same habitat required =	0.14
11	Heathland and shrub	Mixed scrub	No	0.565	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	4.52
12	Grassland	Modified grassland	No	0.039	Low	Good	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	0.23
13	Grassland	Modified grassland	No	0.253	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	1.01
14	Grassland	Modified grassland	No	5.066	Low	Poor	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	10.17
15	Woodland and forest	Other woodland; broadleaved	No	3.841	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	15.36
16	Woodland and forest	Other woodland; mixed	No	0.058	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	0.46
17	Lakes	Ponds (non-priority habitat)	No	0.016	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (2)	0.13
18	Sparsely vegetated land	Ruderal/Ephemeral	No	2.123	Low	Good	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	12.74
19	Sparsely vegetated land	Ruderal/Ephemeral	No	1.286	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	5.14
20	Sparsely vegetated land	Ruderal/Ephemeral	No	0.421	Low	Poor	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	0.84
21	Grassland	Traditional orchards	No	0.206	High	Moderate	Formally identified in local strategy	Same habitat required =	2.84
22	Grassland	Traditional orchards	No	0.217	High	Poor	Formally identified in local strategy	Same habitat required =	1.50
23	Individual trees	Rural tree	Yes	0.1588	Medium	Good	Formally identified in local strategy	Bespoke compensation likely to be required	0.00
24									
25									
26									
27									
28									
Total habitat area				81.08					235.28
Site Area (Excluding area of individual trees, green walls, intertidal hard structures)				80.92					

Area retained	Area enhanced	Baseline units retained	Baseline units enhanced	Area habitat lost	Units lost	Bespoke compensation agreed for losses of VIEDH or irreplaceable habitat	User comments
0.015		0.18	0.00	1.47	17.69		
		0.00	0.00	2.25	17.96		
		0.00	0.00	7.43	29.72		
		0.00	0.00	0.06	0.00		
		0.00	0.00	42.98	85.95		
		0.00	0.00	0.12	0.48		
0.167		0.00	0.00	10.52	0.00		
0.443		9.17	0.00	0.09	1.76		
0.042		0.58	0.00	1.21	16.68		
		0.00	0.00	0.02	0.14		
0.094		0.75	0.00	0.47	3.77		
		0.00	0.00	0.04	0.23		
		0.00	0.00	0.25	1.01		
0.01		0.02	0.00	5.08	10.15		
0.036		0.14	0.00	3.81	15.22		
		0.00	0.00	0.06	0.46		
		0.00	0.00	0.02	0.13		
		0.00	0.00	2.12	12.74		
		0.00	0.00	1.29	5.14		
		0.00	0.00	0.42	0.84		
		0.00	0.00	0.21	2.84		
		0.00	0.00	0.22	1.50		
0.1099	0	Irreplaceable habitat - no units generated ▲	0.00	0.05	Bespoke compensation must be agreed ▲	Pending	Six veteran trees are located within the order limits within the traditional orchard. Compensation is currently set as pending until bespoke compensation has been agreed with the LPA tree officer and ecologist
0.92	0.00	10.85	0.00	80.16	224.43		

Total area lost (excluding area of individual trees, green walls and intertidal hard structures)	80.11
--	-------

M² to hectares conversion tool:	Select a unit	Hectares	M²

Project Name: Cambourne to Cambridge

Map Reference:

A-2 On-Site Habitat Creation

Condense / Show Columns

Condense / Show Rows

Main Menu

Area habitat summary

Total Net Unit Change

11.12

Total Net % Change

4.73%

Trading Rules Satisfied

No - check trading summaries ▲

Area Check

Area Acceptable ✓

Post intervention habitats													
Ref	Broad Habitat	Proposed habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance	Temporal multiplier		Difficulty	Habitat units delivered	Comments		
				Distinctiveness	Condition	Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation		User comments	Planning authority comments	Habitat reference number
1	Urban	Artificial unvegetated, unsealed surface	0.063	V Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Standard time to target condition applied	2	Low	0.00			
2	Cropland	Cereal crops	9.694	Low	Condition Assessment N/A	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	3	Low	17.42			
3	Heathland and shrub	Hawthorn scrub	0.029	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	3	Low	0.10			
4	Urban	Developed land; sealed surface	26.04	V Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Standard time to target condition applied	2	Low	0.00			
5	Woodland and forest	Lowland mixed deciduous woodland	0.387	High	Poor	Formally identified in local strategy	Check details- Delay in starting habitat in required condition? ▲	12	High	0.57			
6	Heathland and shrub	Mixed scrub	2.287	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	7	Low	14.26			
7	Grassland	Modified grassland	0.006	Low	Good	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	9	Low	0.03			
8	Grassland	Modified grassland	0.044	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	6	Low	0.14			
9	Grassland	Modified grassland	8.551	Low	Poor	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	3	Low	15.37			
10	Grassland	Other neutral grassland	19.575	Medium	Good	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	12	Low	153.18			
11	Grassland	Other neutral grassland	0.28	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	7	Low	1.75			
12	Grassland	Other neutral grassland	3.161	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	4	Low	10.96			
13	Woodland and forest	Lowland mixed deciduous woodland	0.377	High	Poor	Formally identified in local strategy	Check details- Delay in starting habitat in required condition? ▲	12	High	0.56			
14	Woodland and forest	Lowland mixed deciduous woodland	0.055	High	Poor	Formally identified in local strategy	Check details- Delay in starting habitat in required condition? ▲	12	High	0.08			
15	Woodland and forest	Other woodland; broadleaved	0.194	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	7	Low	0.60			
16	Lakes	Ponds (non-priority habitat)	0.016	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	5	Low	0.11			
17	Lakes	Ponds (non-priority habitat)	1.491	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	3	Low	5.36			
18	Sparsely vegetated land	Ruderal/Ephemeral	0.459	Low	Good	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	7	Low	2.15			
19	Sparsely vegetated land	Ruderal/Ephemeral	0.999	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	5	Low	3.34			
20	Sparsely vegetated land	Ruderal/Ephemeral	0.177	Low	Poor	Area/compensation not in local strategy/ no local strategy	Check details- Delay in starting habitat in required condition? ▲	3	Low	0.32			
21	Woodland and forest	Lowland mixed deciduous woodland	6.225364107	High	Poor	Formally identified in local strategy	Check details- Delay in starting habitat in required condition? ▲	12	High	9.24			
22													
23													
24													
25													
26													
Total habitat area			80.11							235.55			

Project Name: Cambourne to Cambridge Map Reference:

B-1 On-Site Hedge Baseline

Condense / Show Columns

Condense / Show Rows

Main Menu

Hedgerow summary	
Total Net Unit Change	-5.46
Total Net % Change	-18.15%
Trading Rules Satisfied	No - check trading summary ▲

Existing hedgerow habitats				Distinctiveness		Condition		Strategic significance			Required Action to Meet Trading Rules	Ecological baseline						
Ref	Hedge number	Habitat type	Length (km)	Distinctiveness	Score	Condition	Score	Strategic significance	Strategic significance	Strategic significance multiplier		Total hedgerow units	Length retained	Length enhanced	Units retained	Units enhanced	Length lost	Units lost
1		Native hedgerow	1.472486	Low	2	Good	3	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	10.16	0.89286		6.16	0.00	0.58	4.00
2		Native hedgerow	1.355421	Low	2	Moderate	2	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	6.23	0.07587		0.35	0.00	1.28	5.89
3		Native hedgerow	0.253213	Low	2	Poor	1	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	0.58	0.18723		0.43	0.00	0.07	0.15
4		Native hedgerow with trees	0.146044	Medium	4	Good	3	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	2.02	0.10246		1.41	0.00	0.04	0.60
5		Native hedgerow with trees	0.527793	Medium	4	Moderate	2	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	4.86	0.40258		3.70	0.00	0.13	1.15
6		Native hedgerow - associated with bank or ditch	0.21862	Medium	4	Good	3	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	3.02	0.14963		2.06	0.00	0.07	0.95
7		Native hedgerow - associated with bank or ditch	0.81731	Medium	4	Moderate	2	Formally identified in local strategy	High strategic significance	1.15	Same distinctiveness band or better	7.52	0.77532		7.13	0.00	0.04	0.39
8		Native hedgerow with trees - associated with bank or ditch	0.079968	High	6	Good	3	Formally identified in local strategy	High strategic significance	1.15	Like for like or better	1.66	0.03226		0.67	0.00	0.05	0.99

Project Name: Cambourne to Cambridge Map Reference:

B-2 On-Site Hedge Creation

Condense / Show Columns

Condense / Show Rows

Main Menu

Hedgerow summary	
Total Net Unit Change	-5.46
Total Net % Change	-18.15%
Trading Rules Satisfied	No - check trading summary ▲

		Proposed habitats		Distinctiveness	Condition	Strategic significance	Temporal multiplier		Difficulty risk multipliers	Hedge units delivered
Ref	New hedge number	Habitat type	Length (km)	Distinctiveness	Condition	Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation	
1		Species-rich native hedgerow	0.96187	Medium	Good	Formally identified in local strategy	Standard time to target condition applied	12	Low	8.66
2										
3										
4										
5										
6										
			0.96							8.66

APPENDIX DW5



UK Biodiversity Action Plan Priority Habitat Descriptions

Traditional Orchards

From:

UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008.

This document is available from:

<http://jncc.defra.gov.uk/page-5706>

For more information about the UK Biodiversity Action Plan (UK BAP) visit

<http://www.jncc.defra.gov.uk/page-5155>

Please note: this document was uploaded in November 2016, and replaces an earlier version, in order to correct a broken web-link. No other changes have been made. The earlier version can be viewed and downloaded from The National Archives:
<http://webarchive.nationalarchives.gov.uk/20150302161254/http://jncc.defra.gov.uk/page-5706>

Traditional Orchards: Description, Definition and Extent

Correspondence with existing habitats

- UK BAP broad habitat: Broadleaved, mixed and yew woodland (the proposed habitat is a habitat complex like lowland wood-pasture and parkland, which is in this broad habitat)
- Phase 1: A. Woodland and scrub, A 1.1.2. Broadleaved plantation, orchard, to be identified by existing/added symbols (England Field Unit 1990).
- NVC: Incorporates several types as part of the orchard habitat complex (e.g. MG5, MG6, W24).
- Annex I: Incorporates parts of several Annex I types, for example lowland calcareous grassland in some sites within the Annex I type H6210 semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).

Description

Habitat structure rather than vegetation type, topography or soils, is the defining feature of the habitat.

Traditional orchards are structurally and ecologically similar to wood-pasture and parkland, with open-grown trees set in herbaceous vegetation, but are generally distinguished from these priority habitat complexes by the following characteristics: the species composition of the trees, these being primarily in the family Rosaceae; the usually denser arrangement of the trees; the small scale of individual habitat patches; the wider dispersion and greater frequency of occurrence of habitat patches in the countryside. Traditional orchards include plantings for nuts, principally hazel nuts, but also walnuts. Management of the trees is the other main feature distinguishing traditional orchards and wood-pasture and parkland. Trees in traditional orchards are, or were, grown for fruit and nut production, usually achieved through activities such as grafting and pruning; whereas timber has been the main product from trees in wood-pastures and parkland, mostly derived from pollarding or selective felling. Grazing or cutting of herbaceous vegetation are integral to orchard management, as they are in wood-pastures and parkland. The presence of scrub, mostly in the form of hedgerows on the site boundaries, or sometimes, especially in unmanaged orchards, among the orchard trees, is analogous to the frequent occurrence of scrub in wood-pastures and parkland and plays a similar ecological role (see under biodiversity characteristics described below). Ponds and other wetland features are often present; being used now, or in the past, for watering livestock.

Orchards are hotspots for biodiversity in the countryside, supporting a wide range of wildlife and containing UK BAP priority habitats and species, as well as an array of Nationally Rare and Nationally Scarce species. The wildlife of orchard sites depends on the mosaic of habitats they encompass, including fruit trees, scrub, hedgerows, hedgerow trees, non-fruit trees within the orchard, the orchard floor habitats, fallen dead wood and associated features such as ponds and streams. A feature of the biodiversity of traditional orchards is the great variety of fruit cultivars that they contain. For example, Luckwill and Pollard (1963) list 101 varieties of perry pear distributed across the parishes of Gloucestershire. This agricultural biological diversity is not an explicit part of the current UK BAP, although the UK Government is a signatory to the Global Strategy for Plant Conservation (2001). The Government response (Cheffings and others 2004) includes a target for conserving crop diversity.

Traditional orchards are defined for priority habitat purposes as orchards managed in a low intensity way, in contrast with orchards managed intensively for fruit production by the input of chemicals such as pesticides and inorganic fertilisers, frequent mowing of the orchard

floor rather than grazing or cutting for hay, and planting of short-lived, high-density, dwarf or bush fruit trees.

Spacing of trees in traditional orchards can vary quite widely (from c3m in some plum orchards and traditional cobnut plats, to over 20m in some large perry pear and cherry orchards). There is some overlap of density of planting with intensive orchards, but these orchards often have densities at least twice as high as the most closely-spaced traditional orchard.

Like wood-pastures and parklands, traditional orchards can occur on a wide range of soil types, from slightly acid, relatively infertile soils to fertile river floodplain soils and lime-rich soils. Orchards can be found on slopes ranging from steep to level, and with any aspect. Generally, sites do not have badly impeded drainage, although locally, within sites, there may be wetter areas. Orchards are found in the lowland landscape in the UK, defined as the land below the altitudinal limit of enclosure (i.e. below the 'moor wall').

Traditional orchards can easily be distinguished from other wooded habitats based on the preponderance of domestic fruit and nut species: apple, plum, pear, damson, cherry, walnut and cobnut. Only in a very few cases will there be a significant number of other tree species in a traditional orchard, unless the orchard is becoming woodland through neglect. An arbitrary distinction of requiring, say, 50% of trees to be domestic fruit or nut species in an orchard, is rarely likely to be invoked for distinguishing orchards from wood-pasture/parkland.

Traditional orchards contrast with orchards managed intensively for fruit production, where there are inputs of chemicals such as pesticides and inorganic fertilisers, frequent mowing of the orchard floor rather than grazing or cutting for hay, and planting of short-lived, high-density, dwarf or bush fruit trees (stems generally 75cm or less).

The simplest visual indicator of intensive management is the presence of herbicided strips along the tree rows, where the ground is generally bare or with some annual plant re-growth; contrasting with the permanent grassland of the between-row spaces. Such strips are readily observable on aerial photographs. According to orchard pesticide usage surveys by the Central Science Laboratory (CSL), use of herbicide is associated with other pesticide use and intensive mowing between tree-rows, while in contrast, orchards with fully grassed floors can be considered traditional (Dr Joe Crocker, CSL, pers. comm.). There may potentially be cases where other pesticides or inorganic fertilisers or other intensive management practices are used without herbicide. As a consequence, for instance where herbicide strips are not evident but the trees appear small and closely spaced, there may occasionally be instances for limited ground-truthing by checking density / spacing (see below) and stature of trees on the ground. Spacing of trees in traditional orchards can vary quite widely, from around 3m to over 20m between trees (see above). There is some overlap of density of planting with intensive orchards, so a density distinction is not useful on its own. However, non-traditional orchards often have densities at least twice the density of the most closely-spaced traditional orchard, and density/planting distance (< 3m in many intensive orchards) can help in the distinction of intensive orchards as described above.

Traditional Orchards: UK HAP Definition

Traditional orchards are defined, for priority habitat purposes, as groups of fruit and nut trees planted on vigorous rootstocks at low densities in permanent grassland; and managed in a low intensity way. Cobnut plats are also included.

Background / Explanation to Definition

Traditional orchards are a long-established and widely distributed habitat and make a significant contribution to biodiversity, landscape character and local distinctiveness across the UK. There are many regional variations on this theme, including apple, pear, cherry, plum, damson, and walnut orchards. Although cobnut plot structure and management varies from fruit tree orchards and has affinities with coppice woodland, they are also included in the definition.

They are a composite habitat (similar to wood-pasture and parkland), defined by their structure rather than vegetation type, which can include trees, scrub, grassland, ponds, walls, hedgerows and hedgerow trees. Traditional orchards can take several different distribution patterns, including small and large patches, along linear boundaries, and trees dispersed among settlements.

Prime traditional orchard habitat consists of grazed grassland with fruit trees of varying age structure, with an abundance of standing and fallen dead and decaying wood. Young trees and newly planted orchards that are managed in a low intensity way are also included in the definition.

Low intensity management refers to orchards that are managed extensively, with little or no use of chemicals such as pesticides, herbicides and inorganic fertilisers, with relatively long-lived trees that are allowed to reach the veteran stage, and with a permanent grass sward that is usually grazed by cattle or sheep or cut for hay. Although traditional orchards have sometimes been established with soft fruit or other crops grown between rows, where these are managed extensively the orchard floor has usually been grassed over once the trees have matured and the canopy has closed over.

In contrast, intensive management refers to orchards managed to maximise fruit production, usually including several of the following management practices; dense planting of short-lived trees on dwarfing rootstocks, high chemical inputs, intensive pruning to remove dead and decaying wood and maintain the trees in a restricted form, and frequent mowing and spraying of the orchard floor.

Planting density depends on the species of tree. For apple, pear and cherry this will usually be less than 150 trees/ha. (approximately 8m spacing between the trees), but for other species such as plum and damson this density may be higher. Tree form will usually be standards or half-standards, but will vary accordingly to species and local practice. Vigorous rootstocks include trees that are grown on their own rootstock, seedling rootstocks, and named rootstocks that allow the tree to develop to its full size.

The minimum size of a traditional orchard is defined as five trees with crown edges less than 20m apart. However, the potential biological and genetic interest of sites with fewer trees, such as relict orchards and individual trees within gardens, is noted. Where appropriate these should be considered as potential restoration sites. It is recognised that other sites which fall outside the definition, such as organic bush orchards and fruit collections in walled gardens, may also have biodiversity value, as well as historic, cultural and genetic importance.

Extent of Resource

Traditional orchards are found in all countries of the UK, although England has the bulk of the resource. Areas digitally mapped by the Ordnance Survey have been found to provide a relatively accurate estimate of total orchard area, as a result of testing by ground-truthing and aerial photograph interpretation (Natural England, in prep.). Together with country information on extent of commercial orchards in agricultural census returns, digital Master

Map polygons can be used to make initial estimates of the extent of the resource (see table below).

The estimated extent of traditional orchards in the UK is 25,350ha. This puts the habitat at the rarer end of the scale compared to existing priority habitats. These range from Upland hay meadows (1,100ha), Lowland wood-pasture and parkland (35,000ha), Lowland heathland (over 60,000ha), Upland oakwood (85,000ha) to Upland heath (2,109,400ha).

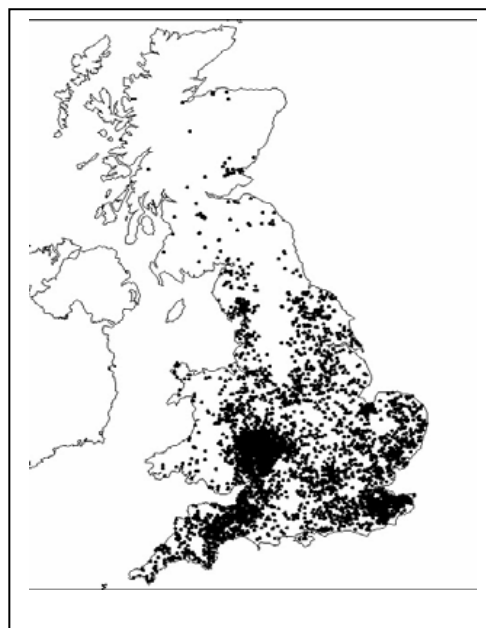
Country	*Orchard area (ha)	**Traditional orchard area (ha)
England	39,600	24,600
Scotland	290	250
Wales	840	440
Northern Ireland	(1,600)	60

*Ordnance Survey area except for Northern Ireland where area under fruit (top and soft) is given from the agricultural census 2004.

** England: Ordnance Survey area in 2006 minus area of commercial orchards in Agricultural census of 2006 defined as intensive (84%) by lack of fully grassed orchard floor (Central Science Laboratory data). Scotland and Wales: Ordnance Survey area minus area of commercial orchards in agricultural censuses of 2003 and 2002 respectively. Note that some of the commercial orchards in Scotland and Wales may be traditional orchards; thus the estimate of traditional orchard area may be an underestimate. Northern Ireland: estimate from figure given in the Environmentally Sensitive Areas scheme booklet, traditional orchards option.

The Ordnance Survey data, which do not distinguish traditional and intensive orchards, show that orchards are dispersed throughout the lowlands of Britain, although there are concentrations in some areas particularly Kent, Cambridgeshire, Somerset and the Three Counties (Herefordshire, Worcestershire and Gloucestershire). The bulk (78%) of the commercial fruit production occurs in these concentrations in England, which implies that traditional orchards comprise the majority of the orchards elsewhere, as well as being known to occur in the orchard concentration areas.

Map: Orchard distribution in England, Scotland and Wales. Reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationary Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceeding. English Nature 100017954 [2005].



An inventory of traditional orchards in England is currently in progress and is due to be completed in March 2011. The data set can be downloaded via the [GIS Digital Boundary Datasets](#) page on the Natural England Website and can be viewed via the MAGIC interactive map online resource <http://www.magic.gov.uk/home.htm>.

A simple mappable definition has been adopted and is based on the rules adopted for the Natural England orchard project. The minimum size of a traditional orchard is defined as five trees with crown edges less than 20m apart.

For further information visit Orchard Network www.orchardnetwork.org.uk (From April 2010).

References:

Cheffings, C., Harper, M. and Jackson, A. 2004. *Plant diversity challenge: the UK's response to the Global Strategy for Plant Conservation*. Peterborough: Joint Nature Conservation Committee.

Luckwill, L.C. and Pollard, A. 1963. *Perry pears*. Bristol: Published for the National Fruit and Cider Institute by the University of Bristol.

APPENDIX DW6

Appendix DW6.

Briefing Note on Methodological and Technical Errors in GCP's BNG assessment

1. Classification of Coton Orchard

- 1.1.1 **Image 1** below is the habitat mapping for Coton Orchard taken from the WSP document [CD1-11.05 TR5.07](#) ("Biodiversity Statement and Biodiversity Net Gain Assessment").



Image 1: UKHab mapping of Coton Orchard section of Order Limits by WSP. Yellow with green hatch is 'Arrhenatherum neutral grassland' ('other neutral grassland' in BNG). Transparent light green hatching is Traditional Orchard., cross hatched is 'mixed scrub' and solid green is 'dense hawthorn scrub'.

- 1.1.2 Most of the habitat layer is not transparent and therefore for better legibility against the underlying satellite imagery, the outer delimitation of 'Arrhenatherum neutral grassland' and Traditional Orchard for the western part of the Orchard has been redrawn onto **Image 2** below to assist understanding of the points made below.
- 1.1.3 **Image 2** shows how the majority of the land within Coton Orchard has been mapped not as orchard but as 'Arrhenatherum neutral grassland' despite the presence of rows of orchard trees of various ages, from young

to mature. Only a minority (around a fifth) of the orchard has been classified as 'Traditional Orchard'. This includes the two red outlined areas in **Image 2**.

- 1.1.4 The primary determinant for identifying Traditional Orchard Priority Habitat is land-use history and management:

"Traditional orchards are defined, for priority habitat purposes, as groups of fruit and nut trees planted on vigorous rootstocks at low densities in permanent grassland; and managed in a low intensity way. Cobnut plats are also included".¹

- 1.1.5 At Coton, all the areas in **Image 2** below form part of one contiguous land-use parcel within which management as traditional orchard is the dominant land-use currently, and has evidently been so for decades. A case can certainly be made for localised exclusions where there are pockets of grassland without fruit trees, as well as internal and external linear boundaries defined by lines of non-orchard trees. In the east of the site (mainly outside the area covered by **Image 2**) there are also more arguable areas where former orchard has been subsumed within (or is in the process of being subsumed within) dense self-sown and/or suckering scrub. Even excluding all such areas, however, the majority of the site logically and comfortably falls within the Priority habitat description.

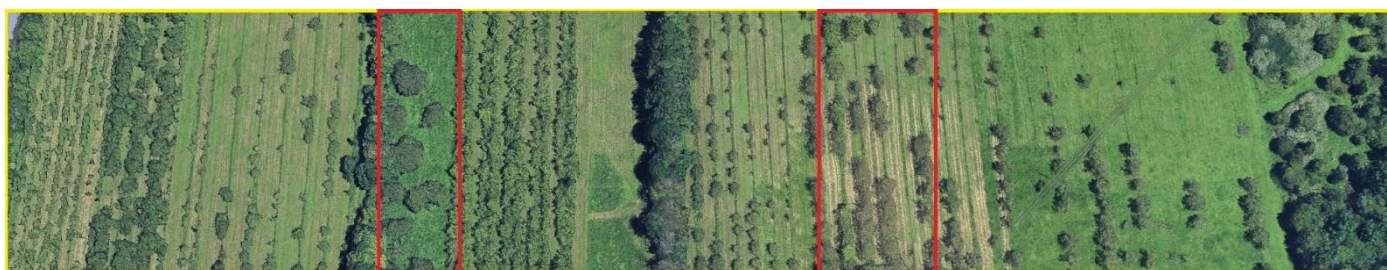


Image 2. Satellite view of the western area of Coton Orchard that falls within the Order Limits. The two areas outline red have been mapped by WSP as Traditional Orchard, but the remainder has been mapped as grassland.

- 1.1.6 One explanation for the approach taken by WSP is that a fixation on tree size and/or age has played a part in decisions as to whether to map the habitat as Traditional Orchard or a lower scoring habitat. For example, the presence of veteran trees in the western (left hand red box) area on **Image 2** appears to have led WSP to accept the presence of the Priority Habitat here. However, this doesn't readily explain why the right-hand red box on **Image 2** encompasses tree size and spacing that is little different from adjacent areas.
- 1.1.7 It is also possible that WSP have decided that the orchard is intensively managed. If so, that is also a flawed assessment by reference to the JNCC criteria at **Appendix DW5** and is self-evidently erroneous on the site in the lack of dominance of dwarf (<75cm trees), the varied age structure including fully mature and young trees, and the lack of herbicide use. The photos below provide a comparison of a typical intensive apple orchard in Kent (upper photo) and a photo taken on Bioscan's visit of 30th July 2025 of an area of the Coton Orchard that has been mapped by WSP as 'other neutral grassland' (lower). On any sensible analysis, Coton Orchard does not sit within the description of an intensive orchard, nor can the trees simply be ignored to arrive at a classification of 'other neutral grassland'.

¹ JNCC (2011). UK Biodiversity Action Plan Priority Habitat Descriptions – Traditional Orchards. Via: <https://hub.jncc.gov.uk/assets/2829ce47-1ca5-41e7-bc1a-871c1cc0b3ae#UKBAP-BAPHabitats-56-TraditionalOrchards.pdf>



Typical intensive orchard



Coton orchard

- 1.1.8 In Bioscan's view, WSP's classification of the majority of Coton Orchard falling within the Order Limits as not orchard but grassland is clearly and demonstrably wrong. **Figures 1 and 2** attached to this note provide corrected habitat mapping for this area and the main body of this proof discusses the consequences of these habitat classification anomalies for the BNG score of the GCP scheme.

2. Tree loss

- 1.2.1 **Images 1 and 2** above also illustrate a further clear departure from BNG ‘rules’ in WSP’s Metric Calculation. This is that the several hundred trees within Coton Orchard that are set to be lost have been excluded from the Biodiversity Net Gain calculation. If one were to accept WSP’s argument that the majority of the affected areas are ‘grassland’ and not Traditional Orchard, then all these individual trees would still need to be mapped,² as grassland is not a habitat defined by tree cover. In the alternative, if these areas are accepted to be Traditional Orchard (which we would say is correct), then all medium³, or larger trees proposed for loss would still need to be mapped and logged as lost in accordance with BNG rules². It was noted on Bioscan’s visit on 30 July that many of the trees present here meet at least the ‘medium’ size criterion.
- 1.2.2 This omission also flatly contradicts claims about a precautionary approach made in the ES main Report (see grey text box at Ch8, p103) which is that *“An estimated 490 of the orchard’s trees (recorded by the topographic survey) are located within the Order Limits. Although some of these are likely to be retained, it is assumed for the ES that all will be felled (emphasis added).”* In fact, no such assumption is accounted for in the BNG calculation.
- 1.2.3 A similar omission has been made for medium or larger trees proposed for loss in hedgerows and treelines, such as the internal and external hedgerows and tree lines within Coton Orchard. Again, the Statutory Metric User Guide (p.60-61) is clear on this:
- ‘If any medium, large or very large trees within a hedgerow or ‘rural’ line of trees are being removed, record these in the area baseline as individual trees.’²*
- 1.2.4 These departures applied across the GCP scheme mean that substantial tree loss has not been accounted for. This will have led in turn to a major underestimate in quantitative habitat unit losses. Correcting for such omissions significantly worsens the GCP scheme’s impact score, as discussed in the main body of this proof.

3. Other examples of incorrect habitat mapping and omission

- 1.3.1 **Image 3** overleaf shows the applicant’s habitat mapping for the section of the GCP scheme running through the Cambridge West campus, south of Charles Babbage Road.

² DEFRA (2025). The Statutory Biodiversity Metric – User Guide. pp60-61.

³ Diameter at Breast Height of >30cm



Image 3: UKHab mapping around Cambridge West campus.

- 1.3.2 The northern part of this area can be seen to be mapped with an opaque grey overlay denoting either 'Developed land; sealed surface' or 'Artificial unvegetated, unsealed surface'. As can readily be appreciated from the opacity of the layer, and which therefore should have been apparent to anyone creating or checking this plan, neither classification is correct for the majority of this land parcel.
- 1.3.3 **Image 4** below provides a close-up satellite image of this area. Far from being unvegetated, this parcel of land is well-vegetated and likely to fall into one of the 'ephemeral/ruderal', 'tall forb', or grassland categories, all of which score far higher than unvegetated land. Nor do the habitats running in an east-west band to the south, which include a watercourse, dense scrub/hedgerow and marginal vegetation, appear to have been classified and mapped correctly.



Image 4: Omitted habitats at Cambridge West

4. Optimistic future habitat condition scores

- 1.4.1 **Image 5** below is a screengrab from Tab A-2 of the completed Metric calculation supplied by GCP (“On-site Habitat Creation”). It shows that a significant quantum (just over 19.5ha) of ‘other neutral grassland’ in ‘good’ condition is assumed to be delivered within the Order Limits after completion of the development. The blue ring in the top-right corner circles output values showing the consequence of this in terms of the Net Unit Change and Net % Change output scores. In short, uplift of habitat quality to ‘other neutral grassland’ in ‘good’ condition across 19.5ha is doing much of the heavy lifting here.

Project Name: Cambourne to Cambridge Map Reference:			Area habitat summary			
A-2 On-Site Habitat Creation			Total Net Unit Change	11.12		
Condense / Show Columns			Total Net % Change	4.73%		
Condense / Show Rows			Trading Rules Satisfied	No - check trading summaries ▲		
Main Menu			Area Check	Area Acceptable ✓		

Broad Habitat	Proposed habitat	Area (hectares)	Distinctiveness		Condition		Strategic significance
			Distinctiveness	Score	Condition	Score	
Heathland and shrub	Mixed scrub	2.287	Medium	4	Moderate	2	Area/compensation not in local strategy
Grassland	Modified grassland	0.006	Low	2	Good	3	Area/compensation not in local strategy
Grassland	Modified grassland	0.044	Low	2	Moderate	2	Area/compensation not in local strategy
Grassland	Modified grassland	8.551	Low	2	Poor	1	Area/compensation not in local strategy
Grassland	Other neutral grassland	19.575	Medium	4	Good	3	Area/compensation not in local strategy
Grassland	Other neutral grassland	0.28	Medium	4	Moderate	2	Area/compensation not in local strategy
Grassland	Other neutral grassland	3.161	Medium	4	Poor	1	Area/compensation not in local strategy
Woodland and forest	Lowland mixed deciduous woodland	0.377	High	6	Poor	1	Formally identified in local strategy
Woodland and forest	Lowland mixed deciduous woodland	0.055	High	6	Poor	1	Formally identified in local strategy
Woodland and forest	Other woodland, broadleaved	0.194	Medium	4	Poor	1	Area/compensation not in local strategy

Image 5: GCP's BNG calculation showing proposed creation of 19.5ha of other neutral grassland in 'good' condition.

- 1.4.2 This is an optimistic outcome. No explanation is given as to why it is assumed this will be achievable on future highways land and verges, when GCP's calculator inputs suggest it has not been achieved on extant, long-established road verges within the Order Limits (the majority of which are described as moderate or poor condition).
- 1.4.3 **Image 6** below shows the effect of adjusting GCP's calculation to a future scenario where only ONG 'moderate' is achieved, which is more in line with the baseline position. The blue ringed values (top right) show that the effect of this change on the scheme's overall output score is profound, changing from plus 4.73% to minus 8.51%. This output figure drops to minus 31.52% if only 'poor' condition other neutral grassland is achieved.

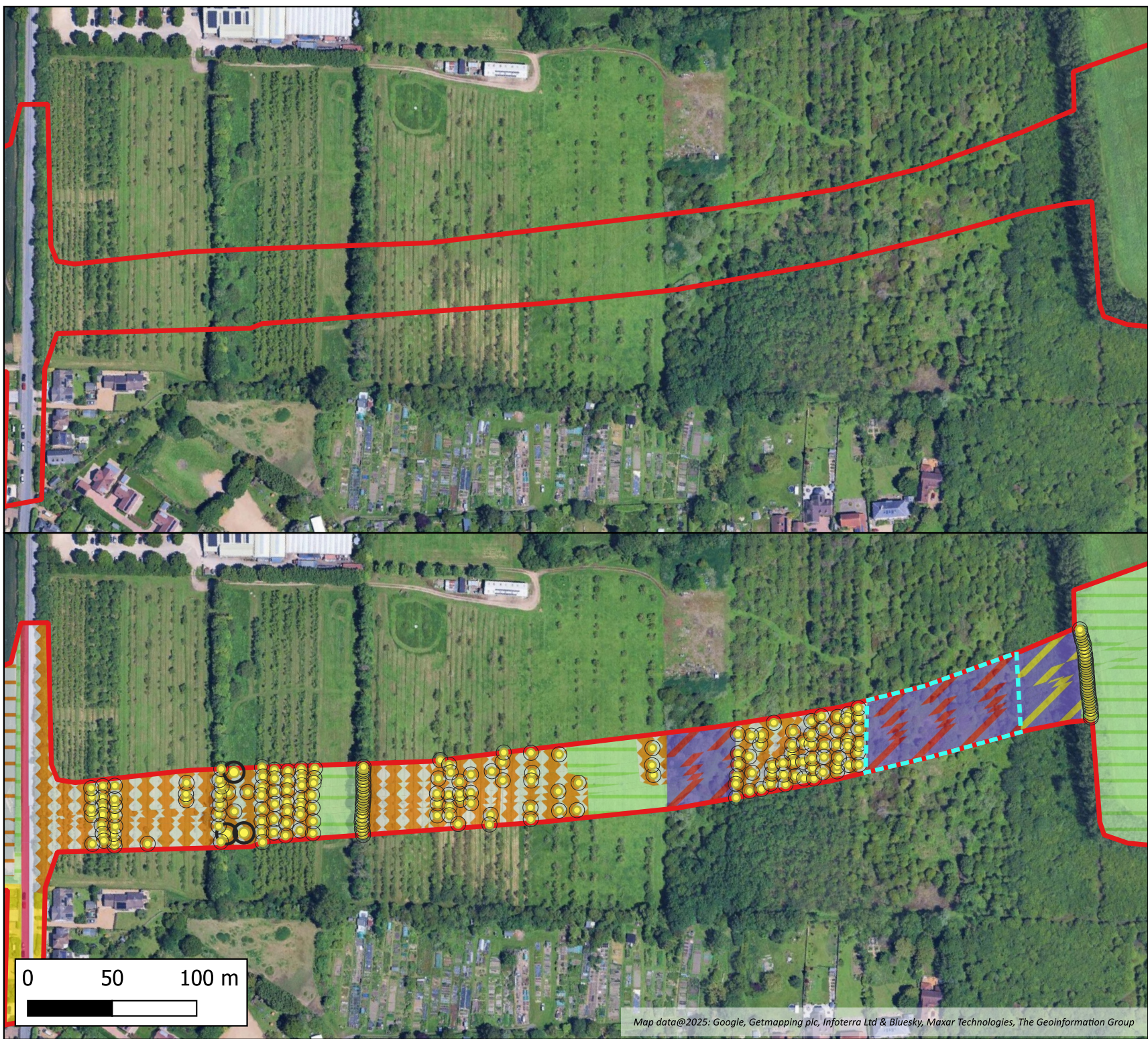
Project Name: Cambourne to Cambridge Map Reference:				Area habitat summary				
A-2 On-Site Habitat Creation				Total Net Unit Change		-20.03		
Condense / Show Columns				Total Net % Change		-8.51%		
Condense / Show Rows				Trading Rules Satisfied		No - check trading summaries ▲		
Main Menu				Area Check		Area Acceptable ✓		
Ref	Broad Habitat	Proposed habitat	Area (hectares)	Distinctiveness		Condition		Strategic
				Distinctiveness	Score	Condition	Score	Strategic significance
6	Heathland and shrub	Mixed scrub	2.287	Medium	4	Moderate	2	Area/compensation not in local strategy
7	Grassland	Modified grassland	0.006	Low	2	Good	3	Area/compensation not in local strategy
8	Grassland	Modified grassland	0.044	Low	2	Moderate	2	Area/compensation not in local strategy
9	Grassland	Modified grassland	8.551	Low	2	Poor	1	Area/compensation not in local strategy
10	Grassland	Other neutral grassland	19.575	Medium	4	Moderate	2	Area/compensation not in local strategy
11	Grassland	Other neutral grassland	0.28	Medium	4	Moderate	2	Area/compensation not in local strategy
12	Grassland	Other neutral grassland	3.161	Medium	4	Poor	1	Area/compensation not in local strategy
13	Woodland and forest	Lowland mixed deciduous woodland	0.377	High	6	Poor	1	Formally identified in local strategy
14	Woodland and forest	Lowland mixed deciduous woodland	0.055	High	6	Poor	1	Formally identified in local strategy
15	Woodland and forest	Other woodland, broadleaved	0.194	Medium	4	Poor	1	Area/compensation not in local strategy

Image 6: GCP's BNG calculation modified to shown attainment of only 'moderate' condition for the same quantum of 'other neutral grassland'.

- 1.4.4 **Images 5 and 6** serve to demonstrate how selecting optimistic assessments of future habitat condition can mask or overcome significant impacts from a scheme. Higher scoring other neutral grassland in good condition is certainly not unattainable, but it has here been assumed as easily delivered in the absence of any evidence from the baseline position that it is likely to happen, evidence that one might expect to include consideration of soil type, fertility, management and factors such as salt spray and nitrogen deposition.

5. Conclusions

- 1.5.1 The cumulative effect of the above issues and errors is to significantly undermine the accuracy and reliability of WSP's BNG calculation for the GCP scheme. It is striking that the above technical and methodological flaws all act on the calculation in the same way; supressing the baseline score and elevating the future (post-implementation) score. The margin of likely error is shown by the adjustment of future grassland condition to be very wide indeed and highly significant for the practicality and cost of attaining an overall +10% or +20% outcome.



Key

- Order Limits
- Cereal crops
- Developed land; sealed surface
- Hawthorn scrub
- Mixed scrub
- Other neutral grassland
- Traditional orchard
- Vegetated garden
- Existing large rural tree
- Existing medium rural tree
- Relict orchard, which may qualify as Traditional Orchard



Title

Coton Orchard BNG Baseline

Project

CtoC Busway

Client

CPPF/CPC

Drawing No.

DW6 - 1

Revision

-

Project No.

E2257

Drawn

OB

Checked

DW

Date

August 2025

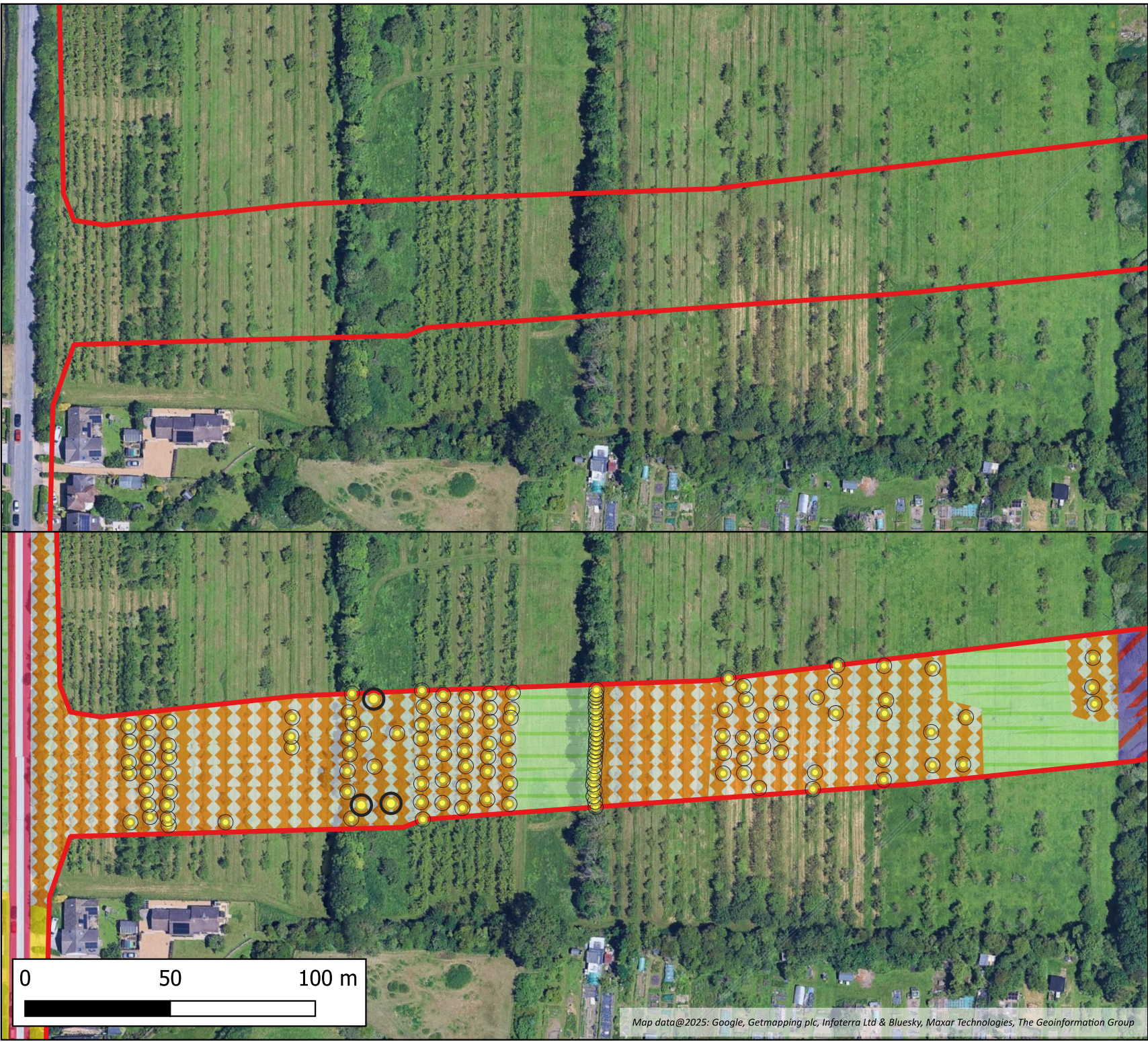
Bioscan (UK) Ltd

The Old Parlour
Little Baldon Farm
Little Baldon
Oxford
OX44 9PU



+44 (0) 1865 341321
bioscan@bioscanuk.com
www.bioscanuk.com

Reproduced from
Ordnance Survey © Crown
Copyright. All rights
reserved Licence
No.100005491



0 50 100 m

Map data@2025: Google, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The Geoinformation Group

Key

- Order Limits
- Developed land; sealed surface
- Mixed scrub
- Other neutral grassland
- Traditional orchard
- Vegetated garden
- Existing large rural tree
- Existing medium rural tree



Title Coton Orchard BNG Baseline		
Project CtoC Busway	Client CPPF/CPC	
Drawing No. DW6 - 2	Revision -	Project No. E2257
Drawn OB	Checked DW	Date August 2025
Bioscan (UK) Ltd The Old Parlour Little Baldon Farm Little Baldon Oxford OX44 9PU +44 (0) 1865 341321 bioscan@bioscanuk.com www.bioscanuk.com  <small>Reproduced from Ordnance Survey © Crown Copyright. All rights reserved Licence No.100005491</small>		

APPENDIX DW7

Appendix DW7: GCP Scheme – pdf readout of extrapolated Metric Calculation for off-road section east of St. Neots Rd. (uncorrected)

Return to results menu

Headline Results

Scroll down for final results ▲

On-site baseline	Area habitat units	150.51		
	Hedgerow units	17.38		
	Watercourse units	1.19		
On-site post-intervention <small>(Including habitat retention, creation & enhancement)</small>	Area habitat units	130.45		
	Hedgerow units	17.38		
	Watercourse units	1.19		
On-site net change <small>(units & percentage)</small>	Area habitat units	-20.06	-13.33%	On-site net gain is less than target set ▲
	Hedgerow units	0.00	0.00%	On-site net gain is less than target set ▲
	Watercourse units	0.00	0.00%	On-site net gain is less than target set ▲
Off-site baseline	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site post-intervention <small>(Including habitat retention, creation & enhancement)</small>	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site net change <small>(units & percentage)</small>	Area habitat units	0.00	0.00%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
Combined net unit change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Area habitat units	-20.06		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Spatial risk multiplier (SRM) deductions	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
FINAL RESULTS				
Total net unit change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Area habitat units	-20.06		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Total net % change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Area habitat units	-13.33%		Total net gain achieved is less than target set ▲
	Hedgerow units	0.00%		Total net gain achieved is less than target set ▲
	Watercourse units	0.00%		Total net gain achieved is less than target set ▲
Trading rules satisfied?	No - Check Trading Summaries ▲			
Unacceptable loss of irreplaceable habitat recorded - no bespoke compensation for losses has been agreed ▲				
Unit Type	Target	Baseline Units	Units Required	Unit Deficit
Area habitat units	10.00%	150.51	165.56	35.11
Hedgerow units	10.00%	17.38	19.12	1.74
Watercourse units	10.00%	1.19	1.31	0.12
Input errors/rule breaks present in metric ▲				

Project Name: Map Reference:

A-1 On-Site Habitat Baseline

Area habitat summary	
Total Net Unit Change	-20.06
Total Net % Change	-13.33%
Trading Rules Satisfied	No - check trading summaries ▲

Condense / Show Columns

Condense / Show Rows

Main Menu

Ref	Existing area habitats				Distinctiveness	Condition	Strategic significance	Required Action to Meet Trading Rules	Ecological baseline						
	Broad Habitat	Habitat Type	Irreplaceable habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance		Total habitat units	Area retained	Area enhanced	Baseline units retained	Baseline units enhanced	Area habitat lost	Units lost
1	Cropland	Cereal crops	No	24.4095	Low	Condition Assessment N/A	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	48.82	20.8362	0	41.67	0.00	3.57	7.15
2	Grassland	Modified grassland	No	2.0439	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	8.18	1.5096	0	6.04	0.00	0.53	2.14
3	Grassland	Other neutral grassland	No	10.9396	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	43.76	9.6556	0	38.62	0.00	1.28	5.14
4	Grassland	Traditional orchards	No	0.5183	High	Moderate	Formally identified in local strategy	Same habitat required =	7.15	0.386	0	5.33	0.00	0.13	1.83
5	Heathland and shrub	Hawthorn scrub	No	0.184	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	1.47	0.1452	0	1.16	0.00	0.04	0.31
6	Heathland and shrub	Mixed scrub	No	0.3992	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	3.19	0.3012	0	2.41	0.00	0.10	0.78
7	Sparsely vegetated land	Ruderal/Ephemeral	No	0.4243	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	1.70	0.3781	0	1.51	0.00	0.05	0.18
8	Sparsely vegetated land	Tall forbs	No	0.2306	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	0.92	0.1784	0	0.71	0.00	0.05	0.21
9	Urban	Developed land; sealed surface	No	5.0027	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Compensation Not Required	0.00	4.2921	0	0.00	0.00	0.71	0.00
10	Urban	Vegetated garden	No	0.1353	Low	Condition Assessment N/A	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	0.27	0.1353	0	0.27	0.00	0.00	0.00
11	Woodland and forest	Lowland mixed deciduous woodland	No	2.3267	High	Moderate	Formally identified in local strategy	Same habitat required =	32.11	2.2147	0	30.56	0.00	0.11	1.55
12	Woodland and forest	Other woodland; broadleaved	No	0.3298	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	2.64	0.2317	0	1.85	0.00	0.10	0.78
13	Woodland and forest	Other woodland; mixed	No	0.0376	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required (≥)	0.30	0.0376	0	0.30	0.00	0.00	0.00
14	Individual trees	Rural tree	Yes	0.158788659	Medium	Good	Formally identified in local strategy	Bespoke compensation likely to be required	Any Loss Unacceptable ▲			Irreplaceable habitat - no units generated ▲	0.00	0.16	Any Loss Unacceptable ▲
15															
16															
17															
18															
19															
20															
21															
Total habitat area				47.14					150.51	40.30	0.00	130.45	0.00	6.84	20.06

Project Name: Map Reference:

A-2 On-Site Habitat Creation

Condense / Show Columns

Condense / Show Rows

Main Menu

Area habitat summary

Total Net Unit Change	-20.06
Total Net % Change	-13.33%
Trading Rules Satisfied	No - check trading summaries ▲
Area Check	Area Acceptable ✓

Ref	Broad Habitat	Proposed habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance
				Distinctiveness	Condition	Strategic significance
1	Urban	Developed land; sealed surface	6.6798	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy
2						
3						
4						
5						
6						
Total habitat area			6.68			

ention habitats

Temporal multiplier		Difficulty	Habitat units delivered	Comments		
Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation		User comments	Planning authority comments	Habitat reference number
Standard time to target condition applied	0	Low	0.00			
			0.00			

Project Name:

Map Reference:

A-3 On-Site Habitat Enhancement

Condense / Show Columns

Condense / Show

Main Menu

Area habitat summary	
Total Net Unit Change	-20.06
Total Net % Change	-13.33%
Trading Rules Satisfied	No - check trading summaries ▲

		Post intervention habitat			
Baseline habitats		Proposed Habitat (Broad habitat pre-populated but can be overridden)		Change in distinctiveness and condition	
Baseline ref	Baseline habitat	Proposed Broad Habitat	Proposed habitat	Distinctiveness change	Condition change
					Total habitat area

Habitat units delivered							Habitat units delivered
Area (hectares)	Distinctiveness	Condition	Strategic significance	Temporal risk multiplier		Difficulty risk multipliers	
			Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of enhancement	
0.00							0.00

APPENDIX DW8

Appendix DW8: GCP Scheme – pdf readout of extrapolated Metric Calculation for off-road section east of St. Neots Rd. (corrected for tree loss error)

Return to results menu

Headline Results

Scroll down for final results ▲

On-site baseline	Area habitat units	178.78		
	Hedgerow units	17.38		
	Watercourse units	1.19		
On-site post-intervention <small>(Including habitat retention, creation & enhancement)</small>	Area habitat units	130.45		
	Hedgerow units	17.38		
	Watercourse units	1.19		
On-site net change <small>(units & percentage)</small>	Area habitat units	-48.34	-27.04%	On-site net gain is less than target set ▲
	Hedgerow units	0.00	0.00%	On-site net gain is less than target set ▲
	Watercourse units	0.00	0.00%	On-site net gain is less than target set ▲
Off-site baseline	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site post-intervention <small>(Including habitat retention, creation & enhancement)</small>	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site net change <small>(units & percentage)</small>	Area habitat units	0.00	0.00%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
Combined net unit change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Area habitat units	-48.34		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Spatial risk multiplier (SRM) deductions	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
FINAL RESULTS				
Total net unit change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Area habitat units	-48.34		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Total net % change <small>(Including all on-site & off-site habitat retention, creation & enhancement)</small>	Area habitat units	-27.04%		Total net gain achieved is less than target set ▲
	Hedgerow units	0.00%		Total net gain achieved is less than target set ▲
	Watercourse units	0.00%		Total net gain achieved is less than target set ▲
Trading rules satisfied?		No - Check Trading Summaries ▲		
Unacceptable loss of irreplaceable habitat recorded - no bespoke compensation for losses has been agreed ▲				
Unit Type	Target	Baseline Units	Units Required	Unit Deficit
Area habitat units	10.00%	178.78	198.66	66.21
Hedgerow units	10.00%	17.38	19.12	1.74
Watercourse units	10.00%	1.19	1.31	0.12
Input errors/rule breaks present in metric ▲				

Project Name: Map Reference:

A-1 On-Site Habitat Baseline

Area habitat summary	
Total Net Unit Change	-48.34
Total Net % Change	-27.04%
Trading Rules Satisfied	No - check trading summaries ▲

Condense / Show Columns

Condense / Show Rows

Main Menu

Ref	Existing area habitats				Distinctiveness	Condition	Strategic significance	Required Action to Meet Trading Rules	Ecological baseline
	Broad Habitat	Habitat Type	Irreplaceable habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance		Total habitat units
1	Cropland	Cereal crops	No	24.4095	Low	Condition Assessment N/A	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	48.82
2	Grassland	Modified grassland	No	2.0439	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	8.18
3	Grassland	Other neutral grassland	No	10.9396	Medium	Poor	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required ≥	43.76
4	Grassland	Traditional orchards	No	0.5183	High	Moderate	Formally identified in local strategy	Same habitat required =	7.15
5	Heathland and shrub	Hawthorn scrub	No	0.184	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required ≥	1.47
6	Heathland and shrub	Mixed scrub	No	0.3992	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required ≥	3.19
7	Sparsely vegetated land	Ruderal/Ephemeral	No	0.4243	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	1.70
8	Sparsely vegetated land	Tall forbs	No	0.2306	Low	Moderate	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	0.92
9	Urban	Developed land; sealed surface	No	5.0027	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy	Compensation Not Required	0.00
10	Urban	Vegetated garden	No	0.1353	Low	Condition Assessment N/A	Area/compensation not in local strategy/ no local strategy	Same distinctiveness or better habitat required ≥	0.27
11	Woodland and forest	Lowland mixed deciduous woodland	No	2.3267	High	Moderate	Formally identified in local strategy	Same habitat required =	32.11
12	Woodland and forest	Other woodland; broadleaved	No	0.3298	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required ≥	2.64
13	Woodland and forest	Other woodland; mixed	No	0.0376	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required ≥	0.30
14	Individual trees	Rural tree	No	3.534065541	Medium	Moderate	Area/compensation not in local strategy/ no local strategy	Same broad habitat or a higher distinctiveness habitat required ≥	28.27
15	Individual trees	Rural tree	Yes	0.158788659	Medium	Good	Formally identified in local strategy	Bespoke compensation likely to be required	Any Loss Unacceptable ▲
16									
17									
18									
19									
20									
21									
				Total habitat area	50.67				
				Site Area (Excluding area of individual trees, green walls, intertidal hard structures)	46.98				
									178.78

Area retained	Area enhanced	Baseline units retained	Baseline units enhanced	Area habitat lost	Units lost
20.8362	0	41.67	0.00	3.57	7.15
1.5096	0	6.04	0.00	0.53	2.14
9.6556	0	38.62	0.00	1.28	5.14
0.386	0	5.33	0.00	0.13	1.83
0.1452	0	1.16	0.00	0.04	0.31
0.3012	0	2.41	0.00	0.10	0.78
0.3781	0	1.51	0.00	0.05	0.18
0.1784	0	0.71	0.00	0.05	0.21
4.2921	0	0.00	0.00	0.71	0.00
0.1353	0	0.27	0.00	0.00	0.00
2.2147	0	30.56	0.00	0.11	1.55
0.2317	0	1.85	0.00	0.10	0.78
0.0376	0	0.30	0.00	0.00	0.00
		0.00	0.00	3.53	28.27
		Irreplaceabl e habitat - no units generated ▲	0.00	0.16	Any Loss Unacceptable ▲
40.30	0.00	130.45	0.00	10.37	48.34

Condense / Show Columns

Condense / Show Rows

Main Menu

Area habitat summary	
Total Net Unit Change	-48.34
Total Net % Change	-27.04%
Trading Rules Satisfied	No - check trading summaries ▲
Area Check	Area Acceptable ✓

						Post intervention
Ref	Broad Habitat	Proposed habitat	Area (hectares)	Distinctiveness	Condition	Strategic significance
				Distinctiveness	Condition	Strategic significance
1	Urban	Developed land; sealed surface	6.6798	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy
2						
3						
4						
5						
6						
		Total habitat area	6.68			

entention habitats						
Temporal multiplier		Difficulty	Habitat units delivered	Comments		
Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation		User comments	Planning authority comments	Habitat reference number
Standard time to target condition applied	0	Low	0.00			
			0.00			

Project Name:	Map Reference:
A-3 On-Site Habitat Enhancement	

Condense / Show Columns

Condense / Show

Main Menu

Area habitat summary	
Total Net Unit Change	-48.34
Total Net % Change	-27.04%
Trading Rules Satisfied	No - check trading summaries ▲

Baseline habitats		Proposed Habitat (Broad habitat pre-populated but can be overridden)		Post intervention habitats	
Change in distinctiveness and condition					
Baseline ref	Baseline habitat	Proposed Broad Habitat	Proposed habitat	Distinctiveness change	Condition change
					Total habitat area



Habitat units delivered						
Area (hectares)	Distinctiveness	Condition	Strategic significance	Temporal risk multiplier		Difficulty risk multipliers
			Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of enhancement
0.00						0.00

APPENDIX DW9

Headline Results		Return to results menu		
Scroll down for final results ▲				
On-site baseline	Area habitat units	192.56		
	Hedgerow units	17.38		
	Watercourse units	1.19		
On-site post-intervention (Including habitat retention, creation & enhancement)	Area habitat units	140.85		
	Hedgerow units	17.38		
	Watercourse units	1.19		
On-site net change (units & percentage)	Area habitat units	-51.71	-26.86%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
Off-site baseline	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site post-intervention (Including habitat retention, creation & enhancement)	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Off-site net change (units & percentage)	Area habitat units	0.00	0.00%	
	Hedgerow units	0.00	0.00%	
	Watercourse units	0.00	0.00%	
Combined net unit change (Including all on-site & off-site habitat retention, creation & enhancement)	Area habitat units	-51.71		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Spatial risk multiplier (SRM) deductions	Area habitat units	0.00		
	Hedgerow units	0.00		
	Watercourse units	0.00		
FINAL RESULTS				
Total net unit change (Including all on-site & off-site habitat retention, creation & enhancement)	Area habitat units	-51.71		
	Hedgerow units	0.00		
	Watercourse units	0.00		
Total net % change (Including all on-site & off-site habitat retention, creation & enhancement)	Area habitat units	-26.86%	Total net gain achieved is less than target set ▲	
	Hedgerow units	0.00%	Total net gain achieved is less than target set ▲	
	Watercourse units	0.00%	Total net gain achieved is less than target set ▲	
Trading rules satisfied?	No - Check Trading Summaries ▲			
Unacceptable loss of irreplaceable habitat recorded - no bespoke compensation for losses has been agreed ▲				
Unit Type	Target	Baseline Units	Units Required	Unit Deficit
Area habitat units	10.00%	192.56	211.81	70.97
Hedgerow units	10.00%	17.38	19.12	1.74
Watercourse units	10.00%	1.19	1.31	0.12
Input errors/rule breaks present in metric ▲				

[Main Menu](#)

						Bespoke compensation agreed for losses of VHDH or irreplaceable habitat
Area retained	Area enhanced	Baseline units retained	Baseline units enhanced	Area habitat lost	Units lost	
20.8362	0	41.67	0.00	3.57	7.15	
1.5096	0	6.04	0.00	0.53	2.14	
8.5734	0	34.29	0.00	0.93	3.73	
0.0782	0	1.62	0.00	0.03	0.53	
1.2575	0	17.35	0.00	0.42	5.74	
0.1452	0	1.16	0.00	0.04	0.31	
0.4369	0	3.50	0.00	0.14	1.12	
0.3781	0	1.51	0.00	0.05	0.18	
0.1784	0	0.71	0.00	0.05	0.21	
4.2921	0	0.00	0.00	0.71	0.00	
0.1353	0	0.27	0.00	0.00	0.00	
2.2147	0	30.56	0.00	0.11	1.55	
0.2317	0	1.85	0.00	0.10	0.78	
0.0376	0	0.30	0.00	0.00	0.00	
		0.00	0.00	3.53	28.27	
		Irreplaceable habitat - no units generated ▲	0.00	0.16	Any Loss Unacceptable ▲	No
40.30	0.00	140.85	0.00	10.37	51.71	

Project Name: Map Reference:

A-2 On-Site Habitat Creation

Condense / Show Columns

Condense / Show Rows

Main Menu

Area habitat summary

Total Net Unit Change	-51.71
Total Net % Change	-26.86%
Trading Rules Satisfied	No - check trading summaries ▲
Area Check	Area Acceptable ✓

Ref	Broad Habitat	Proposed habitat	Area (hectares)	Distinctiveness	Condition	Post interv Strategic significance
				Distinctiveness	Condition	Strategic significance
1	Urban	Developed land; sealed surface	6.6796	V.Low	N/A - Other	Area/compensation not in local strategy/ no local strategy
2						
3						
4						
5						
6						
Total habitat area			6.68			

ention habitats						
Temporal multiplier		Difficulty		Habitat units delivered	Comments	
Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of creation			User comments	Planning authority comments
Standard time to target condition applied	0	Low	0.00			
			0.00			

Project Name:

Map Reference:

A-3 On-Site Habitat Enhancement

Condense / Show Columns

Condense / Show

Main Menu

Area habitat summary	
Total Net Unit Change	-51.71
Total Net % Change	-26.86%
Trading Rules Satisfied	No - check trading summaries ▲

Baseline habitats		Proposed Habitat (Broad habitat pre-populated but can be overridden)		Post intervention habitats		Area (hectares)
Baseline ref	Baseline habitat	Proposed Broad Habitat	Proposed habitat	Distinctiveness change	Condition change	
Total habitat area						0.00

Distinctiveness	Condition	Strategic significance	Temporal risk multiplier		Difficulty risk multipliers	Habitat units delivered
		Strategic significance	Standard or adjusted time to target condition	Final time to target condition (years)	Final difficulty of enhancement	
						0.00



Bioscan (UK) Ltd
The Old Parlour
Little Baldon Farm
Oxford
OX44 9PU

Tel: +44 (0) 1865 341321
Fax: +44 (0) 1865 343674

bioscan@bioscanuk.com
www.bioscanuk.com