Middlewick Ranges

Local Plan Housing Allocation: Ecological Evidence Base Report

On behalf of **Defence Infrastructure Organisation**

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Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: Caversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DN
T: +44 (0)118 950 0761 E: PBA.Reading@stantec.com

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	Name	Position	Signature	Date
Prepared by:	Project Team Ecologists, led by Rebecca Strawbridge	Associate Ecologist	RS	October 2020
Reviewed by:	Helen Evriviades Elaine Richmond	Senior Associate Ecologist Director	HE ER	October 2020 November 2020
Approved by:	Tim Allen	Director	TA	November 2020
For and on behalf of Stantec UK Limited				

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Executive Summary

In 2017, Stantec (formerly Peter Brett Associates) were instructed by JLL on behalf of the Defence Infrastructure Organisation (DIO) to provide technical consultancy services in relation to the proposed allocation of Middlewick Training Area, Colchester (hereafter referred to as the Allocation Boundary), in Colchester Borough Council's (CBC) Emerging Local Plan (2017 -2033). Specifically, Stantec were instructed to: complete ecological surveys sufficient to robustly inform the developable area and quantum of development within the Allocation Boundary; inform preparation of an ecologically considered masterplan; consult with CBC's Ecological Officer in relation to the proposed allocation, emerging proposals and mitigation designs; define the principles of ecological mitigation to enable legal and policy compliance for development defined by the site allocation; demonstrate that a net gain to biodiversity can be achieved from the proposals; and present the above in a combined evidence base for review as part of the examination of CBC's Emerging Local Plan (2017– 2033). The ecological surveys were completed over a three year period (2017–2020) and focused on a range of habitat types and species groups. Many surveys were extended beyond the Allocation Boundary into land immediately south, referred to as the 'Mitigation Land' to provide greater confidence in the efficacy of the mitigation and compensation that could be achieved.

The ecological considerations for any future development have been categorised as 'key' or 'non-key' to the allocation. Key ecological considerations are those which could reasonably affect the developable area, masterplan designs, or the viability of the scheme when mitigation strategies are factored in. Non-key ecological considerations are those which will likely require survey and assessment at planning application stage. Given the understanding of the location, designation criteria, habitat requirements, likely distribution and nature conservation value of non-key ecological considerations, any further mitigation (to be defined at planning application stage) will focus on legal and policy compliance. Such measures will not affect the overall deliverability of the scheme.

Key ecological considerations for the allocation were defined as internationally designated sites; Roman River Site of Special Scientific Interest (SSSI); Birch Brook and Middlewick Ranges Local Wildlife Sites (LWS); acid grassland; mature broadleaved semi-natural woodland habitat; Barbastelle roosting, foraging and commuting habitat; breeding bird habitat; and terrestrial invertebrate habitat. The key ecological considerations have influenced the development footprint, and masterplan designs over the three year period such that the masterplan (PRP Concept Masterplan Dated 28/09/20) delivers an ecological sensitive development, capable of maintaining ecological functionality of the key ecological features. High level avoidance, mitigation and compensation measures relevant to the key ecological considerations have been detailed and are fundamental to the scheme's viability in ecological terms. A metric has been completed which demonstrates a minimum of 8 -16% net gain to biodiversity (habitat areas) can be achieved (using the example enhancements to the habitats in the 'Mitigation Land') as part of these proposals. The Mitigation Land is immediately south of the Allocation Boundary, will remain in the Ministry of Defence (MOD) ownership and will be used for military training operations going forwards. The enhancements in the Mitigation Land have been designed to complement and allow the military activities that may take place on the land. Deliverability of the key mitigation, compensation and enhancement measures has been considered (including consideration of the technical, financial, land access and land use elements of viability).

The masterplan (PRP Concept Masterplan Dated 28/09/20) responds to the key ecological considerations, and measures to avoid, mitigate and compensate for impacts upon the key ecological considerations have been defined. These measures, including an example layout of enhancements to the Mitigation Land which achieves a net gain to biodiversity, are considered to be viable technically, financially and with respect to future land uses; (i.e. the mitigation is deliverable). For that reason, whilst there is undoubtedly extensive further ecological survey and assessment work required to inform a future planning application, there is no reason ecologically why this site cannot be allocated in CBC's emerging local plan given a legally and policy compliant scheme (ecologically) can be achieved.

This Executive Summary contains an overview of the key findings and conclusions. However, no reliance should be placed on any part of the executive summary until the whole of the report has been read.

1 Introduction

1.1 Overview

1.1.1 Stantec (formerly Peter Brett Associates) were instructed by JLL on behalf of the Defence Infrastructure Organisation (DIO) to provide technical consultancy services in relation to the proposed allocation of Middlewick Training Area, Colchester in Colchester Borough Council's (CBC) Emerging Local Plan (2017 -2033).

1.1.2 Specifically, Stantec were instructed to:

- complete ecological surveys sufficient to robustly inform the developable area and quantum of development within the proposed allocation boundary;
- inform preparation of an ecologically considered masterplan design;
- consult with CBC's Ecological Officer in relation to the proposed allocation, emerging proposals and mitigation designs;
- define the principles of ecological mitigation to enable legal and policy compliance for development defined by the site allocation;
- demonstrate that a net gain to biodiversity can be achieved from the proposals; and
- present the above in a combined evidence base for review by the Planning Inspector as part of the examination of CBC's Emerging Local Plan (2017 – 2033).

1.1.3 Stantec have been continuously working on this project since 2017.

1.2 Site Location and Setting

1.2.1 'Middlewick Ranges', hereinafter referred to as 'the Allocation Boundary', is located at to the south east of Colchester, Essex. The Allocation Boundary is centred on grid reference TM00982285. The Allocation Boundary, as shown on **Figure 1** comprises a total of approximately 83 ha, and is dominated by an operational small arms range complex. The Allocation Boundary also includes a woodland block on the western boundary which is aligned approximately north-south, and which separates the firing ranges from the residential development beyond. Elsewhere in the Allocation Boundary, to the north and east of the enclosed firing ranges is land which is currently open grassland, with a small number of remnant hedgerows demarking field boundaries. The Allocation Boundary is entirely owned by the Ministry of Defence (MOD), with the fencing around the firing ranges an artefact of security rather than land ownership.

1.2.2 South of the Allocation Boundary is the remainder of the woodland belt which lies broadly east – west and which supports Birch Brook. Further south of the Allocation Boundary is dominated by agricultural land and woodland (Donyland Woods) with Abberton Reservoir located to the south west. The City of Colchester surrounds the Allocation Boundary to the west, north and north east. The River Colne Estuary is located to the east, beyond the built extents of Colchester. The River Colne is a prominent landscape feature to the south east of the Allocation Boundary.

1.2.3 Land parcel terminology is further defined in **Section 3** below to enable accurate and consistent referencing of land within the wider landscape for the purposes of the remainder of this report.

1.3 Strategic (Military) Background

1.3.1 The Ministry of Defence's (MoD) 'A Better Defence Estate' (2016) defined the strategic intent to dispose of Middlewick Range's 'small arms ranges' and re-provision at Fingringhoe. A planning application for the *"construction of 2 No. 600 metre Firing Ranges with eight-metre high stop-butts and facilities, 2 No. control buildings, 1 No. range support building, together with associated demolition and site clearance work, access, turning areas, parking areas, drainage and associated infrastructure, and to enable the operation of the Ranges to extend the Range Danger Area to the MOD freehold boundary at Fingringhoe which will include an intensification of the usage of the Range Danger Area"* has been consented (Colchester Borough Council Planning Application Reference 181189), and it is understood these upgraded facilities are under construction, with the intent for the active use of Middlewick Ranges to transfer fully to Fingringhoe later in 2020.

1.3.2 The MoD's *A Better Defence Estate* also states that the additional proceeds from implementation of the strategy (i.e. that defined in *A Better Defence Estate*) will be re-invested in the estate over the next 10 years; in short, the sales receipts from development of Middlewick Ranges is required to re-invest in defence infrastructure.

1.4 Project Background

1.4.1 In accordance with the MoD's *A Better Defence Estate*, the DIO have promoted inclusion of Middlewick Ranges in the Emerging Local Plan as a strategic housing allocation – refer to **Section 1.5** below for the Policy wording in the Emerging Local Plan.

1.4.2 Over the project's duration, there have been a number of delays to the examination (and subsequent adoption) of CBC's Emerging Local Plan; this has resulted in a change of strategic intent at key stages in the project, as the disposal date for the ranges has neared. Specifically, there was a time in autumn 2018 when the project team decided to commence preparation for a planning application, rather than allocation. Whilst the difference in the baseline information required to support an allocation in the local plan, and a planning application is discussed in greater detail below (**Section 1.6**), the change in strategic intent for the project has meant that planning application level surveys were commenced, and aborted part way through, before the strategic intent reverted back to allocation. The methods and results of the started, and then aborted planning application level surveys are presented in this report as baseline information to support the allocation; this has been done for completeness and to provide additional context.

1.5 Colchester Borough Council Local Plan Housing Allocation

1.5.1 CBC's Emerging Local Plan (publication draft, June 2017) contains Policy SC2: Middlewick Ranges. This policy states:

"The allocation shown on the Policies Map is expected to deliver approximately 1000 new dwellings. The final number of dwellings will only be confirmed when full details of constraints are known…development will be supported on land within the area identified on the policies map which provides:

i. Up to 1000 new houses of a mix and type of housing to be compatible with surrounding development;

ii. Access and highway works on the local road network, including new junctions, to be agreed with The Highway Authority and delivered at the appropriate time commensurate with the development;

iii. *Detailed ecological surveys and appropriate mitigation to enhance the ecology of the remaining areas of the Local Site including the provision of compensatory habitat to replace habitat lost to development;*

iv. *Strategic areas of public open space;*

v. *Delivery of enhancements to sustainable travel connectivity including public transport, cycling and walking infrastructure;*

vi. *Mitigation measures to address site contamination; and*

vii. *Provision for retention or diversion of any existing public rights of way within the site.*

A masterplan will be required to inform the detailed definition and mix of uses within the site."

1.5.2 As identified within the policy wording, and the surrounding preamble within the publication draft of the Emerging Local Plan, the Allocation Boundary includes land designated as Local Wildlife Sites (LWSs). The policy also specifically identifies the need for compensatory habitat to replace the LWS habitat lost to development. These aspects are considered in detail in the later sections of this report.

1.6 Evidence Base Aims and Objectives

1.6.1 The aims of this collated evidence base are:

- Summarise the policy and legislative drivers for ecological consideration of the acceptability of a strategic housing allocation at Middlewick Ranges;
- Detail the methodology of ecological surveys completed within the Allocation Boundary (or wider area);
- Present the results of the ecological surveys completed within the Allocation Boundary (or wider area);
- Interpret the results of the ecological surveys to define the 'key' ecological considerations using geographic frames of reference, and with reference to the policy and legislative drivers (see above);
- Define an ecologically viable developable area, based on the results of the surveys (i.e. considering 'key' ecological considerations only, relevant to this stage of the project);
- Appraise the proposed masterplan with reference to the 'key' ecological considerations with reference to the policy and legislative drivers; and
- Demonstrate how a net gain to biodiversity can be achieved using land within the MOD's ownership (evidencing this with a metric).

1.6.2 The structure of this evidence base is defined in **Section 1.7** below.

1.6.3 It should also be noted that the level of ecological survey effort required in support of an allocation (be that housing, or for other use types) is generally to a lower level than that required to underpin a planning application. The allocation test is essentially about the realistic deliverability of the site in a way that is commercially and technically viable. Hence, the work to support an allocation is required to determine whether development at a given site, of the quantum and nature that would be proposed in a policy is ecologically viable (i.e. the resulting impacts on ecological features can be appropriately avoided, mitigated or compensated for). In

broad terms this requires consideration of whether there are any 'key' considerations to the proposals. A key consideration would be something which would affect the developable area, or which would render the proposals non-compliant with policy or legislation (after the application of the mitigation hierarchy), or which would be so extensive as to render the site unviable in a commercial context.

1.6.4 This distinction in survey and evidence requirements for an allocation (vs an application) is reflected in guidance. **Paragraphs 1.6.5** and **1.6.6** summarise the requirements for an allocation and application respectively, with **Paragraph 1.6.7** below confirming the overall aim of this evidence base.

1.6.5 The Chartered Institute of Ecology and Environmental Management (CIEEM)'s Guidelines for Preliminary Ecological Appraisal (PEA) (December 2017[1]) state that "*A PEA can also be used to inform, for example…an assessment as to whether a particular site should be included as an **allocated site in a development plan**…".* Separately, CIEEM's Guide to Ecological Surveys and their purpose' (December 2017[2]) states that a PEA is *"A rapid assessment of the ecological features present, or potentially present, within a site or the surrounding area (within the Zone of Influence for a proposed project). It normally comprises a desk study and a walkover survey, such as an Extended Phase 1 Habitat Survey. A PEA can be undertaken in a variety of contexts, often as a preliminary assessment of likely impacts of a development project. It can help the project proposer and planning authority in scoping the subsequent EcIA or in concluding that ecological issues will not be significant in determining the application and no further survey work is required (see CIEEM's Guidelines on Preliminary Ecological Appraisal). The results of the PEA can be provided in a PEA Report (PEAR)."* The scope of the survey work to inform the allocation of Middlewick Ranges is necessarily more fulsome than a PEA.

1.6.6 Comparatively, case law (Woolly Ruling and Cornwall Judgement) has established the need for relevant baseline surveys to inform the determination of a planning application by a local authority. Depending on the nature of a site's development proposals, an **Environmental** Impact Assessment (**EIA**) may be required to inform the determination of a planning application. Regardless of whether an EIA is required, an **Ecological** Impact Assessment (**EcIA**) would be required to assess the impacts of a planning application at Middlewick Ranges. The EcIA would either be standalone (if no EIA was required) or form part of the EIA. An EcIA is defined by CIEEM as *"An assessment of the likely significant ecological effects of a project, irrespective of the scale or type of project"* (CIEEM, 2017b).

1.6.7 For clarity, the evidence base provided in this report relates only to the allocation of Middlewick Ranges in CBC's Emerging Local Plan; and whilst it is comprehensive in the context of Local Plan evidence, it does not purport to contain sufficient information to determine a planning application. This evidence base, and its subsequent review as part of the Local Plan process at Examination in Public (EiP) to inform the site allocation in the Emerging Local Plan is based on the knowledge that determination of a future planning application would need to be informed by an EcIA, which in turn will need to be informed by:

- The results of full baseline ecological surveys (building on the work completed to date to inform the site allocation);
- Final development proposals;
- Mitigation strategies for all the pertinent ecological features.

[1] 'CIEEM, 2017a': https://cieem.net/wp-content/uploads/2019/02/Guidelines-for-Preliminary-Ecological-Appraisal-Jan2018-1.pdf

[2] 'CIEEM, 2017b': https://cieem.net/wp-content/uploads/2019/02/Guide-to-Ecological-Surveys-and-Their-Purpose-Dec2017.pdf

1.7 Evidence Base Structure:

1.7.1 To address all key requirements of this evidence base, the remainder of this document has been structured as follows, supported by Figures and Appendices where required:

- Policy and Legislation
- Methodology
- Results
- Evaluation
- Masterplan
- Net Gain for Biodiversity – Mitigation Strategy
- Conclusion

2 Policy and Legislation

2.1 Overview

2.1.1 This section defines the policy and legislative drivers pertinent to ecological consideration of the allocation of Middlewick Ranges in the emerging CBC Local Plan.

2.1 Legislative Drivers[3]

Conservation of Habitats and Species Regulations 2017

2.1.1 The Conservation of Habitats and Species Regulations transpose the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ("The Habitats Directive") into law.

2.1.2 The 2017 Regulations consolidate the various amendments made to the Conservation (Natural Habitats, &c.) Regulations 1994 in respect of England and Wales. The regulations provide for:

- Designation and protection of European Sites (Special Protection Areas (SPA) and Special Areas of Conservation (SAC)) including the need for Appropriate Assessment of plans and proposals;
- Protection of European protected species;
- Public body duties in relation to wild bird habitat

2.1.3 It should be noted that whilst this legislation is relevant to the proposed allocation of Middlewick Ranges, this is primarily in relation to European designated sites, and the 'concept' of acceptable development in relation to protected species and wild bird habitats. Detailed consideration in relation to European protected species would be expected at the planning application stage, with any site works which could affect such species or their habitat needing to be licensed by Natural England prior to commencement.

The Wildlife and Countryside Act, 1981 (as amended)

2.1.4 The Wildlife and Countryside Act places a general duty on statutory bodies to take reasonable steps to further the conservation and enhancement of the special features of Sites of Special Scientific Interest (SSSIs). It should be noted there are no SSSIs within the Allocation Boundary, however this is of relevance to the nearby Roman River SSSI which is owned by the MOD.

[3] Note that a number of Government Bills (ie a proposal for new law or change to existing law), to include the 'Environment Bill' and the 'Bat Habitats Regulations Bill' are being considered by a Public Bill Committee (at the time of writing (Environment Bill) or scheduled for debate following objection at the second reading (Bat Habitats Regulations Bill). Given at the current time, these Bills have not been passed by Parliament; they are not considered statute. The Environment Bill is summarised on parliament.co.uk as *"A Bill to make provision about targets, plans and policies for improving the natural environment; for statements and reports about environmental protection; for the Office for Environmental Protection; about waste and resource efficiency; about air quality; for the recall of products that fail to meet environmental standards; about water; about nature and biodiversity; for conservation covenants; about the regulation of chemicals; and for connected purposes."*. It is anticipated that Biodiversity Net Gain will be mandated in this Bill, however until it becomes statute it is not appropriate to comment on the contents. The Bat Habitats Regulations Bill is similarly described as *"A Bill to make provision to limit the protection for bat habitats in the built environment where the presence of bats has a significant adverse impact upon the users of buildings; and for connected purposes."*

2.1.5 The Wildlife and Countryside Act 1981 (as amended) (the Act) implements the Convention of European Wildlife and Natural Habitats (The Bern Convention) and the Directive 2009/147/EC 'The Birds Directive' and has been amended by the Countryside and Rights of Way (CROW) Act 2000.

2.1.6 Schedules 1 (birds) and 5 (animals) of the Act identify species of bird and other animal in relation to which the Act makes killing, injury, taking and disturbance an offence. Schedule 8 of the Act lists species of plant in relation to which the Act makes it an offence to intentionally pick, uproot or destroy.

2.1.7 Section 14(2) of the Act makes it an offence to cause any species of animal or plant listed in Schedule 9 of the Act to grow in the wild.

The Natural Environment and Rural Communities (NERC) Act, 2006

2.1.8 The NERC Act sets a duty on public bodies (including Local Authorities and the MOD/DIO) to have due regard for Habitats of Principal Importance (HPIs) and Species if Principal Importance (SPIs) for biodiversity in England when carrying out their duties. In this instance, this would include Colchester Borough Council during preparation of the Emerging Local Plan. Furthermore, the NERC Act places additional duties on statutory bodies to conserve / protect SSSIs (within the proper exercise of their function).

2.1.9 Section 41 (S41) the Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The list is used by decision-makers, such as Local Authorities, in implementing their protection duties under this Act when carrying out their functions.

2.2 Planning Policy Drivers

2.3 National Planning Policy Framework

2.3.1 The National Planning Policy Framework (NPPF), published in February 2019, sets out the government's planning policies for England and how these are expected to be applied. The following NPPF policies (and their implementation) are pertinent to the ecological consideration of Middlewick Ranges in CBC's emerging Local Plan.

Sustainable Development

2.3.2 Paragraph 8 of the NPPF states: "Achieving sustainable development means that the planning system has three overarching objectives [economic; social and environmental], which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives)… an environmental objective – to contribute to **protecting and enhancing** our natural, built and historic environment; including making effective use of land, **helping to improve biodiversity**, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy"

Conserving and Enhancement of the Natural Environment

2.3.3 Section 15 of the NPPF relates to: Conserving and Enhancement the Natural Environment. Paragraph 170 states:

"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)

b) recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land, and of trees and woodland;

c) maintaining the character of the undeveloped coast, while improving public access to it where appropriate;

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;

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."

Paragraph 171 then states "Plans should: **distinguish between the hierarchy of** international, national and locally **designated sites**; **allocate land with the least environmental or amenity value**, where consistent with other policies in this Framework; take a **strategic approach to maintaining and enhancing networks of habitats and green infrastructure**; and plan for the **enhancement of natural capital** at a catchment or landscape scale across local authority boundaries".

Habitats and Biodiversity

2.3.4 Paragraph 174 of the NPPF states that:

"To protect and enhance biodiversity and geodiversity, plans should:

a. *Identify, map and **safeguard components** of **local wildlife-rich habitats and wider ecological networks**, including the hierarchy of international, national and locally designated sites of importance for biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation; and*

b. *promote the **conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species**; and identify and pursue opportunities for **securing measurable net gains for biodiversity**.*

2.3.5 Paragraph 175 of the NPPF relates to the determination of planning applications, not the preparation of plans or policies. Paragraph 176 is also not relevant to Middlewick Ranges, however Paragraph177 states:

"The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the habitats site."

2.4 Local Planning Policy

2.4.1 At a local level, at the time of writing (March 2020), the Colchester Borough Council Adopted Local Plan 2001 – 2021 remains the current point of reference for decision making in the Borough. Within this, policy ENV1 – Environment states that *"The Council will safeguard the Borough's biodiversity…through the protection and enhancement of sites of international, national, regional and local importance."* It also states that where new development within a 'rural location'[4] is proposed, it should demonstrably *"be in accord with national, regional and local policies for development within rural areas, including those for European and nationally designated areas; be appropriate in terms of its scale, siting, and design; protect, conserve or enhance landscape and townscape character, including maintaining settlement separation; protect, conserve or enhance the interests of natural and historic assets; apply a sequential approach to land at risk of fluvial or coastal flooding in line with the guidance of PPS25; protect habitats and species and conserve and enhance the biodiversity of the Borough; and . provide for any necessary mitigating or compensatory measures."*

2.4.2 Given however the Emerging Local Plan may be adopted by the time this evidence base is considered, and to ensure a robust approach is taken to defining the policy drivers for the consideration of the site allocation, the Emerging Local Plan Part 1 Policy wording has also been considered. Policy ENV1 of the Emerging Local Plan is included in **Appendix A** due to it's length, however of most relevance to allocation level decisions (rather than application level decisions) states *""The Local Planning Authority will conserve and enhance Colchester's natural and historic environment, countryside and coastline. The Local Planning Authority will safeguard the Borough's biodiversity, geology, history and archaeology, which help define the landscape character of the Borough, through the protection and enhancement of sites of international, national, regional and local importance."*

2.4.3 Policy ENV2 relates to Coastal Areas, Policy ENV3 relates to Green Infrastructure with a focus on accessibility to green areas within the borough rather than an ecological or biodiversity focus, Policies ENV4 and ENV5 relate to Dedham Vale Area of Outstanding Natural Beauty, and Pollution and Contaminated Land. None of Policies ENV2 to ENV5 are considered relevant this evidence base.

2.5 Local Initiatives

Colchester Green Committee

2.5.1 The Colchester Green Committee (Environment and Sustainability Panel) meeting held on 17th September 2020 included a section on the Climate Emergency: One Year On. This presentation, as part of the meeting, provided an update on Colchester's Climate Emergence Response projects / commitments. Of relevance to biodiversity, this includes reference to:

- **Planning and Climate Change:** Providing green space around developments, protecting biodiversity;
- **Greening**: requiring developers to provide a Canopy Cover Assessment for major applications, increase use of Tree Preservation Orders (TPOs) on allocated sites to safeguard canopy cover, encourage green roofs and green walls;
- **Biodiversity**: LPA to produce guidance on measurable biodiversity net gain measures and explore options for a long term, strategic measurable biodiversity net gain strategy similar to the Essex Coast RAMS;

[4] Referring to "Unallocated greenfield land outside of settlement boundaries"

- **Woodland Project (and biodiversity):** In October 2019, the Council announced its plan to plant 200,000 trees between 2020- 2024 as part of the Colchester Woodland Project. Ensuring there is a focus on increasing tree cover, whilst also protecting biodiversity;

- **Colchester Orbital:** can be incorporated into a climate emergency checklist which will be provided to developers. Also includes how to protecting biodiversity and incorporating with open spaces within housing developments, incorporate renewable energy alternatives within developments etc. The orbital is a 14/15 walking/cycling link around the borough. Discussions around how to develop these in the future and how they can be 'greened' in the future whilst being beneficial to biodiversity and be visually attractive.

3 Methodology

3.1 Overview

3.1.1 This section provides a high-level summary of the ecological surveys presented in this evidence base report. The full survey methodologies are provided in **Appendix B**.

3.2 Survey Areas

3.2.1 The spatial extent of surveys varied depending upon the type of survey; **Figure 2** shows the below described areas which are referenced later in this report on multiple occasions:

- Partly or completely within the Allocation Boundary:
  - Allocation Boundary;
  - Middlewick Ranges LWS;
  - Birch Brook LWS;
- Outside the Allocation Boundary:
  - Land to the south of Birch Brook, north of Weir Lane;
  - Mitigation Land;
  - North of Birch Brook, Outside of Allocation Boundary; and
  - Donyland Woods.

3.3 Survey Types

3.3.1 **Table 1** below shows the ecological survey types completed , noting that some surveys (notably items 7, 8, 11 and 12) were commenced when a preparation for a planning application submission was the strategic intent for the project. As discussed in **Section 1.4** above, whilst these surveys were aborted prior to completion, the methods and results are still presented in this evidence base for context.

3.3.2 The survey area for each survey type is shown on the relevant results figures and discussed later in this evidence base

Table 1: Summary of Ecological Survey Types, Aims and Dates

Item	Survey Title	Aim	Survey Date
	Desk Study Data		
1	Desk Study (Freely Available Resources)	Understand designated site and notable habitat information within a 2km – 10km radius of the Allocation Boundary	May 2017, and March 2020
2	Essex Field Club	Understand existing site and species records for the Allocation Boundary and Mitigation Land (as far south as Weir Lane) and 2km radius	March 2017
2	Essex Wildlife Trust		May 2019

Item	Survey Title	Aim	Survey Date
3	British Trust for Ornithology	Understand existing nightingale data in four tetrads relating to the Allocation Boundary and surrounding area	Received May 2019
	Habitat Surveys / Appraisals		
4	Extended Phase 1 Habitat survey	To map habitats present within the Allocation Boundary and Mitigation Land as far south as Weir Lane	May 2017
5	Botanical Survey	To better understand botanical value of grasslands within the Allocation Boundary and Mitigation Land as far south as Weir Lane	June 2018
6	Extended Phase 1 Habitat Survey	To confirm the mapped status of habitats from 2017 and 2018 surveys remains representative. The survey covered the Allocation Boundary and Mitigation Land (to its full extent, south of Weir Lane)	March 2020
	Species Surveys / Appraisals		
7	Dormouse (*Muscardinus avellanarius*) Nut Search	Search for evidence of foraging hazel dormice (within suitable habitat)	October 2018
8	Riparian Mammals Survey	Search for signs of otter (and other riparian mammals) along Birch Brook	October 2018
9	Habitat Appraisal: Suitability for Terrestrial Invertebrates	Appraisal of the relative value of the habitats within the Allocation Boundary and the remaining land within the Invertebrate Survey Area.	June 2019
10	Habitat Appraisal: Suitability for Breeding Birds	Gather information on the potential of the habitats present Allocation Boundary and Mitigation Land (as far south as Weir Land), to support breeding bird species, including species of conservation concern.	January 2019
11	Bat Activity Survey	Understand the species distribution, relative activity levels of foraging and commuting bats within the Allocation Boundary and Mitigation Land as far south as Birch Brook.	September – October 2018
12	Bat Hibernation Survey	Collect bat droppings for DNA analysis; record suitability for hibernating bats over the winter period; and complete automated static detector survey of the Marker's Gallery, to record any bat echolocation calls within the structure.	December 2018 – February 2019
13	Habitat Appraisal: Suitability for Bat Foraging and Roosting	Appraisal to gather information on the potential of the habitats present to support bat species, particularly the barbastelle bat *Barbastella barbastellus*; a rare woodland species.	January 2019
14	Advanced Survey Techniques: Bat Trapping and Tracking	Investigate the status of barbastelle and other tree-roosting bats (e.g. *Myotis* and possibly *Nyctalus*) in the zone of influence of the proposed housing scheme(s), with an emphasis on woodland habitat and treelines during the 2019 bat active period (May – September). Radio-track key individuals using the Allocation Boundary or Birch Brook to locate breeding colonies of barbastelle and other tree-roosting	June, August and September 2019

Item	Survey Title	Aim	Survey Date
		bats and to determine activity patterns and habitat use.	
	Intrusive Sampling		
16	Soil Sampling	Determine basic soil chemistry of land within the Mitigation Land (extending south of Weir Lane) in comparison to the Firing Ranges.	January 2020

3.4 Survey Personnel

3.4.1 The above surveys have been completed by experienced professional ecologists; full details of personnel have been provided in **Appendix B**. The surveys have also been planned and coordinated by Stantec, with deliverables reviewed by at least two of the following key team members, and Dr Stuart Otway:

- **Rebecca Strawbridge (nee Blamey)**: Associate Ecologist at Stantec (formerly Peter Brett Associates). Rebecca is an Associate Member of the Chartered Institute for Ecology and Environmental Management (CIEEM) and as such is subject to a professional code of conduct and peer review. Rebecca has over 8 years experience in ecology consultancy, and holds an MA from the University of Cambridge (Natural Sciences), and a MSc from the University of Reading (Wildlife Management and Conservation). Rebecca has been the ecological lead on this project since 2017, and has supported the scoping, delivery, review and interpretation of all surveys. She has a good understanding of the legal and planning framework driving guiding planning and development work with respect to ecology, has experience in both public and private sector projects, including local plan representation, pre-planning survey and assessment work, through to condition discharge and supporting site clearance, construction or management.

- **Duncan McLaughlin:** Associate Ecologist at Stantec (formerly Peter Brett Associates). Duncan is a full member of CIEEM, and a Chartered Environmentalist and is subject to a professional code of conduct and peer review. Duncan has over fourteen years of experience relating to biodiversity issues in the context of environmental impact assessment, development schemes and the land use planning system. He has worked with planners, developers and contractors at all project stages from optioneering/feasibility, through assessment to delivery. He holds various species survey and development licences, and is a specialist in ornithological survey design and impact assessment, as well as undertaking Habitats Regulations Assessments (HRAs) for infrastructure, flood defence, aviation and energy schemes. Duncan has overseen elements of Rebecca's work and reviewed technical deliverables.

- **Helen Evriviades:** Senior Associate Ecologist at Stantec (formerly Peter Brett Associates). Helen is a full member of CIEEM and is also subject to a professional code of conduct and peer review, and is a licensed bat worker; she also holds survey licences for dormouse and great crested newt. Helen has over 20 years' experience in ecological consultancy. She has significant experience working and leading on the ecological aspects of projects in housing, regeneration, renewables, road schemes and mineral extraction and takes pride in being clear on risks and providing practical and pragmatic advice which maximises value for our clients and biodiversity. She has worked with clients in both the public and private sectors, often working as part of large multi-disciplinary project teams. Helen leads and manages the delivery of ecological survey, mitigation and reporting, including the provision

of technical review and guidance, including for Ecological Impact Assessments and Habitats Regulations Assessments. Helen has overseen much of Rebecca's work and reviewed technical deliverables.

- **Elaine Richmond:** Director of Environmental Services at Stantec (formerly Peter Brett Associates). Elaine is a Chartered Ecologist, a Chartered Environmentalist, and a full member of CIEEM, and is also subject to a professional code of conduct and peer review. Elaine has over 20 years' environmental consultancy experience, with an in depth knowledge of ecological issues associated with infrastructure projects and land development schemes. Elaine recognises the importance of providing integrated and pragmatic solutions to allow effective project outcomes for clients, communities and the environment. Elaine has broad experience of dealing with linear infrastructure projects as well as providing environmental consultancy services associated with EcIAs for mixed-use and residential developments, extensive experience of stakeholder consultation and liaison. Elaine has led multi-disciplinary teams, completed and reviewed numerous EcIAs and Habitat Regulations Assessments, and has provided input to Development Consent Order (DCO) applications. She has acted at Expert Witness, most recently at the DCO Examination Hearing for Millbrook Power Plant and CPO hearing at Poynton Relief Road. Elaine has also overseen elements of Rebecca's work and reviewed technical deliverables.

- **Dr Stuart Otway:** Senior Ecologist at the Defence Infrastructure Organisation. Stuart is a Chartered Environmentalist and a full member of CIEEM. Stuart has 25 years' experience in EcIA, HRA, EIA, land management and ecological research, and leads on natural environment policy, guidance and standards for the MOD. Stuart acts as an independent technical reviewer of the ecological work which Stantec have been doing for JLL on behalf of the DIO.

3.5 Evaluation

3.5.1 The importance of ecological features have been evaluated with regard to CIEEM's Guidelines for Ecological Impact Assessment in the UK and Ireland (hereafter referred to as 'the CIEEM Guidelines') (CIEEM, 2018). The CIEEM Guidelines recommend that valuation of ecological features associated with a site is made with reference to a geographical framework, i.e. a feature may be of importance within the following context:

- International and European;
- National (England);
- Regional (south-east England);
- County (Essex);
- Borough (Colchester)
- District (South Colchester (Old Heath, Black Heath, Berechurch and Rowhedge)).

3.6 Consultation

3.6.1 As part of the preparation of this evidence base for the Local Plan Part 2, consultation with CBC's Ecologist has been completed in 2017 and 2018 (with Beverley McClean - Coast & Countryside Planner). Since Beverley's departure from the LPA, consultation in 2019 and 2020 has been completed with an Essex Ecology Services (EECOS) ecologist, Pat Hatch, providing the LPA Ecologist Role for CBC. Key things of note which have been discussed over the past 3 years with either Beverley or Pat include:

- Discussion and agreement of scope of survey to inform the Site's allocation within the Local Plan;
- Discussion of survey results;
- High level mitigation concepts;
- Consultation on masterplan designs and rationale;
- Review of draft versions of the ecological evidence base (2020);
- Discussion in relation to the use of Defra's Biodiversity Metric 2.0; and
- Review of and agreement to use a bespoke metric.

3.6.2 In response to the comments to the first review of the draft evidence base by Pat Hatch, the expert opinion in relation to one element of the mitigation strategy (specifically the creation of acid grassland) has been sought. The opinion of Dr Philip Putwain was therefore sought in September 2020 in relation to the proposed approach to the acid grassland creation proposed in later sections of this evidence base report. Dr Putwain's CV is contained in **Appendix M**, which details his extensive academic research and practical experience in plant ecology, ecological restoration and land regeneration. He has c. 125 mainly peer reviewed and other published conference papers, and >100 commission reports to national government, local authorities, government organisations, civil engineering and industrial companies. His experience includes acid grassland and heathland creation on several projects in the UK. A copy of Dr Putwain's opinion on the strategy is also contained in **Appendix M** and referenced as appropriate in the relevant section of this evidence base.

4 Results

4.1 Overview

4.1.1 This section of the evidence base provides the results of the desk study and field surveys; the results in the main body of the report are kept at a high level, with greater detail provided in Appendices. An indication of the value of each ecological feature (where there is sufficient information and it is appropriate to do so) is given in the relevant section, with **Section 5** then summarising the value of the key ecological considerations pertinent to the allocation of Middlewick Ranges.

4.2 Designated Areas for Nature Conservation

Internationally Designated Areas

4.2.1 Four designated areas for nature conservation of international importance were identified within 10 km of the Allocation Boundary; the full designation criteria for each of these are included in **Appendix C**, and the areas are shown on **Figure 3**:

- **Abberton Reservoir Ramsar Site and Special Protection Area** (SPA) (located 2.71 km south west of the Allocation Boundary). These areas are designated for the bird populations (primarily waders and wildfowl) the habitats support, including both the overwintering, spring and autumn peak counts, and breeding bird counts;
- **Colne Estuary (Mid-Essex Coast Phase 2) Ramsar Site and SPA** (located 3.28 km south east of the Allocation Boundary)**.** These areas are designated for saltmarsh habitat, nationally scarce plants and important bird assemblages (primarily peak counts during breeding and overwintering of waders and waterfowl);
- **Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar Site and SPA** (6.23 km south of the Allocation Boundary). These areas are also designated for the saltmarsh habitat, invertebrate fauna, overwintering and breeding bird (primarily peak counts of waders and waterfowl); and
- **Essex Estuaries Special Area of Conservation (SAC)** (3.28 km south east of the Allocation Boundary). This area is designated for estuaries, mudflats and sandflats, mud and sand colonising species, spartina swards, salt meadows and halophilous scrubs with sandbanks as a supporting feature.

4.2.2 The designated sites listed above are all considered to be of value at the International level, when considered using the geographic frames of reference defined within the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland (September 2018).

Nationally Designated Areas

4.2.3 Two statutory designated Sites of Special Scientific Interest (SSSI) and two Local Nature Reserves (LNRs), were identified by the MAGIC search within 2 km of the Allocation Boundary. These include:

- **Roman River SSSI** is located c. 0.7km south of the Allocation Boundary also with a second parcel to the south west. This SSSI supports a complex mosaic of woodland, scrub, heath, grassland and fen as well as unimproved acid grassland, which together supports a diverse population of breeding birds (including nightingale *Luscinia megarhynchos*), butterflies and moths.

- **Upper Colne Marshes SSSI** is located c. 0.61km to the east of the Allocation Boundary, to the west of Rowhenge Road. This SSSI supports a series of marshes on the sides of the Roman River and River Colne. The SSSI includes a variety of notable intertidal habitats, and well as those with aquatic influence (such as grazing marshes). The SSSI has botanical, invertebrate and bird interest.

- **Colne Local Nature Reserve (LNR)** is located to the east of the Colne River, c. 1.39km east of the Allocation Boundary. It comprises Wivenhoe Woods; Ferry Marsh and Lower Lodge Farm. The LNR supports a range of habitats, which then support reptiles, otter *Lutra lutra*, water vole *Arvicola amphibious*, birds, plants and aquatic invertebrates.

- **Salary Brook LNR** is located to the north of the A133, approximately 1.89 km north east of the Allocation Boundary. The LNR is a river valley which includes rough grassland, scrub, woodland and emergent vegetation with marshy and wet grassland which in combination are of importance for plants, reptiles, birds, water voles and bats.

4.2.4 The designated sites listed above are all considered to be of value at the between the National level (SSSI) and County level (LNR), when considered using the geographic frames of reference defined within the CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland (September 2018).

4.2.5 The Allocation Boundary falls within several Natural England SSSI Impact Risk Zones (IRZs) as shown on the MAGIC website and **Figure 4,** and which likely relate to Roman River and Upper Colne Marshes SSSIs. IRZs detail criteria for developments which should be subject to consultation with Natural England with regards to potential impacts on SSSIs. It should be noted that developments which exceed the thresholds are not prohibited, but require consultation with Natural England. The criteria of relevance to the Allocation Boundary and its future development include:

- Residential: Residential development of 100 units or more.

- Rural Residential: Any residential development of 50 or more houses outside existing settlements/urban areas.

- Discharges: Any discharge of water or liquid waste of more than 2m³/day to ground (i.e. to seep away) or to surface water, such as a beck or stream (NB This does not include discharges to mains sewer which are unlikely to pose a risk at this location).

4.2.6 For the purposes of the allocation, only the Roman River SSSI is considered to be a key ecological consideration; this is due to the proximity of the SSSI to the Mitigation Land, and the functional link to habitats within the Allocation Boundary. Whilst the Upper Colne Marshes are geographically closer, they are separated from the Allocation Boundary by existing built development including residential development. It is considered likely that considerations relevant to the Upper Colne Marshes will include discharge, and recreational impacts; both of which could affect LWS closer to the Allocation Boundary, and the SSSI which is functionally linked to the Allocation Boundary. For that reason, only Roman River SSSI is considered to be a key ecological consideration for the purposes of Allocation; further explanation is provided in **Section 5** (and **Appendix K**).

Non-statutory Designated Areas

4.2.7 Two non-statutory designated Local Wildlife Sites (LWSs) are present within the Allocation Boundary, these are also shown on **Figure 5**:

i. **The Middlewick Ranges LWS (Co122)**[5] is 76ha in size, spans the Allocation Boundary, and land immediately south. This LWS is designated for its acid grassland, scrub and sandy bank habitats which support populations of notable invertebrates. The invertebrate records noted in the citation include seven nationally threatened (Red Data Book) and eight Nationally Scarce hymenopteran (bees, ants and wasps) species and was the last known site for the grayling butterfly *Hipparchia semele* in Essex. The most significant species are the SPI digger wasps *Cerceris quadricincta* (RDB1) and *Cerceris quinquefasciata* (RDB3), the latter's brood-parasite cuckoo-wasp *Hedychrum niemelai* (RDB3) and the Small Blue Carpenter-bee *Ceratina cyanea* (RDB3). Some of the short-mown sandy banks bordering the range roads support a large population of the RDB2 Bee-wolf (*Philanthus triangulum*).

ii. **Birch Brook Wood LWS (C0128)** is 30.5ha and lies partially within the Allocation Boundary and extends beyond. This LWS supports stream valley woodland, which includes dry pedunculate oak *Quercus robur* woodland on the higher, dryer ground and willow *Salix spp.* and birch *Betula pendula* woodland on lower, wetter ground. The woodland to the east (Birch Grove) is more indicative (from the flora) of ancient origins, with the remainder (western areas) comprising secondary woodland. The woodland ground fauna is rich in ferns and supports ferns on the Essex red data list. The LWS also encompasses occasional dry acid grassland and scrub around the redoubt.

4.2.8 A further six LWSs were identified within 1 km of the Allocation Boundary, 14 between 1km and the 2km of the Allocation Boundary, and 3 beyond the 2km radius[6]; these are summarised within **Appendix C**.

4.2.9 The LWSs listed above are all considered to be of value of up to the County level, when considered using the geographic frames of reference defined within the CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland (September 2018).

4.2.10 Both Middlewick Ranges and Birch Brook LWS are considered to be key ecological considerations for the purpose of the allocation; further explanation is provided in **Section 5** (and **Appendix K**).

4.3 Habitats

Desk Study

4.3.1 The desk study identified several areas of semi-natural and replanted ancient woodland within 2 km of the Allocation Boundary. The closest of these was at Donyland Woods, approximately 1.28 km south of the Allocation Boundary or immediately south of the Mitigation Land. Additional ancient woodland was present at Friday Wood and Wivenhoe Wood to the south-west and south east of the Allocation Boundary respectively.

4.3.2 The desk study also identified a wide corridor of lowland deciduous woodland HPI within the Allocation Boundary (as shown on the MAGIC website), alongside Birch Brook, extending into the mitigation land to the south. Additional areas of this habitat were present in the wider 2km search radius.

4.3.3 The areas of ancient woodland and HPI within 2 km of the Allocation Boundary are shown on **Figure 6**.

[5] The Local Wildlife Sites within or adjacent to the Allocation boundary have been updated since the Colchester Wildlife Site Review 2015 (Essex Ecology Services, February 2016). Note that the boundaries on **Figure 5** have been updated for Co122 and Co128 only given these are the most relevant to this allocation. All other boundaries are as provided by Essex Wildlife Trust.

[6] Noting the data was originally purchased for the 2km radius of land as far south as Weir Lane.

4.3.4 The grasslands within the Allocation Boundary were not mapped on MAGIC as an HPI 'lowland dry acid grassland' nor as non-HPI 'good quality semi-improved grassland'.

Field Survey

4.3.5 This section summarises the habitats present within the Allocation Boundary, and the Mitigation Land, based on the results of the two extended Phase 1 habitat surveys (2017 and 2020) and the botanical survey. A number of habitats present within the Allocation Boundary and Mitigation Land likely qualify as Habitats of Principle Importance (HPI) based on the classification in the JNCC BAP Priority Habitat Descriptions (BRIG, 2008) or as Essex Biodiversity Action Plan habitats. These include:

- **Lowland mixed deciduous woodland HPI-** woodlands within the Allocation Boundary and Mitigation Land likely qualify as lowland mixed deciduous woodland as they were largely composed of dominant pedunculate oak stands with hazel *Corylus avellane* and bramble *Rubus fruticosus* understorey. Some of these areas are indicative of ancient woodland particularly around Birch Brook;

- **Wet woodland HPI**- woodlands immediately adjacent to Birch Brook which were dominated by alder *Alnus glutinosa* and ash *Fraxinus excelsior* likely qualify as wet woodland;

- **Lowland dry acid grassland HPI and Essex Priority**- regularly mown semi-improved acid grassland on the range floors that contains indicators such sheep's fescue *Festuca ovina*, and sheep's sorrel *Rumex acetosella* likely qualify as lowland dry acid grassland;

- **Rivers HPI and Essex Priority** - Birch Brook is likely to qualify under the criteria of a shingle river. This combined with the potential for it to support Species of Principle Importance (SPI) means it is likely to qualify under criteria Level B (widespread BAP species less dependent on river quality) such as otter, brown trout *Salmo trutta*, bullhead *Cottus gobio* and brook lamprey *Lampetra planeri* (although further survey will be required to confirm);

- **Hedgerows HPI and Essex Priority** - hedgerows within the Mitigation Land are composed of at least one UK native woody species with a number of both species-rich and species-poor hedgerows with trees, as such, they qualify as a HPI, with a proportion also likely to qualify as "Important" hedgerows under the Hedgerow Regulations.

4.3.6 Full habitat descriptions are provided in **Appendix D**, and shown on **Figure 7a** with the detailed results of the botanical survey also contained in **Appendix D** and shown on **Figure 7a**. The location of photographs shown in **Appendix D.4** are shown on **Figure 7b**.

4.3.7 The habitats within the Allocation Boundary are all considered to be of value of up to the County level, when considered using the geographic frames of reference defined within the CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland (September 2018). Both the mature broadleaved woodland and acid grassland are considered to be key ecological consideration for the purpose of the allocation; further explanation is provided in **Section 5** (and **Appendix K**).

4.4 Species

Dormice

4.4.1 One record of a hazel nut (apparently chewed by a hazel dormouse) was returned in the desk study from 2017, from within Birch Brook (300m south of the Allocation Boundary). A search for nuts was completed in 2018, and sought to confirm or otherwise the presence of hazel dormice from within Birch Brook. No nuts which had been chewed by hazel dormice were

found during the nut search. Full results, including a summary of the legal and policy protection are provided in **Appendix E,** and location of survey areas shown on **Figure 8.**

4.4.2 It should be noted that this survey type (hazel nut search) was completed as a rapid way of potentially replicating the positive desk study record from 2017, to confirm whether dormice are present in Birch Brook (i.e. to verify the earlier desk study record). A nut search is not a full presence / likely absence survey, and does not purport to be one. Furthermore, this species can also occur in scrub and hedgerow habitats where hazel growth was absent.

4.4.3 This survey result neither confirms the presence of hazel dormice within Birch Brook woodland, nor does it indicate likely absence of this species.

4.4.4 The potential presence of hazel dormice within suitable habitat within the Allocation Boundary and the immediate vicinity does not require detailed consideration for the purposes of Allocation, as it is not considered to be a 'key' consideration (refer to **Section 5**). Further explanation is provided in **Section 5** (and **Appendix K**) in this regard.

Riparian Mammals

4.4.5 The full desk study, and field survey results relating to otter are included in **Appendix F** alongside a summary of the legal protection afforded to riparian mammals, with the survey area and results shown on **Figure 9.**

4.4.6 No evidence of otter was found during the field survey. Birch Brook is considered to be too shallow, with limited food resources to enable otter to regularly use the Brook, however occasional foraging and commuting and sheltering is possible. Given the lack of connectivity of the Birch Brook to other river networks, the value of this stretch to landscape scale connectivity of otter is limited. The River Colne (where records of otter do exist) provides far superior habitat for this species.

4.4.7 The watercourse is unsuitable for water vole (for further detail refer to **Appendix F**).

4.4.8 Riparian mammals are not considered to be a pertinent consideration to the Allocation. Further explanation is provided in **Section 5** (and **Appendix K**) in this regard.

Invertebrates

4.4.9 The desk study enabled consideration of important invertebrate habitat connections in the wider landscape; these are shown on **Figure 10.** The desk study and field survey enabled the Allocation Boundary, and land as far south as Weir Lane to be categorised with respect to their value to terrestrial invertebrates. The value of the grassland and open mosaic habitats within the invertebrate survey area (i.e. excluding Birch Brook Woodland and Hedgerows) can be placed into three categories higher, moderate and lower potential value (as shown on **Figure 11**). Full results are contained within **Appendix G.**

4.4.10 With reference to the Table in **Appendix G.7** and **Figure 11**, the habitat mosaics immediately north and south of Compartment A are considered to be the highest value to terrestrial invertebrates, as they provide a range of features such as bare ground, structurally complex (heterogeneous) vegetation likely to support a range of invertebrate fauna, including taxa known to be present within the wider Middlewick Ranges LWS including the previously recorded solitary bees and wasps. Of these two areas, the habitat mosaic to the south of the firing ranges is considered to be most important, due to its greater extent and that it occurs in close proximity to the higher value woodland along the Birch Brook Corridor.

4.4.11 The most spatially extensive habitat within the Middlewick Ranges LWS is the lowland acid grassland (compartments A and B) and taller grassland swards (Compartments C to F). Whilst there is botanical variation in habitat quality (refer to **Appendix E**), each of these grassland

areas is important both due to their extensive nature, and the supporting role they are likely to provide to the higher value mosaic habitats. For example, many invertebrate species are likely to be reliant on the habitat mosaics for breeding and foraging during the spring and summer but will also require the taller swards and ruderal vegetation for overwintering or seeking shade during periods of drier weather conditions. It is on this basis that all open grassland in the north of the Invertebrate Survey Area is considered to be uniformly of moderate value for terrestrial invertebrates.

4.4.12 The relatively species-poor grasslands, including that to the south of Birch Brook, and in the eastern extent of the Invertebrate Survey Area are of lower interest for terrestrial invertebrates (i.e. compartments G and I). This is largely based on their management (land to the South of Birch Brook) or homogeneity.

4.4.13 The Birch Brook LWS is functionally connected to the Roman River SSSI via the network of hedgerows within the land to the south of Birch Brook. To the north of the Birch Brook LWS, wooded habitat extends into the habitat mosaics, thus there is the potential for invertebrate species and assemblages dependent on trees and shrubs, particularly phytophagous species ('vegetation eating') to move between the two locations. The tree and woodland network is therefore of moderate value to terrestrial invertebrates as a result of the connecting and sheltering habitat they provide.

4.4.14 The areas of highest value for terrestrial invertebrates are the areas immediately north and south of the ranges; of these the southern area is of greater value to size and complexity (i.e. H1 and H2). The expansive grasslands across the area north of Birch Brook, though variable, all contribute to its nature conservation value. The relationship between these open-habitats, and the Birch Brook woodland corridor, particularly the ecocline between the grasslands and woodland edge are also a contributing factor.

4.4.15 It is not considered appropriate, or possible, to accurately assign a relative value of the Invertebrate Survey Area or Allocation Boundary to terrestrial invertebrates using the geographic frames of reference defined within CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland (September 2018). This is because the level of survey work completed for the Invertebrate Survey Area was purposely scoped to inform consideration at the Local Plan level, rather than at the planning application level, and would be a speculative exercise if done at this early stage.

4.4.16 For the purposes of determining whether the terrestrial invertebrate assemblage is a key consideration for the allocation, the professional opinion of the entomologist is that the invertebrate community present within land to the north of Birch Brook is likely to be of at least County nature conservation value, but may be higher based on the results of the detailed survey work which would be expected to support a planning application.

4.4.17 Note, no consideration has been given to the aquatic invertebrate assemblage within Birch Brook for the purposes of this project stage (allocation). This is on the basis of consideration of habitats likely to be directly affected by development proposals at Middlewick Ranges, and based on the noted criteria within the LWS citation for Birch Brook (which do not include aquatic invertebrates). More detailed consideration may need to be given to this species group at a later project stage (e.g. application), however this would depend upon the development proposal extent and quantum, and to be agreed at a later date with the LPA Ecologist. For the purposes of the allocation, the potential for a diverse aquatic invertebrate assemblage within the Birch Brook is not a key consideration.

Breeding Birds

4.4.18 The desk study results are provided in **Appendix H**, alongside information on the legislative and policy protection breeding birds receive.

4.4.19 Results of the field survey appraising the broad habitat types and the potential bird species/assemblage they may support are shown on **Figures 12 - 15** with labels on **Figure 2** for reference. A commentary for the breeding bird habitat appraisal survey area as a whole is provided in **Appendix H**, divided into spatial areas. Throughout this section of the evidence base (including **Appendix H**), the species mentioned are those thought to represent the likely species which could be found in similar habitat at the same geographical location. The presence or absence of specific species would need to be established via full survey in the breeding season (i.e. at the planning application stage). These species (and others) may or may not occur, but possible presence is considered based on the habitats present, the geographical location of the Allocation Boundary and remainder of the breeding bird habitat appraisal area, and the professional experience of the surveyor.

4.4.20 The open area of the ranges is likely to be of some value to foraging bird species associated with open ground (due to daily firing and mowing to 100mm every 3 weeks through the bird breeding season), and of moderate value to ground nesting species (likely limited to the edge of the ranges, where the cutting regime is less intense). The open area of the ranges is of low or negligible value to birds associated with scrub and tree cover. As a result, the overall diversity and abundance of species here would be expected to be lower (but likely to include species of conservation concern). The central woodland area (Birch Brook) would likely support the greatest diversity of species, as it has potential for generalist and woodland specialist birds. However, the woodland is of negligible value to ground nesting species. The land to the south of Birch Brook woodland (north of Weir Lane), as well as the mosaic of grassland, scrub and hedgerows to the east of the ranges, has some potential for ground nesting species, but this is generally lower than the ranges themselves. However, these areas around the ranges do have value to generalist species as well as species such as woodland specialists where mature cover is present. As a result, these areas would be expected to support at least a moderate diversity of bird species in the breeding season. Land outside the ranges (particularly open grassland areas) is subject to public use, which may affect the number and types of bird species present.

4.4.21 Overall, habitats within the breeding bird habitat appraisal survey area are likely to support a range of bird species during the breeding season. However, the types of species and species diversity would likely vary across the area based on habitats present. The ranges themselves could support some foraging species of conservation concern (e.g. skylark *Alauda arvensis*) although overall breeding success, abundance and species diversity is likely to be low due to the homogenous nature of the grassland within the ranges, the regular mowing, and the current use (for firing). In practice, successful breeding of ground nesting species is likely to be limited to the periphery of the firing ranges. Other parts of the breeding bird habitat appraisal survey area are likely to support a greater range of species (e.g. the more established woodland).

4.4.22 The BTO data supplied identified 58 nightingale territories from the 2012 surveys in the four tetrads requested. Based on the results of the national nightingale survey in 2012, the BTO estimated a mean UK population size of 5,542 territories. The total number of territories within the four tetrads analysed (58 territories) therefore represents just over 1% of this population (1.04%). The 19 territories within the Allocation Boundary and land in the remainder of the breeding bird habitat appraisal survey area, represents approximately 0.34% of the 2012 UK population estimate. This suggests the local area including breeding bird habitat appraisal survey area is of value to nightingale. Of the 19 territories within the Allocation Boundary and breeding bird habitat appraisal survey area, there are 6 territories within the Allocation Boundary; this equates to 0.1% of the 2012 UK population estimate. All territories are located in the southern part of the Allocation Boundary; i.e. the mosaic habitat at the south of the ranges and in Birch Brook woodland.

4.4.23 Overall therefore, the Allocation Boundary and Mitigation Land are considered to be of at least County level importance for the breeding bird assemblage, including nightingale. This is however an estimate based on the habitat quality, and not based on a full breeding bird

survey. The Allocation Boundary alone is likely to be of up to Borough level value, given these habitats are closer to the built area of Colchester, and include the large expanse of open and disturbed grassland, when considered in the context of CIEEM's geographic frames of reference.

Bats (Foraging, Commuting, Roosting and Hibernating)

4.4.24 The full desk study, and field survey results relating to all elements of the bats surveys are included in **Appendix I** alongside a summary of the legal protection afforded to bats. The survey results shown on **Figures 16 - 20.**

4.4.25 The bat activity survey work showed that varied assemblage of bats foraging and commuting over the Allocation Boundary and Birch Brook, with the highest activity levels at static detector locations S1 (woodland) and S4 (an established hedgerow) (refer to Figure 16). The bat activity was lowest at locations S2 (north of the Allocation Boundary), S5 (south east) and S3 (above the open grassland). Calls from two species were notable; barbastelle and Nathusius' pipistrelle *Pipistrellus nathusii* which are both considered to be relatively rare in the UK[7]. Small numbers of barbastelle bat calls were recorded during these surveys, but the data was indicative (at that time) of pre-hibernation foraging. Nathusius' pipistrelle calls were also recorded, which was also attributed to migration towards hibernation sites. Transect survey results are shown on **Figures 17a – 17b**.

4.4.26 eDNA analysis of droppings found in the disused toilet block in the Marker's Gallery (Figure 17) confirmed the presence of three species of bat:

- Brown long-eared bat *Plecotus auritus*
- Natterer's bat *Myotis natterei*
- Barbastelle Barbastella barbastellus

4.4.27 Hibernation survey of the disused toilet block in the Marker's Gallery (shown on **Figure 18**) (both inspection on multiple occasions and acoustic recording) did not confirm the use of the structure as a hibernation structure by any species of bat during the winter of 2018 – 2019. The possible future use of this structure by hibernating bats cannot be ruled out at this stage..

4.4.28 A walkover of the Allocation Boundary and Mitigation Land as far south as Weir Lane was completed to consider the suitability of habitat present for foraging, commuting and roosting bats, including barbastelle. This walkover found the open area of the ranges and other areas of grassland are considered to be of limited potential value to bats with the larger woodland parcels and linking hedgerow features likely of highest potential value to barbastelle bats and other species. Detailed results are contained in **Appendix I**, and on **Figures 19 - 20**.

4.4.29 Given the presence of barbastelle droppings within the Allocation Boundary, and the noted suitability of particularly the Birch Brook woodland and hedgerows to the south for foraging, commuting or roosting bats, including barbastelle, advanced bat survey techniques were instructed. The advanced survey techniques were licensed by Natural England and trapped bats on three nights, on three occasions, in locations shown on **Figure 21**. Trapped bats were tagged following consideration of their species, and physical health, and then radio-tracked for the remainder of the session (up to a maximum of five nights, depending on when the bat was tagged) to determine the location of roost sites, objective core areas (where bats spent the

[7] Described on the Bat Conservation Trust (BCT) website (http://bats_new.brix.fatbeehive.com/index.phpl) as: *"Nathusius' pipistrelle is a rare bat in the UK, though records have increased in recent years."* and *"Barbastelle is uncommon in England and Wales. It is absent from Scotland and Northern Ireland. Note: The population estimates are considered to be poor and should be treated with caution. Estimates are based on little or no population data and rely on expert opinion only".*

majority of their flying time) and their wider home ranges (all the area the bats used during the tracking).

4.4.30 Tagging was limited to species of high conservation interest; a total of six individual bats were tagged and tracked; three barbastelle bats, a Daubenton's *Myotis daubentonii* and a Natterer's (each were tracked for one of the three sessions). The Daubenton's and Natterer's bats were primarily tagged to find roost sites, and this was generally undertaken during daylight hours, whilst the barbastelle were tagged to determine home range data, objective core range and wider home range.

4.4.31 Follow up radio tracking of Natterer's and Daubenton's bat in June 2019 located day roosts for male Natterer's bats and a maternity roost for a breeding population of Daubenton's bat within the Birch Brook woodland. The location of the Birch Brook to nearby lakes/reservoirs to the north and the River Colne valley to the east of the site is a logical choice as a roosting site for Daubenton's bats that forage over open water habitats. It is likely that a greater number of trees within the Birch Brook woodland will be used for roosting sites by both these species as tree dwelling species move frequently utilising fission fusion behaviour. Post breeding Daubenton's bats were captured again in August and September within the Birch Brook woodland. Such fission fusion behaviour has been observed elsewhere with both tree and building roosting bat species (Kerth et al, 2011). Roost movements and switching are considered to be a response to a range of environmental influences affecting the efficient development of pregnancy and the rearing of young or thermoregulatory requirements or predator evasion. It can also be related to social relatedness (Kerth et al, 2011).

4.4.32 One male juvenile barbastelle was captured in the Birch Brook Woodland in August 2019. This individual was tagged and tracked to a maternity roost in Donyland Woods. Further trapping in Donyland Woodsood in September confirmed the continued presence of barbastelle bats and further a further roost site. This provides a high level of confidence that the Donyland Woods complex supports a maternity population of barbastelle bats, and based on previous studies of similar populations, it is likely that the main woodland complex is the 'roost woodland' with sporadic use of outlying woodlands (such as Manwood, Friday Wood, and Birch Brook) as roosting habitat at other times of the year (refer to **Figure 22**).

4.4.33 A limited level of trapping and tracking of barbastelle bats was undertaken in 2019, however there is sufficient data to develop context of the allocation site and the Birch Brook woodland in relation to this barbastelle bat maternity population found using Donyland Woods. Based on the radio tracking and trapping data, as well as the previous standard surveys of the rifle range butts (confirmed with barbastelle bat droppings), the allocation site and Birch Brook is considered likely to be a peripheral woodland habitat used occasionally by bats from this maternity population. This could include ad hoc roosting and foraging, and almost certainly likely to be used outside the maternity roost period by individual bats from this population day roosting or hibernating during the winter months.

4.4.34 Excluding barbastelle bat, it is considered that the woodlands adjacent to the Allocation Boundary (including the Birch Brook) are of District value for the assemblage of bats within it, noting the presence of a Daubenton's maternity population. Considering the Allocation Boundary alone, it is considered to be of Borough Value to bats (excluding barbastelle).

4.4.35 The presence of a maternity barbastelle population, an Annex II (Habitats Regulations) and NERC 2006 Section 41 species, in Donyland Wood is considered of Regional value. The entire Birch Brook woodland and immediately adjacent habitat (which includes some habitat within the Allocation Boundary) is considered to be of County value for barbastelle bats given the supporting role these habitats are likely to have for the maternity population. The part Birch Brook woodland within the Allocation Boundary (i.e. only a small proportion of the wider Birch Brook corridor), and the grassland immediately adjacent within the Allocation Boundary is considered to be of Borough level importance for barbastelle bats, given the supporting role this habitat has on the wider home ranges of the maternity population. This can be

represented through habitat area (considering woodland area only, using the MAGIC dataset of HPI as the proxy for large scale woodland extents) – see **Table 2** below. These woodlands are labelled on **Figure 22.**

Table 2: Woodland parcels which fall (partially or completely) within the home ranges of the tracked Barbastelle, and their perceived value

<table>
<tr><th>Woodland Parcel</th><th>Area (woodland only, not including the edge habitat or grassland immediately adjacent of the woodland)</th><th>% of Total (woodland only)</th><th colspan="3">Value[8]</th></tr>
<tr><td>Birch Brook (inside Allocation Boundary)</td><td>10ha</td><td>3%</td><td>The part of Birch Brook woodland and immediately adjacent habitat within the Allocation Boundary is considered to be of Borough importance to barbastelle bats.</td><td rowspan="2">The entire Birch Brook woodland and immediately adjacent habitat is considered to be of County importance to barbastelle bats.</td><td rowspan="5">The woodland complex comprising all constituent parts is together valued as being of Regional importance to barbastelle bats.</td></tr>
<tr><td>Birch Brook (outside Allocation Boundary)</td><td>22 ha</td><td>7%</td><td rowspan="4">No valuation appropriate in this circumstance</td></tr>
<tr><td>Manwood</td><td>22 ha</td><td>7%</td><td rowspan="3">No valuation appropriate in this circumstance</td></tr>
<tr><td>Friday Wood</td><td>185 ha</td><td>57%</td></tr>
<tr><td>Donyland Wood</td><td>95 ha</td><td>26%</td></tr>
<tr><td>Total</td><td>384 ha</td><td>100%</td><td>-</td><td>-</td><td>Regional</td></tr>
</table>

4.4.36 These data have been used to determine a developable area within the Allocation Boundary, based on the known and likely presence of barbastelle bat and their known habitat use (Zeale, Davidson-Watts and Jones, 2012; Davidson-Watts, 2015), and is discussed further in **Section 6.**

4.5 Other Species

4.5.1 The Allocation Boundary, remainder of the Middlewick Ranges LWS and Birch Brook LWS, and Mitigation Land all have suitability for a range of legally protected species; these include great crested newts *Triturus cristatus*, reptiles, and badger *Meles meles* (among others). Further information is provided in **Appendix J** in relation to these species, however in summary:

- It is expected that the Allocation Boundary, and land adjacent would support moderate or good reptile populations, of some, if not all of the UK's common and widespread reptile

[8] The survey scope enables us to predict the value of the entire woodland group (i.e. all woodland parcels used by the maternity colony). Given inclusion of Birch Brook in the scope it is also possible to make reasonable predictors of the value of Birch Brook corridor as shown, however given the nature of barbastelle (i.e. requiring a woodland complex, and not just a tree / part of woodland) it is not appropriate to consider the woodlands in isolation with respect to their value to barbastelle.

species (common lizard *Zootoca vivipara*, slow worm *Anguis fragilis*, grass snake *Natrix natrix* and adder *Vipera berus).* This is supported by the records identified in the desk study. The Allocation Boundary falls extensively beyond the known ranges of the UK's rare reptiles (smooth snake *Coronella austriaca* and sand lizard *Lacerta agilis*), using distribution maps published online by the Amphibian and Reptile Conservation Group[9]. A reptile survey has not been completed as this is not required for this stage of the project (i.e. Allocation), as the presence of the UKs common and widespread reptile species within the Allocation Boundary does not affect consideration of the acceptability of development at Middlewick Ranges.

- No suitable breeding habitat for great crested newts is present within the Allocation Boundary (owing to the lack of water bodies). There are however waterbodies in the 500 m radius of the Allocation Boundary which could provide habitat suitable for breeding great crested newts. If present the Allocation Boundary could support terrestrial phase GCN. Great crested newt licences have been granted for works to the south west of the Allocation Boundary, c. 1.4 km (or 300 m south west of the Mitigation Land). Given the absence of suitable breeding habitat within the Allocation Boundary, no targeted survey has been completed for this species for this stage of the project (i.e. Allocation), as the presence of great crested newts within the 500 m radius of the Allocation Boundary would not affect consideration of the acceptability of development Middlewick Ranges.

- Badger setts, and evidence of badger activity are present within the Allocation Boundary and Mitigation boundary. Owing to the size of the Mitigation Land, multiple badger clans could be supported. An extensive badger survey has not been completed as this is not required for this stage of the project (i.e. Allocation), as the presence of badger sett(s) does not affect consideration of the acceptability of development at Middlewick Ranges.

4.5.2 **Section 5** and **Appendix K** provide further information on the ecological consideration which are not considered 'key' to the allocation of Middlewick Range, but which will require further consideration at the planning application stage of the project.

[9] https://www.arc-trust.org/

5 Evaluation

5.1.1 This section provides a summary of the ecological features which require high level, or more detailed consideration for the allocation of Middlewick Ranges. **Table 3** overleaf also provides the Section and Appendix references within this evidence base relating to the results of the surveys (where completed), the maximum ecological value of the identified feature (either the designated site, or the value of the habitat of species within the Allocation Boundary). Finally, a rationale is provided as to why the ecological feature is considered to be a key consideration for the allocation. The rationale considers the value of the ecological feature in combination with the potential for either 'direct' or 'indirect' impacts[10] which could result from the proposals, and whether the resulting effects[11] could affect viability of the proposals. For example, direct impacts would include habitat loss, whereas indirect impacts would include lighting, and recreation, with the potential to result in associated disturbance effects.

5.1.2 Note that **Table 3** is intended to provide an overview how the 'key' considerations for the allocation have been identified. **Appendix K** details the 'other' ecological features which will require consideration at later project stages, for example to inform a planning application, either because of their legal protection or to respond to specific planning requirements (refer to **Section 1.6** for a summary of the differences in the information requirements for varying project stages). In addition, 'key' considerations in this context, relates only to defining a viable developable area and masterplan for the purposes of allocation; key considerations should not be considered a proxy or synonymous with 'important' ecological receptors which may be scoped into an EcIA. An ecological feature can be both 'important' in EcIA terms (for the purposes of impact assessment work at a planning application) but not 'key' to defining the viable developable area for allocation.

[10] Defined by CIEEM as "actions resulting in changes to an ecological feature. For example, the construction activities of a development removing a hedgerow"

[11] Defined by CIEEM as "Outcome to an ecological feature from an impact. For example, the effects on a dormouse population from loss of a hedgerow"

Table 3: Evaluation and Rationale for Key Ecological Features pertinent to the Allocation

Ecological Feature	Section References (Results)	Maximum Ecological Value of Identified Feature or Allocation Boundary	Rationale
European Designated Sites	Section 4.2 Appendix C	International	The Conservation of Habitats and Species Regulations 2017 affords protection to European designated sites. In response to this legislation, European designated sites are also protected via the Essex Coast Recreational Disturbance Avoidance and Mitigation Strategy (RAMS) (Place Services, undated) which defines the high-level strategy to mitigate in combination recreation effects resulting from additional residential development. At a project level this entails a financial contribution per new unit (for developments within the impact area). The RAMS also identifies site level mitigation to reduce the incidence of new residents visiting the coastal sites; these include providing accessible green space for residents to use, near to the development. Colchester Borough Council are the 'competent authority' for both plan and project level consideration of impacts on internationally designated sites. The Habitat Regulations Assessment (HRA) completed as part of the emerging Local Plan preparation (CBC, 2017) indicates the allocation of Middlewick Ranges is unlikely to result in significant effects upon the designation criteria of these designated areas. It should however be noted that since the CBC HRA was completed, there has been a change in the required approach to HRA (specifically which stage of the assessment mitigation is applied) prompted by the Court of Justice of the European Union (CJEU) ruling on People Over Wind and Sweetman v Coillte Teoranta (C-323/17). Furthermore, the Essex Coast RAMS (Place Services, undated) has also been prepared since CBC's HRA. A project specific HRA will be required to inform a planning application. European designated sites are therefore deemed to be a key ecological consideration given the potential influence on development proposals with respect to providing sufficient accessible open space for residents. The capacity of any future development to provide on site facilities for recreation (targeted at dog walkers) needs to be demonstrated. Furthermore, financial contributions to the RAMS need to be factored into scheme financial viability calculations.
UK Statutory Designated Sites	Section 4.2 Appendix C	National	Roman River SSSI is 0.7km from the Allocation Boundary and is functionally linked via the Mitigation Land. This UK statutory designated site has already informed very high-level consideration of development location within the MOD ownership. Further consideration will be required in relation to management of recreation and as such has been identified as a key consideration for the allocation. The capacity of any future development to provide on site facilities for recreation (targeted at dog walkers) needs to be demonstrated. Colne Marshes SSSI is not considered to be a key consideration for allocation given the separation from the Allocation Boundary by further residential development, and the lack of direct functional link. Further rationale is provided in **Appendix K**, and further consideration will likely be required at the planning application stage.

Ecological Feature	Section References (Results)	Maximum Ecological Value of Identified Feature or Allocation Boundary	Rationale
Non-Statutory Designated Sites (Middlewick Ranges)	Section 4.2 Appendix C	County	The presence of this LWS within the Allocation Boundary rendered it a key consideration for the allocation given the potential influence on developable footprint of the scheme. To demonstrate viability of the proposals, consideration of the relative value of habitats within the LWS, and whether the potential for post-development continued ecological functionality is feasible, is required. Also see 'Terrestrial Invertebrates' and 'Acid Grassland' below.
Non-Statutory Designated Sites (Birch Brook)	Section 4.2 Appendix C	County	The presence of this LWS within (and adjacent to) the Allocation Boundary rendered it a key consideration for the allocation given the potential influence on developable footprint of the scheme. To demonstrate viability of the proposals, consideration of the relative value of habitats within the LWS, and whether the potential for post-development continued ecological functionality is feasible, is required. Also see 'Broadleaved Semi-Natural Woodland' below.
Acid Grassland	Section 4.3 Appendix D	County	The presence of acid grassland within the Allocation Boundary is a key consideration for the allocation given the potential influence on the developable footprint of the scheme. Given the protection this habitat type is afforded in policy and legislation (under the NERC Act), any losses of acid grassland need to be compensated for to enable no net loss of this habitat type. Consideration of the possible location and feasibility of acid grassland creation is therefore required to demonstrate viability of proposals, as well as consideration of recreation management.
Mature Broadleaved Semi-Natural Woodland	Section 4.3 Appendix D	Local	The presence of mature broadleaved semi-natural woodland within and adjacent to the allocation boundary is a key consideration for the allocation given the policy protection this habitat is given. Consideration required to inform viability of proposals relates to retention of habitat, the proximity of development to the retained woodland parcels and management of recreation.
Terrestrial Invertebrates	Section 4.4 Appendix G	County, Regional or National[12]	The terrestrial invertebrate assemblage associated with the LWS is a key consideration for the allocation given the potential influence on habitat retention and the requirement for landscape scale connectivity. Whilst the invertebrate assemblage does not receive specific legal protection, there is a duty on the LPA through the NERC Act to consider assemblages and species of elevated conservation value. Furthermore, to enable compliance with CBC's emerging local plan policy ENV1, the retained LWS habitats together with habitat enhancements (outside the LWS) (refer to Section 7 below) need to provide ecological functionality and connectivity for the key designation criteria of the LWS (terrestrial invertebrates).
Breeding Birds (including Nightingale)	Section 4.4 Appendix H	Borough	The breeding bird assemblage, including specifically nightingale are a key consideration for the purposes of allocation given the potential influence on habitat retention and proximity of development to key habitat. Whilst some birds do receive elevated legal protection this primarily relates to active nests, and disturbance whilst breeding. At this stage, to demonstrate viability of proposals, consideration of available habitat suitable for species of elevated conservation concern is required to inform consideration of likely mitigation and compensation measures (and consideration of whether these are achievable).

[12] Noting that this assessment is made for the entire invertebrate study area and not the Allocation Boundary alone given the importance of the habitat mosaic to this species group.

Ecological Feature	Section References (Results)	Maximum Ecological Value of Identified Feature or Allocation Boundary	Rationale
Bats – Roosting	Section 4.4 Appendix I	Borough	Bats and their roosts (to include hibernation roosts) are legally protected. Whilst the planning application and subsequent construction phases will require detailed consideration of both elements, for the purposes of allocation, these are considered to be a key consideration at a high level for allocation. The consideration relevant to these groups relates to habitat with suitability for roosting and hibernating bats (in general terms to facilitate preparation of a viable developable footprint), but also focusing on those species of elevated conservation value (also see Barbastelle below). With specific reference to the toilet block in the Marker's Gallery (refer to **Section 4.4.27**), it is necessary to demonstrate that development within the Allocation Boundary will not affect hibernating bats. This is particularly important with respect to the use by barbastelle, given the high conservation status of this rare bat species. Based on the survey results to date however, it is not necessary for the toilet block to be retained as part of proposals, provided compensatory suitable roosting habitat can be provided in the Allocation Boundary, or nearby. The potential capacity of the Allocation Boundary to provide a compensatory or enhancement[13] hibernation roost for bats, including barbastelle, as part of any future development, should therefore be demonstrated to give confidence to the deliverability of the quantum of future development, such that it will be capable of meeting legislative and policy requirements with respect to bats and biodiversity resources.
Bats – Hibernating	Section 4.4 Appendix I	Borough	
Barbastelle	Section 4.4 Appendix I	Borough	Barbastelle is an Annex II (Habitats Directive) species, and one of the UK's rarest bats. The presence of barbastelle roosts and associated commuting or foraging activity near to the Allocation Boundary is a key consideration for the allocation. An ecologically viable development within the Allocation Boundary needs to demonstrate that the habitat loss, and impacts of proximity would not undermine the ability of the barbastelle population present to maintain a Favourable Conservation Status.

[13] Note, given no evidence of use of this structure for hibernating barbastelle was found during the survey, this is not compensation for the loss of a known hibernation roost. The proposal however seeks to take a precautionary approach at this stage given the suitability of the structure for hibernation, and the presence of barbastelle droppings inside the structure. The suggested approach instead provides a replacement structure suitable for barbastelle hibernation will either be an 'enhancement' (if planning stage surveys do not confirm use of the toilet block by hibernating barbastelle), or 'compensation' (if planning stage surveys do confirm the use of the toilet block by hibernating barbastelle). In either scenario, a suitable hibernation structure could be provided, contributing to the overall Favourable Conservation Status of the local population of barbastelle.

6 Masterplan

6.1.1 This section of the evidence base confirms which ecological features have influenced preparation of the ecologically viable development area, and how it goes on to introduce, and appraise the masterplan from the perspective of these ecological features.

6.2 Key Ecological Considerations

6.2.1 The following ecological considerations (as identified through the desk study and field surveys described in the sections above) have been identified as those which were key to this project's viability (i.e. are defined as the 'key ecological considerations'):

- Internationally Designated Sites (specifically, Abberton Reservoir Ramsar and SPA, Colne Estuary Ramsar and SPA, Essex Estuaries SAC, and Blackwater Estuary Ramsar and SPA);
- Roman River SSSI;
- Birch Brook and Middlewick Ranges LWS;
- Acid grassland;
- Mature broadleaved semi-natural woodland habitat;
- Barbastelle roosting, foraging and commuting habitat;
- Breeding bird habitat; and
- Invertebrate habitat.

6.3 Ecologically Viable Development Area

6.3.1 The key ecological considerations as identified in **Section 6.2** above have influenced preparation of the 'ecologically viable development area'. An ecologically viable development area is considered to be the area in which the ecological function of the above key considerations can be supported post development.

6.3.2 The ecologically viable development area has been informed by the 'key' ecological considerations, and hence not necessarily all of the ecological considerations. This level of consideration is appropriate to this project stage (i.e. site allocation rather than planning application); further distinction is made between these stages in **Section 1.6.** In any event, it is anticipated that appropriate avoidance, mitigation and compensation measures associated with other ecological considerations can be achieved within the proposed development area or within the Mitigation Land that is available within the control of MOD.

6.3.3 **Table 4** below provides a high level summary as to how the key ecological considerations have each influenced the developable area.

Table 4: Key Ecological Considerations and their influence on the viable developable area

Key Ecological Considerations	Influence on Viable Developable Area
Internationally and nationally Designated Sites	Provision of accessible open greenspace within / near to the Allocation Boundary and allowance for walking routes to

Key Ecological Considerations	Influence on Viable Developable Area
	minimise subsequent footfall on the Essex coastal sites and nearby Roman River SSSI.
Birch Brook LWS Mature broadleaved semi-natural woodland habitat	Retention of the entire Birch Brook Woodland LWS, with a buffer from development proposals given the age and value of the woodland as habitat, and also the potential for the woodland to support a wide range of protected and notable species. Influence measures in relation to management of recreation.
Middlewick Ranges LWS Acid grassland	Minimise the loss of the acid grassland from the LWS. Retain the acid grassland and extents of the LWS which are ecologically most connected to habitat of high ecological value (i.e. Birch Brook Woodland LWS) and retain the habitat mosaic at the south of the firing ranges which has greatest value to terrestrial invertebrates (see also 'Invertebrates' below). Influence measures in relation to management of recreation.
Bats (including barbastelle) roosting, foraging and commuting habitat	Retention of Birch Brook LWS, with a buffer to the north of the woodland edge to minimise impacts on bat foraging, and commuting associated with increased light levels. Influence measures in relation to management of recreation.
Breeding bird habitat	Retention of Birch Brook LWS with a buffer to the north of the woodland edge to minimise impacts of proximity; this is most pertinent for both the nightingale and woodland / generalist species. Influence measures in relation to management of recreation.
Invertebrate habitat	Retention of the mosaic habitat at the base of the firing ranges, alongside areas of acid grassland, coarser grassland, and all in proximity to retained woodland habitat (note that the important habitat features are not each individual element, but the combined mosaic of habitat types). Connectivity to Hythe Brownfield, and Birch Brook are also important influences for invertebrates. Influence measures in relation to management of recreation.

6.4 Masterplan Appraisal

6.4.1 The masterplan (PRP Concept Masterplan Dated 28/09/20) has been ecologically informed throughout all stages of its preparation and refined in response to key ecological findings over the past 3 years. The masterplan is considered to provide the required development needs whilst also minimising ecological impact where possible and making provision for long term ecological functionality and landscape scale connectivity. The masterplan has the following key attributes which respond to the key ecological considerations as follows (and summarised on **Figure 23)**:

- Siting the development footprint overall in the habitats of least ecological value, and which are of least value to a range of species. This includes consideration of the conflicting needs, such as the need for a green offset from Abbot's Road (effectively pushing development proposals south) whilst balancing ecological need (which is to retain habitat in the south, and provide a sufficiently large buffer from valuable habitat in the south, essentially pushing development proposals north).

- Retention of Birch Brook LWS in its entirety, with at least a 50 m buffer from development for its entirety (the very northerly tip of Birch Brook woodland is the closest part, and the developable area is c. 70 m from the woodland).

- Retention of 30 hectares of the Middlewick Ranges LWS boundary, prioritising the areas of acid grassland (over the less ecologically valuable grassland), the habitat mosaic at the base of the ranges, and prioritising the location of LWS retention such that the remnant areas remain ecologically connected to adjacent high value habitat and are not isolated by development proposals. Such retention and connectivity is considered to be of importance for both the continued ecological functionality of the LWS, but also the species it supports, such as the invertebrate assemblage.

- Retention of sufficient habitat to enable continued use of Birch Brook and the immediately adjacent habitats by foraging and commuting bats, roosting bats, and a range of bird species. This includes sufficient buffers from built development such that issues associated with light spill on retained woodland should not adversely affect the use of the woodland by such species.

- Provision of substantial green corridors throughout the built footprint of the development to facilitate landscape scale connectivity for bats, birds and other species. This includes retention of the two existing and high value remnant hedgerows in the north, as well as extended north – south and east west habitat linkages, and the retention (and bolstering) of hedgerows along the existing frontage of Abbot's Road.

- A stepped built form in both density and typology, to minimise ecological impacts associated with a 'hard' development edge. Examples include siting the lower density housing on the southern boundary of the footprint, siting the higher density and building types which are associated with greater footfall and disturbance (such as the local centre) in the centre of the footprint.

- Provision for 2 km, 3 km and 6 km walking routes within the development footprint, and then in Mitigation Land to the south. These seek to provide a targeted walking route for recreation and dog walking use, but with specific routes devised to minimise impact on retained habitat.

- Development of a built footprint which delivers the required housing numbers, infrastructure and associated uses, in the smallest form possible (without compromising densities, green corridors or other open space commitments).

7 Net Gain for Biodiversity – Mitigation Strategy

7.1 Overview

7.1.1 This Section defines the principles of the mitigation hierarchy, and a high level mitigation strategy to support the development of Middlewick Ranges. The mitigation strategy considers each of the designated sites, habitats and species, and where possible tabulates information to avoid duplication (i.e. where one mitigation measure benefits more than one species group, for example). The mitigation strategy focuses only on the key ecological considerations identified in **Section 5.** Net gain to biodiversity is currently required under the NPPF, and is expected to be mandated in the Environmental Bill (should this become statute), and so consideration has also been given to how net gain can be delivered as part of these proposals.

7.1.2 It should be noted that the measures outlined in this section are suggestions for how legal and policy compliance can be achieved for the key ecological considerations, based on the masterplan designs (PRP: AA6742 Concept Masterplan 28/09/2020). This does not purport to be a 'fixed and final' strategy for avoidance, mitigation and compensation for ecological impacts, resulting in a net gain to biodiversity. It does however provide a means, but not necessarily the only means, by which legal and policy compliance can be achieved, resulting in an overall net gain to biodiversity. A greater level of detail will be required at the planning application stage, as part of an EcIA (refer to **Section 1.6**). This section seeks to provide confidence to CBC and through the EiP process that measures required to achieve legal and policy compliance are deliverable (technically), viable (financially), accessible (with respect to land availability for compensation), and compliant (with respect to future military use of the same land).

7.1.3 Furthermore, it would be necessary, at the planning application stage (or associated condition discharge) to define detailed strategies for legal and policy compliance, as well as to describe the longer term establishment, management and maintenance of mitigation / compensation. It is also expected that at the planning application stage (or associated condition discharge) a strategy for the monitoring of key mitigation or compensation would be defined, which would enable adaptive management as required.

7.2 Mitigation Hierarchy

7.2.1 Redevelopment proposals will be considered against national and local planning policy in addition to relevant legislation (refer to **Section 2**). The key relevant National and Local Planning policies are presented, with a key overarching aim of protecting and enhancing the natural environment.

7.2.2 To enable redevelopment to be demonstrably compliant with planning policy and to protect features of ecological value within and around Middlewick Ranges, the 'Mitigation Hierarchy' has been applied in preparation of the masterplan to date, and will need to continue to be applied in later stages of the project. The Mitigation Hierarchy is a set of principles, in sequential order of preference which can be defined as follows[14]:

[14] These terms are all used within Ecological Impact Assessment (EcIA), and form part of the mitigation hierarchy. The terms are defined in the with the Chartered Institute of Ecology and Environmental Management's (CIEEM) Guidelines for EcIA (September 2018). Definitions of mitigation, compensation and enhancement have been taken from the EcIA guidelines.

- *"**Avoidance**: measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to avoid impacts on certain components of biodiversity.*

- ***Mitigation:** Measures taken to avoid or reduce negative impacts and effects. Measures may include: locating the development and its working areas and access routes away from areas of high ecological interest, fencing off sensitive areas during the construction period, or timing works to avoid sensitive periods. An example of a reduction measure is a reed bed silt trap that is designed to minimise the amount of polluted water running directly into an ecologically important watercourse. Depending on circumstances, mitigation measures may be located within or outside the project site.*

- ***Compensation:** Measures taken to offset the loss of, or permanent damage to, ecological features despite mitigation. Any replacement area should be similar in terms of biological features and ecological functions that have been lost or damaged, or with appropriate management have the ability to reproduce the ecological functions and conditions of those biological features. Compensation addresses negative effects which are residual, after avoidance and mitigation have been considered. It is this objective of compensation, and not its location, that distinguishes compensation from 'mitigation'. Depending on circumstances, compensation measures may be located within or outside the project site."*

- ***Enhancement –** Enhancement is improved management of ecological features or provision of new ecological features, resulting in a net benefit to biodiversity, which is unrelated to a negative impact or is 'over and above' that required to mitigate/ compensate for an impact. For example, mitigation for bats may involve erecting bat boxes in a woodland to replace suitable bat roosting features that have been removed, and the woodland habitat itself may be enhanced for foraging bats by increased woodland planting and the creation of glades."*

7.3 Principles

Avoidance and Mitigation

7.3.1 Much of the avoidance and mitigation in relation to the key considerations relates to the Masterplan design development (refer to **Section 6**). Further avoidance and mitigation measures will be brought forwards at later design stages, such as a sensitive lighting design strategy for both birds and bats (in line with the measures defined in the Institute of Lighting Professionals (ILP) guidance for bats (2018)), and a sensitive drainage strategy to facilitate creation of biodiverse Sustainable Urban Systems (SuDS) (open systems and provision for both permanently and temporarily wet habitat areas).

7.3.2 Further avoidance and mitigation measures will then need to be defined at a later stage, and will relate to the construction stages of the development, for example:

- construction methodology to protect retained habitat (either physically from damage, from dust particulates during earthworks, from surface run-off),

- strategies for protected and notable species (either key or non key), to enable legal compliance, and best practice. In practice this will likely include measures such as translocation for species such as reptiles into a receptor site, timed vegetation clearance relating to nesting birds, clearance activities under licensed methodology (if required) for dormouse and bats (depending on whether dormice are confirmed to be present within the development footprint, and whether bat roosts are present in tree(s) or building(s) on or adjacent to the development footprint. Such strategies inherently include elements of both avoidance and mitigation.

7.3.3 The above measures will also need to be incorporated into a site-wide Construction Environmental Management Plan (CEMP) for the construction stage, with operation stage adaptive management of SUDS and receptor sites included in a Landscape and Environmental Management Plan (LEMP) and/or the DIO's Integrated Rural Management Plan (IRMP) for Colchester Training Area.

7.3.4 In relation to the European designated sites, the accessible open green space required by the Essex Estuaries RAMS would also be considered mitigation, as would guided or encouraged walking routes to avoid unnecessary damage to retained habitats within the Allocation Boundary or immediately adjacent habitats.

Compensation

7.3.5 Much of the remainder of the key aspects of the ecological strategy then relate to compensation. The key elements of the compensation strategy entail the need to provide replacement acid grassland for the area lost to development, replacement of roosting / potential hibernation features, and habitat features of value to species of conservation concern. There will be many such measures required, and the exact requirements will be dependent upon the further surveys completed to inform a future planning application.

7.3.6 For the purposes of this evidence base, the compensation measures detailed in **Table 5** below focus on the key ecological considerations (as defined in **Section 5**), which have had some influence on the developable area, or where the mitigation for that particular ecological consideration is not well established and documented, such that confidence is required in the viability of such measures to support the allocation of Middlewick Ranges in the emerging local plan.

Enhancement

7.3.7 Enhancements specific to species are also considered in **Table 5** below, however under the NPPF, and emerging policy all projects need to result in a net gain to biodiversity. This means the value of all habitats post development (factoring in the how 'distinctive' a given habitat is ecologically, it's condition and area) needs to be greater than the value of habitats pre-development. In broad terms, when associated with development proposals this typically requires either or all of: planting new or ecologically more distinct habitat in areas of lower ecological value, encouraging existing habitat to reach a better condition (through supplementary planting, intervention or management), or where this cannot be achieved, making a financial contribution to the LPA to spend on conservation activities elsewhere in the Borough. In general terms, habitat gains should be prioritised within a given site, and where this is not possible, taken off site, with a preference for an off-site location close to where the habitat has been lost (rather than far away). In broad terms, it is also preferred to replace habitat types lost (across groups) such that a scheme which results in a loss of woodland is not compensated for with only grassland.

7.3.8 Calculations for the habitat value pre and post development are based on the original Defra 'Biodiversity Offsetting' approach, which has been refined by many (and resulting in multiple approaches). The Defra approach standardises information to avoid user bias where possible; it sets criteria for the habitats (such as their distinctiveness, ease of creation and time to reach a target condition). The latest Defra metric is referred to as The Biodiversity Metric 2.0 and is at the time of writing in Beta test stage. This beta version has been interrogated extensively by the project team, and a decision has been made that a more transparent approach can be achieved for Middlewick Ranges by returning to the base principles of the original Defra metric, rather than using the beta test version of the Biodiversity Metric 2.0. Full methodology and results of this approach are detailed in **Appendix N,** with **Figures 25 and 26** showing the pre, and post development habitats. The design of the bespoke metric has been reviewed and considered by CBC Ecologists at EECOS, and through consultation it has been agreed that this is an appropriate tool for the allocation stage of this project.

7.3.9 It should be noted that the post development habitat types, have been discussed extensively with the training estate managers and operators to ensure that enhancements to habitats within the Mitigation Land do not conflict with the training objectives of the land (either resulting in damage to proposed planting, or risk to training personnel or the public). Beyond that, the training needs of the military following closure of the firing ranges, have been discussed and understood to identify ways in which the habitat enhancements can better support the training needs of military personnel. **Appendix O** contains a high level confirmation that the habitat creation proposed is acceptable.

7.3.10 It should be noted however that the habitat creation shown on **Figure 26** is intended at this stage to show an indication of how a net gain to biodiversity can be achieved at Middlewick Ranges, in a format compatible with the training estate, and which does not undermine the viability of the wider scheme. The habitat creation shown should not be considered the 'final, 'guaranteed' or otherwise 'decided' habitat enhancements; such measures would need to be agreed at the planning application stage. The habitat creation does however consider the habitat losses in the Allocation Boundary, habitat type, quality and connectivity requirements of varying species groups, the needs of the military, and the need to balance the losses of acid grassland.

7.3.11 It should also be noted that the net gain has been calculated on a 'precautionary worst case' basis for the following reasons (with further information provided in **Appendix N**):

- No retained habitats have been enhanced in their condition between the pre and post development stages. In practice, this is unlikely to be the case, as targeted enhancements will be made to retained habitats as part of landscape and ecological mitigation and management strategy for any resulting development (to be defined at the planning application stage of the project).
- The condition of some habitats very close to the development footprint have been downgraded from pre development to post development in light of the potential influence of recreation.
- No allowance for greenspace has been made within the development footprint, whereas in practice there will be gardens, trees lines, hedgerows, SUDS features and other areas which will contribute positively to the net gain assessment post development. This will again be defined at the planning application stage as part of any detailed scheme design / landscape masterplan.
- The potential errors in the Biodiversity Metric 2.0 beta version, as described in the Defra consultation report (refer to **Appendix N**) in relation to the time to target condition and difficulty of creation for woodland have not been pre-emptively amended in this bespoke metric. The revised Biodiversity Metric is expected to be released in December 2020, and will contain new data for woodland creation, which would be expected to benefit the post development scenario for Middlewick.
- Realistic but not optimistic target conditions have set for habitat creation to avoid over valuing the post development habitats to be created.
- No consideration of the starting habitat has been factored into the metric, and no use of an accelerated succession function (relevant for woodland creation from grassland) has been made; both of which are downgrading the value of the post development scenario in comparison to the pre development.

7.3.12 Four scenarios have been run using the metric. Scenarios 1 – 3 are based on the same calculation, but each take a slightly different approach to the inclusion or exclusion of Birch Brook from the pre and post development calculations, the 'time to target condition' for the acid grassland. Scenario 4 takes the Biodiversity Metric 2.0 approach to calculation of a

percentage change in biodiversity, by defining the on site and off site habitats for both pre and post development (note on site and offsite differs to a given Allocation / Application / Built Footprint boundary, but is instead defined through ecological consideration).

7.3.13 The metric results for the above described four scenarios are shown below. In summary, they indicate an anticipated minimum 9% net gain in biodiversity of habitat areas (with 0% for watercourses and loss of -1% for hedgerows) across the entire Allocation Boundary and Mitigation Land Boundary (calculated with Birch Brook woodland included). There is a single c. 110m stretch of hedgerow removal based on the development footprint shown on **Figures 25 and 26**. The -1% change in hedgerows (-1% change in Scenarios 1 – 3, or -19% change in Scenario 4, for the same 110m lost) is not considered to constrain the viability of the allocation and any future development, given no allowance has been made in the metric for provision of new hedgerows within the built development footprint nor for the enhancement of retained hedgerows; both of which are anticipated. It is therefore considered that the losses of hedgerow currently reported will be easily compensated for, with net gains actually achieved, once full detailed proposals are used for metric calculations.

7.3.14 It should also be noted, that the approach to Scenario's 1 – 3 below takes a truly 'precautionary worst case' as the percentage change has been calculated using the entire Allocation Boundary and Mitigation Land pre-development biodiversity unit total. Scenario 4 described below mirrors the approach in the Biodiversity Metric 2.0, and measures the percentage change against the 'onsite' pre development biodiversity unit total. Note, in the Biodiversity 2.0, the definition of 'onsite' is not necessarily that of an Allocation Boundary, Planning Application Boundary or Development Footprint; it is instead an area defined specifically for the metric purposes with reference to potential for ecological impact.

7.3.15 There is no statutory national target for net gain to biodiversity, however the Environment Bill proposes to mandate 10% (note that until the Bill passes parliament to become statute the 10% provides neither a policy nor mandatory target). Achieving a 10% net gain (should this be approved, unchanged through the passing of the Environment Bill through parliament) is very achievable for this development given this assessment is a precautionary worst case for the reasons described above. For further information on the policy background to Biodiversity Net Gain refer to **Appendix N.2.**

7.3.16 The results of the metric have shown between a 9% and 12% net gain to biodiversity (polygon habitat areas), 0% change for watercourses and -1% change for hedgerows (Scenarios 1- 3) as a result of the development footprint and habitat creation shown on Figure 26. The three scenarios are as follows:

- Scenario 1 – Pre Development Habitats as Per Figure 25, Post Development Habitats as per Figure 26; Birch Brook woodland (semi-natural) left in the calculation (i.e. increases baseline biodiversity units); time to target condition for acid grassland 8 years (refer to **Appendix O** for expert's opinion on timeframes). Overall scenario 1 results in a 9% gain in habitats areas overall (split: areas – 9%, watercourses – 0%, hedgerows – -1%).

- Scenario 2 – Pre Development Habitats as Per Figure 25, Post Development Habitats as per Figure 26; Birch Brook woodland (semi-natural) removed from the calculation (both pre development and post development (i.e. reduces baseline biodiversity units); time to target condition for acid grassland 8 years (refer to **Appendix O** for expert's opinion on timeframes). Overall Scenario 2 results in an 12% gain in habitat area overall (split: areas – 12%, watercourses – 0%, hedgerows – -1%).

- Scenario 3 – Pre Development Habitats as Per Figure 25, Post Development Habitats as per Figure 26; Birch Brook woodland (semi-natural) removed from the calculation (both pre development and post development (i.e. reduces baseline biodiversity units); time to target condition for acid grassland 10 years (refer to **Appendix O** for expert's opinion on

timeframes). Overall scenario 3 results in an 10% gain in habitats overall (split: areas – 10%, watercourses – 0%, hedgerows – -1%).

7.3.17 All these represent a 'precautionary worst case' approach, as factors described above under **Section 7.3.11** have not been ameliorated.

7.3.18 Scenario 4 takes a different approach to how the percentage change is calculated (i.e. it mirrors the Biodiversity Metric 2.0 approach – refer to **Appendix N** for further information). In Scenario 4, a 16% gain in habitat areas is achieved, with a 0% change in watercourses and a -19% change in hedgerows. Note, the habitat distribution has not changed, this is simply another approach to calculating the net gain percentage.

7.3.19 As shown in the results of the metric contained in **Appendix N**, overall net gain of either 9%, 10%, 12% or 16% for habitat areas (depending on the scenario) is broken down into gain by habitat grouping. The main loss from the development footprint is acid grassland and poor semi improved grassland, with smaller areas of woodland and scrub lost. The focus therefore was to create a sufficient gain in grassland types to demonstrably show a net gain in these habitat types, with a net gain also shown in the woodland and scrub grouping. It should be reiterated that that achieving a net gain in woodland is comparatively poorly scored given limitations in the Biodiversity 2.0 metric (refer to **Appendix N** for further detail), and given the very high baseline level of woodland in the combined Allocation Boundary and Mitigation Land (relevant to Scenario 1 only). In Scenario 1 therefore, the overall 57% net gain in grassland types is considered a strong and appropriate target for this project, of which the gain in acid grassland types is 27%. The gain for woodland and scrub habitat is lower at 3% overall, however note this represents 25.69 ha of new woodland and scrub habitat types. To aid visualisation, 25.69 ha equates to 31 full sized UK football pitches[15] of new woodland and scrub habitat types over the Allocation Boundary and Mitigation Land (in comparison to the small area lost as part of the proposals). Comparatively, Scenario 2 results in a 7% gain in woodland and scrub habitats, with 57% gain on grassland types, and Scenario 3 results in a 7% gain for woodland and scrub habitats with a 53% gain in grassland. Whilst it takes a different approach to the calculation, Scenario 4 achieves a 9% gain in woodland and scrub types and 65% gain in grassland types. A 10% or greater net gain to biodiversity for woodland and scrub habitats is considered easily achievable through enhancement of existing (retained) woodland and scrub to be defined in the later stages of this project.

[15] Using the larger 0.82ha as the size of a full UK football pitch https://www.reference.com/science/many-football-pitches-hectare-c79dcfb34def6acb

Table 5: Summary of Avoidance, Mitigation, Compensation and Enhancement Measures for the Key Ecological Features

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
Walking Routes, including measures to keep residents 'on the path', reduce littering, and dog walking on 'off the path' areas This is likely to include advertised circular routes, a mix of surfaced non-motorised user paths (making them accessible for a range of users) and more informal paths, information boards to encourage residents to use the identified walking routes (including justification as to why this is important for the area's biodiversity), dog waste bins, use of sandy mounds along the paths (see below) planted with shrubs to further encourage users to remain on the path (whilst also providing benefits to a range of species), use of planting (prickly and dense scrub) in Birch Brook to discourage off-route walking, provision of seats and bins along the paths. Routes would be unlit where possible (especially outside of the main built footprint) of the scheme to avoid light disturbance issues with light sensitive species.	M	M	M	M	M	M/ C	M	M/C	✓
Acid grassland creation **Appendix L** provides further information in relation to this. In summary however, soil sampling was completed (**Figure 24**) and the result analysed to consider which fields in the mitigation land were suitable for restoration to acid grassland (noting the fields have had their pH artificially increased using lime application for agricultural use in the recent past). The analysis and subsequent review identified that a range of fields are suitable for	-	-	C	C/E	C/E	C/E	C/E	C/E	✓

[16] Native, local, varied, appropriate to location and setting

[17] Roosting, Commuting and Foraging, to include barbastelle

[18] Further detail in relation to the avoidance, mitigation and compensation for species which are not considered key to the allocation will need to be addressed and defined at the planning application stage. For further information please refer to **Appendix L**.

[19] This gives an indication of whether this measure will contribute to net gain calculations to biodiversity (see above and **Appendix N**).

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
restoration to acid grassland (noting the underlying soil conditions are sandy / loamy soils, conducive to reversion to acid conditions). A literature review has been completed (refer to **Appendix L**) which includes examples of acid grassland creation from arable land at RSPB Minsmere, and heathland creation in Shropshire. Other ecological consultants were also consulted on acid grassland creation, including Dr Philip Putwain (who jointly supervised early academic research (PhD student) or led the RSPB Minsmere and Shropshire examples respectively). Together this has supported the development of a high level strategy to restore the habitat at Middlewick Ranges, and includes the following key stages (noting there are a number of possible variations, to be defined within the detailed strategy): 1) Cessation of lime application 2) Application of a sulphur and sand mix 3) Repeat pH testing to review revised levels 4) Repetition of stage 2 and 3 until an acceptable pH reached 5) Deep ploughing of top soil layer in order to expose infertile subsoil 6) Seeding with commercial acid grassland mix, green hay from nearby SSSI acid grassland (in MOD's ownership), and translocation of turves from acid grassland to be lost from the Allocation boundary). A mix of all three methods likely to be required. 7) Monitoring and maintenance to enable remedial work as required until an acid sward is established throughout. Whilst the above strategy is indicative, costings for the above have been factored into the wider project's viability assessment. Consideration should be given to submitting a Conservation Evidence article following completion to provide further evidence of methods and techniques.									

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
Further aspects for consideration at later stages of the project are: - Completion of trial pits to understand the full topsoil and subsoil profile. If subsoil levels have a higher sand content, then completion of a deep plough (to bring subsoil to the surface) may be a cost effective solution in the early stages of land preparation as it may reduce the requirement for sand and sulphur addition. This was a successful undertaking in the Shropshire project (refer to **Appendix L**). - Preparation of trial areas for acid grassland creation in advance of the main works, to inform or refine the later stages of the strategy. The aim would be to complete these areas in advance of finalisation of a detailed strategy, so that detailed methods to be applied on a much larger scale can be refined to maximum efficiency. - Consideration of the commencement of soil preparation in the masterplan area prior to commencement of development activities, to give time for the soil conditions to respond to changes in pH. This would be imperative to the practical use of turves from the ranges. The detailed strategy would be expected to define the following: - Ultimate habitat target condition, and realistic timescales (habitat creation of acid grassland may be achievable within, for example 5 years, however establishment of U1 NVC community could be expected to take longer (based on literature review)). - Green hay source location (i.e. one location, multiple locations applied spatially separately, or multiple locations applied uniformly).									

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
- Detailed methods for all stages, and targets which need to be met prior to moving onto the next strategy item. - Remedial measures for plausible scenarios of failure or ambiguity, for example, unstable pH levels following sulphur treatment, poor uptake of seed or presence of undesirable species in sward (note, management of undesirable species in the sward is expected to be achieved through cutting regimes, rather than application of herbicide (in the first instance). - Management prescriptions for both early establishment and beyond. - Monitoring methods and thresholds for remedial action. - Clarity on spatial separation of methods, need for meticulous site record keeping, and adherence to agreed protocols; all to facilitate the scientific interpretation of success to inform future similar projects. **Appendix M** includes a letter of comment from Dr Philip Putwain (a leading ecologist in the field of heathland and acid grassland creation) in relation to the above defined high level strategy.									
Bat Hibernation Structure Whilst no bats were found to be hibernating in the toilet block in the Markers Gallery in 2018-2019 winter, there will be a loss of this structure, which could **support hibernating bats**. The exact form of such a structure would be defined at the planning application stage (dependent upon update field survey results), and could be designed within part of a tactical training building (such as within a 'stone tent'). The below text summarises the key variables for barbastelle hibernation, based on current research.	-	-	-	-	C / E	-	-	-	-

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
A study undertaken by De Boer et al found that "the internal building variables (mainly the size of hibernacula and the number of hiding possibilities) affected the hibernating bat abundance and species richness. Climatic variables, such as changes in temperature and humidity, were less important". This study also found that "the absence of human use and public access enhanced hibernation site suitability, but the internal size-related variables had the greatest positive effect on hibernation site suitability" (De Boer et al, 2013). The suggested location for this structure is shown on **Figure 18**. To design the structure to be suitable for a range of species, including barbastelle, the following design elements should be considered (based on current research): the following points should therefore be considered when creating a new structure: ▪ Hibernation sites should be sufficiently large to achieve stable winter temperatures of 0-6ºC for Vespertilionid bats (Mitchell-Jones, 2004). If creating a structure which needs to provide habitat suitable for hibernating barbastelle, then a lower temperature of 0 - 3 ºC is more appropriate (Ian Davidson-Watts, pers comm); ▪ In order to achieve optimal climatic conditions (humidity and cool temperatures) the structure should be partially sunk into the ground; ▪ A number of structural features should be provided within the interior of the structure to provide a varied range of potential hibernation opportunities. These could include but need not be limited to the provision of bat boxes on internal walls, the provision of wooden baffles affixed to walls to provide crevices for bats and/or cavities could be drilled into sections of the wall to provide cavities for bats to hibernate within;									

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
▪ The ecologically preferred location for the structure would be for it to be sited within the fields to the south of the Site (to the south of the Birch Brook woodland), preferably on or adjacent to one of the established treelines ensuring good connectivity with the local landscape; ▪ Consideration should be given to making the building as resistant to damage by vandalism as possible. Doors can be reinforced and sited some way above ground level to make it difficult to damage them; flammable materials that can be reached from ground level should be avoided. Planting thorny shrubs around the building may also help to discourage trespass by making access difficult (Mitchell-Jones, 2004); and ▪ The access/egress point for bats should be unobstructed but should face the treeline allowing bats efficient access to commuting features (treelines). The entrance should measure 50cm x 50cm and should have widely spaced bars to prevent access by members of the public.									
BMX Track (or similar sandy bike track) A key feature of the habitat mosaics, and elsewhere within the grasslands, are the areas of bare ground, including exposed substrate on various aspects, creating micro-cliffs. These features are maintained through the existing land use (bunds disturbed by military activity) and rabbit *Oryctolagus cuniculus* grazing and burrowing. Post-construction, whilst initial creation will remain for a relatively short period, the ongoing maintenance of bare ground becomes a persistent challenge, particularly if rabbit populations became unsustainable due to predation of their young by domestic cats, or simply through lack of suitable habitat. Therefore, it is suggested that an area is designed for recreation, such as a BMX track, which will provide habitats for invertebrates through creation an uneven topography whilst also providing social benefits to the community. The regular use of the BMX tracks can reasonably be expected to maintain open areas through erosion (to be	-	-	C / E	C/ E	C / E	C / E	C / E	C / E	✓

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
viewed as an ecologically positive occurrence) and thus provide nesting habitat for the known important solitary bee and wasp populations. By connecting/ surrounding this feature with a nectar-rich resource and embedding it into the landscape design such that it provides a corridor, maintaining connectivity with the adjacent LWS, this will offer a habitat compensation solution which also provides amenity benefit. Provision of such an area in a targeted manner may also reduce the informal creation of cycle tracks, thereby reducing the potential impact of recreational pressure elsewhere in the Mitigation Land. The BMX track would ideally be located in the south eastern part of the Allocation Boundary, or immediately outside it, in close proximity to the retained habitat of the LWS.									
Low sandy bunds planted with nectar rich shrubs Provision of nectar-rich planting and suitable shrubs on low sandy bunds to demarcate edges of footpaths within the retained LWS, north of Birch Brook. These low sandy bunds should mimic the firing lines within the firing ranges, and seek to encourage members of the public to remain on demarcated paths, but also provide significant areas of habitat for terrestrial invertebrates. Whilst main driver is terrestrial invertebrates, benefits will be provided for multiple species groups. Suitable planting can be defined at the planning application stage, however broom *Cytisus scoparius*, and heather *Calluna vulgaris* could be suitable species to provide cover.	-	-	C / E	C / E	C / E	C / E	C / E	C / E	✓
Retention and provision of taller swards Retention and provision of taller swards, including tall ruderal vegetation associated with scrub, hedgerow and woodland edge. Whilst these habitats may be botanically less valuable in terms of comprising ubiquitous and widespread species such as common nettle *Urtica dioica*, hogweed *Heracleum sphonylium*, cow parsley *Anthriscus sylvestris*, and/ or tussock-forming grasses including cock's-foot *Dactylis glomerata* or false oat-grass *Arrhenatherum elatius*, they nevertheless provide relevant supportive habitat for many invertebrates, including those associated with the shorter acid grassland communities recognised for their botanical as well as invertebrate interest. Their value	-	-	C / E	A / M / C / E	M / C / E	M / C / E	M / C / E	M / C / E	✓

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
lies in providing breeding, roosting or overwintering sites for various species that may rely on the acid grassland and/ or habitat mosaics. These taller vegetation communities offer shelter and provide higher humidity environments for species that are less tolerant to desiccation during extended periods of hot, dry spells. Whilst main driver is terrestrial invertebrates, benefits will be provided for multiple species groups.									
Housing and LWS Interface Where housing and particularly gardens will front onto the retained habitat, a buffer area of scrub mosaic planting should be provided along the boundaries of these houses (the current masterplans include this, alongside a SuDs network). This seeks to provide two key benefits for terrestrial invertebrates (as well as benefits for other species groups). Firstly it will seek to replace the high value habitat lost at the north of the ranges but also provide a barrier to the potential impacts of proximity between residential gardens and targeted habitat retention. The potential impacts of proximity (in the absence of a planted buffer area) includes cultivar or garden escapes establishing within the retained LWS, decreased species diversity resulting from residents dumping high nutrient compost waste over their boundary fencing, and increased disturbance and habitat degradation as residents create direct access to the LWS from their boundary fences.	-	-	M/C/E	M / C / E	M / C / E	M / C / E	M / C / E	M / C / E	✓
Provision of **new woodland, scrub and hedgerow** habitat in the Mitigation Land	-	-	C/E	C/E	M/C/E	M/C/E	M/C/E	M/C/E	✓
Targeted Thinning of Birch Brook LWS Targeted thinning of the trees within the Birch Brook LWS, particularly western boundary of the Allocation Boundary would create a more structurally diverse habitat which would benefit a range of species groups.	-	-	E	E	E	E	E	E	✓

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
New nesting opportunities for birds within new structures themselves such as nest bricks for species in decline such as swifts *Apus apus*, house sparrows *Passer domesticus* and starlings *Sturnus vulgaris*.	-	-	-	-	-	-	C/E	-	-
New roosting opportunities for bats within trees and new structures.	-	-	-	-	C/E	-	-	-	-
Creation of **waterbodies** and / or wetland features	-	-	E	E	E	E	E	E	✓
Scrub Margins The creation of dense scrub margins to the woodland (e.g. 8 – 14m deep) would potentially benefit species such as nightingale, although a greater buffer (e.g. woodland grading through dense scrub into diverse grassland) would aid with reducing potential impacts from public disturbance, light spill and cat predation. Further benefits would be provided to other species.	-	-	M/C/E	C/E	M/C/E	M/C/E	M/C/E	M/C/E	✓
Dog Control Measures to limit or reduce potential disturbance and predation by pet dogs within retained habitat may need to be considered if a residential application is put forward. This could include the provision of clear paths to promote use of some areas whilst discouraging use in other parts of the Site (i.e. to create less disturbed refuge areas). Enforceable Dog Control Orders could also be explored for parts of the retained landscape to ensure dogs are kept on leads.	-	-	-	-	M	M	M	M	-
Open Grassland Provision The developable area will likely have an impact of some ground nesting species of conservation concern such as skylark. Compensation for such losses can be provided through improvement of some of the open grassland in the Mitigation Land (south of the central woodland). This would involve diversifying the grassland structure and plant species diversity through appropriate management to provide additional nesting habitat	-	-	-	C/E	C/E	C/E	C/E	C/E	✓

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
for skylark (and other species). This may also benefit species such as barn owls *Tyto alba* if present locally (by providing new foraging habitat). Initial establishment, monitoring and adaptive management of the Mitigation Land will be detailed in a Land and Environmental Management Plan (LEMP). Longer term management and use of the Mitigation Land by the military will be addressed via the DIO's Integrated Rural Management Plan (IRMP) and Standing Orders (SOs) for the Colchester Training Areas. Detailed provisions of the LEMP and IRMP / SOs will require clarification at the application stage.									
Woodland Proximity Inclusion of a 50 m buffer to the developable area from the woodland (achieved through masterplanning) and a lighting plan to avoid and minimise the potential impacts on barbastelle bats movements and favoured prey items such as noctuid moths (Zeale *et al*, 2011).	-	-	M	-	M	M	M	M	-
Connectivity – Mitigation Land Habitat enhancements will also be made barbastelle bats for the non-developable areas to proactively support the local maternity population in the Donyland Woods complex. This will include the conversion of arable habitats between Donyland and the Birch Brook to semi-improved grassland (increasing the diversity and quantity of invertebrates). In addition, hedgerow/treelines will be managed more favourably for wildlife and the extent of broadleaved woodland will be increased providing sheltered foraging sites, commuting routes and further roosting habitat for barbastelle and other tree roosting bat species (e.g. Natterer's and Daubenton's bat). Initial establishment, monitoring and adaptive management of the Mitigation Land will be detailed in a Land and Environmental Management Plan (LEMP). Longer term management and use of the Mitigation Land by the military will be addressed via the DIO's Integrated Rural Management Plan (IRMP)	-	E	E	C/E	C/E	C/E	C/E	C/E	✓

Mitigation / Compensation / Enhancement Measure pertinent to Key Ecological Features[16]	Designated Sites (International)	Designated Sites (National)	Designated Sites (Local)	Habitats	Bats [17]	Invertebrates	Birds (including nightingale)	Other (Non-Key) Species Group[18]	[19][20]Net Gain to Biodiversity
and Standing Orders (SOs) for the Colchester Training Areas. Detailed provisions of the LEMP and IRMP / SOs will require clarification at the application stage.									
Mosaic Habitat The habitats in the Mitigation Land could be further enhanced by creating additional mosaics of habitat as well as enhancing open grassland. This could include allowing natural out-growth of trees and scrub from some of the existing boundary features or planting of new small areas of scrub and tree cover.	-	-	C/E	C/E	C/E	C/E	C/E	C/E	✓
Revision of Local Wildlife Site Boundary The Middlewick Ranges LWS boundary will require revision, either as part of a planning application or the next scheduled LWS review to respond to development proposals at Middlewick Ranges (as appropriate to the project stage). The revision is expected to remove the built footprint from the LWS boundary; the retained habitats would still be expected to achieve the current LWS selection criteria. There is potential to positively amend the LWS in two ways; 1) To the east, outside the Allocation Boundary, to meet the existing field boundary (refer to Parcel 72 on **Figure 26**). 2) It may also be possible to explore the designation of the proposed, newly created acid grassland (and neutral grassland) parcels in the Mitigation Land once established, should they meet the criteria for designation as LWS (either as a second parcel of the same LWS or a standalone LWS). Parcels to be considered for inclusion within a new or extended LWS would preferentially mirror the existing Middlewick Ranges designation criteria, being acid grassland, and the terrestrial invertebrate assemblage. The latter of which requires a range of grassland types (hence inclusion of both acid and neutral grassland areas may be appropriate).	-	-	C/E	-	-	-	-	-	-

8 Conclusion

8.1.1 This document has presented the methods and results of targeted ecological desk study and field surveys completed over the past 3 years to determine the ecological baseline in respect of the allocation of land at the Middlewick Ranges site for development. The studies have defined the 'key' ecological considerations for the proposed housing allocation, and subsequently formed the basis of a comprehensive mitigation strategy to inform the masterplan, and future stages of the project.

8.1.2 The key ecological considerations were defined as internationally designated sites (specifically, Abberton Reservoir Ramsar Site and SPA, Colne Estuary Ramsar Site and SPA, Essex Estuaries SAC, and Blackwater Estuary Ramsar Site and SPA); Roman River SSSI; Birch Brook and Middlewick Ranges LWS; acid grassland; mature broadleaved semi-natural woodland habitat; Barbastelle roosting, foraging and commuting habitat; breeding bird habitat; and terrestrial invertebrate habitat. Key ecological considerations should not be confused with important ecological features scoped into assessment within an EcIA. Ecological features can be both 'important' in EcIA terms (for the purposes of impact assessment work at a planning application) but not 'key' to defining the viable developable area for allocation. All the ecological considerations to development, and the opportunities to provide biodiversity benefit will be carefully considered at the planning application stage of this scheme.

8.1.3 The influence which the key ecological considerations have had upon the development footprint, and evolving masterplan designs have been summarised, alongside an ecological appraisal of the current masterplan (PRP Concept Masterplan Dated 28/09/20) to demonstrate its ecological viability. The high-level avoidance, mitigation and compensation measures relevant to the key ecological considerations have been detailed; these measures have been defined to evidence the scheme's viability in ecological terms. A metric has been completed which demonstrates a minimum of a 9% net gain to biodiversity (habitat areas) can be achieved (using the example enhancements to the habitats in the 'Mitigation Land'), and noting this metric has been completed on a precautionary worst case basis (refer to **Appendix N**). The Mitigation Land is in MOD ownership and is being retained and enhanced for military training with the key mitigation, compensation and enhancement measures have been considered and shown to be viable and deliverable.

8.1.4 The masterplan prepared (PRP Concept Masterplan Dated 28/09/20) responds to the key ecological considerations, and measures to avoid, mitigate and compensate for impacts upon the key ecological considerations have been defined. These measures, including an illustration of enhancements to the Mitigation Land that could be undertaken which achieve a net gain to biodiversity are deliverable.

8.1.5 Whilst further ecological survey and assessment work required to inform a planning application, there is no reason from an ecological perspective why this site cannot be allocated in CBC's emerging local plan given development which is both legally and policy compliant (ecologically) is possible.

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10 Figures

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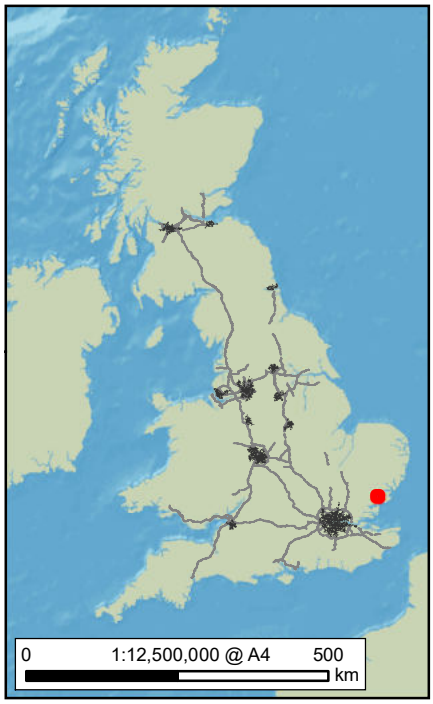

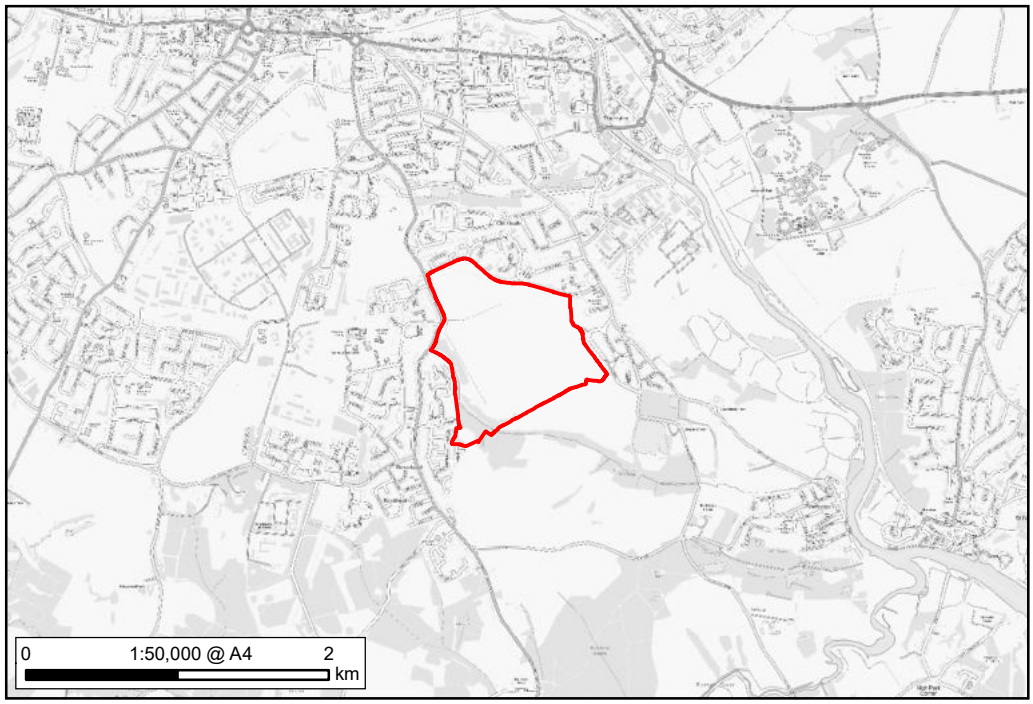

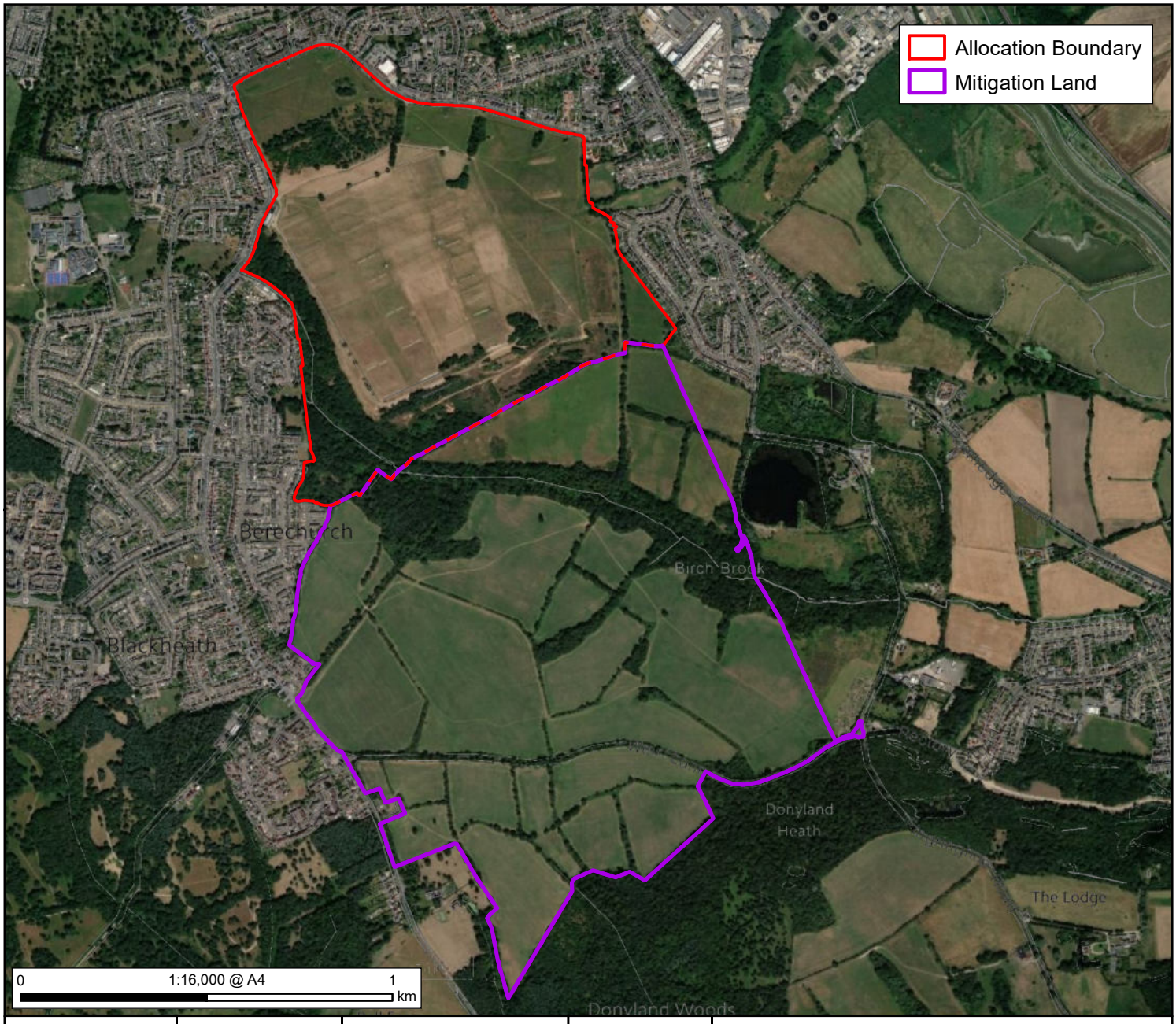

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MIDDLEWICK RANGES, COLCHESTER

Site Location Plan

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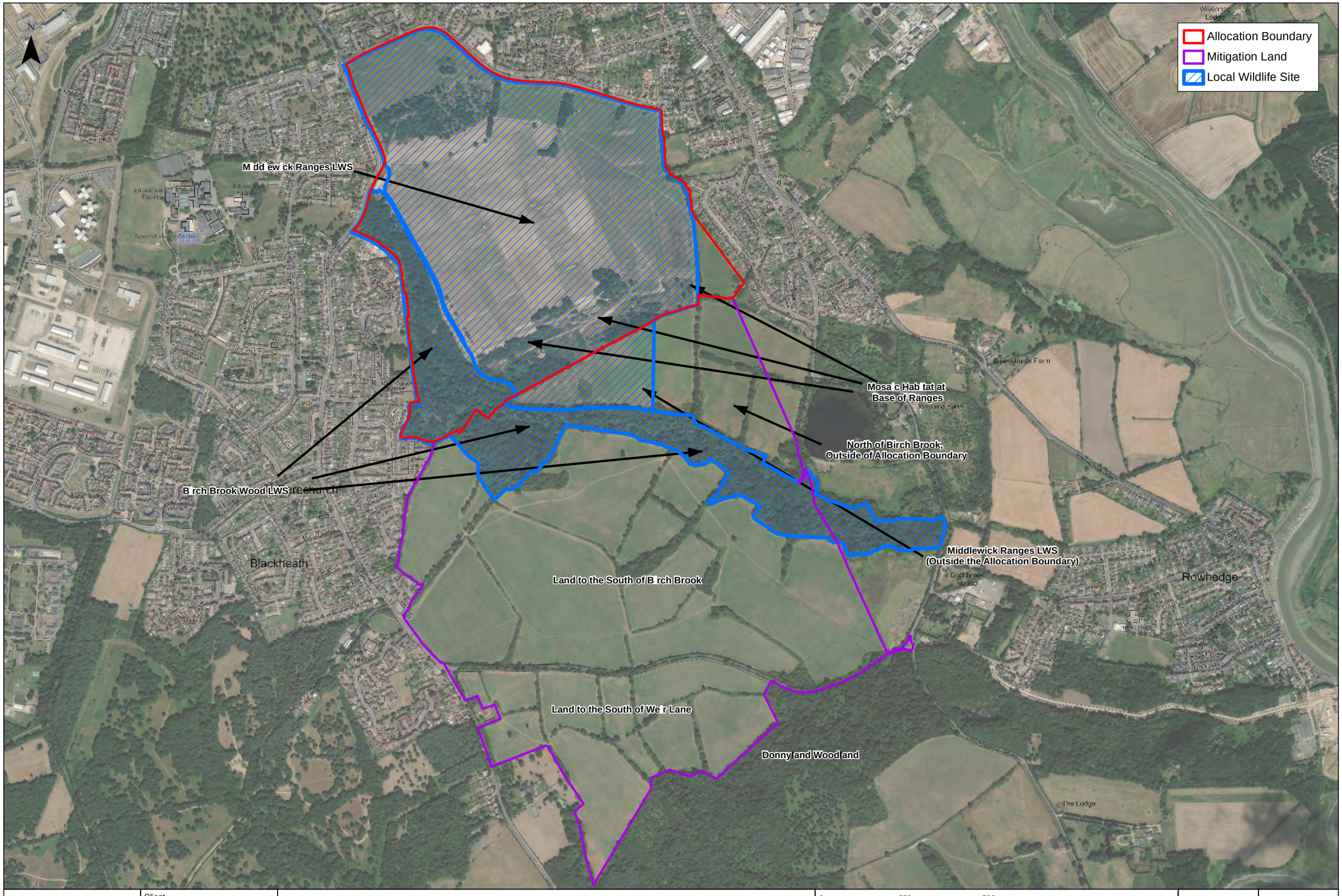
Figure 1 | Rev A



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Allocation Boundary
Mitigation Land
10km Buffer from Allocation Boundary
Ramsar
Special Areas of Conservation
Special Protection Area

Abberton Reservoir SPA and Ramsar

Colne Estuary (Mid-Essex Coast Phase 2) SPA and Ramsar

Blackwater Estuary (Mid-Essex Coast Phase 4) SPA and Ramsar

Essex Estuaries SAC

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MIDDLEWICK RANGES, COLCHESTER

European Designated Sites

0 2.5 5 km

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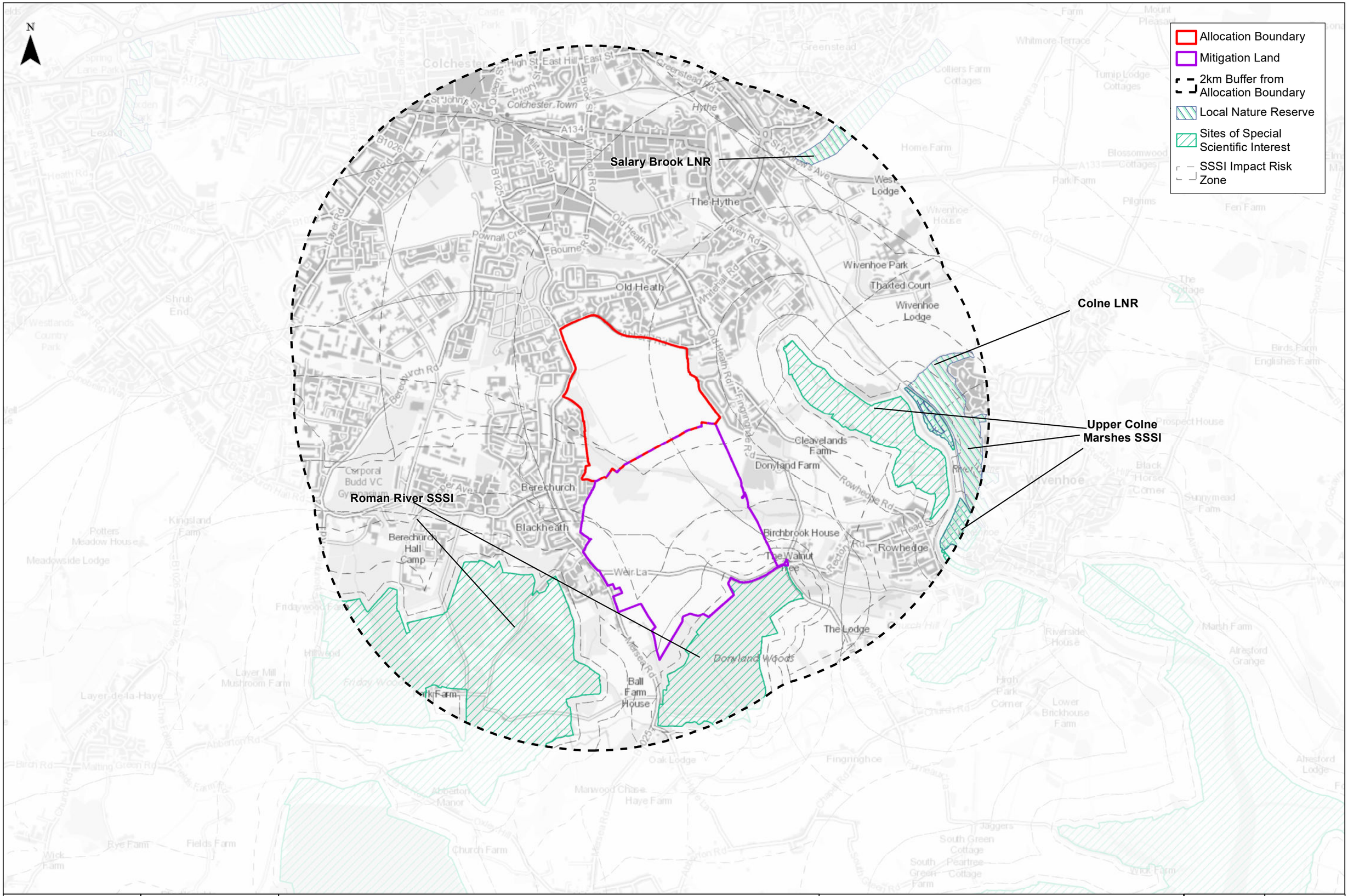

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MIDDLEWICK RANGES, COLCHESTER

UK Statutory Designated Sites

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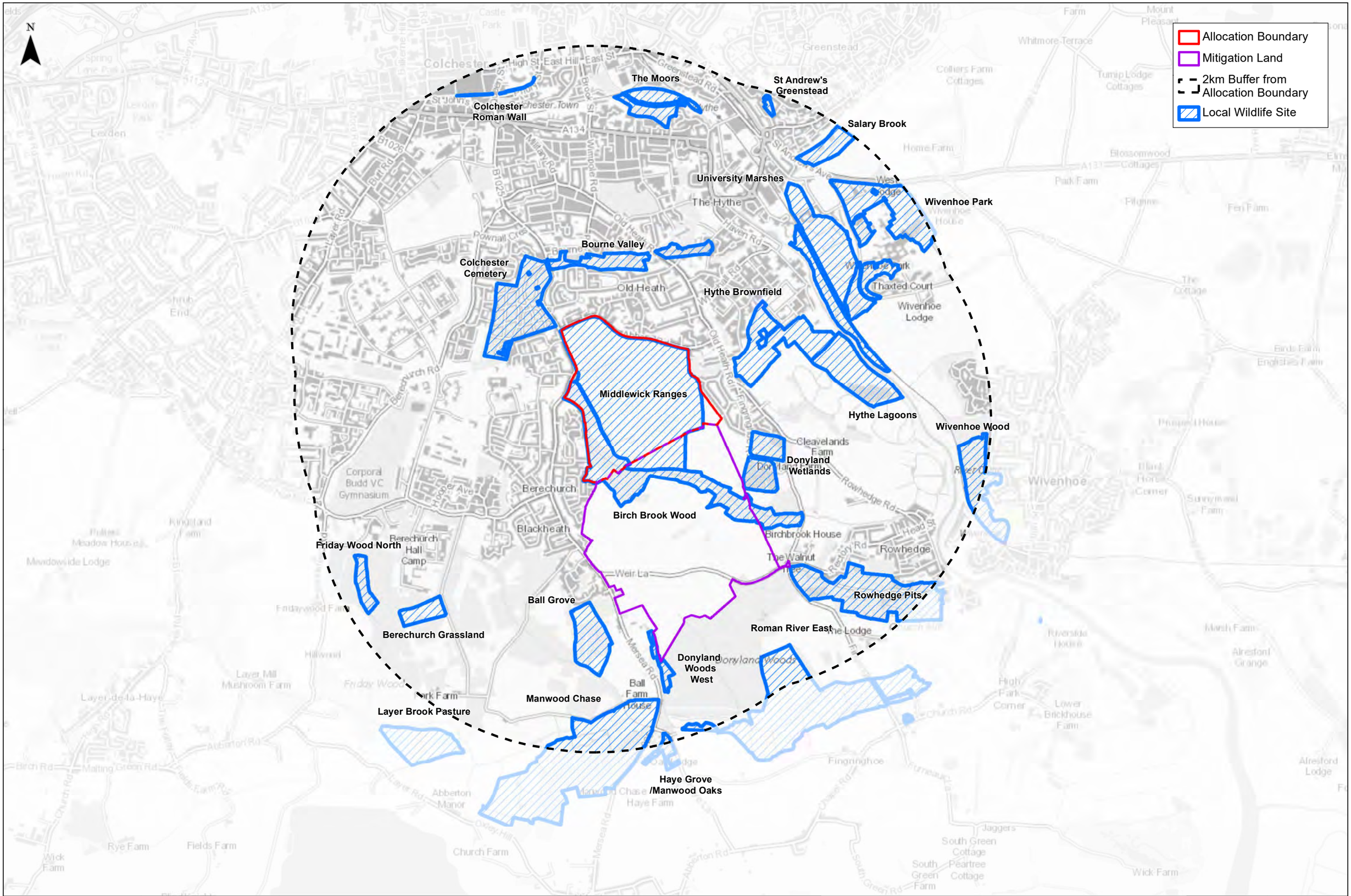

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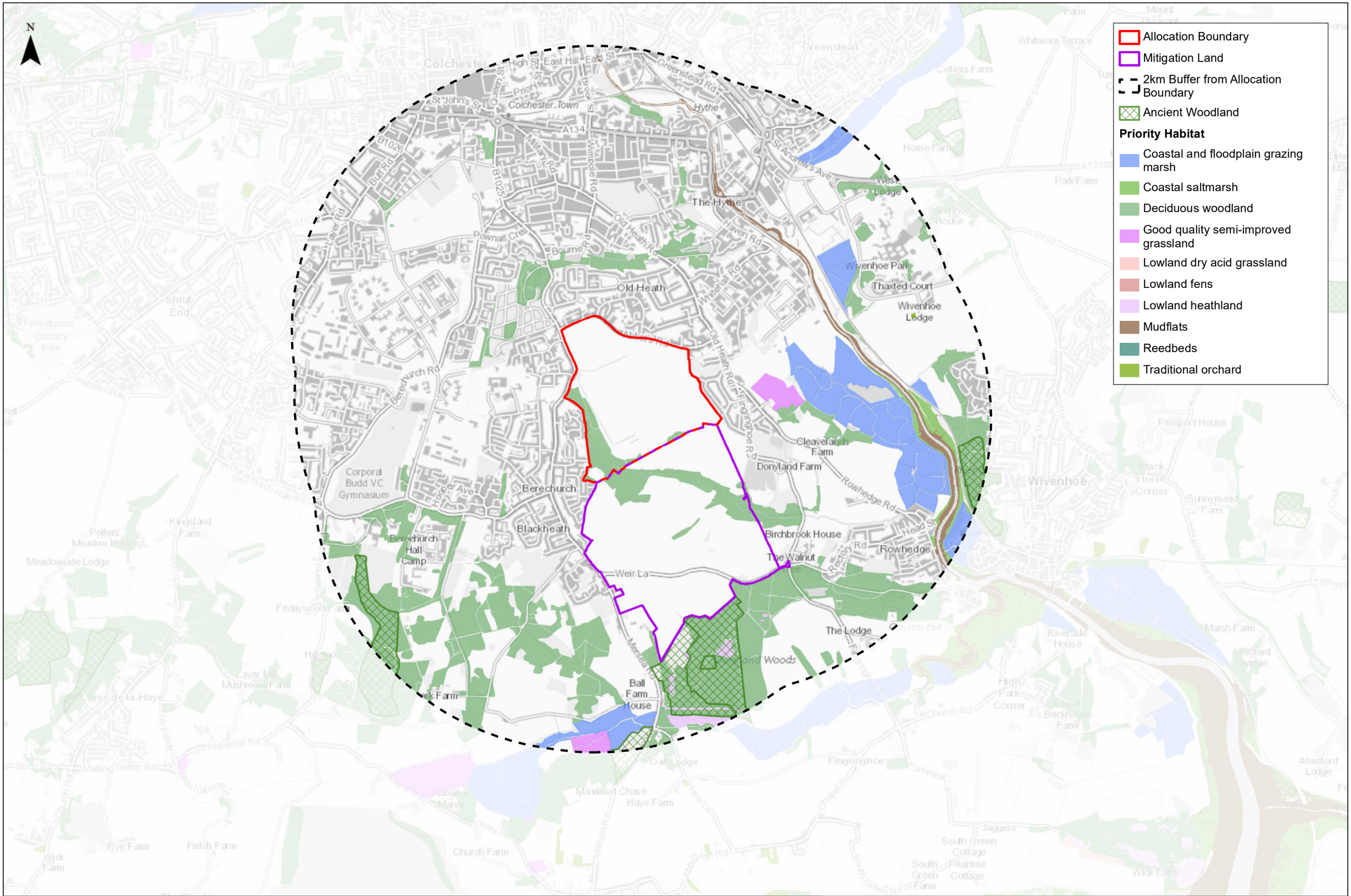

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MIDDLEWICK RANGES, COLCHESTER

Ancient Woodland and Habitats of Principal Importance (HPI)

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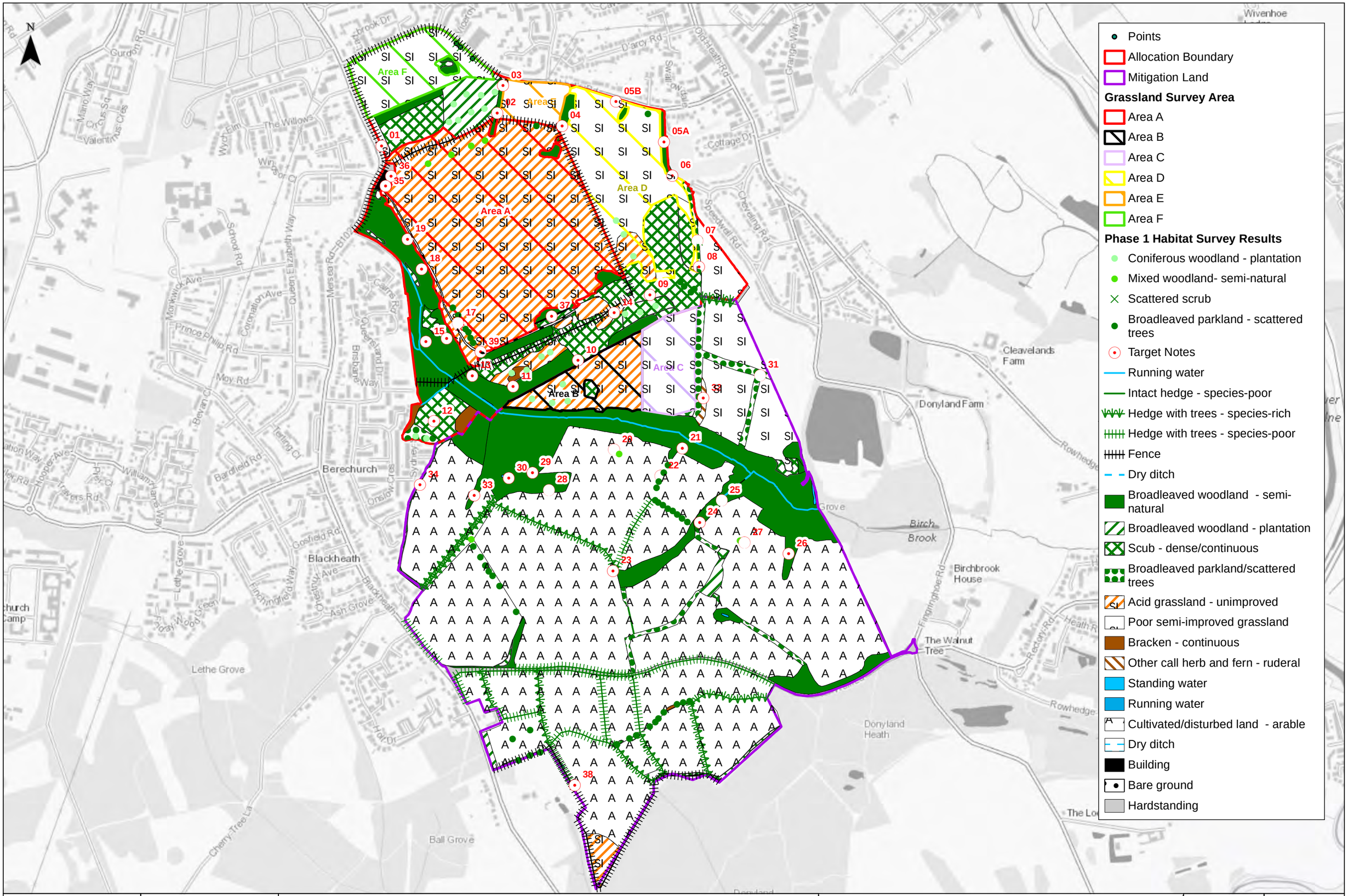

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MIDDLEWICK RANGES, COLCHESTER

Habitat Survey Areas and Results

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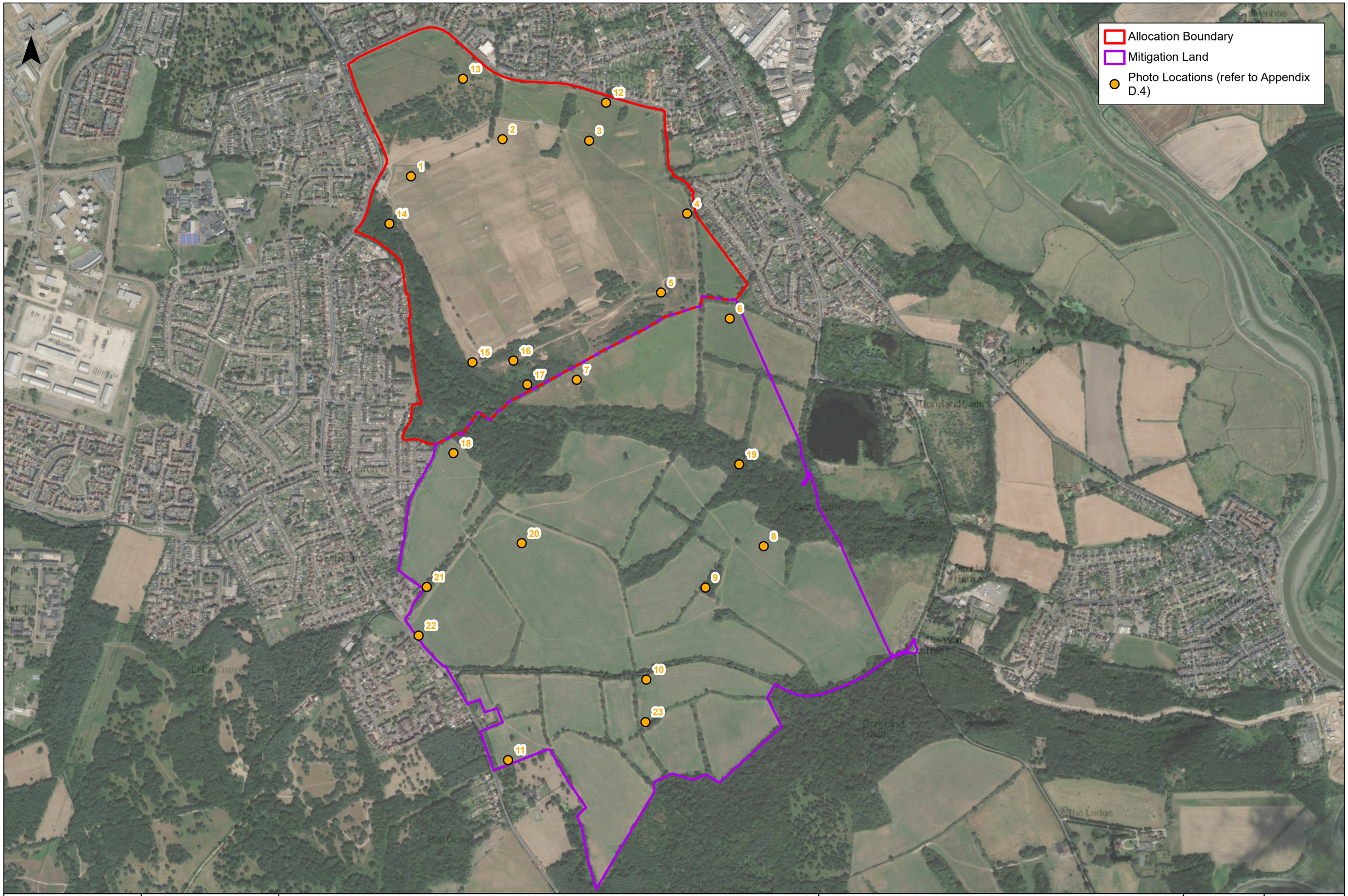

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MIDDLEWICK RANGES, COLCHESTER

Otter Survey - Target Note Locations

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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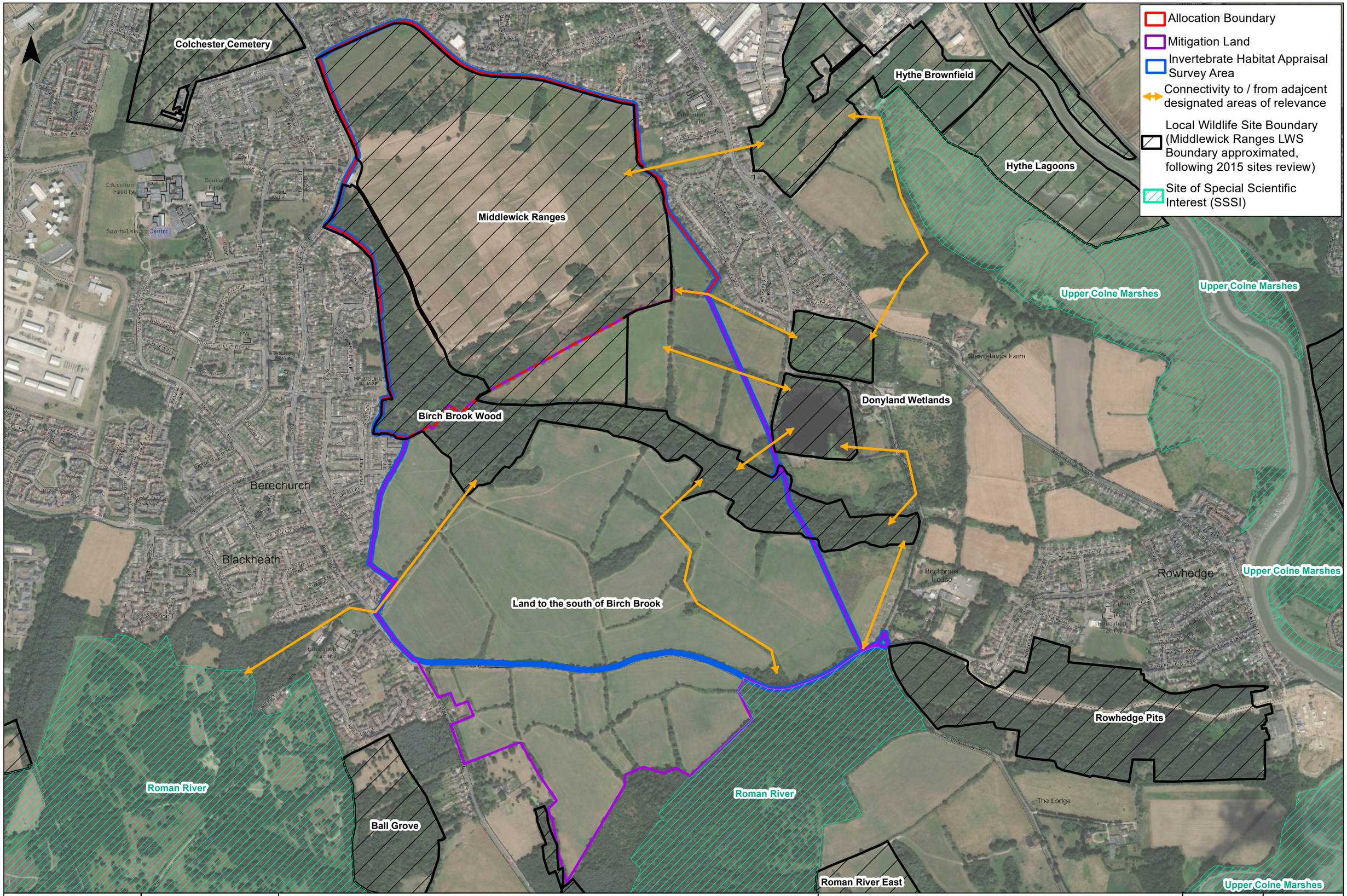

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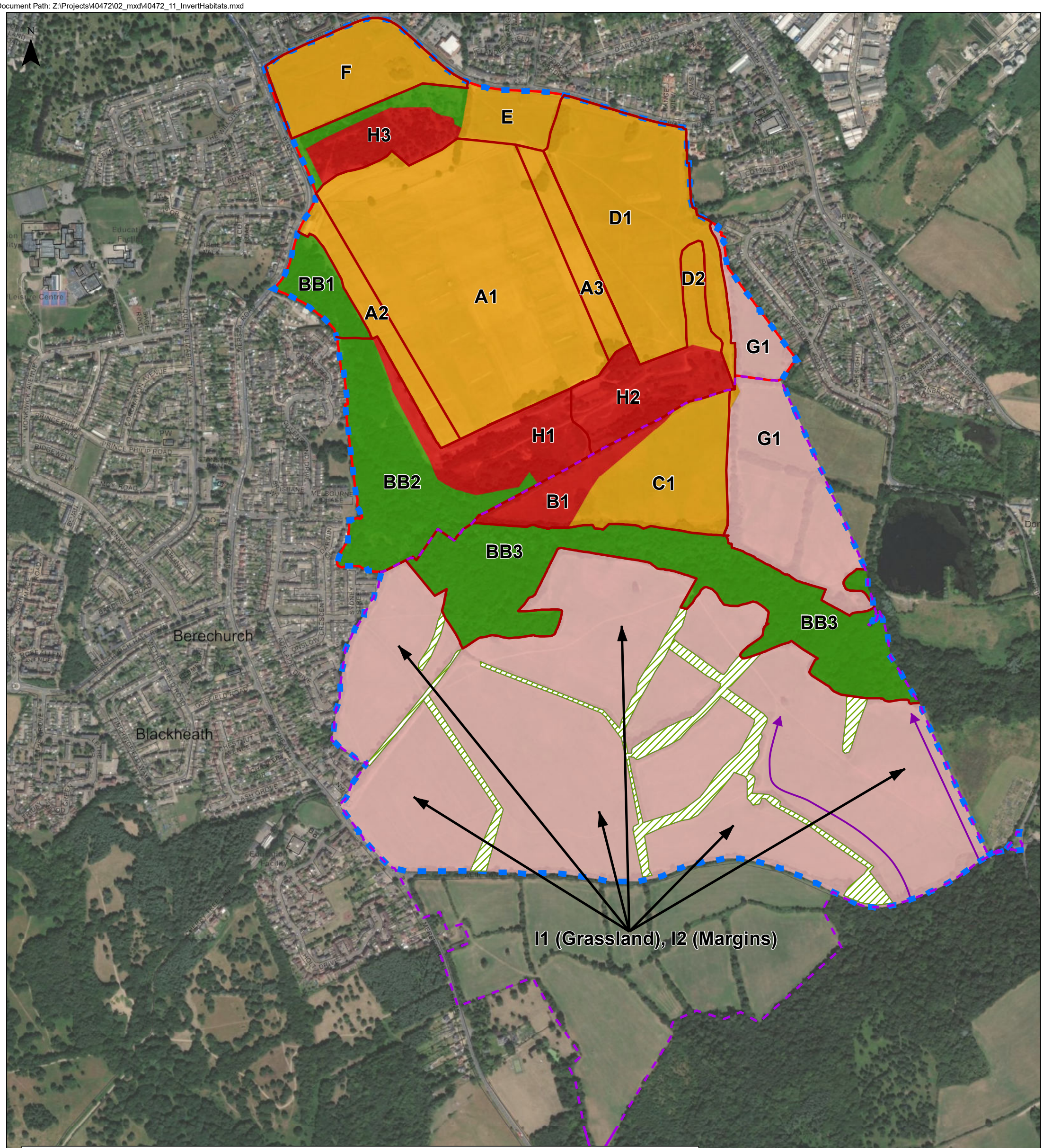

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Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

Invertebrate Habitat Appraisal Results

0 100 200 m

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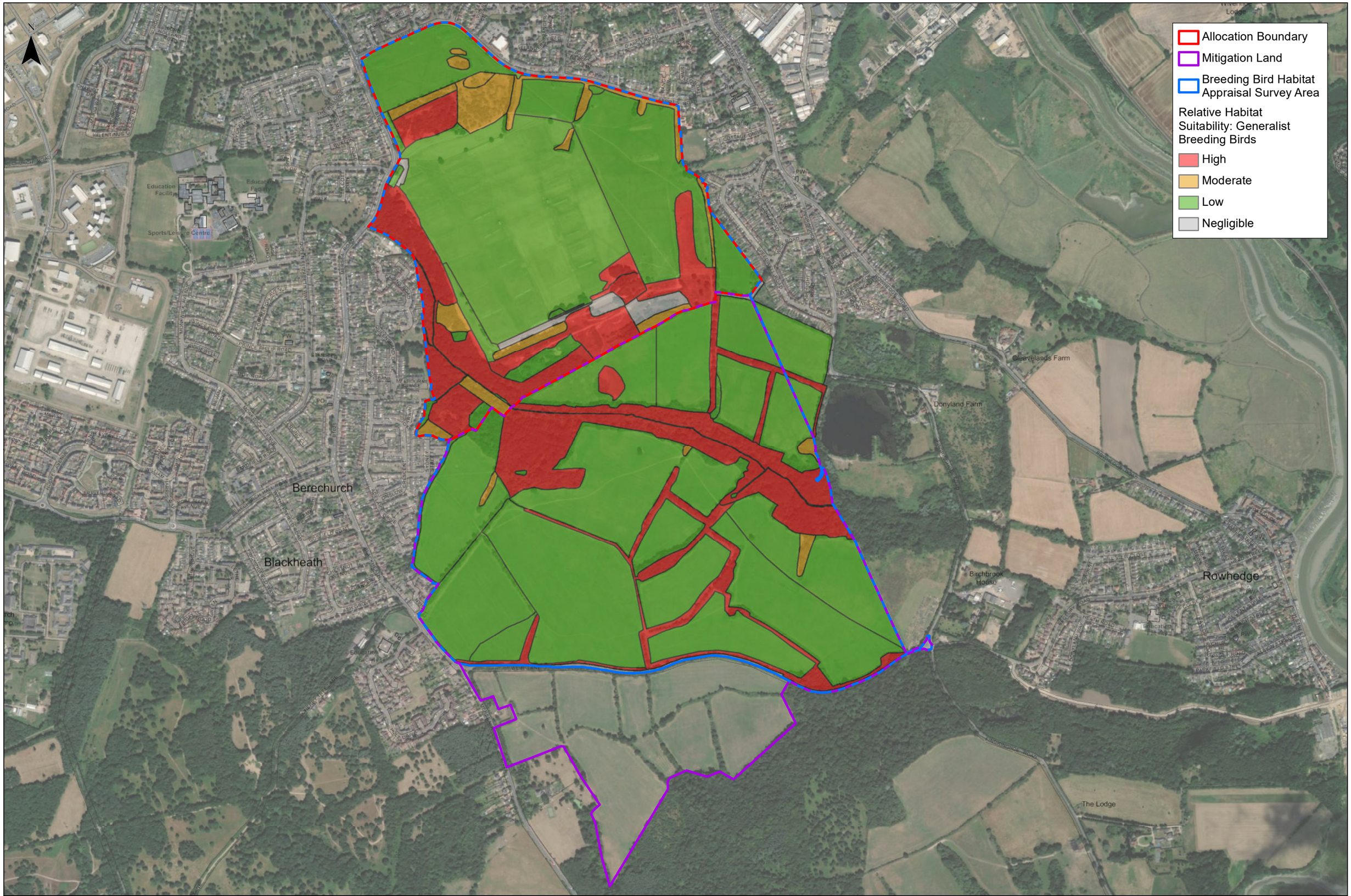

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Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

Habitat Appraisal: Generalist Breeding Birds

0 250 500 m

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure 12	Rev A

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Allocation Boundary
Mitigation Land
Breeding Bird Habitat Appraisal Survey Area

Relative Habitat Suitability: Ground Nesting Breeding Birds

High
Moderate
Low
Negligible
Small area of grassland unlikely to support ground nesting species

Education Facility
Education Facility
Sports Leisure Centre
Berechurch
Blackheath
Dory and Farm
Glenye Ends Farm
Birchwood House
Rowhedge
The Lodge

Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

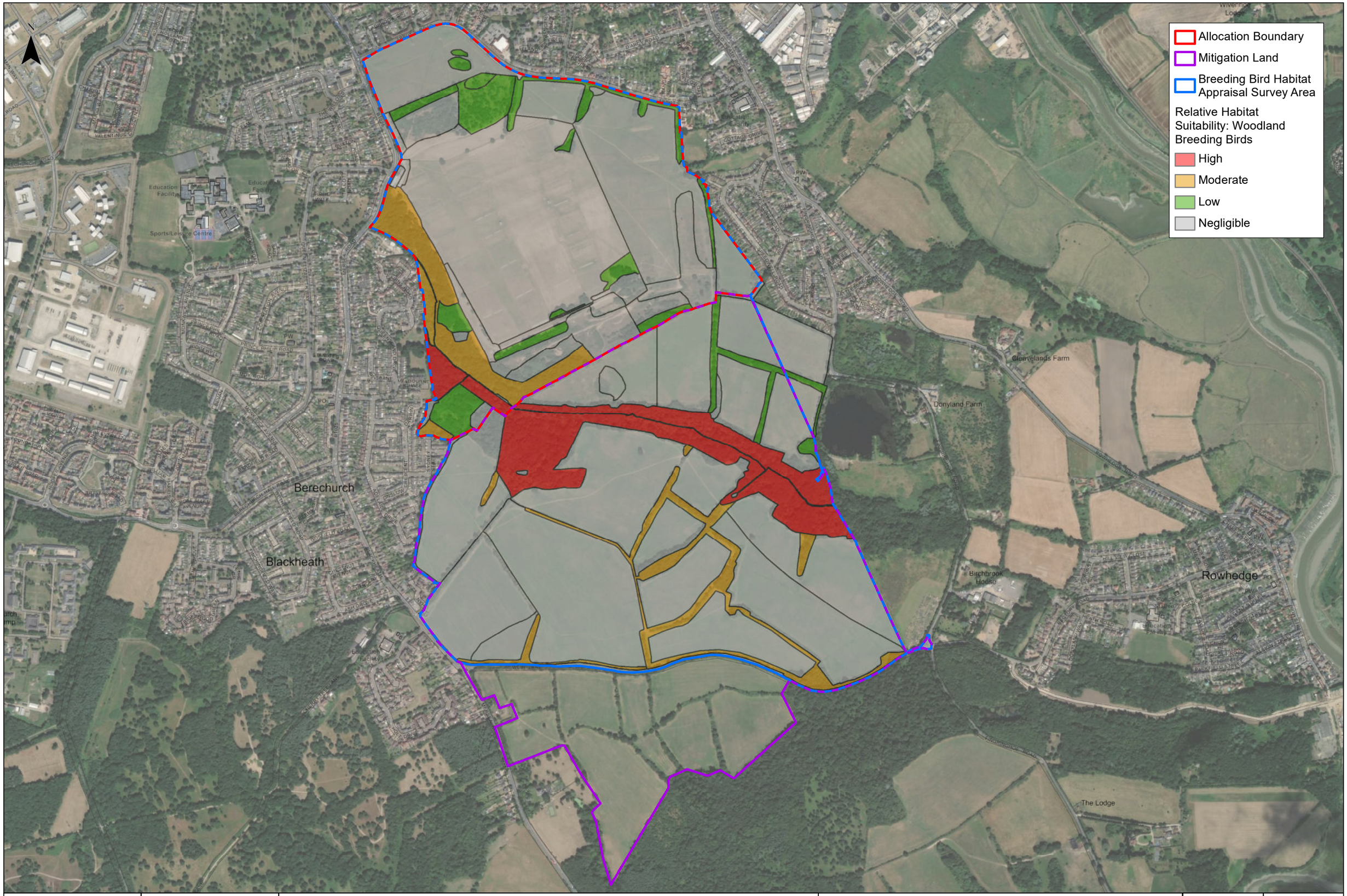
Habitat Appraisal: Ground Nesting Breeding Birds

0 250 500 m

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

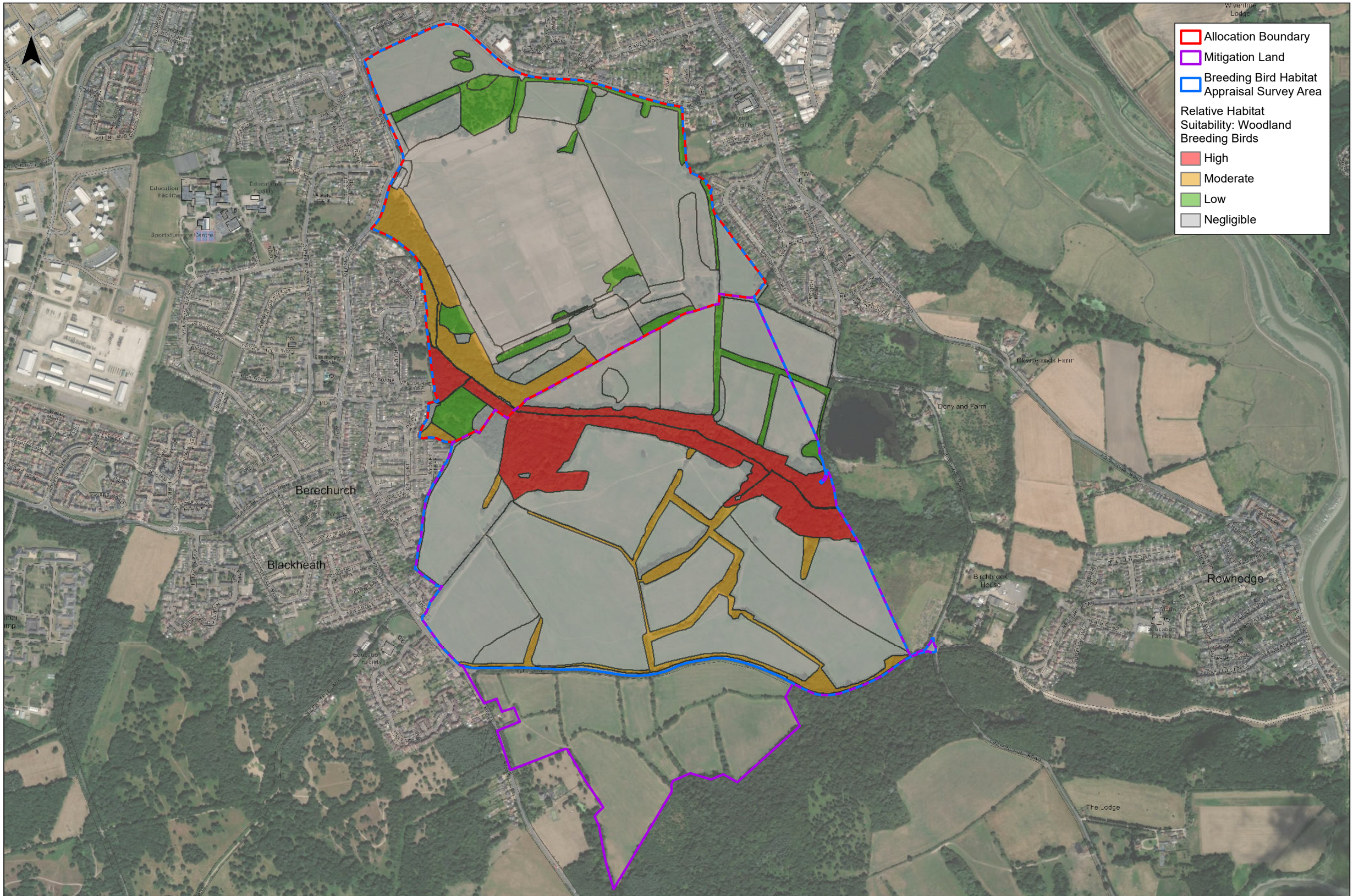
1:10,000 @ A3	Date: 18/05/2020
Drawn: TL	Checked: BS
Figure 13	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_13_GroundNesting.mxd



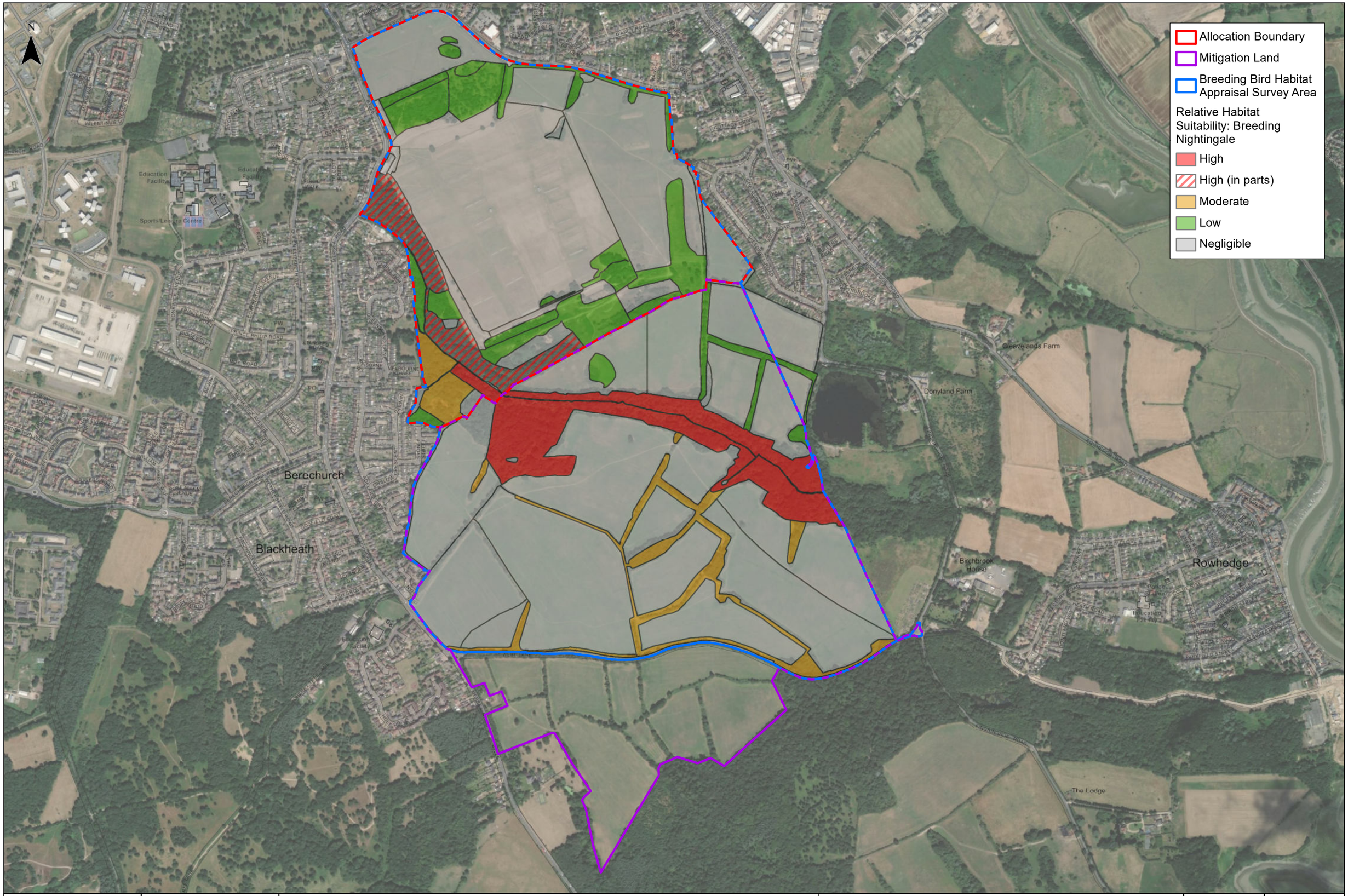
Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Habitat Assessment: Appraisal Breeding Birds	0 250 500 m Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Contains Ordnance Survey data (c) Crown copyright and database right 2019.	1:10,000 @ A3	Date: 18/05/2020
				Drawn: TL	Checked: BS
				Figure 14	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_14_Woodland.mxd



Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Habitat Appraisal: Woodland Breeding Birds	0 250 500 m Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Contains Ordnance Survey data (c) Crown copyright and database right 2019.	1:10,000 @ A3	Date: 18/05/2020
				Drawn: TL	Checked: BS
				Figure 14	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_14_Woodland.mxd



Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

Habitat Appraisal: Breeding Nightingale

1:10,000 @ A3	Date: 18/05/2020
Drawn: TL	Checked: BS
Figure 15	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_15_Nightingale.mxd

Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Activity Transect Route and Location of Automated Static Detectors	0 0.5 1 km Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Contains Ordnance Survey data (c) Crown copyright and database right 2019.	1:10,000 @ A3	Date: 18/05/2020
				Drawn: TL	Checked: BS
				Figure 16	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_16_BatActivityTransectRoute.mxd

Static S2:
19 total passes, of species breakdown:
- Leislers': 2
- Noctule: 1
- Common pipistrelle: 11
- Soprano pipistrelle: 5

Static S1:
363 total passes, of species breakdown:
- Long-eared bat: 7
- Myotis: 29
- Noctule: 2
- Common pipistrelle: 138
- Soprano pipistrelle: 187

Static S6:
66 total passes, of species breakdown:
- Barbastelle: 1
- Myotis: 5
- Noctule: 3
- Nyctalus sp.: 45
- Soprano pipistrelle: 12

Static S3:
57 total passes, of species breakdown:
- Long-eared bat: 17
- Myotis: 2
- Noctule: 5
- Nyctalus sp.: 1
- Pipistrelle (40khz): 1
- Common pipistrelle: 13
- Soprano pipistrelle: 18

Static S4:
174 total passes, of species breakdown:
- Barbastelle: 1
- Long-eared bat: 8
- Myotis: 3
- Common pipistrelle: 102
- Soprano pipistrelle: 49
- Nathusius' pipistrelle: 6
- Serotine: 4

Static S5:
9 total passes, of species breakdown:
- Noctule: 6
- Common pipistrelle: 1
- Soprano pipistrelle: 2

Allocation Boundary
Mitigation Land
Transect 1 Stop
Transect 2 Stop
Transect Route

Bat Species
Barbastelle
Common pipistrelle
Long-eared bat
Myotis sp.
Noctule
Soprano pipistrelle

Bat Species Detected at Static
Barbastelle
Common pipistrelle
Leislers'
Long-Eared
Myotis sp.
Nathusius' pipistrelle
Noctule
Nyctalus sp.
Pipistrelle (40khz)
Pipistrelle (50khz)
Serotine
Soprano pipistrelle

Berechurch
Blackheath
Donyland Farm
Birchbrook House
The Lodge
WEIR LANE

Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

Bat Activity Survey Results - September 2018

0 0.5 1 km

1:10,000 @ A3 | Date: 12/06/2020
Drawn: TL | Checked: BS
Figure 17a | Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_17a_BatActivitySurvey_Sept.mxd

Static S2:
5 total passes, of species breakdown:
- Soprano pipistrelle: 3
- Nasthusius' pipistrelle: 2

Static S1:
464 total passes, of species breakdown:
- Myotis: 70
- Common pipistrelle: 92
- Soprano pipistrelle: 277
- Pipistrelle (50khz): 25

Static S6:
19 total passes, of species breakdown:
- Myotis: 10
- Nyctalus sp.: 1
- Pipistrelle (50khz): 8

Static S3:
17 total passes, of species breakdown:
- Barbastelle: 2
- Long-eared bat: 6
- Myotis: 4
- Noctule: 1

Static S4:
203 total passes, of species breakdown:
- Barbastelle: 4
- Long-eared bat: 4
- Myotis: 2
- Nyctalus sp.: 1
- Common pipistrelle: 87
- Soprano pipistrelle: 88
- Pipistrelle (50khz): 17

Static S5:
2 total passes, of species breakdown:
- Noctule: 1
- Common pipistrelle: 1

Allocation Boundary
Mitigation Land
Transect 1 Stop
Transect 2 Stop
Transect Route

Bat Species
Barbastelle
Common pipistrelle
Long-eared bat
Myotis sp.
Noctule
Soprano pipistrelle

Bat Species Detected at Static
Barbastelle
Common pipistrelle
Leislers'
Long-Eared
Myotis sp.
Nathusius' pipistrelle
Noctule
Nyctalus sp.
Pipistrelle (40khz)
Pipistrelle (50khz)
Serotine
Soprano pipistrelle

Berechurch
Blackheath
Cleavelands Farm
Birchbrook House
The Lodge

Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER
Bat Activity Survey Results - October 2018

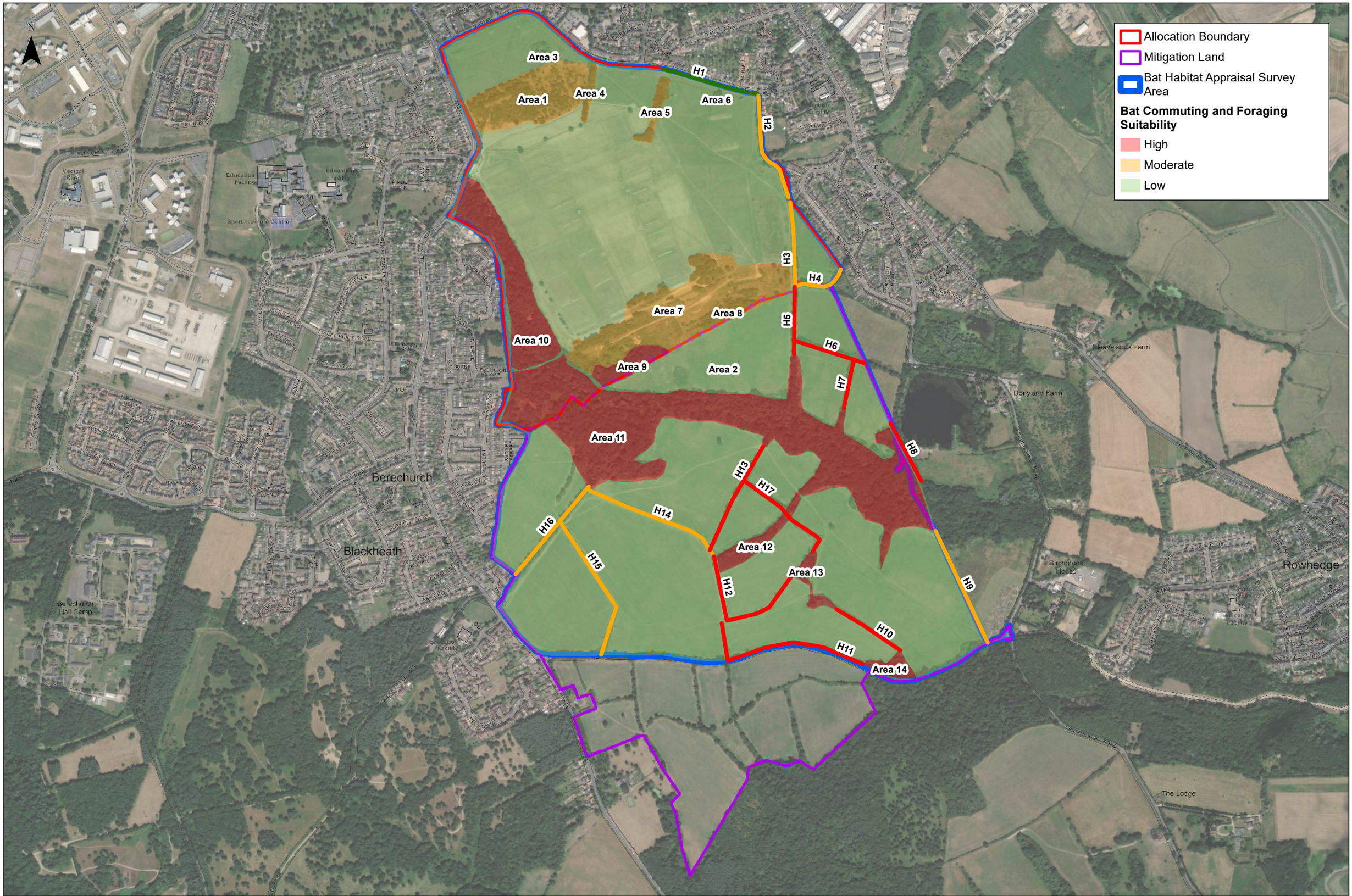
0 0.5 1 km

1:10,000 @ A3 | Date: 12/06/2020
Drawn: TL | Checked: BS
Figure 17b | Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_17b_BatActivitySurvey_Oct.mxd

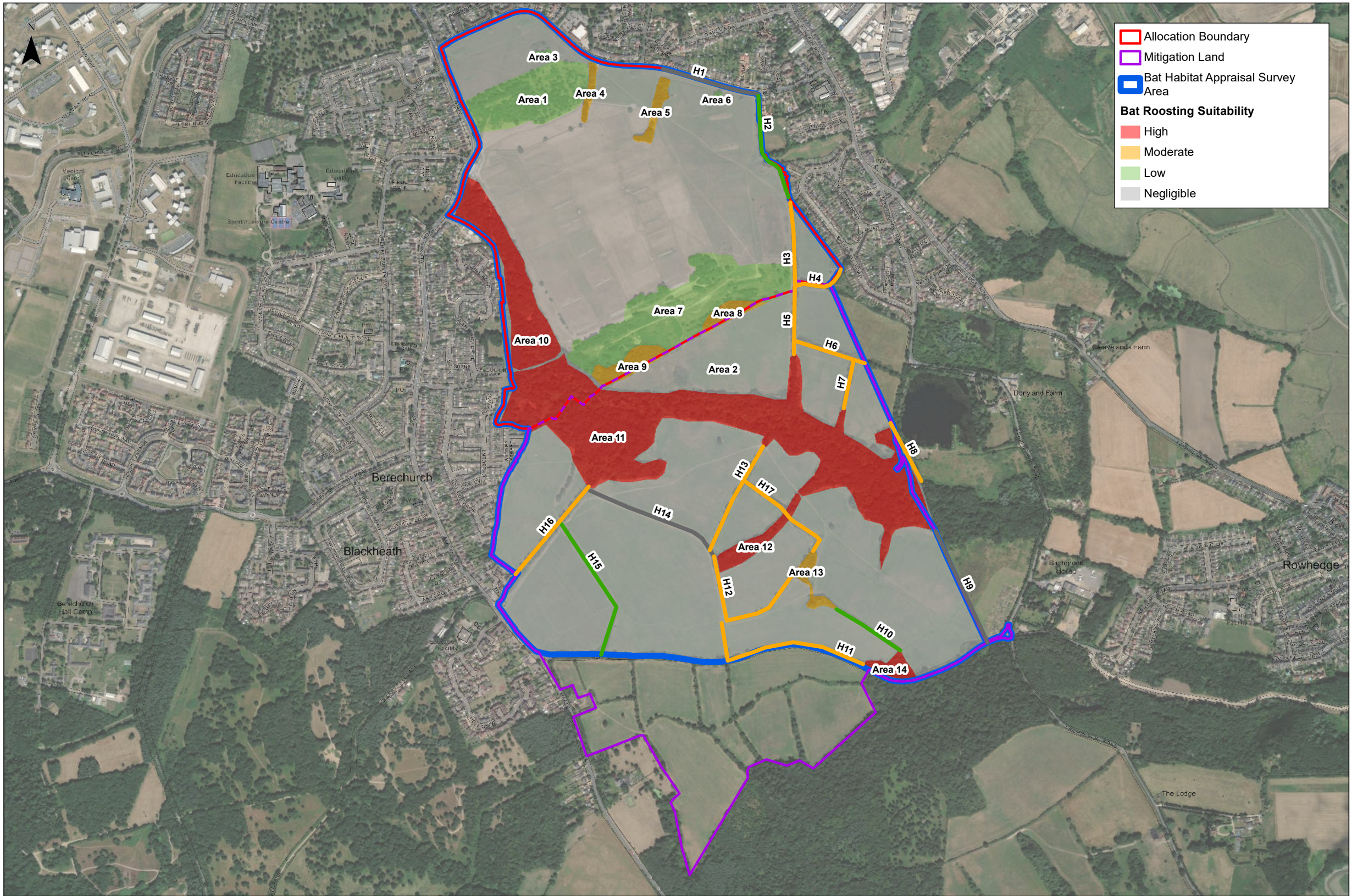
Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Bat Hibernation Survey Key Points	0 250 500 m Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community	1:8,000 @ A3	Date: 18/11/2020
				Drawn: IB	Checked: ER
				Figure 18	Rev A

Document Path: Z:\Projects\40472\Job 3\02_mxd\40472_01_BatHibernation.mxd



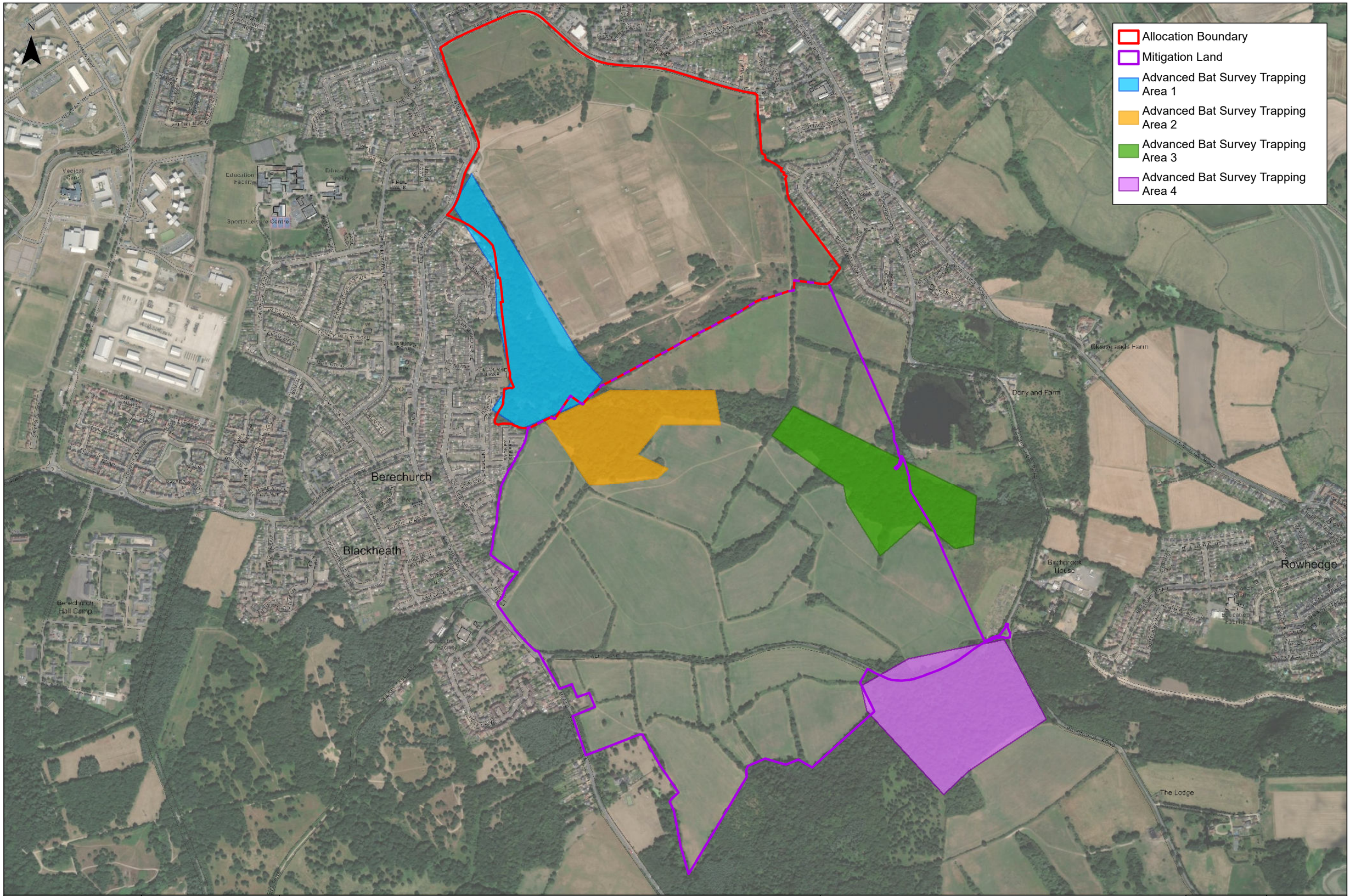
Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Bat Commuting and Foraging Value	0 250 500 m Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Contains Ordnance Survey data (c) Crown copyright and database right 2019.	1:10,000 @ A3	Date: 12/06/2020
				Drawn: TL	Checked: BS
				Figure 19	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_19_BatCommutingForagingValue.mxd



Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Bat Roosting Suitability	0 250 500 m Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Contains Ordnance Survey data (c) Crown copyright and database right 2019.	1:10,000 @ A3	Date: 20/05/2020
				Drawn: TL	Checked: BS
				Figure 20	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_20_BatRoostingSuitability.mxd



Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

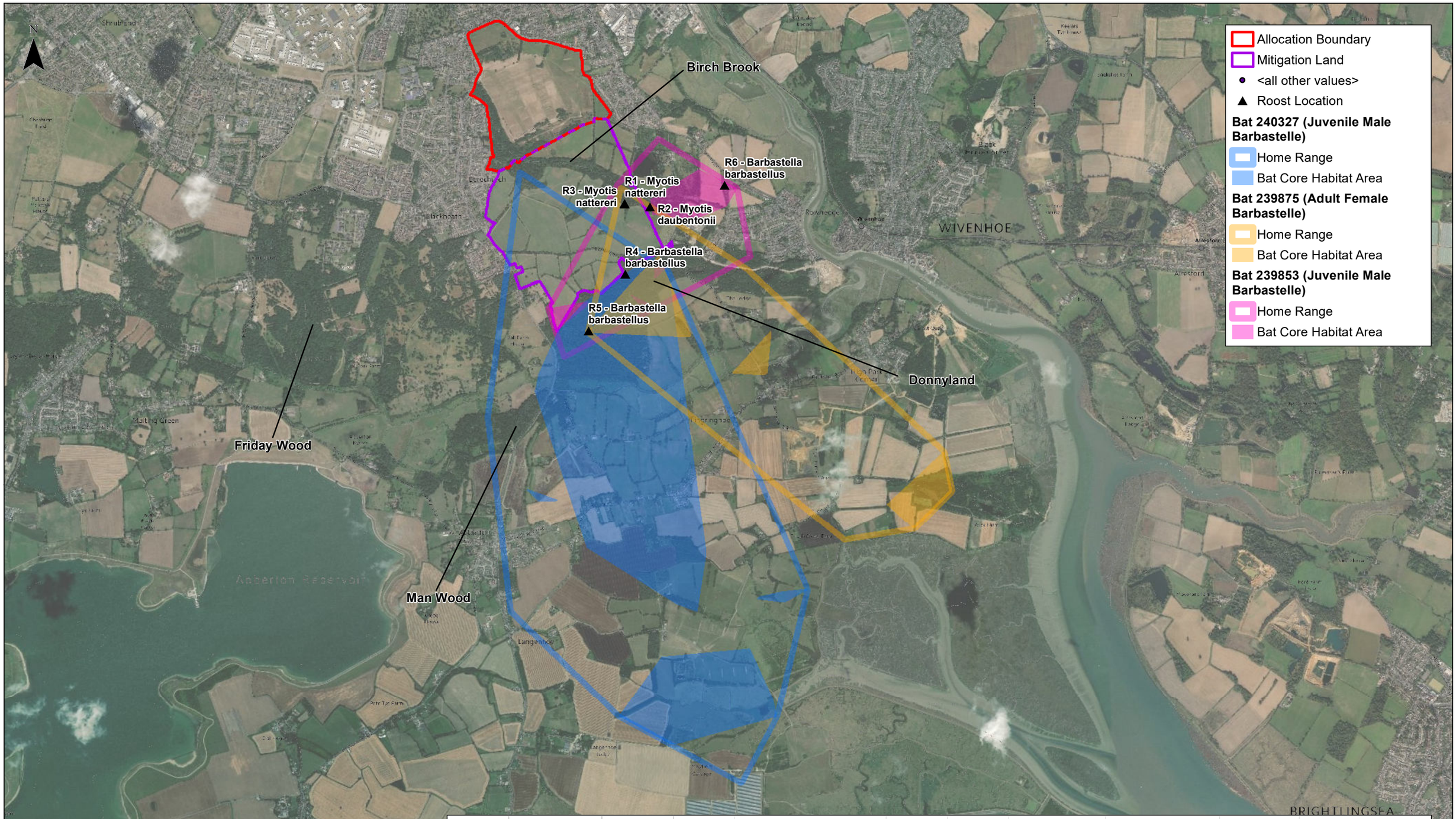
Advanced Bat Survey: Trapping Areas

0 250 500 m

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:10,000 @ A3	Date: 12/06/2020
Drawn: TL	Checked: BS
Figure 21	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_21_BatTrappingAreas.mxd



Roost Ref	Location	Date	BatID	Species	Sex	Status	Roost Type	Feature	Roost Status	Max Count
R1	TM0170521873	18/06/2019	240318	Myotis nattereri	Male	Adult	Oak Tree	Scar	Night	1
R2	TM0191321845	18/06/2019	237065	Myotis daubentonii	Female	Pregnant	Oak Tree	Woodpecker Hole	Maternity	23
R3	TM0170321874	18/06/2019	240318	Myotis nattereri	Male	Adult	Goat Willow	Woodpecker Hole	Day	2
R4	TM0170821291	13/08/2019	240327	Barbastella barbastellus	Male	Juvenile	Oak Tree	Loose Bark	Maternity	17
R5	TM0140620824	17/09/2019	239875	Barbastella barbastellus	Female	Adult	Oak Tree	Loose Bark	Day	1
R6	TM0253022027	18/09/2019	239853	Barbastella barbastellus	Male	Juvenile	Stable Building	Unknown	Unknown	Unknown - no access

Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

Tracking Results (Barbastelles)

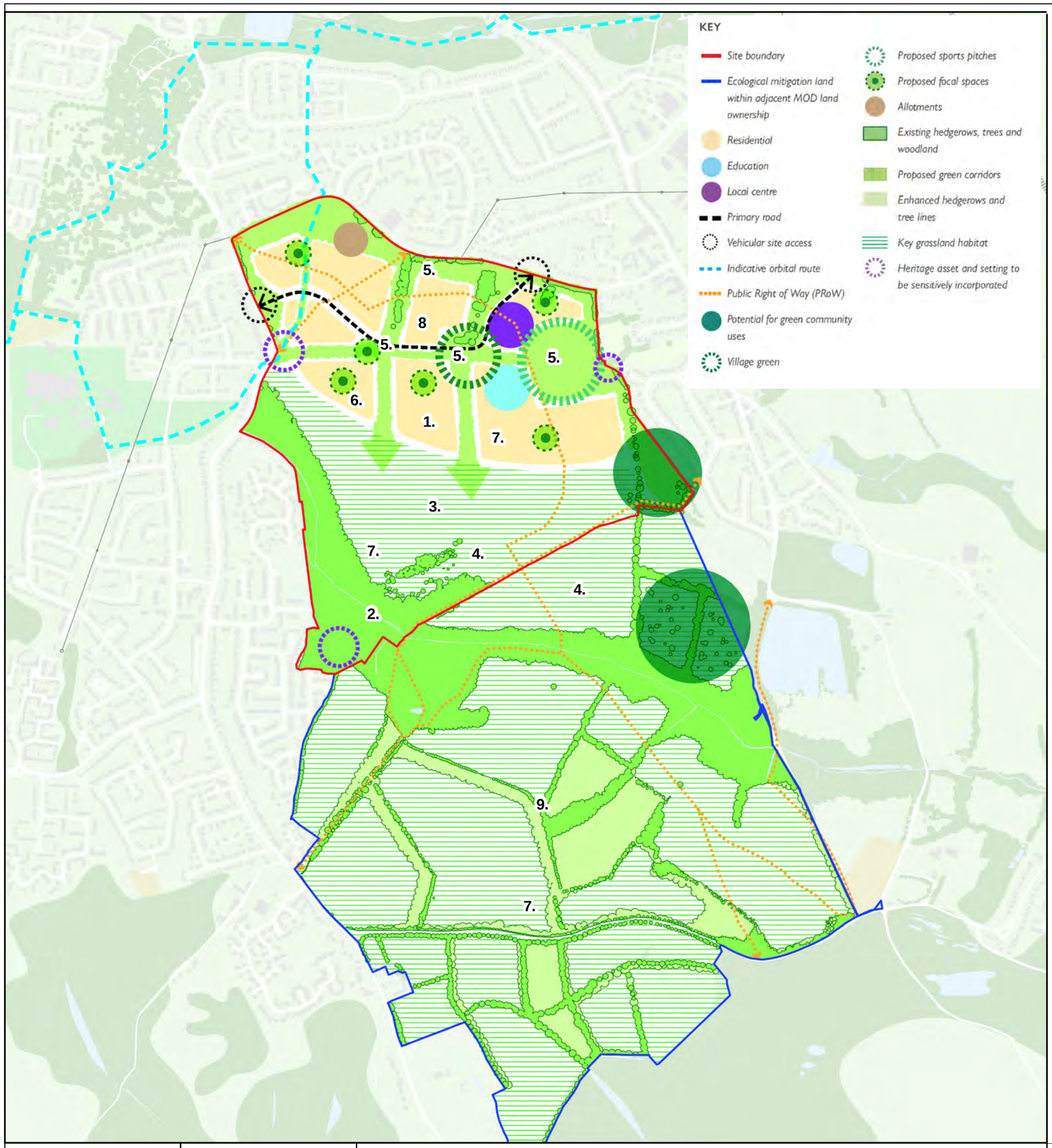
0 1 2 km

1:30,000 @ A3 | Date: 27/05/2020

Drawn: TL | Checked: BS

Figure 22 | Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_22_BarbastelleResults.mxd



1. Development Location
Siting the development footprint overall in the habitats of least ecological value, and which are of least value to a range of species. This includes consideration of the conflicting needs, such as the need for a green offset from Abbot's Road (effectively pushing development proposals south) whilst balancing ecological need (which is to retain habitat in the south, and provide a sufficiently large buffer from valuable habitat in the south, essentially pushing development proposals north).

2. Retention of Birch Brook
Retention of Birch Brook LWS in its entirety, with at least a 50 m buffer from development for its entirety (the very northerly tip of Birch Brook woodland is the closest part, and the developable area is c. 70 m from the woodland).

3. Retention of Middlewick Ranges
Retention of 30 hectares of the Middlewick Ranges LWS boundary, prioritising the areas of acid grassland (over the less ecologically valuable grassland), the habitat mosaic at the base of the ranges, and prioritising the location of LWS retention such that the remnant areas remain ecologically connected to adjacent high value habitat and are not isolated by development proposals. Such retention and connectivity is considered to be of importance for both the continued ecological functionality of the LWS, but also the species it supports, such as the invertebrate assemblage.

4. Habitat Retention
Retention of sufficient habitat to enable continued use of Birch Brook and the immediately adjacent habitats by foraging and commuting bats, roosting bats, and a range of bird species. This includes sufficient buffers from built development such that issues associated with light spill on retained woodland should not adversely affect the use of the woodland by such species.

5. Habitat Provision
Provision of substantial green corridors throughout the built footprint of the development to facilitate landscape scale connectivity for bats, birds and other species. This includes retention of the two existing and high value remnant hedgerows in the north, as well as extended north – south and east west habitat linkages, and the retention (and bolstering) of hedgerows along the existing frontage of Abbot's Road.

6. Stepped Built Form
A stepped built form in both density and typology, to minimise ecological impacts associated with a 'hard' development edge. Examples include siting the lower density housing on the southern boundary of the footprint, siting the higher density and building types which are associated with greater footfall and disturbance (such as the local centre) in the centre of the footprint.

7. Walking Routes
Provision for 2 km, 3 km and 6 km walking routes within the development footprint, and then in Mitigation Land to the south. These seek to provide a targeted walking route for recreation and dog walking use, but with specific routes devised to minimise impact on retained habitat.

8. Scheme Delivery
Development of a built footprint which delivers the required housing numbers, infrastructure and associated uses, in the smallest form possible (without compromising densities, green corridors or other open space commitments).

9. Biodiversity Net Gain
Delivery of significant ecological enhancements in the Mitigation Land which delivers benefits to a range of species as well as achieves a Biodiversity Net Gain. These enhancements include bolstered hedgerows and tree lines connecting Birch Brook with Roman River SSSI, as well as provision of new woodland, scrub and acid grassland to offset losses in the north as a result of the development proposals.

Stantec

Client
JLL & DIO

MIDDLEWICK RANGES, COLCHESTER
Masterplan Appraisal

This Figure uses the PRP "Middlewick Concept Masterplan" as the base, 28/09/2020"

1:10,000 @ A3	Date: 13/10/2020
Drawn: BS	Checked: ER
Figure 23	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_23_MasterplanAppraisal.mxd

Allocation Boundary
Mitigation Land
Middlewick Ranges Local Wildlife Site
Soil Sample Location
Sub Sample Location
Sampling Transect

Supplementary Notes on Field Methodology:

Field Number	Number of Sub Samples
1	15
3	30
4	18
7	29
11	15
12	24
14	15
17	23
19	30
20	16
20a	15
21	16
22	15

Samples to be collected from top 7.5cm of soil horizon immediately underlying sward. Remove vegetation prior to stowing in sample bag.

Avoid all desire lines and footpaths (by 2m minimum) and any topographical or botanical indicators of difference in soil types.

Scan all sample locations with CAT and to be cleared by UXO engineers.

Sub samples to be homogenised prior to placing in laboratory supplied tubs (minimum 4/sampling area).

Berechurch
Blackheath
Bonylane Farm
The Lodge

Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER
Soil Sample Locations

0 250 500 m

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Essex Wildlife Trust 2020

1:10,000 @ A3 | Date: 12/06/2020
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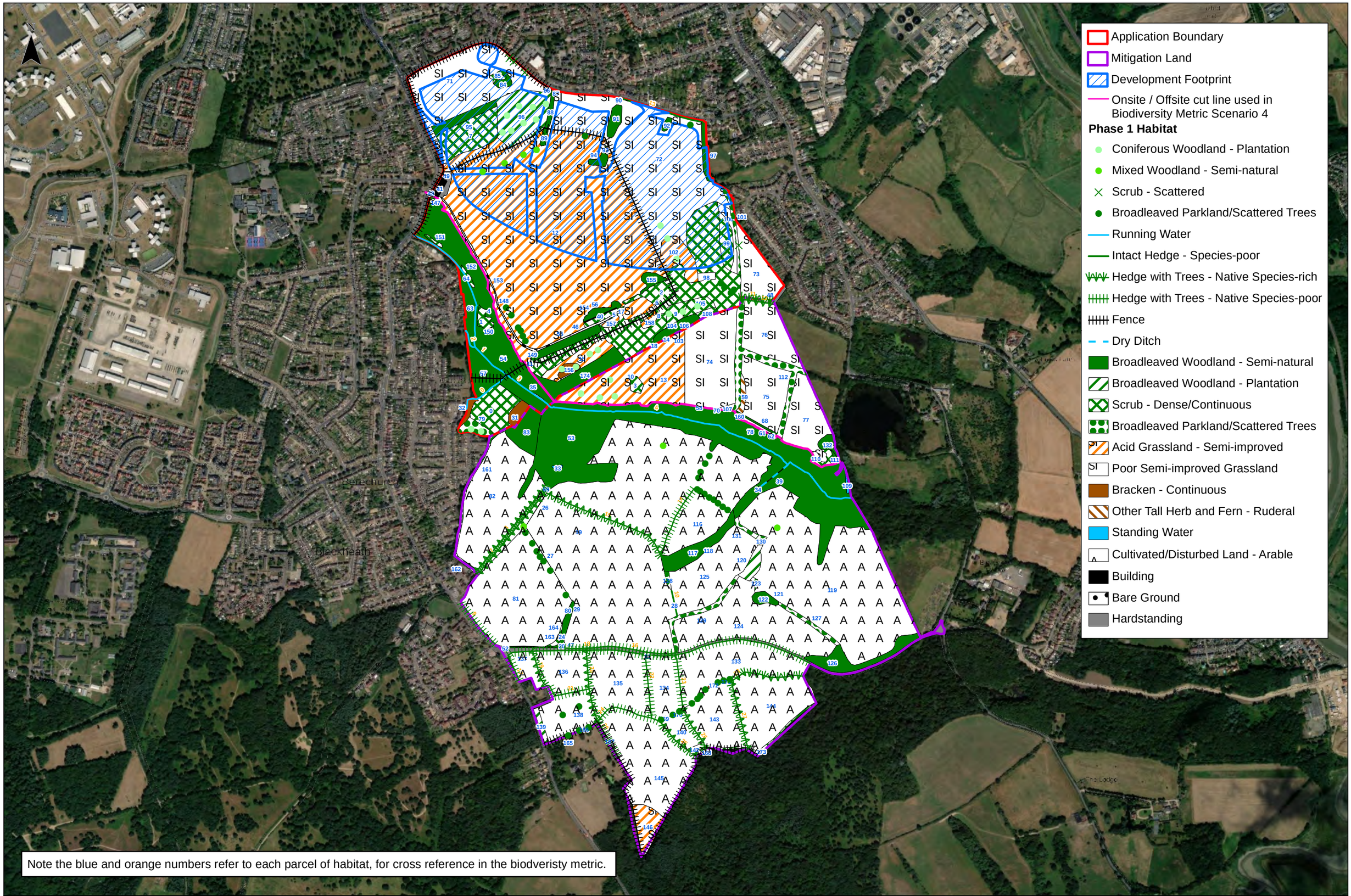
Figure 24 | Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_23_SoilSampleLocations.mxd



Stantec

Client: JLL & DIO

MIDDLEWICK RANGES, COLCHESTER

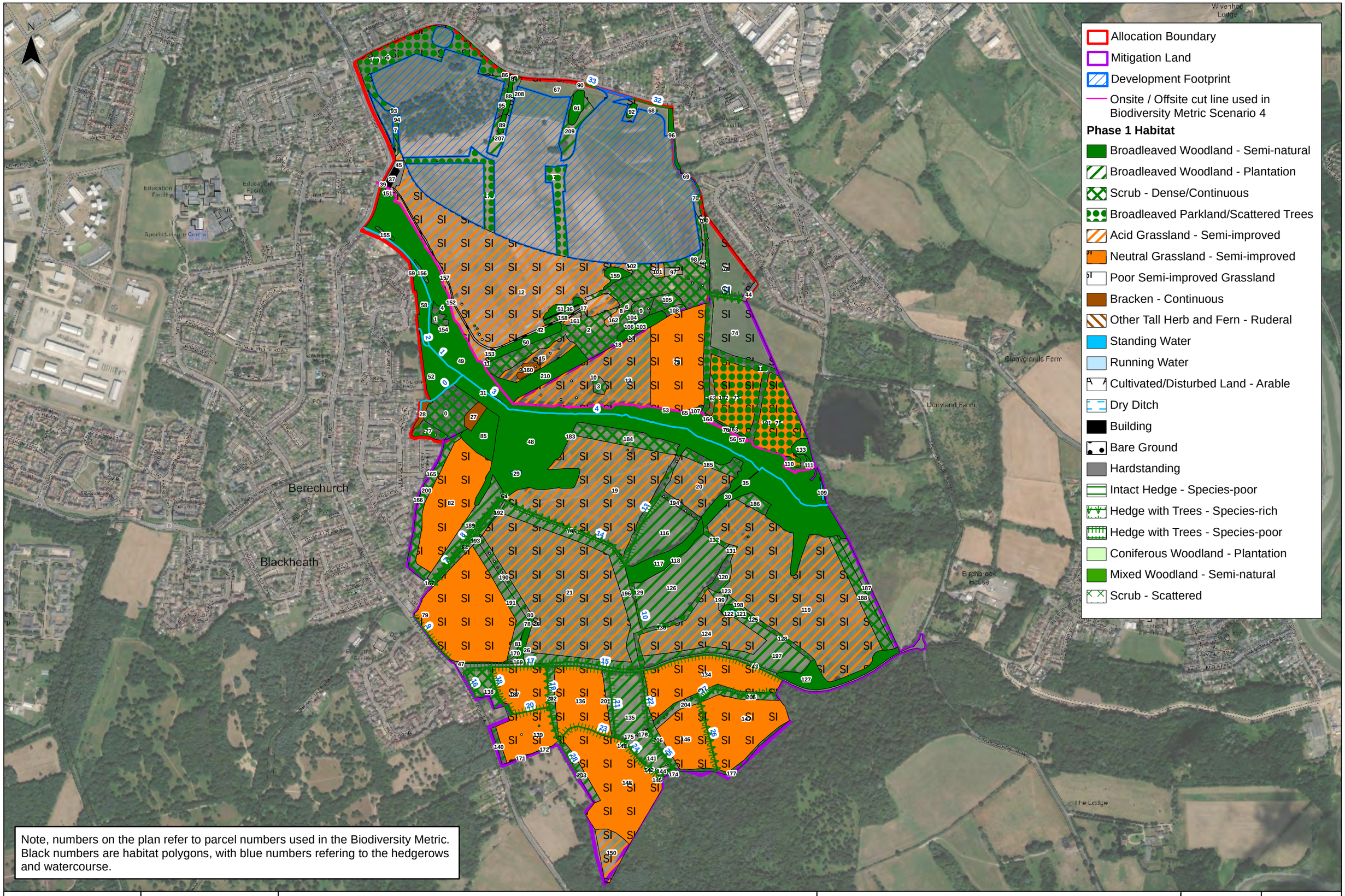
Pre-development Habitats

0 0.5 1 km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:10,613 @ A3	Date: 14/10/2020
Drawn: TL	Checked: BS
Figure 25	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_25_PreDevelopment.mxd



Stantec	Client: JLL & DIO	**MIDDLEWICK RANGES, COLCHESTER** Post-development Habitats	0 0.5 1 km Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Contains Ordnance Survey data (c) Crown copyright and database right 2019.	1:10,000 @ A3	Date: 14/10/2020
				Drawn: TL	Checked: BS
				Figure 26	Rev A

Document Path: Z:\Projects\40472\02_mxd\40472_26_PostDevelopment14102020.mxd

Appendix A Local Plan Policy

A.1.1 Policy ENV1 of the Emerging Local Plan states:

"The Local Planning Authority will conserve and enhance Colchester's natural and historic environment, countryside and coastline. The Local Planning Authority will ***safeguard the Borough's biodiversity****, geology, history and archaeology, which help define the landscape character of the Borough, through the protection and enhancement of sites of international, national, regional and local importance.*

In particular, developments that have an adverse impact on the integrity of European sites, Sites of Special Scientific Interest or the Dedham Vale Area of Outstanding Natural Beauty (including its setting) will not be supported. Development proposals within designated areas or within the Coastal Protection Belt will need to comply with policies ENV2 and ENV4.

Development proposals where the principal objective is to conserve or enhance biodiversity and geodiversity interests will be supported in principle.

For all proposals, development will only be supported where it:

(i) Is supported with appropriate ecological surveys where necessary;

(ii) Where there is reason to suspect the presence of a protected species (and impact to), or Species/Habitats of Principal Importance, applications should be accompanied by an ecological survey assessing their presence and, if present, the proposal must be sensitive to, and make provision for their needs;

(iii) Will conserve or enhance the biodiversity value of greenfield and brownfield sites and minimise fragmentation of habitats;

(iv) Maximises opportunities for the preservation, restoration, enhancement and connection of natural habitats in accordance with the UK and Essex Biodiversity Action Plans or future replacements; and

(v) Incorporates beneficial biodiversity conservation features and habitat creation where appropriate.

Plans or projects, which may have a likely significant effect on a European site which have not been screened or considered in the Borough's Habitat Regulations Assessment or Appropriate Assessment, will be required to prepare a separate HRA screening and if necessary to complete a separate appropriate assessment to ensure compliance with the Habitat Regulations 2010.

Proposals for development that would cause direct or indirect adverse harm to nationally designated sites or other designated areas, protected species, Habitats and Species of Principle Importance or result in the loss of irreplaceable habitats, such as ancient woodland, Important Hedgerows and veteran trees, will not be permitted unless:

(i) They cannot be located on alternative sites that would cause less harm;

(ii) The benefits of the development clearly outweigh the impacts on the features of the site and the wider network of natural habitats; and

(iii) Satisfactory mitigation and compensation measures are provided.

The Local Planning Authority will take a precautionary approach where insufficient information is provided about avoidance, mitigation and compensation measures and secure mitigation a and compensation through planning conditions/obligations where necessary."

Appendix B Methodology

B.1 Desk Study (Freely Available Resources)

B.1.1 A desk-based review exercise was conducted using third party and open-access resources to identify relevant existing ecological data in relation to the Allocation Boundary its surrounds. This included consideration of:

- Information relating to statutory designated areas for nature conservation within a 2 km radius of the Allocation Boundary (extended to 10 km for European or internationally designated areas), as held on the Multi-Agency Geographic Information for the Countryside (MAGIC) website;
- Habitats of Principal Importance (HPI) as listed in accordance with Section 41 of the Natural Environment and Rural Communities (NERC) Act (2006), and ancient woodland parcels within a 2 km radius of the Allocation Boundary as held by MAGIC;
- Records held on MAGIC for European Protected Species (EPS) licences granted within a 2 km of the Allocation Boundary;
- Natural England's Impact Risk Zones (IRZs) covering the Allocation Boundary as held by MAGIC;
- Aerial photography of the Allocation Boundary and its surrounds; and
- The Essex Biodiversity Action Plan (BAP) (to establish local biodiversity priorities).

B.1.2 This desk study was completed in May 2017 and repeated in March 2020.

B.2 Essex Field Club

B.2.1 Third party biological records for the Allocation Boundary and Mitigation Land as far south as Weir Lane plus a 2km radius beyond were purchased from the Essex Field Club (data received 22nd March 2019). Report reference: EFC3510, 22 Mar 2019.

B.2.2 The data was subsequently used to inform preparation of a scope of works, and interpretation of species specific surveys.

B.3 Essex Wildlife Trust

B.3.1 Third party biological records and designated areas search for Allocation Boundary and Mitigation Land as far south as Weir Lane plus a 2km radius beyond were purchased from the Essex Wildlife Trust (data received May 2018). Report reference: Colchester Training area.

B.3.2 A data clarification was submitted and returned in September 2018 relating to moth records.

B.3.3 The data was subsequently used to inform preparation of a scope of works, and interpretation of species specific surveys, and to inform the

B.3.4 The 2015 LWS review was later interrogated to update the Middlewick Ranges LWS boundary in line with the review results.

B.4 British Trust for Ornithology

B.4.1 Data from the British Trust for Ornithology (BTO) nightingale survey 2012 (the most recent national survey data) was sourced from the BTO (data received May 2019). This included data on the total number of singing males recorded (in 2012) within the four 2km^2 tetrads covering the Allocation Boundary and immediate surroundings (tetrads TM02A, TM02B, TM02F and TM02G). In addition, mapping data was also supplied by the BTO showing the approximate territory centres for singing male nightingales recorded during the 2012 survey.

B.4.2 The desk study data supplied by the BTO was gathered as part of a national monitoring programme and, as such, may have been originally collected by volunteer surveyors. However, the data was subject to a degree of quality assurance via the BTO regional representatives' system (who were responsible for sourcing the volunteers). It is noted that data was limited to a single breeding season in the past (2012) so cannot be used to indicate current or recent (last few years) nightingale territory numbers or precise locations, as these will naturally vary over time and in response to a range of variables that are all outside the scope or control of this study. However, the data provides useful background information on the distribution of nightingale within the survey area from a recent season.

It should be noted that the results of the above described desk study data collation were reviewed as part of the relevant and below described technical workstreams, however for the purposes of avoiding duplication this has not be discussed under the methodology for each survey.

B.5 Extended Phase 1 Habitat Survey (2017)

Method

B.5.1 The extended Phase 1 habitat survey considered the Allocation Boundary and Mitigation Land as far south as Weir Lane. Note this survey did not extend south of Weir Lane, which was added to the total survey area at a later date.

B.5.2 During the survey, habitat types were identified and the potential for these to support protected and/or notable species was assessed, to enable consideration of ecological constraints and opportunities associated with redevelopment of the Allocation Boundary. In this context, notable species are those which receive no legal protection, but are either a Species of Principal Importance (SPI) via the provisions of Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006, or are a priority species under the Essex BAP.

B.5.3 The results of the survey were used to inform discussions within the project team, and with Colchester Borough Council's Ecological Officer pertaining to the ecological constraints and opportunities that redevelopment of the Allocation Boundary offers.

Limitations

B.5.4 The walkover survey was completed within the optimal period for habitat and vegetation surveys (April to September). The tall grasslands had just been cut for hay before the survey and therefore some plant species in the grassland may have been overlooked if not identifiable from vegetative characters. Despite this vegetative identification was possible of the majority of grassland species and an evaluation of the grassland habitat classification and its ecological value were still possible.

Weather Conditions and Survey Personnel

B.5.5 An extended Phase 1 habitat survey of the Site was undertaken on 27 and 28th June 2017 by experienced botanists Liz Powell and Hannah Brett. Liz Powell is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that they are bound to a Professional Code of Practice and subject to peer review. The survey followed best practice survey methodology (JNCC, 2010). The weather was approximately 20 degrees, intermittent cloud and dry for the period of the survey.

B.6 Botanical Survey

Method

B.6.1 A botanical survey consisting of a 'site walkover' rather than a formal National Vegetation Classification (NVC) survey. The walkover sought to clarify the type and quality of the grassland present within the Allocation Boundary and Mitigation Land (north of Birch Brook).

B.6.2 A walkover was undertaken covering representative transects of all areas shown on **Figure 7a**. Grassland and forb species were identified and categorised based on relative abundance within the sward using the "DAFOR"[21] scale.

B.6.3 The total area of grassland was then divided based on its qualities, to define the 'best fit' NVC category[22], the extended Phase 1 habitat category (JNCC, 2010) and consideration as to whether the grassland qualifies as Habitat of Principal Importance (HPI) (see below).

B.6.4 There are 56 HPI defined in response to the Natural Environment and Rural Communities (NERC) Act, which came into force on 1st Oct 2006. Section 41 (S41) of the Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The list has been drawn up in consultation with Natural England, as required by the Act.

B.6.5 In the absence of specific definitions for HPI, two separate assessment methodologies have been used to consider the grasslands status as HPI: the UK Biodiversity Action Plan (UK BAP) definitions as prepared by the Joint Nature Conservation Committee (JNCC), and Natural England Technical Information Note TIN110 *Assessing whether created or restored grassland is a BAP Priority Habitat.*

B.6.6 The UK BAP definitions were last revised in 2007. According to the gov.uk website (National Archives), the 56 HPI 'are all the habitats in England that were identified as requiring action in the UK Biodiversity Action Plan (UK BAP), and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework'. This system remains the 'accepted norm' for assessment of HPI when considering conservation value for planning applications.

B.6.7 The second methodology for consideration of whether the grasslands constitute HPI is TIN110. This Technical Note is titled 'Assessing whether created or restored grassland is a BAP Priority Habitat' and 'has been written to allow Natural England advisers and others to systematically judge whether grassland under Environmental Stewardship is achieving, or progressing towards, scheme objectives'. Whilst not designed to be used for consideration of

[21] DAFOR is an acronym that relates to:
D - Dominant (75% or more)
A - Abundant (51-75%)
F - Frequent (26-50%
O - Occasional (11-25%)
R - Rare (1-10%)
Additional categories of LD, LA and LF, where L = locally

[22] Based on the professional judgement of the botanist (Anna Gundry)

the conservation value of grassland within planning applications with reference to HPI defined in response to the NERC Act (it has been prepared as a land management tool for assessing grassland under Stewardship), it has been prepared more recently than the JNCC BAP descriptions. Of relevance to the grassland in question, it provides a greater level of detail as to the indicator species which need to be present in a sward for qualification as HPI. This differs to the JNCC BAP description method, which instead refers to NVC categories.

B.6.8 To provide a holistic review of the value of the grassland, review of the habitats has also been made against:

- The Natural England 'Priority Habitat Inventory – Lowland Dry Acid Grassland' Priority Habitat Inventory 'Lowland Meadows' and 'Priority Habitat Inventory – Good Quality Semi-Improved Grassland' datasets, as available via the Multi-Agency Geographic Information for the Countryside (MAGIC) website (most recently reviewed in September 2018);
- The Essex BAP Habitat criteria; and
- The habitat information within the Middlewick Ranges Local Wildlife Site citation.

B.6.9 This has enabled an initial assessment of the relative value of the grassland, with reference to the geographic frames of reference defined within the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland (September 2018). Please note that this assessment is made only on the botanical value of the grassland during the survey on 26 June 2018, and as perceived in the context of the given criteria.

Limitations

B.6.10 Whilst the survey was undertaken in the 'optimal' period for botanical surveys of acid grassland, and the regular maintenance of the grassland was delayed to enable effective identification of the botanical community, the survey was undertaken during an unusually hot and dry summer. The weather conditions were evident during the survey, with vegetation particularly within Area A of the Allocation Boundary heavily parched. As such it is likely that a number of broadleaved species were no longer in evidence when the site was visited, and a spring or early summer visit is recommended next year to confirm the species diversity within particularly Area A. Recommendation for a repeat site visit would have no bearing on masterplan consideration, and does not preclude consideration of the relative value of the botanical community present.

Weather Conditions and Survey Personnel

B.6.11 A site visit to the grassland on the Middlewick Ranges was carried out on 26th June 2018, by:

- Rebecca Strawbridge (Senior Ecologist (now Associate Ecologist), PBA (now Stantec));
- Dr Stuart Otway (Senior Ecologist, DIO Environmental Support and Compliance Team);
- Anna Gundrey (Consultant Ecologist, Pure Ecology); and
- Other members of the wider project team.

B.6.12 The botanical survey was led out by Anna Gundrey, a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that they are bound to a Professional Code of Practice and subject to peer review.

B.6.13 Anna Gundrey MCIEEM has worked as 24 years of professional experience as a botanical and habitat surveyor and researcher, specialising in grassland communities. She has

extensive experience of Phase 1 habitat surveying, NVC surveys and other Phase 2 botanical surveys as well as botanical monitoring programmes. She has worked for both English Nature (as was) and the Institute of Grassland and Environmental Research and has worked in consultancy for the last 12 years.

B.6.14 The survey was completed on a hot, dry day with little wind.

B.7 Extended Phase 1 Habitat Survey (2020)

B.7.1 Due to the passage of time since the 2017, and 2018 habitat surveys, an update extended Phase 1 habitat survey was completed in March 2020.

Method

B.7.2 The site visit was undertaken on the 16th March 2020. The habitats within the Allocation Boundary and Mitigation Land (extended to its full extent) were identified and described following the standard JNCC Phase 1 habitat survey methodology, as detailed in the Phase 1 habitat Survey Handbook (JNCC, 2016). This uses a system of codes to describe different habitat types based on the dominant vegetation present.

Limitations to Methodology

B.7.3 The survey was undertaken just outside of the optimal time of year for extended Phase 1 habitat survey. However, given that extensive botanical data was gathered in the summer of 2018 the timing of this survey was not considered to be a constraint. It was also possible to identify early flowering species and to identify plants from their vegetative characteristics allowing any changes in the species composition of the habitat types since previous survey work to be determined.

Weather Conditions and Survey Personnel

B.7.4 The weather conditions were dry with generally clear skies (3/8 cloud cover) and a light breeze (Beaufort Scale F2). Air temperatures were mild ranging between 6˚C and 12˚C.

B.7.5 The update extended Phase 1 habitat survey was undertaken by Stephen Foot and Ed Austin. Both Stephen and Ed are full members of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that they are bound to a Professional Code of Practice and subject to peer review.

B.7.6 Both have worked as a professional ecologists for over 15 years and have extensive experience of completing ecological assessments across a variety of sites and habitat types using the extended Phase 1 method.

B.8 Dormouse Nut Search

Method

B.8.1 The nut searches involved searching the ground near hazel (*Corylus avellana*) and cherry trees (*Prunus* sp.) within suitable habitat in the Allocation Boundary and Birch Brook woodland for hazel nuts or cherry stones which were gnawed in a characteristic fashion by dormice. In this case, as per current guidance (Natural England, 2018), a total of five 10x10 m quadrats were searched across the Dormouse Survey Area. Each quadrat was placed in suitable habitat where fruiting hazel was present (see **Figure 8**).

Limitations

B.8.2 The surveys were undertaken at an appropriate time of year in suitable weather conditions. As such there are not considered to be any limitations to the methods used.

Weather Conditions and Survey Personnel

B.8.3 The nut search was conducted on 16th October 2018. Weather conditions were dry.

B.8.4 The surveys were led by Stephen Foot and Ed Austin. Both Stephen and Ed are full members of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that they are bound to a Professional Code of Practice and subject to peer review.

B.8.5 Stephen Foot MCIEEM has worked as a professional ecologist since 2005 and has extensive experience in undertaking protected species survey work. Stephen holds a licence to survey for hazel dormice.

B.8.6 Ed Austin MCIEEM has worked as a full-time professional ecologist since 2004 and began his career in environmental consultancy in 2002.

B.9 Riparian Mammals Survey

Method

B.9.1 A survey for evidence of otters *Lutra lutra* was undertaken within the Birch Brook along the western and southern boundaries of the Allocation Boundary and in Birch Brook woodland. This survey conformed to standard methodology for otter survey (Chanin, 2003). Signs that otter may be present were searched for including characteristic spraints (droppings), holts, resting places, otter paw prints and pathways through vegetation along or down the bank (slides). Particular attention was paid to crossing points and bridges during the course of the otter survey as these can be a focus of activity. Where evidence of other riparian species were recorded, these were noted.

Limitations

B.9.2 The surveys were undertaken at an appropriate time of year in suitable weather conditions. As such there are not considered to be any limitations to the methods used.

Dates, Weather Conditions and Survey Personnel

B.9.3 The otter survey was undertaken on 25th September 2018. Weather conditions were dry with partially cloudy skies (2/8 cloud cover) and moderate winds (Beaufort Scale F3-F4). Air temperatures ranged between 13°C and 16°C.

B.9.4 The surveys were led by Stephen Foot and Ed Austin. Both Stephen and Ed are full members of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that they are bound to a Professional Code of Practice and subject to peer review.

B.9.5 Ed Austin MCIEEM has worked as a full-time professional ecologist since 2004 and began his career in environmental consultancy in 2002. Ed has particular expertise in river surveys including both River Corridor Survey (RCS) and River Habitat Survey (RHS) methodologies and during his time as a consultant ecologist has undertaken numerous surveys for otters.

B.9.6 Stephen Foot MCIEEM has worked as a professional ecologist since 2005 and has extensive experience in undertaking protected species survey work.

B.10 Habitat Appraisal: Terrestrial Invertebrates

Methods

B.10.1 The whole Invertebrate Survey Area (i.e. the Allocation Boundary and Mitigation Land as far south as Weir Lane) were walked making notes on the habitats present (type, extent and context), land management and topography. Features which many invertebrate assemblages/ guilds exploit and which are not typically mapped such as the extent and type of bare ground (substrate, aspect and micro-variations in topography), nectar resources and edge-effects created by habitat mosaics (e.g. 'sun-traps' or still-air habitat), or wood decay resource were also considered. Notes were made on adjacent habitats abutting the Survey Area but these were only visually appraised from within the Survey Area.

B.10.2 It was originally proposed to supplement this habitat walkover with some collecting, focussing on known important invertebrate groups which include aculeate Hymenoptera (predominantly solitary bees and wasps). Due to access restrictions associated with the active firing ranges, access is only permissible by pre-arranged site visit. The permitted access dates (8th and 9th June 2019) unfortunately coincided with inclement weather (see below - Limitations) and therefore, no collecting was possible.

B.10.3 The majority of the fields in the north of Birch Brook woodland were uncut at the time of the visit, however the majority of the grassland to the south of Birch Brook had been recently cut at the time of the visit, presumably for sileage.

B.10.4 The Invertebrate Survey Area was divided into compartments of varying ecological value for terrestrial invertebrates, to enable the results to be more easily interpreted for the purposes of discussion, masterplanning, and biodiversity accounting. Where possible, the numbering of the compartments have been aligned with those in the botanical survey areas (to avoid multiple reference systems for the same parcel of land).

Limitations

B.10.5 The weather during the site visit was inclement on 8th June 2019, with persistent drizzle to light rain from arrival at the site (approximately 09:30 hrs) until 14:00 hrs. This included periods, albeit brief, of heavy squalls. Later, it remained cool with intermittent showers for the remainder of the survey period. Air temperatures peaked at 14° C, with a light breeze (Beaufort Scale 2) from the south-west. In these conditions, the target groups generally useful for appraising a site's value for invertebrates, and particularly for aculeate Hymenoptera, are inactive and take shelter from the prevailing conditions in burrows (such as solitary bees and wasps), or under/ amongst vegetation and thus remain unobtrusive. Survey methods such as sweeping or beating vegetation become pointless as nets become waterlogged and ineffective. Therefore, no attempt to collect material was undertaken.

B.10.6 Therefore terrestrial invertebrate appraisal work has been based on consideration of features such as habitat mosaics, plant species-richness, including nectar resource (geospatial and temporal (seasonal) distribution), vegetation structure complexity, presence and aspect of bare ground; and their relationships with each other intra- and inter-compartmentally, including connectivity with the wider landscape.

B.10.7 The lack of material is a limitation in so far as there is no snapshot of the invertebrate fauna that may have been realistically observed or captured during a single visit in early summer. However, the survey effort was sufficient to provide:

- a detailed commentary on the Invertebrate Survey Area's potential nature conservation value for terrestrial invertebrates;

- location(s) within and across compartments where features are likely to be of higher interest for terrestrial invertebrates are located such that masterplanning can take into account the location of any areas of likely higher sensitivity for terrestrial invertebrates (and contribute to consideration of the maximal developable area); and

- define key elements of a high level mitigation, and compensation (where avoidance is not feasible) strategy to enable the ecological functionality of the Middlewick Ranges Local Wildlife Site (LWS) to be maintained, with respect to terrestrial invertebrate interest.

B.10.8 Despite the limitation, the information is considered sufficient to inform the preparation of a robust evidence base for the allocation of Middlewick Ranges within the Local Plan.

Dates, Weather Conditions and Survey Personnel

B.10.9 The invertebrate habitat walkover was completed by Richard Wilson. Richard is a Chartered Environmentalist, a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM), and a Member of the Royal Entomological Society; he is an experienced senior-level entomologist.

B.10.10 The survey dates and weather conditions are described above under 'Limitation's.

B.11 Habitat Appraisal: Suitability for Breeding Birds

Method

B.11.1 The breeding bird habitat appraisal survey area included the Allocation Boundary, and land to the south in the MOD ownership as far as Weir Lane. This entire breeding bird habitat appraisal survey area is shown on **Figures 12 - 15**. Labels are also shown on **Figure 2** to support with cross referencing whilst reading the later parts of this evidence base.

B.11.2 The habitats within the breeding bird habitat appraisal survey area were broadly assessed for their potential to support both common and widespread species of bird and bird species of conservation importance (e.g. red and amber list species[23], Species of Principal Importance[24] and Schedule 1[25] bird species) in the breeding season.

B.11.3 No specific recording of bird species present was undertaken as this was beyond the scope of the walkover survey. However, species incidentally encountered were considered as part of the appraisal (i.e. likelihood of breeding within the breeding bird habitat appraisal survey area).

Limitations

B.11.4 The walkover survey was completed with full access to the breeding bird habitat appraisal survey area and in appropriate weather conditions. There were therefore no significant limitations to the method described above.

B.11.5 It should be noted that the walkover survey was designed to gather initial information on the broad habitat types present and their potential to support breeding bird species later in the year (i.e. spring and summer). The survey was therefore inherently limited to fulfil this scope

[23] Bird of high (red) or medium (amber) conservation concern in Birds of Conservation Concern 4 (Hayhow *et al*, 2017)

[24] Species of Principal Importance to the conservation of biodiversity in England as listed in response to Section 41 (S41) of the Natural Environment and Rural Communities Act 2006

[25] Species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) granting legal protection from disturbance at or near an active nest site.

only and should not be interpreted as a breeding bird survey, as it does not provide information on the specific species occurring within the survey area.

Dates, Weather Conditions and Survey Personnel

B.11.6 A walkover survey was completed by an experienced ornithologist, Ed Austin on 16th January 2019. Weather conditions were dry and cool (8°C) with overcast skies (8/8 cloud cover) and a moderate breeze (Beaufort Scale force 4).

B.11.7 Ed is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that he is bound to a Professional Code of Practice and subject to peer review. He has over 15 years' experience of ecological survey, with over 17 years' experience of working in environmental consultancy. He has particular experience in undertaking both breeding and non-breeding bird survey and appraisal using standard methods such as the Common Bird Census (CBC), Breeding Bird Survey (BBS), Wetland Bird Survey (WeBS) and tailored or bespoke methods for specific species or project requirements. He also holds a Bird Identification Qualification (IDQ) issued by the London Natural History Museum.

B.12 Bat Activity Survey

Method

Walked Transects

B.12.1 Walked activity transect surveys were undertaken in September and October 2018. The Bat Activity Survey Area included the Allocation Boundary extended south to include the northern part of Birch Brook woodland (refer to **Figure 16**). The bat activity survey area and its immediate surrounds represent moderate/high quality habitat for foraging and commuting bats. This is due to the presence of open grassland and scrub (moderate quality habitat) along with the presence of established hedgerows, treelines and mature woodland (high quality habitat). Given the large size of the bat activity survey area, two transect routes were devised to ensure sufficient coverage of suitable habitat during the peak times of bat activity. During the survey visits the transects were walked by two pairs of surveyors at dusk, periodically stopping for three-minute listening intervals. The transect surveys began at sunset and finished two hours after sunset in line with current guidance (Collins, 2016).

B.12.2 The surveyors used Bat Logger M bat detectors to listen to and record echolocation calls of bats observed. During the survey, the surveyors made a note of the flight-lines used by any bats (if present and observed). The recorded calls were analysed using BatExplorer computer software following the survey to confirm the identification of the species observed in the field. A bat pass was defined as an unbroken stream of echolocation calls, heard as a series of 'clicks' on the bat detector as the bat passed in and out of the detector's range. The BatExplorer software classifies the beginning of a new pass once there has been a break of more than 1.5 seconds between call pulses (i.e. a distinct break in activity). A plan showing the transect route walked during the survey is provided as **Figure 16.**

Automated Static Detector Surveys for Bats

B.12.3 In combination with the walked transect surveys, additional bat activity data was gathered using static bat detectors. Automated static bat detectors (Anabat Express) were installed to sample three locations per transect route within the Bat Survey Area (six in total). The static detectors were set to record each night from half an hour before sunset and to until half an hour after sunrise. The static detectors were set out on 25th September and 16th October 2018, and were collected in at least five nights later.

B.12.4 The six static bat detectors were deployed in the following locations across the bat activity survey area as shown on **Figure 16**:

- S1 – Located within the woodland parcel on the western boundary of the Bat Survey Area.
- S2 – Located within scrub/scattered trees in the north of the Bat Survey Area.
- S3 – Affixed to a small building within the open grassland in the north/centre of the Bat Survey Area.
- S4 – Affixed to hawthorn scrub in a tree line/hedgerow in the south-west of the Bat Survey Area.
- S5 – Affixed to a mature oak on the woodland edge in the south-western corner of the Bat Survey Area.
- S6 – Located within woodland in the south of the Bat Survey Area.

B.12.5 Calls registered by the static bat detectors were recorded for later analysis using specialist computer software (Analook); data analysis details are provided below.

Analysis of Bat Call Data

B.12.6 Bats generate echolocation calls which were recorded by the detectors during the activity and static detector surveys. As mentioned above, these were analysed using the BatExplorer software in the case of the Bat Logger M and Analook software for the static detector data to give an indication of the species of bat present and their relative levels of activity. The software enables analysis of the relative activity of different species of bats by counting the minimum number of bats recorded within discrete sound files.

B.12.7 Once triggered, the Bat Logger M has been set to record ultrasound pulses for up to 15 seconds unless there is a break in the pulses for more than 1.5 seconds. If there is a break a new recording file (pass) is created.

B.12.8 With regard to the Anabat, once triggered by ultrasound, the Anabat Express records sound files with a duration of 15 seconds, which may contain a number of individual bat calls (or passes), or discrete groups of ultrasound 'pulses'. The assessment of relative bat activity between species is based on the relative abundance of recorded calls of each species within each survey period (i.e. each walked transect survey or period of static monitoring).

B.12.9 It should be recognised that a series of separate sound files could represent multiple bats calling infrequently (e.g. as they each pass overhead moving in one direction) or a small number of bats (or even one individual) calling frequently (e.g. bats making repeated foraging passes up and down a feature). This cannot be determined without ground-truthing (i.e. unless bats can be directly observed at all times). While this is often impractical, the activity survey does provide supporting information of this nature, allowing overall patterns of use of the Site by different species to be established based on the regularity of recording.

B.12.10 Where possible, bat calls are identified to species level. However, species of the genus *Myotis* are grouped together in most cases as their calls are similar in structure and have overlapping call parameters, making species identification problematic (Russ, 2012).

B.12.11 For *Pipistrellus* species the following criteria based on measurements of peak frequency are used to classify calls:

- Common pipistrelle ≥ 42 and <49kHz;
- Soprano pipistrelle ≥ 51kHz;
- Nathusius' pipistrelle <39kHz;

- Common/soprano pipistrelle ≥49 and <51kHz; and
- Common/Nathusius' pipistrelle ≥39 and <42kHz.

B.12.12 In addition, the following categories are used for calls which cannot be identified with confidence due to the overlap in call characteristics between species or species groups:

- Myotis/Plecotus sp.;
- Nyctalus sp. (either Leisler's bat or noctule);
- Serotine/Leisler's; and
- Serotine/Plecotus sp.

Limitations

B.12.13 The surveys were undertaken at an appropriate time of year in suitable weather conditions. As such there are not considered to be any limitations to the methods used.

Dates, Weather Conditions and Survey Personnel

B.12.14 The surveys were led by Stephen Foot and Ed Austin. Both Stephen and Ed are full members of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that they are bound to a Professional Code of Practice and subject to peer review.

B.12.15 Stephen Foot MCIEEM has worked as a professional ecologist since 2005 and has extensive experience in undertaking protected species survey work. Stephen holds a licence to handle and disturb bats since 2010. During his time as an ecologist he has undertaken an extensive number of surveys for bats including, external and internal building assessments, ground level tree assessment, dusk emergence and dawn return to roost surveys and activity transect surveys across the UK and Ireland. He has been involved in numerous projects requiring bespoke mitigation to be designed and implemented where proposed development has an impact on roosting bats.

B.12.16 Ed Austin MCIEEM has worked as a full-time professional ecologist since 2004 and began his career in environmental consultancy in 2002. Ed has extensive experience in bat activity surveys throughout the UK.

B.12.17 The date, timings and weather conditions for the transect survey visits are provided in **Table 6** below.

Table 6: Bat Activity Survey Dates, Survey Timing and Weather Conditions

Date	Sunset Time	Start/Finish Time	Weather Conditions
25/09/18	18:49	18:49 – 20:49	Dry with clear skies (1/8 cloud cover) and calm conditions (Beaufort Scale F1). Air temperatures ranged between 13°C and 11°C.
16/10/18	18:01	18:01 – 20:01	Dry with partially cloudy skies (2/8-3/8 cloud cover) and a light breeze (Beaufort Scale F2). Air temperatures ranged between 19°C-16°C.

B.13 Bat Hibernation Survey and Droppings Analysis

Method

Bat Dropping DNA Analysis

B.13.1 A brief inspection of the Marker's Gallery was undertaken on 5th October 2019 (location shown on **Figure 18**). During this inspection bat droppings were noted indicating possible use of the structure as a hibernation site. Droppings were therefore collected and sent to Swift Ecology for subsequent DNA analysis. Although all droppings collected looked superficially similar, a request to test for multiple species (rather than the most dominant) was undertaken to determine which species of bats had used the toilet block within the Marker's Gallery.

Hibernation Survey

B.13.2 A hibernation survey of the toilet block within the Markers Gallery B32 Surveys were undertaken in accordance with good practice guidelines (Collins, 2016), with two visits (one in January and a second visit in February) conducted. Air temperature and humidity within the bunkers was recorded and the interior of the structures was searched using a powerful torch for signs of hibernating bats including bat droppings, feeding remains (e.g. moth wings) and hibernating bats themselves.

Automated Static Detector Survey

B.13.3 In addition to a detailed search for hibernating bats, an Anabat Express bat detector was installed within the toilet block. Bats use echolocation calls to determine their position in space and navigate in flight. The Anabat express is able to detect and record echolocation calls of any bats present within the Marker's Gallery. This detector was installed on 4th December 2018 and was left in-situ before being collected on the 14th February 2019. The detector recorded data between 4th December-31st December 2018 and the 11th January 2019-14th February 2019 (batteries ran out at end of December and were replaced on 11th January 2019 hence the gap in data). Following collection of the detector the data was analysed (using Analook software) in order to help to determine the current usage of the toilet block by hibernating bats.

Analysis of Calls

B.13.4 The echolocation calls recorded by the Anabat Express were analysed using Analook software to give an indication of the species of bat present and their relative levels of activity. The software enables analysis of the relative activity of different species of bats by counting the minimum number of bat calls recorded within discrete sound files.

B.13.5 Once triggered by ultrasound, the Anabat Express records sound files with a duration of 15 seconds, which may contain a number of individual bat calls (or passes), or discrete groups of ultrasound 'pulses'. The assessment of relative bat activity between species is based on the relative abundance of recorded sound files of each species within each survey period (i.e. each period of static monitoring).

B.13.6 It should be recognised that a series of separate sound files could represent multiple bats calling infrequently (e.g. as they each pass moving in one direction) or a small number of bats (or even one individual) calling frequently (e.g. as a result of a bat making repeated passes). Therefore, numbers of sound files does not necessarily directly relate to numbers of bats.

B.13.7 Where possible, bat calls are identified to species level. However, species of the genus *Myotis* are grouped together in most cases as their calls are similar in structure and have overlapping call parameters, making species identification problematic (Russ, 2012).

B.13.8 The following categories are used for calls which cannot be identified with confidence due to the overlap in call characteristics between species or species groups:

- Myotis sp;
- Myotis/Plecotus sp.;
- *Nyctalus* sp. (either Leisler's bat or noctule);
- Serotine/Leisler's; and
- Serotine/*Plecotus* sp.

Limitations

B.13.9 There were considered to be no constraints to the methods employed in this assessment with visits undertaken at an appropriate time of year and at least two weeks of data collected from the static detector as per current best practice guidance (Collins, 2016).

Dates, Weather Conditions and Survey Personnel

B.13.10 The weather conditions during the two hibernation visits are provided within **Table 7** below. Dates for the remainder survey elements are provided in the methods above.

Table 7: Bat Hibernation Survey Dates and Weather Conditions

Survey Visit	Date	Weather Conditions
Visit 1	16th January 2019	Dry with overcast skies (8/8 cloud cover) and a light/moderate breeze (Beaufort Scale F2-F3). Air temperatures ranged between 4°C and 7°C.
Visit 2	21st February 2019	Dry with partially cloudy skies (5/8 cloud cover) with a moderate breeze (Beaufort Scale F3) and air temperatures ranging between 6°C and 8°C.

B.13.11 The hibernation survey was led by Stephen Foot who is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). This means that he is bound to a Professional Code of Practice and subject to peer review.

B.13.12 Stephen Foot MCIEEM has worked as a professional ecologist since 2005 and has extensive experience in undertaking protected species survey work. Stephen holds a licence to handle and disturb bats since 2010. During his time as an ecologist he has undertaken an extensive number of surveys for bats including, external and internal building assessments, ground level tree assessment, dusk emergence and dawn return to roost surveys, hibernation surveys and activity transect surveys across the UK and Ireland. He has been involved in numerous projects requiring bespoke mitigation to be designed and implemented where proposed development has an impact on roosting bats.

B.13.13 The recorded acoustic information was independently assessed by Helen Evriviades (a bat licensed ecologist with 20 years' experience in ecological consultancy, and who has extensive experience analysing bat calls).

B.14 Habitat Appraisal: Suitability for Foraging and Roosting Bats

Methods

B.14.1 The survey included the Middlewick Ranges themselves and land located to the east beyond the range fencing plus areas of woodland, grassland and open fields further south also outside the range as far south as Weir Lane. This entire area is shown on **Figures 19-20**.

B.14.2 The habitats within the bat habitat appraisal survey area were broadly assessed for their potential to support both common and widespread species of bat and roosting, foraging and commuting habitat for barbastelle bats in particular. Please note that a ground-level tree assessment (GLTA) was not undertaken as part of this assessment; however, some trees supporting features of obvious high roosting potential were recorded as examples of good quality roosting habitat. The secondary purpose of the visit was to identify suitable areas within the bat habitat appraisal survey area in which to deploy mist nets and harp traps to capture bats for subsequent radio-tracking (ultimately aiming to identify the location of roost sites in and close to the bat habitat appraisal survey area (refer to sections below for further information on the radio-tracking survey.

Limitations

B.14.3 The walkover survey was completed with full access to the bat habitat appraisal survey area and in appropriate weather conditions. There were therefore no significant limitations to the method described above.

B.14.4 It should be noted that the walkover survey was designed to gather initial information on the broad habitat types present and their potential to support roosting, foraging and commuting bats. The survey was therefore inherently limited to this scope only and should not be interpreted as a definitive aid as to where bat roosts or key foraging and commuting areas are located.

Dates, Weather Conditions and Survey Personnel

B.14.5 A walkover survey was completed over two days by two experienced bat workers on 16th and 17th January 2019. Weather conditions were dry and cool on 16th (8-10°C) with overcast skies (8/8 cloud cover) and a moderate breeze (Beaufort Scale Force F3-F4). On 17th January 2019 weather conditions were dry with clear skies (1/8 cloud cover) with a light breeze (Beaufort Scale Force F2) and air temperatures ranging between 10-12°C.

B.15 Advanced Bat Survey Techniques: Bat Trapping and Trapping

Methods

Overview

B.15.1 Investigating the habitat use and roost locations of barbastelle and tree roosting bats generally is considered highly challenging, due to their frequent roost movements, flight behaviour and in the case of barbastelle bats specifically, large home ranges (Zeale, Davidson-Watts and Jones, 2012). Therefore, trapping of bats and the fixing of radio transmitters (tags) from which individual bats could be followed using radio telemetry receivers, was the primary approach to achieving the survey objectives.

B.15.2 Three survey sessions of approximately five days duration were undertaken in late May/June, July and September 2019. The survey session included the trapping of bats at various locations, predominantly in forest/tree-dominated habitats adjacent to, or within the zone of influence of the project (i.e. the Middlewick Ranges proposed allocation). In accordance with the conditions of Natural England licence 2019-39885-SCI-SCI and project objectives, target bats were radio-tagged which included a primary species of interest barbastelle and secondary priority species including bats from the genus *Myotis* and *Nyctalus*. Tagged bats were simultaneously or subsequently followed by radio tracking teams during the survey session to locate and identify roost sites and to examine nocturnal flying activity of the tagged bats, with a focus on collecting activity data for bats within the project's zone of influence and other key areas considered potentially important to barbastelle bat population(s). Where access was possible to roost sites, emergence counts were undertaken at identified roosts to determine the status/function of the roost.

B.15.3 The following methods were undertaken in line with Chapter 9 (Advanced licensed bat survey methods) in Collins, 2016.

Trapping Survey

B.15.4 Bats were caught using up to six 4m^2 harp traps or survey 6-12m mist nets, placed in forest/parkland habitats within the Birch Brook woodland. Up to six acoustic lures (Sussex Autobats) were used to improve catch efficiency (Hill and Greenaway, 2005). The lures emitted synthesised bat social calls including calls based on barbastelle bat social calls, and a number of other calls based on European bat social calls (David Hill, 2001 unpublished data). Lures were placed next to harp traps and mist nets. Any bats captured were identified, sexed, aged and breeding status was determined.

B.15.5 Bats which met the project objectives were fitted with lightweight radio-transmitter tags (BD-2 0.39g or BD-2x 0.31g tags, Holohil Systems, Ontario, Canada) weighing <5 % of the weight of the bat using Torbot/Permabond contact adhesive. Bats were processed quickly, and non-target bats were released within 30 minutes of capture. Tagged bats were released once the glue attaching the transmitter had cured.

B.15.6 Generally trapping teams monitored trap sites with handheld bat detectors (Pettersson 240x or Elekon Batlogger M) during the trapping survey, mainly to assess bat activity in the vicinity of the traps.

Radio Tracking Surveys

B.15.7 All tagged bats were tracked using a Sika receiver (Biotrack Ltd., Wareham, United Kingdom) and a 3-element Yagi antenna (Biotrack Ltd/Sirtrack). Tracking teams tracked bats using a combination of vehicle mounted antennae and on foot, depending on the movements of the bats.

B.15.8 Tracking of bats was undertaken for a period of 3-6 nights over a period of one week each survey session. Barbastelle bats were followed from dusk until dawn post capture. Positions of tagged bats were pinpointed at regular intervals throughout the night depending on whether the tracker was in contact with the bat. Tracking aimed to record positional fixes that enabled determination of home ranges and core areas of activity and when in contact position fixes were recorded every 10 minutes. Bats were tracked using the ‘‘homing-in’’ method (White and Garrott, 1990) on foot or by vehicle, and/or through the triangulation method (Kenwood, 2000).

B.15.9 Surveyors obtained a fix on a bat by driving in the direction of the strongest signal of a target bat. A bat’s position was estimated by close approach whenever possible. Where access was not possible, multiple compass bearings were taken by circling around the signal in as short a time period as practically possible, keeping contact with the bat to assess any change in location. These approaches enabled an estimate of a bat’s location depending on the distance.

B.15.10 After a position fix was established for a bat, the surveyors searched for another target bat, repeating the same method in turn for all bats with active transmitters continually until dawn. This approach generally enabled fixes to be made every 10-45 minutes for each bat depending on the location of the bats in relation to each other i.e. the closer the bats were to each other the more regular the position fixes. This method allowed for fixes to be independent of each other to avoid auto-correlation effects, but there were often periods of time that a tagged bat’s position remained unrecorded whilst the tracking team searched for the target bat. As a result, systematic and regular time intervals for recording of all the tagged bat’s position were not achieved, especially those bats that left the Allocation Boundary and Mitigation Land. Further, in some cases individual bats were prioritised for tracking where less tracking data had been obtained and their movements were within the influence of the road scheme, or where transmitter batteries were expected to fail earlier.

B.15.11 Where *Myotis/Nyctalus* species were tagged for roost location purposes, individual bats were released on the night of capture and daytime roost searches were undertaken the following day.

Roost Emergence Surveys

B.15.12 When tagged bats were tracked to roost sites, subsequent roost exit counts were undertaken where access to the roost location was permitted. Emergence counts were prioritised for newly located roosts over known roosts.

B.15.13 The emergence surveys followed a standard methodology (Collins, 2016). The surveyors were in position adjacent to the tree where it was considered the tagged bat was roosting half an hour before sunset and remained in position until it was too dark to see bats emerge. Bats were counted as they emerged.

B.15.14 All roost emergence surveys were supported by infrared cameras (Canon XA10/XA25) with infrared illuminators to determine the numbers of bats emerging to assist with making roost status/type assessment (e.g. maternity roost).

B.15.15 Roost attributes such as location, type of structure and other descriptors were recorded where trees were accessible.

Licensing

B.15.16 All trapping and tracking were undertaken under a project licence from Natural England number: 2019-39885-SCI-SCI obtained by Dr Ian Davidson-Watts MCIEEM with 26 years bat survey experience, who designed and coordinated the field surveys and undertook the analysis of the results and evaluation. For a full summary of Ian's experience, refer to 'Survey Personnel' below.

Data Analysis

B.15.17 Radio tracking fixes for all capture locations, roost locations and the night-time tracking surveys for each individual bat were plotted in the field on digitised 1:25,000 scale OSGB Maps mobile (e.g. MemoryMap, View Ranger Applications on smart phones or tablets). All the fixes were pooled for each bat and subsequently transferred into Ranges 9 radio tracking software (Anatrack Ltd, Wareham, UK).

B.15.18 Accuracy of locations was considered +/-100m. This was based on observer experience, knowledge of the area and the combined use of close approach and triangulation, rather than triangulation alone. Therefore, for analysis of home ranges in Ranges 9, a tracking resolution of 100m was applied to take account of accuracy issues associated with triangulation at distance.

B.15.19 The digitised radio tracking data was analysed in Ranges 9 (Anatrack Ltd., Wareham, United Kingdom) to calculate home range areas, which are also known as 100% Minimum Convex Polygons (MCPs), and core activity areas using objective core analysis (Kenwood *et al*, 2001). MCP mapping is a polygon based on the outside of all the fixes associated with a tagged bat. The MCP technique of determining home range was used as it is considered relatively unaffected by the effects of autocorrelation (Harris *et al*, 1990). However, this method does overestimate home range and often includes large areas that the tagged bat flew through to get to possible foraging or roosting areas.

B.15.20 The identification of core areas for each bat is important as it highlights the habitats in which the bats are spending most of their time. Cluster polygons (Kenward, 2000) were considered the most appropriate minimum-linkage estimators to define the areas bats were using. This is because the barbastelle bats spent most of their time in relatively small areas compared to

their full home range, moving quickly between them. The fragmented cluster polygons show where bats were highly active (e.g. foraging/social activity) or night roosting/returning to roosts, rather than the area travelled through to get to such areas.

B.15.21 For the estimation of core areas, 'objective core analysis' was the chosen method. This approach is scientifically rigorous as it calculates core areas from the distribution of the bats' locations themselves rather than manual determination of what percentage of fixes should be excluded from the analysis, usually from assessment of utilisation distributions continuities (a manual method of excluding outlying locations). The objective core analysis method (Kenwood *et al,* 2014) uses the distribution of nearest-neighbour distances detecting and excluding outlying locations (Kenward *et al*., 2001) resulting in an objective core.

B.15.22 Use of objective core analysis was especially relevant to this study as it was considered that all estimated bat fixes should be used to determine overall activity patterns, and would provide a more conservative method, smoothing any accuracy issues with the collection of fixes. The limitation of objective coring is that the process sometimes estimates core areas larger than those from an equivalent number of locations compared to more manual methods.

Limitations

B.15.23 *B. barbastellus* are a highly mobile species and use a variety of roosts, commuting routes and foraging areas during their yearly lifecycle, which is influenced by a range of factors such as breeding status, climate, energetic requirements and the availability of prey (Zeale, 2011). The survey techniques described in this report involve a sampling effort that is considered appropriate for obtaining information on the location of roosts and core activity areas during 2019 potentially affected by the proposals, while ensuring that local bat populations are not disturbed adversely by the survey method itself. The methods used here do not provide a full account of all bat activity in the area or activity at other times of the year outside of the survey periods (i.e. outside the early breeding period) which are focussed on identifying early forming maternity populations.

B.15.24 Weather conditions were appropriate throughout all survey sessions and as such the results of trapping and radio tracking were not constrained or affected by significant weather. During rain events, tagged bats generally remained active during the dusk/dawn surveys.

B.15.25 Usual scientific best practice avoids using data collected on the night of capture for analysis of ranging behaviour (e.g. Davidson-Watts *et al,* 2006), due to the effects on behaviour of the disturbance from the capture/tagging procedure. In this study, data collected during the first night of tracking was incorporated for analysis as some bats were trapped in locations where they were not recorded for the remainder of the study. The exclusion of this information would not have reflected what was known of their home range and whilst rigorous scientific approaches have been adopted to objectively record and asses/interpret the radio tracking data, the study objective is to primarily understand as much about the movement of the barbastelle bats potentially affected by the site allocation proposal.

B.15.26 A limitation of radio tracking studies relates to accuracy of positional fixes. Accuracy of fixes can be a common problem in studies of fast-moving bats, particularly those species (such as barbastelles) that have relatively large home ranges (Holland and Wilelski, 2009). Whilst methods such as biangulation/triangulation can provide relatively rapid and systematic location data for bats, studies have shown that due to variability of surveyor skill, especially at distance, positional fixes might only be accurate to >250m^2 (Bontanida *et al*, 2002).

B.15.27 A combination of triangulation and close approach methods were adopted to increase accuracy. A number of factors such as the landform, access to private land and time bats spent in an area can affect the accuracy of fixes. To take account of this location error the analysis of radio tracking data has been relatively conservative, especially when estimating

core areas of activity. For instance, a tracking resolution of 100m has been applied to all location fixes and use of objective cores also aims to take account of these limitations.

B.15.28 Whilst it is typical to seek trapping of 10% of the known population (up to max of 25%), this is more difficult when the population size of the area is unknown (as is the case in this situation). The work completed is considered to provide a sound evidence base from which it is possible to determine the importance of the Allocation Boundary and adjacent habitats for roosting, foraging and commuting barbastelle and provides a strong evidence base for the purposes of the Allocation. On the basis of the work completed to date, it can confidently be concluded that the Allocation Boundary is not a critical component of the local barbastelle population's sustenance zone and that for suitable foraging habitats that do occur on and adjacent to the Allocation Boundary can be protected/retained enhanced. It is expected further survey work to inform a planning application is likely to be required to inform detailed mitigation and enhancement proposals.

Dates and Survey Personnel

B.15.29 Field surveys were led by Dr David Hill, Mike Bird and Anton Kattan (all named persons on the project licence and all with over 15 years bat survey experience and holding their own, Class 3 or 4 licences). Experienced radio trackers, Alan Tom Foxley, David Kent, Jade Flear O'Rourke undertook the radio tracking surveys.

B.15.30 Dr Ian Davidson Watts designed the surveys, held the Natural England licence, analysed the data and wrote the bat analysis sections of this evidence base.

B.15.31 Ian Davidson-Watts has been researching bats since 1993 and mist netting bats and training bat workers for permit/consent related activities since 1996. In the UK Ian has led a range of research and development related projects involving advanced techniques for the capture of bats, resulting in designation of two major protected areas for rare woodland bat species (Mottisfont bats and Briddlesford Copse Special Areas of Conservation). Ian's PhD investigated the ecological differences between the common and soprano pipistrelle bats through radio-tracking and he has undertaken research into bat swarming sites (Box Mines, Chilmark and Fonthill Grottoes), and the ecology of barbastelle, Bechstein's and greater horseshoe bats. Ian has utilised mist netting for bat projects in Eastern Europe, Cyprus, south Pacific islands and New Zealand. In summary the applicant:

- Is currently working with Department of Conservation in New Zealand catching and radio tracking bats in Southland testing the effectiveness of acoustic lure systems on NZ bats species and undertaking a range of trapping/tracking surveys for major road schemes in Hamilton and Kauri dieback research in the Waitakere Ranges near Auckland.
- Previously held a wildlife permit for the West Coast Conservancy, NZ, for capture and radio tracking of long and short tailed bats (2010-2013).
- Recently obtained 33 project/research licences for the extensive trapping and/or radio tracking of various bat species during 2013-2018 in the UK, mainly for major infrastructure projects (roading/rail/housing). Involving the capture of over 1000 bats of 15 different species using mist nets and harp traps and radio tracking of 200+ individual bats during the same timeframe.
- Currently holds level 3 (Mist net) & 4 (harp trap) personal bat class survey licence for England;
- Previously held Natural England/English Nature/ Countryside Council for Wales (CCW) licences to mist net/harp trap and mark for radio-tracking and with aluminium rings a wide range of bats species including barbastelle, Bechstein's, common and soprano pipistrelle,

noctule, Natterer's, whiskered, Brandt's, Daubenton's, brown long-eared bat and greater horseshoe bat species (1998-2008) in southern England and south Wales.

- Is the author of Chapter 9 of the 3rd Edition of the Bat Survey Guidelines (2016) – Advanced Licensed Bat Surveys for the UK

- Developed the Bat Conservation Trust's (UK) advanced bat survey training course and delivered it in 2016.

B.15.32 Ian's refereed publications include:

- PARSONS, K.N., JONES, G. DAVIDSON-WATTS, I., F & GREENAWAY, F. 2003. Swarming of bats at underground sites in Britain - implications for conservation. Biological Conservation 111: 63-70.

- DAVIDSON-WATTS, I., WALLS, S. & JONES, G. 2006. Differential habitat selection by *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus* identifies distinct conservation needs for cryptic species of echolocating bats. Biological Conservation 133: 118-127.

- DAVIDSON-WATTS, I. & JONES, G. 2006. Differences in foraging behaviour between *Pipistrellus pipistrellus* (Schreber, 1774) and *Pipistrellus pygmaeus* (Leach, 1825). Journal of Zoology 268: 55-62.

- DAVIDSON-WATTS, I.F. 2007. Roost selection, foraging behaviour and habitat use of two cryptic species of pipistrelle bat. PhD Thesis. Open/Bristol Universities.

- ZEALE, M.R.K., DAVIDSON-WATTS, I.F. & JONES, G. 2012. Home range use and habitat selection by barbastelle bats (*Barbastella barbastellus*): implications for conservation'. Journal of Mammalogy, vol 93(4): 1110-1118.

- WRIGHT, P.G.R., MATTHEWS, F., HAMILTON, P.B., SCHOFIELD, H., GLOVER, A., DAMANT, C., & DAVIDSON-WATTS, I.F. (2018). Genetic structure and diversity of a rare woodland bat, *Myotis bechsteinii*: comparison of continental Europe and Britain. Vol.:(0123456789)1 3Conservation Genetics https://doi.org/10.1007/s10592-018-1053-z

B.15.33 Ian's relevant recent projects:

- - The design and delivery of advanced bat surveys of forest dwelling species including barbastelle bat (trapping and radio tracking) for the A358 bypass at Taunton. (2018 – Client Mott McDonald, Highways Agency).

- - The design and delivery of advanced bat surveys of forest dwelling species (acoustic, trapping and radio tracking- all species) and tree climbing surveys for High Speed 2 West Midlands and the provision of detailed mitigation advice (2014, 2015 and 2018– Client ARUP/AECOM, HS2 Ltd).

- - The design and delivery of advanced bat surveys/monitoring (trapping and radio tracking of barbastelle bats) for A120 road Bypass at Bishops Stortford, and the provision of detailed mitigation advice (2016 and 2017 – Client ARUP, Herts County Council).

- - The design and delivery of advanced bat surveys of tree roosting species including barbastelle bats (acoustic, trapping and radio tracking, primary species barbastelle bat) for the Stonehenge Bypass A303 Wiltshire (2017 – Client Atkins, Highways Agency).

- - Design and delivery of advanced bat surveys (primary species barbastelle and Bechstein's bat) for the northern Eastleigh urban extension. Hampshire (2016 and 2017 – Eastleigh Borough Council, Client WYG, Highwood Group).

- Design and delivery of advanced bat surveys (trapping and radio tracking, primary species barbastelle bat) for the Bourn Airfield development (5,000 houses) Cambridge (2015 and 2016) – Client Thomson Ecology.
- Design and delivery of advanced bat surveys (trapping and radio tracking, primary species Bechstein's bat) for the Welbourne development, Fareham (5,000 houses), Hampshire (2014) – Client Thomson Ecology.
- Design and delivery of advanced bat surveys (full acoustic, trapping and radio tracking, primary species horseshoe bats) for The Vale development (3-5,000 houses) Bristol (2016 and 2017)– Client PBA.
- Design and delivery of advanced bat surveys (trapping and radio tracking, primary species barbastelle and horseshoe bats) for the Cullompton Garden Village (5,000 houses) development Devon (2018)– Ethos Environmental.

B.15.34 Bats were trapped on the following nights, with the trapping areas shown on **Figure 21:**

- June:
  - 16/06/2019
  - 17/06/2019
  - 18/06/2019
- August:
  - 11/08/2019
  - 12/08/2019
  - 13/08/2019
- September:
  - 15/09/2019
  - 16/09/2019
  - 17/09/2019

B.16 Soil Sampling

Method

Fieldwork & Scope of Investigation

B.16.1 The scope of the investigation was determined after review of the Natural England Technical Information Notes (TIN) 035 and 036. Prior to the commencement of the sampling, sampling grids were overlaid on the sample fields and sample locations were placed and uploaded to Geographic Information System (GIS) software. A handheld tablet was utilised by the engineer to navigate around the site and locate the sample locations.

B.16.2 A total of thirteen composite soil samples were obtained across thirteen fields (**Figure 24**). Each field was subdivided into sampling grids ranging from 15 to 30 sampling points per field.

Hazard Scanning and Avoidance

B.16.3 Prior to sampling, each sample location was initially scanned for buried services/underground utilities by a Cable Avoidance Tool (CAT) by the Stantec engineer.

B.16.4 First Line Defence, a UXO specialist contractor licensed to work on MOD sites, provided an engineer for the duration of the works. Upon completion of the CAT scan the sample position was then scanned with a UXO magnetometer to test for any historical ordnance before the excavation of the soil sample.

Soil Coring

B.16.5 The soil samples were cored from the selected field locations using a handheld soil 'Pot-Corer' (TIN035, 2008) which was pressed into the soil by hand and the first 7.5cm was extracted and placed into a clean polythene bulk bag in order to create a composite soil sample.

B.16.6 The composite soil samples (thirteen in total) were then split into four 500ml plastic tubs and stored in cool boxes before being transported with full chain of custody to an accredited laboratory for post fieldwork chemical analysis.

Laboratory Testing

B.16.7 Chemtest Laboratories, who hold UKAS accreditation, were commissioned by Stantec to complete the geoenvironmental testing.

B.16.8 The soil samples were tested for Soil Nutrient and Soil Classification in compliance with the Natural England Technical Information Notes (TIN) 035 and 036 and BS1377.

B.16.9 Each of the thirteen samples were tested for

i. Moisture Content,
ii. Soil Texture Class,
iii. pH,
iv. Nitrogen,
v. Organic Matter and
vi. Extractable potassium, magnesium and phosphorous

Interpretation

B.16.10 To aid with the interpretation of the soil sampling results, the soil texture was defined using the Soil Texture Triangle, as contained in TIN 037 (Soil Texture).

Dates and Survey Personnel

B.16.11 The soil survey was undertaken by a Stantec engineer under the supervision of an Unexploded Ordnance Engineer (UXO) from First Line Defence from the 27th to the 29th January 2019.

Limitations

B.16.12 The soil sampling results represent a snap-shot of the geo-environmental conditions in the sample locations shown, on the day of field survey. As such there may be temporal or spatial variation, should further survey be completed. The methodology (i.e. taking multiple sub-samples) responds to the noted spatial variation, by providing an average. This noted restriction of environmental sampling is however not considered to be a limitation to the conclusions drawn for this high-level appraisal.

Appendix C Desk Study Results: International and Locally Designated Sites

Table 8: Summary of Designated Site (Location and Designation Criteria)

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
European Designated Sites		
Abberton Reservoir Ramsar	2.71 km south-west	**Ramsar criterion 6 – species/populations occurring at levels of international importance:** *Species with peak counts in spring/autumn*: gadwall *Anas strepera* and northern shoveler *Anas clypeata*. *Species with peak counts in winter:* Eurasian wigeon *Anas penelope*. *Species/populations identified subsequent to designation* - Peak counts in spring/autumn: mute swan *Cygnus olor*, common pochard *Aythya ferina*.
Abberton Reservoir Special Protection Area (SPA)	2.71 km south-west	**Article 4.2 qualification (79/409/EEC):** *Populations of breeding birds:* great comorant *Phalacrocorax carbo*. *Populations of over-wintering birds:* Northern shoveler, teal *Anas crecca*, Eurasian wigeon, common pochard, gadwall, tufted duck *Aythya fuligula*, common goldeneye *Bucephala clangula*, mute swan, Eurasian coot *Fulica atra*, great crested grebe *Podiceps cristatus*. **Article 4.2 Qualification (79/409/EE)** *An internationally important assemblage of overwintering birds, including*: great crested grebe, Eurasian wigeon, gadwall, teal, common pochard, tufted duck, common goldeneye and Eurasian coot.
Colne Estuary Ramsar	3.28 km south-east	**Ramsar criterion 1 -** Extent and diversity of saltmarsh present. This site, and the four other sites in the Mid-Essex Coast complex, includes a total of 3,237 ha, that represent 70% of the saltmarsh habitat in Essex and 7% of the total saltmarsh in Britain. **Ramsar criterion 2 -** Site supports 12 species of nationally scarce plants and at least 38 British Red Data Book invertebrate species. **Ramsar criterion 3 -** Site supports a full and representative sequences of saltmarsh plant communities covering the range of variation in Britain. **Ramsar criterion 5 -** Assemblage of international importance: Species with peak counts in winter: 32041 waterfowl (5 year peak mean 1998/99-2002/2003) **Ramsar criterion 6 – species/populations occurring at levels of international importance.** *Species with peak counts in winter*: dark-bellied brent goose *Branta bernicla*, common redshank *Tringa totanus* *Species/populations identified subsequent to designation* - Peak counts in winter: black-tailed godwit *Limosa limosa islandica*.
Colne Estuary SPA	3.28 km south-east	**Article 4.1 qualification (79/409/EEC):** *Population of breeding little tern Sterna albifrons.* *Population of overwintering hen harrier Circus cyaneus, avocet and golden plover/.* **Article 4.2 qualification (79/409/EEC):** *Populations of overwintering birds*: dark-bellied brent goose and common redshank. **Article 4.2 qualification (79/409/EEC):** *assemblage wetland of international importance: Over winter, the area regularly supports 38,548 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Black-tailed Godwit*

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
		Limosa limosa islandica, Dunlin Calidris alpina alpina, Lapwing Vanellus vanellus, Grey Plover Pluvialis squatarola, Ringed Plover Charadrius hiaticula, Shelduck Tadorna tadorna, Cormorant Phalacrocorax carbo, Great Crested Grebe Podiceps cristatus, Redshank Tringa totanus, Dark-bellied Brent Goose Branta bernicla bernicla, Golden Plover Pluvialis apricaria, Avocet Recurvirostra avosetta.
Essex Estuaries Special Area of Conservation (SAC)	3.28 km south-east	**Annex I habitats that are a primary reason for site selection:** *1130 Estuaries* - coastal plain estuarine system with associated open coast mudflats and sandbanks. Extensive area of contiguous estuarine habitat. Wide range of characteristic marine and estuarine sediment communities. Some diverse and unusual marine communities including sponges. Very rich sublittoral invertebrate fauna, including the reef-building worm *Sabellaria spinulosa*, the brittlestar *Ophiothrix fragilis*, crustaceans and ascidians. Large areas of saltmarsh and other important coastal habitats. *1140 Mudflats and sandflats not covered by seawater at low tide* - extensive intertidal mudflats and sandflats. Wide range of sediment flat communities: estuarine muds; sands and muddy sands; and fully saline, sandy mudflats with extensive growths of eelgrass *Zostera spp.* on the open coast. Maplin Sands- nationally-important dwarf eelgrass *Zostera noltei* beds and associated animal communities. *1310 Salicornia and other annuals colonizing mud and sand* - Glasswort *Salicornia spp.* Saltmarsh. Extensive and varied intertidal mud and sandflats through to upper saltmeadows. *1320 Spartina swards Spartinion maritimae* The most extensive remaining stand of small cord-grass *Spartina maritima* in the UK at Foulness Point. Other smaller stands elsewhere in the estuary. *1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)* - Extensive salt meadows, with floristic features typical of this part of the UK. Golden samphire *Inula crithmoides* is a characteristic species. *1420 Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi).* Local variant of this vegetation, which features sea-lavenders *Limonium spp.* and sea-heath *Frankenia laevis*, occurs at Colne Point. **Annex I habitats present as a qualifying feature, but not a primary reason for site selection:** *1110 Sandbanks which are slightly covered by sea water all the time.*
Blackwater Estuary Ramsar	6.23 km south	**Ramsar criterion 1 -** Extent and diversity of saltmarsh habitat present. This site, and the four others in the Mid-Essex Coast complex, includes a total of 3,237 ha that represent 70% of the saltmarsh habitat in Essex and 7% of the total area of saltmarsh in Britain. **Ramsar criterion 2 -** Invertebrate fauna is well represented and includes at least 16 British Red Data Book species. In descending order of rarity these are: Endangered: a water beetle *Paracymus aeneus*; Vulnerable: a damselfly *Lestes dryas*, the flies *Aedes flavescens, Erioptera bivittata, Hybomitra expollicata* and the spiders *Heliophanus auratus* and *Trichopterna cito*; Rare: the beetles *Baris scolopacea, Philonthus punctus, Graptodytes bilineatus* and *Malachius vulneratus*, the flies *Campsicemus magius* and *Myopites eximia*, the moths *Idaea ochrata* and *Malacosoma castrensis* and the spider *Euophrys*. **Ramsar criterion 3 -** Full and representative sequences of saltmarsh plant communities covering the range of variation in Britain. **Ramsar criterion 5 -** Assemblage of international importance: Species with peak counts in winter (105061 waterfowl (5 year peak mean 1998/99-2002/2003) **Ramsar criterion 6 – species/populations occurring at levels of international importance.**

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
		Species with peak counts in winter: dark-bellied brent goose *Branta bernicla*, grey plover *Pluvialis squatarola*, dunlin *Calidris alpine* and black-tailed godwit**.** *Species/populations identified subsequent to designation*: *Species with peak counts in winter***:** common shelduck *Tadorna tadorna***,** European golden plover *Pluvialis apricaria* and redshank.
Blackwater Estuary SPA	6.23 km south-	**Article 4.1 qualification (79/409/EEC)** *Population of breeding little tern.* Population of overwintering hen harrier, avocet, golden plover and ruff. **Article 4.2 qualification (79/409/EEC)** *Populations of passage birds:* ringed plover. *Populations of overwintering birds*: dark bellied brent goose, redshank, shelduck, common ringed plover, dunlin, black-tailed godwit and grey plover. **Article 4.2 Qualification (79/409/EEC):** *A wetland of international importance: Over winter, the area regularly supports 109,815 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Great Crested Grebe Podiceps cristatus, Golden Plover Pluvialis apricaria, Ruff Philomachus pugnax, Dark-bellied Brent Goose Branta bernicla bernicla, Shelduck Tadorna tadorna, Ringed Plover Charadrius hiaticula, Grey Plover Pluvialis squatarola, Dunlin Calidris alpina alpina, Avocet Recurvirostra avosetta, Redshank Tringa totanus, Curlew Numenius arquata, Cormorant Phalacrocorax carbo, Wigeon Anas penelope, Teal Anas crecca, Pintail Anas acuta, Shoveler Anas clypeata, Goldeneye Bucephala clangula, Red-breasted Merganser Mergus serrator, Lapwing Vanellus vanellus, Black-tailed Godwit Limosa limosa islandica.*
Nationally Designated Sites		
Roman River SSSI	0.75 km south (adjacent to Mitigation Land)	Complex mosaic of woodland, scrub, heath, grassland and fen as well as unimproved acid grassland, which together supports a diverse population of breeding birds, and more than a thousand species of butterflies and moths. The woodland is ancient, and the breeding bird population includes a large population of nightingales (as well as many other species), and the invertebrate population includes thirty notable species.
Upper Colne Marshes Site of Special Scientific Interest (SSSI)	0.61m east	The Upper Colne Marshes lie along both sides of the River Colne and Roman River; the site includes grazing marshes, with associated ditches and open water habitat, as well as a series of tidal salt marshes, and intertidal mud. The habitats support an outstanding assemblage of nationally scarce plants, unusual variety of brackish ditch types, terrestrial and aquatic invertebrates, and breeding and wintering birds.
Colne Local Nature Reserve (LNR)	1.39 km east	The Colne LNR lies on the north side of the River Colne consisting of 3 main areas; ▪ Wivenhoe Woods is a mixed coppice and secondary woodland; ▪ Ferry Marsh is a former grazing marsh which includes brackish water ditch system and associated marsh and swamp habitats. The marsh supports bird, plant and aquatic invertebrates; and ▪ Lower Lodge Farm is mainly scrub and grassland, and has been used as a receptor site for common lizard as a result of development activities in Colchester. Otters have been known to use the LNR and there is a good water vole population in the ditch system; this ditch system was extended in 2010.
Salary Brook LNR	1.89 km north east	This river valley corridor covering 48 acres constitutes an important urban wildlife area and comprises a wealth of habitats including pasture, grassland, marsh, fishing ponds and the brook itself which runs the entire length of the reserve. The site comprises rough grassland, scattered scrub, broadleaved woodland and emergent vegetation on the western side of the river. Marshy and wet grassland flora dominate the eastern areas. The drier parts of the brooks open space have probably been used for extensive grazing for many centuries and, therefore, retain areas of historic semi- natural vegetation.

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		Salary Brook retains a distinctive community of plants and animals, many of which are associated with wetlands. The wealth of wildlife includes species not often encountered in the urban area including nightingale, reed warbler, lizard, water vole and four species of bat, including pipistrelle. At the heart of the site lies Berrimans pasture, home to over one hundred plant species, including many characteristic of damp unimproved grasslands. These include lady's smock, sneezewort, common sedge and devilsbit scabious. The latter three are all scarce in Essex.
Non-Statutory Local Wildlife Sites (LWSs) (Citation information taken from the 2015 sites review (EECOS, 2017) report rather than the data provided as part of the desk study)		
Middlewick Ranges	Within and beyond Allocation Boundary	The vegetation here comprises tall sward grassland and scrub to the north and south, short-mown acidic turf over the rifle ranges and scrubby acidic grassland behind the main butts. The northern-most field is hay-cut and species-poor, but retains an acidic character with Red Fescue (Festuca rubra) and Common Bent (Agrostis tenuis), along with Common Sorrel (*Rumex acetosa*), Sheep's Sorrel (*Rumex acetosella*), Autumn Hawkbit (*Scorzoneroides autumnalis*). To the south of this the grassland has been invaded by scrub, which now includes Pedunculate Oaks (*Quercus robur*) of considerable size, with elm (*Ulmus sp.*), Hawthorn (*Crataegus monogyna*) and Blackthorn (*Prunus spinosa*). The open grassland is marginally more diverse here, with Sweet Vernal Grass (*Anthoxanthum odoratum*), Field Wood-rush (*Luzula campestris*), meadow-grass (*Poa* sp.), Yarrow (*Achillea millefolium*) and Bird's-foot-trefoil (*Lotus corniculatus*). However, False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot Grass (*Dactylis glomerata*) are frequent and there is abundant Gorse (*Ulex europaeus*) and Broom (*Cytisus scoparius*) scrub. A population of the Nationally Scarce Lesser Calamint (*Clinopodium calaminta*) can be found on the western edge of the site here. To the south of the butts there is a combination of Gorse scrub, bare ground and sparse sward acidic grassland over uneven ground. Although not floristically diverse on the whole, there are patches of lichen heath, dominated by Cladonia lichens. The meadow to the south of this area, beyond some more scrubby Pedunculate Oak woodland, is more diverse, in part, with Common Bent, Red Fescue, timothy (Phleum sp.), Wild Carrot (*Daucus carota*), Lesser Stitchwort (*Stellaria graminea*), Common Knapweed (*Centaurea nigra*) and Hare's-foot Clover (*Trifolium arvense*). The principal value of this site, however, is it invertebrate populations. The main rifle butts at the south end of the site, along with smaller sandy banks to the north, provide significant nesting habitat for a range of insects, whilst the extensive grasslands surrounding them, including those areas kept closely mown over the active parts of the rifle range, provide the necessary additional foraging grounds. The best-studied group of insects here is the hymenoptera (bees, wasps and ants), within which seven nationally threatened (Red Data Book) and eight Nationally Scarce species have been recorded. The most significant species are the SPI digger wasps *Cerceris quadricincta* (RDB1) and *Cerceris quinquefasciata* (RDB3), the latter's brood-parasite cuckoo-wasp *Hedychrum niemelai* (RDB3) and the Small Blue Carpenter-bee *Ceratina cyanea* (RDB3). Some of the short-mown sandy banks bordering the range roads support a large population of the RDB2 Bee-wolf (*Philanthus triangulum*).
Birch Brook Wood	Within and beyond Allocation Boundary	Although now predominantly a woodland site, Birch Grove, towards the eastern end, is the only section of any age, with a flora that suggests it may be ancient in origin. The remainder of the site supports secondary woodland, spreading from old field boundaries, wet woodland along the brook and in lower lying areas and localised areas of acid grassland. On the higher, dry ground the woodland consists of Pedunculate Oak (*Quercus robur*), Elm (*Ulmus* sp.) and Birch (*Betula* spp.) with Holly (*Ilex aquifolium*) and Hazel (*Corylus avellana*) in the understorey and a ground flora that includes Bracken (*Pteridium aquilinum*) and Wood Sage (*Teucrium scorodonia*). Scrubbier margins include Hawthorn (*Crataegus monogyna*) and, in places, Gorse (*Ulex europaeus*) while larger Pedunculate Oaks mark old hedge lines. The wet woodland is largely made up of Crack Willow (*Salix fragilis*) and Grey Willow (*S. cinerea*), with some Silver Birch (*Betula pendula*). In more open areas there are localised sedge (*Carex* sp.) beds with Marsh Thistle (*Cirsium palustre*) and Skullcap (*Scutellaria galericulata*). Birch Grove consists of Pedunculate Oak and Ash (*Fraxinus excelsior*) with Alder (*Alnus glutinosa*) along the streamside. The ground flora is rich in ferns, with the Essex Red Data List (ERDL) species Narrow Buckler-fern (*Dryopteris carthusiana*), Lady Fern (*Athyrium filix-femina*), Hard Fern (*Blechnum spicant*) and Scaly Male Fern (*Dryopteris affinis*) of particular note. Other

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		noteworthy plant species include Hart's-tongue Fern (*Asplenium scolopendrium*), Wood Anemone (*Anemone nemorosa*), Pignut (*Conopodium majus*), Dog's Mercury (*Mercurialis perennis*), Enchanter's Nightshade (*Circaea lutetiana*), Bluebell (*Hyacinthoides non-scripta*), Creeping Jenny (*Lysimachia nemorum*), Wood Sorrel (*Oxalis acetosella*), Remote Sedge (*Carex remota*) and the ERDL Wood Horsetail (*Equisetum sylvaticum*) at one of its few Essex locations. The area around the Redoubt comprises dry acid grassland and scrub, providing additional habitat diversity. The ground flora includes Red Fescue (*Festuca rubra*), Common Bent (*Agrostis capillaris*), Sheep's Sorrel (*Rumex acetosella*), *Hieracium sabaudum* (a hawkweed) and Bracken, with Pedunculate Oak, Gorse, Bramble (*Rubus fruticosus*) and Broom (*Cytisus scoparius*) scrub. A further area of sparse acid grassland is found on the southern edge of the site near its eastern end. Plant species here include Common Bent, Sheep's Sorrel, *Hieracium sabaudum*, Common Centaury (*Centaurium erythraea*), Blue Fleabane (*Erigeron acris*), Heath Speedwell (*Veronica officinalis*), *Cladonia* lichens and Hoary Cinquefoil (*Potentilla argentea*).
Colchester Cemetery	0.05 km north-west	As with many churchyards, this large, old cemetery has encapsulated and helped to preserve an area of old grassland, albeit modified by its use. The best flora lies in the older western section, where the Essex Red Data List plant Meadow Saxifrage (*Saxifraga granulata*) is particularly notable. Other characteristic acid grassland species include Field Scabious (*Knautia arvensis*), Mouse-ear-hawkweed (*Pilosella officinarum*), Bird's-foot (*Ornithopus perpusillus*), Knotted Clover (*Trifolium striatum*) and Heath Bedstraw (*Galium saxatile*). Invertebrates recorded around the site include several Nationally Scarce species such as the SPI Stag Beetle (*Lucanus cervus*), the solitary bee *Dasypoda hirtipes* and the micro-moth *Nemophora fasciella.* The Anglican Chapel supports roosting Long-eared Bat and Common Pipistrelle.
Donyland Wetlands	0.25 km south-east	This is the area of a former mineral extraction site and supports significant populations of breeding amphibians, most notably a large colony of Common Toad, a SPI, with Common Frog and Smooth Newt The northern section comprises a broad, shallow lake that draws down in the summer. The shallow margins support dense willow (*Salix* spp.) woodland with swamp vegetation and some rough grassland. The lake supports a dense population of pondweed (*Potamogeton* sp.) and breeding Little Grebe and Tufted Duck. Great Green Bush-cricket (*Tettigonia viridissima*) (an Essex Red Data List species) has been recorded here. The southern section comprises a deep flooded pit, which is now a fishing lake, and sloping rough grassland dropping down to the adjacent Birch Brook LoWS. The fishing lake is fringed with scrub and Reedmace (*Typha latifolia*) and is well used by waterfowl in the winter. Along its western edge is an old lane with large Pedunculate Oaks (*Quercus robur*). The grassland is recent in origin, following the disturbance of quarrying operations, including the main processing area at its eastern end. It includes exposed sandy banks and damp hollows, with significant patches of Bramble scrub becoming established. Plant species include Common Knapweed (*Centaurea nigra*), Agrimony (*Agrimonia eupatoria*), Red Bartsia (*Odontites vernus*), Common Bird's-foot-trefoil (*Lotus corniculatus*), Creeping Cinquefoil (*Potentilla reptans*) and Perforate St John's-wort (*Hypericum perforatum*). In some more open areas, including where rabbits have grazed, the mineral origin of the soils is revealed by the presence of Red Fescue (*Festuca rubra*), Common Stork's-bill (*Erodium cicutarium*) and Common Centaury (*Centaurium erythraea*).
Hythe Brownfield	0.27 km east	This series of post-industrial habitats includes an old sand pit, disused parts of a sewage treatment work and an area of old grazing marsh modified by sludge deposition. Such areas are known to be important for invertebrates, and the old sand pit cliff in particular supports a nationally important assemblage of solitary bees and wasps, including the Nationally Rare (RDB3) *Cerceris quinquefasciata*, a UK BAP Priority species; its cuckoo-wasp brood parasite *Hedychrum niemelai*, the nomad bee N*omada fulvicornis* and the Small Blue Carpenter-bee *Ceratina cyanea* (all also RDB3), along with numerous other Nationally Scarce species. Much of the surrounding brownfield grassland provides essential foraging habitat for these and many other invertebrates. The grassland at Place Farm is varied according to ground conditions. On the higher ground, the sward features Red Fescue (*Festuca rubra*), Common Bent (*Agrostis tenuis*), Sheep's Sorrel (*Rumex acetosella*), Bird's-foot-trefoil (*Lotus corniculatus*) and Autumn Hawkbit (*Scorzoneroides autumnalis*), reflecting the acidic nature of the soil. On lower ground to the south and west it is more varied with Crested Dog's-tail (*Cynosurus cristatus*), cat's-tail (*Phleum* sp.), Creeping Bent (*Agrostis stolonifera*), Common Knapweed (*Centaurea nigra*), Meadow Buttercup (*Ranunculus*

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		acris). To the north of the meadow is a pool and associated marshy grassland that supports Nodding Bur-marigold (*Bidens cernua*), Floating Sweet-grass (*Glyceria fluitans*), Jointed Rush (*Juncus articulates*), Brooklime (*Veronica beccabunga*) and a water-crowfoot (*Ranunculus* sp.).
Bourne Valley	0.34 km north	This site contains freely draining and swampy woodland, marsh, tall grassland, stream and lake habitats of great intrinsic interest, especially given its place in the urban environment. The woodland south of Bourne Pond is very old, if not ancient, comprising Sweet Chestnut (*Castanea sativa*) coppice with some Pedunculate Oak (*Quercus robur*) and an understorey of Holly (*Ilex aquifolium*). The flora here includes abundant Bluebell (*Hyacinthoides non-scripta*) and Creeping Soft-grass (*Holcus mollis*). Alder (*Alnus glutinosa*) and willow (*Salix*) wood fringes the pond with Pendulous Sedge (*Carex pendula*) and Tufted Hair-grass (*Deschampsia cespitosa*). Eastwards, past planted poplars (*Populus* sp.) and large willows, this grades into young oak wood with Ash (*Fraxinus excelsior*), Alder, Hazel (*Corylus avellana*), Hawthorn (*Crataegus monogyna*) and Holly. The ground flora consists of Bramble (*Rubus fruticosus* agg.) and Bracken (*Pteridium aquilinum*) with Wood Avens (*Geum urbanum*) and Honeysuckle (*Lonicera periclymenum*). The stream and adjacent marshes support species such as Reed Canary-grass (*Phalaris arundinacea*), Fool's-water-cress (*Apium nodosa*), Great Willowherb (*Epilobium hirsutum*), Gipsywort (*Lycopus europaeus*) and Lesser Pond-sedge (*Carex acutiformis*). Pignut (*Conopodium majus*) is present in grassy areas. The Willow (*Salix spp.*) and Alder woodland surrounding Distillery Pond has a diverse swamp flora which includes Cuckooflower (*Cardamine pratensis*), Lesser Pond-sedge, Meadowsweet (*Filipendula ulmaria*), Reed Sweet-grass (*Glyceria maxima*), Yellow Flag (*Iris pseudacorus*) and Skullcap (*Scutellaria galericulata*). Invertebrate surveys have revealed an interesting fauna associated with the stream and wet woodland communities, including the Nationally Scarce (Na) Pale-lemon Sallow Moth (*Xanthia ocellaris*). Common Toad, SPI, breeds here.
Hythe Lagoons	0.79 km east	These lagoons are of importance as a breeding ground for Little Ringed Plover and, in some years, Avocet (both listed under Schedule 1 of the Wildlife and Countryside Act, 1981 (as amended)), as well as Lapwing, Shelduck and Linnet. It also provides a high tide roost and feeding habitat for a variety of coastal birds, including a significant proportion of the estuary's population of Black-tailed Godwits through autumn and winter. Although artificially created by the construction of embanked lagoons to take dredging material from the adjacent river Colne, the ecology of this site is very much one of coastal grazing marsh, which was the habitat present before the lagoons were created. It contains habitats that augment the adjacent Upper Colne Marshes SSSI and is now managed by Colchester Borough Council as a Local Nature Reserve. The northernmost lagoon supports dense stands of Common Nettle (*Urtica dioica*) with scattered scrub, particularly around its margins. To the south, the next lagoon is dry for much of the year, but supports stands of Sea Club-rush (*Bolboschoenus maritima*), Annual Sea-blite (*Suaeda maritima*), glassworts (*Salicornia* spp.) and the Nationally Scarce Sea Barley (*Hordeum marinum*). The habitat of the central lagoon is dry coastal grassland that is equivalent to upper saltmarsh communities, dominated by Sea Couch (*Elytrigia atherica*). The southern lagoon holds a large area of permanent water that draws down to leave broad, muddy margins with fringing stands of Common Reed (*Phragmites australis*) and Sea Club-rush. On the eastern edge of the site there is open mosaic habitat that reveals the previous industrial use of the area. Throughout the site there is an exceptional population of the Nationally Scarce Dittander (*Lepidium latifolium*) and significant quantities of another now scarce Essex plant, Wormwood (*Artemisia absinthum*). A large population of Great Green Bush Crickets is also present.
Ball Grove	0.89 km south	This site comprises a mosaic of ancient woodland, recent woodland, rough grassland and, in the southeast corner, an old, species-rich meadow. The most significant species in the largely free-draining meadow are Green-winged Orchid (*Orchis morio*), Adder's-tongue Fern (*Ophioglossum vulgatum*), Lesser Calamint (*Clinopodium calamintha*) and Fairy Flax (*Linum catharticum*), amongst Musk Mallow (*Malva moschata*), Barren Strawberry (*Potentilla sterilis*), Bird's-foot-trefoil (*Lotus corniculatus*), Red Fescue (*Festuca rubra*), Common Sorrel (*Rumex acetosa*), Agrimony (*Agrimonia eupatoria*), Crested Dog's-tail (*Cynosurus cristatus*), Creeping Cinquefoil (*Potentilla reptans*), Lesser Stitchwort (*Stellaria graminea*) and Heath Speedwell (*Veronica officinalis*). Waxcap mushrooms, an indicator of unimproved grassland, are present and, the lower, southern part of the meadow is damp, with Marsh Thistle (*Cirsium palustre*).

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		The northern grasslands, pylon rides and other clearings are taller and unmanaged, but still retain an acid grassland flora, which includes Common Bent (*Agrostis tenuis*), Common Centaury (*Centaurium erythraea*), Mouse-ear-hawkweed (*Pilosella officinarum*), Heath Speedwell, Sheep's Sorrel (*Rumex acetosella*), Wood Sage (*Teucrium scorodonia*) and Field Wood-rush (*Luzula campestris*). Common Knapweed (*Centaurea nigra*), Lesser Stitchwort, Bird's-foot-trefoil and Perforate St John's-wort are also present. The central area of woodland, around a spring and seepage, is the remnant ancient Ball Grove, which is typically old Hazel (*Corylus avellana*) and Sweet Chestnut (*Castanea sativa*) coppice with Pedunculate Oak (*Quercus robur*) standards and occasional Ash (*Fraxinus excelsior*), Holly (*Ilex aquifolium*) and Crab Apple (*Malus sylvestris*). The ground flora includes Bluebell (*Hyacinthoides non-scripta*), Remote Sedge (*Carex remota*), Enchanter's-nightshade (*Circaea lutetiana*), Foxglove (*Digitalis purpurea*) Dog's Mercury (*Mercurialis perennis*) and Wood Anemone (*Anemone nemorosa*). Along the spring are Alder (*Alnus glutinosa*) and Creeping-jenny (*Lysimachia nummularia*) with frequent ferns. To the north and west of the ancient wood are blocks of maturing, but recent, scrubby oak woodland with a ground flora dominated by Bramble (*Rubus fruticosus*) and, in more open areas, some remaining grassland species such as Agrimony.
Rowhedge Pits	1.19 km south-east	These former gravel pits now predominantly support woodland, with a distinction between lower, seasonally wet land and land closer to the original ground level. Within this are seasonal and permanent ponds, exposed sandy banks and more open grass and scrub mosaics. It is bisected by the former wharf access road. On the higher ground, the woodland canopy is made up of Pedunculate Oak (*Quercus robur*), Ash (*Fraxinus excelsior*), Silver Birch (*Betula pendula*) and Sycamore (*Acer pseudoplatanus*) with some Wild Cherry (*Prunus avium*). The understorey includes willow (*Salix* spp.), Hawthorn (*Crataegus monogyna*), Elder (*Sambucus nigra*), and Holly (*Ilex aquifolium*). The ground flora is generally low in diversity with Male Fern (*Dryopteris filix-mas*), Broad Buckler Fern (*Dryopteris dilatata*), Wood Avens (*Geum urbanum*), False-brome (*Brachypodium sylvaticum*), Herb-Robert (*Geranium robertianum*), Honeysuckle (*Lonicera periclymenum*), Common Ivy (*Hedera helix*), Bracken (*Pteridium aquilinum*) and Bramble (*Rubus fruticosus* agg.). Small quantities of *Hieracium sabaudum*, a grassland and heath species, remain in more open areas. The lower areas, largely with exposed mineral soils, are damp with extensive standing water over the winter months. Silver Birch, Sallow (*Salix cinerea*), and Aspen (*Populus tremula*) have colonised to form a canopy, but there is little understorey or ground layer. Mosses, including *Polytrichum* species, are widespread alongside *Peltigera* lichens with Soft-rush (*Juncus effusus*) and Bramble also present. The bog-moss *Sphagnum squarrosum*, which is scarce in Essex and especially in the northeast, occupies several damp hollows in a restricted area of the site. The water bodies are varied in size and nature, with fringes of Common Reed (*Phragmites australis*), Lesser Bulrush (*Typha angustifolia*) and Sea Club-rush (*Bolboschoenus maritimus*) being typical species. The few steep, sandy faces that are still exposed provide nesting habitat for solitary bees and wasps, including the Nationally Rare (RDB3) *Nomada fulvicornis*. Great Crested Newts are known to be present.
Donyland Woods West	1.17 km south	This site consists of an old streamside woodland strip together with more recent planted woodlands that augment the adjacent Donyland Woods part of the Roman River SSSI. The northern end of the narrow, streamside wood has Pedunculate Oak (Q*uercus robur*) and Ash (*Fraxinus excelsior*) standards with occasional Alder (*Alnus glutinosa*) and a Hazel (*Corylus avellana*) coppice and Holly (*Ilex aquifolium*) understorey. The ground flora includes Dog's Mercury (*Mercurialis perennis*), Primrose (*Primula vulgaris*), Enchanter's Nightshade (*Circaea lutetiana*), Foxglove (*Digitalis purpurea*), Remote Sedge (*Carex remota*), Common Marsh-bedstraw (*Galium palustre*) and abundant Bluebell (*Hyacinthoides non-scripta*) in the ground flora. To the west of the stream is a block of maturing planted Pedunculate Oak and Beech (*Fagus sylvatica*) into which Ash, Bluebell and Dog's Mercury have spread. Further south there is more Ash with Sweet Chestnut (*Castanea sativa*) and Elm (*Ulmus* sp.). The blocks to the east of the stream were planted with conifers in the 1960s/70s, but are now being converted to broad-leaved woodland. The central one of these three blocks consists of Pedunculate Oak woodland with Elm, Hazel and Silver Birch (*Betula pendula*) over an acidic ground flora of Heath Speedwell (*Veronica officinalis*), Sheep's Sorrel (*Rumex acetosella*), Wood

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		Sage (*Teucrium scorodonia*), Common Bent (*Agrostis capillaris*), *Polytrichum* moss and *Cladonia* lichens. The north, eastern block is the oldest of the recent woodland, planted in the early 20th Century and now made up of Pedunculate Oak and poplar (*Populus* sp.) with Hawthorn (*Crataegus monogyna*) and elm (*Ulmus* sp.). It includes some old Pedunculate Oak pollards and coppiced Ash, which may derive from old field boundary features.
Wivenhoe Park	1.20 km north-east	This site comprises the modified parkland associated with Wivenhoe House, now dominated by the University of Essex. The parkland includes some oak (*Quercus* spp.) trees in excess of 400 years old, with large specimens of Cork Oak (*Q. suber*), redwoods, pines and cedars. Some areas of woodland appear to be very old, with locally plentiful Bluebell (*Hyacinthoides non-scripta*). The intimate association that can develop between wildlife and the built environment of old parkland is demonstrated by the interesting fern fauna that has developed on the ha-ha (sunken wall) of Wivenhoe House, with a significant population of Hart's-tongue Fern (*Asplenium scolopendrium*). Areas of short acidic grassland are dominated by Red Fescue (*Festuca rubra*), Common Bent-grass (*Agrostis capillaris*), and Sheep's Sorrel (*Rumex acetosella*) with Field Wood-rush (*Luzula campestris*), Creeping Soft-grass (*Holcus mollis*), Heath Bedstraw (*Galium saxatile*), Creeping Cinquefoil (*Potentilla reptans*), Hairy Sedge (*Carex hirta*) and timothy (*Phleum* sp.). More noteworthy species include Blinks (*Montia fontana*), Slender Parsley-piert (*Aphanes microcarpa*) and the ERDL species Early forget-me-not (*Myosotis ramossissima*) and Subterranean Clover (*Trifolium subterraneum*). In less free-draining areas, the grassland is lusher and here there are additional species such as Sweet Vernal Grass (*Anthoxanthum* odoratum), Yorkshire-fog (*Holcus lanatus*), Common Knapweed (*Centaurea nigra*), Wild Carrot (*Daucus carota*), Hare's-foot Clover (*Trifolium arvense*), Prickly Sedge (*Carex muricata*), Bird's-foot Clover (*Lotus corniculatus*), Lesser Stitchwort (*Stellaria graminea*) and Cuckooflower (*Cardamine pratensis*). The invertebrate fauna includes a good range of butterflies, including White-letter and Purple Hairstreaks, Ringlet, Speckled Wood and skippers. Nightingales regularly occur in an area of scrubby woodland close to the railway line. The park also supports a rookery, good breeding numbers of Jackdaws and significant numbers of over-wintering Goosander on the lakes.
University Marshes	1.07 km north-east	This relict grazing-marsh retains many typical species, such as Grass Vetchling (*Lathyrus nissolia*), Dittander (*Lepidium latifolium*), Hairy Buttercup (*Ranunculus sardous*) and Divided Sedge (*Carex divisa*), whilst the larger drains support broad bands of Common Reed (*Phragmites australis*), with Brackish Water-crowfoot (*Ranunculus baudotii*) in areas of more open water. The section between the River Colne and the railway line is currently unmanaged and is being invaded by False Oat-grass (*Arrhenatherum elatius*) and scrub.
Berechurch Grassland	1.37 km south-west	This site comprises an area of regenerating acid grassland that has developed following the clearance of a conifer plantation, forming a valuable extension of habitat to the adjacent Friday Woods SSSI. The sward is dominated by Common Bent (*Agrostis capillaris*) but also includes Sweet Vernal-grass (*Anthoxanthum odoratum*), Red Fescue (*Festuca rubra*), Field Wood-rush (*Luzula campestris*), Wood Sage (*Teucrium scorodonia*) and localised Soft-rush (*Juncus effusus*). The fauna includes Green Hairstreak (*Callophrys rubi*), an uncommon Essex butterfly. The northern portion of the site includes a strip of taller neutral grassland that supports coarse grasses and locally abundant Common Knapweed (*Centaurea nigra*), along an overgrown tree line containing Pedunculate Oak (*Quercus robur*), Brambles (*Rubus fruticosus* agg.) and Gorse (*Ulex europaeus*), providing structural diversity.
The Moors	1.48 km north	This unusual site comprises beds of Common Reed (*Phragmites australis*), woodland, rough grassland and ruderal communities that have developed an unusual flora and fauna. In the mid-19th Century this area supported a series of riverside meadows either side of a meander in the River Colne, but by the turn of the 20th Century the river had been straightened, presumably to allow bigger boats to reach the East Mills upstream. Common Reed forms dense fringes along the river's banks and a large stand is found on low lying ground between the river and the railway line. More interesting plant species include Hemlock Water-dropwort (*Oenanthe crocata*), Wormwood (*Artemisia absinthum*), the Essex Red Data List species Small Teasel (*Dipsacus pilosus*) and the Nationally Scarce Dittander (*Lepidium latifolium*), with Wild Celery (*Apium graveolens*) and Marsh Woundwort (*Stachys palustris*) on the banks of the tidal River Colne also being of note. In general, away from the river, the site supports rough grassland with scattered bushes and patches of dense scrub. Along the

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
		southern edge there is an old boundary hedge and a band of Sycamore (*Acer pseudoplatanus*) and willow (*Salix* sp.) woodland on damp land fed by springs. The invertebrate populations are of note, with Wormwood Shark moth (*Cucullia absinthii*), several interesting hoverflies and, unusually for Colchester, a good mollusc fauna. Also present are a good range of bumblebees and butterflies, and populations of Slow Worm and Common Lizard.
Salary Brook	1.89 km north-east	This river valley corridor constitutes an important urban wildlife area, allowing for a variety of informal countryside recreational pursuits close to a large urban population. It is comprised of a mosaic of scrub, woodland and a diverse series of grassland. The grasslands have variable species diversity, but the flower-rich areas support Black Knapweed (*Centaurea nigra*), Lady's Bedstraw (*Galium verum*), Ox-eye Daisy (*Leucanthemum vulgare*), Meadow Vetchling (*Lathyrus pratensis*) and Lesser Stitchwort (*Stellaria graminea*). Damper areas within the grassland support Angelica (*Angelica sylvestris*), Cuckooflower (*Cardamine pratensis*), Reed Sweet-grass (*Glyceria maxima*), Meadowsweet (*Filipendula ulmaria*), Tufted Hair-grass (*Deschampsia cespitosa*), Common Hemp-nettle (*Galeopsis tetrahit*), Trifid Bur-marigold (*Bidens tripartita*), Common Marsh-bedstraw (*Galium palustre*), Water Chickweed (*Myosoton aquaticum*) and Sharp-flowered Rush (*Juncus acutiflorus*) as well as a number of beds of sedge (*Carex* spp.) and Common Reed (*Phragmites australis*). The ERDL species, Sneezewort (*Achillea ptarmica*) is found in the better quality, northern meadows. A series of shallow ponds have a marginal flora of Reedmace (*Typha latifolia*), Reed Canary-grass (*Phalaris arundinacea*), Reed Sweet-grass (*Glyceria maxima*), rushes (*Juncus* spp.), Branched bur-reed (*Sparganium erectum*) and Greater Pond-sedge (*Carex riparia*). Most of the ponds are fished. Scattered throughout are riverside Alder (*Alnus glutinosa*) and willows (*Salix* spp.) with patches of scattered or dense scrub. The northern stream sides are wooded, with large Pedunculate Oaks, Alder and Hazel (*Corylus avellana*) coppice and a ground flora that includes Dog's Mercury (*Mercurialis perennis*) and False-brome (*Brachypodium sylvaticum*). Scrub and hedgerow habitats along the brook have recently been found to support a population of Dormouse, which may be associated with nearby ancient woodland sites.
Roman River East	1.72 km south	This site comprises a band of former grazing-marsh bordering the tidal Roman River, together with two valley side pastures with acid grassland vegetation on their upper slopes. The site sits between and connects the Roman River SSSI to the west and the Upper Colne Marshes SSSI to the east. The floodplain grassland retains a flora characteristic of grazing marshes, including Grass Vetchling (*Lathyrus nissolia*), Cuckooflower (*Cardamine pratensis*) and Hairy Buttercup (*Ranunculus sardous*), amongst Marsh Foxtail (*Alopecurus geniculatus*), Meadow Foxtail (*Alopecurus pratense*), Crested Dog's-tail (*Cynosurus cristatus*), Sweet Vernal-grass (*Anthoxanthum odoratum*), Red Fescue (*Festuca rubra*) and Meadow-grasses (*Poa* spp.). Sea Club-rush (*Bolboschoenus maritimus*) is found along parts of the associated ditches, which are generally fringed by Common Reed (*Phragmites australis*). Dittander (*Lepidium latifolium*), an Essex Red Data List species, is also of note amongst areas of rough grassland. The grassland includes some scattered and dense scrub as well as tussocky sections with anthills, which support resident Common Lizards. To the north of the river are two large pastures which form part of the flood plain, but also rise to form areas of dry acid grassland on their upper slopes, characterised by Common Bent-grass (*Agrostis capillaris*), Red Fescue, Common Sorrel (*Rumex acetosa*), Lesser Stitchwort (*Stellaria graminea*) and Sheep's Sorrel (*Rumex acetosella*). The wet ditch between the pastures supports marsh vegetation including Nodding Bur-marigold (*Bidens cernua*), which is an Essex Red Data List species.
Friday Wood North	1.71 km south-west	This site comprises woodland on the northern edge of Friday Wood that is not included within the Roman River SSSI. The woodland forms three distinct compartments, the first being a rather open canopy to the south and west along the streamside, made up of Pedunculate Oak (*Quercus robur*) and Downy Birch (*Betula pubescens*), with some Sweet Chestnut (*Castanea sativa*), Ash (*Fraxinus excelsior*), Hazel (*Corylus avellana*) and climbing Honeysuckle (*Lonicera periclymenum*). The ground flora here supports Wood Sage (*Teucrium scorodonia*), Bluebell (*Hyacinthoides non-scripta*), Remote Sedge (*Carex remota*), Three-nerved Sandwort (*Moehringia trinervia*), Stinging Nettle (*Urtica dioica*), Primrose (*Primula vulgaris*) and Lesser

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
		Celandine (*Ficaria verna*). Bracken (*Pteridium aquilinum*) and Bramble (*Rubus fruticosus* agg.) dominate the ground cover in other areas. A large central portion is almost entirely dominated by the exotic Cherry Laurel (*Prunus laurocerasus*), which suppresses any form of ground flora, and is spreading within the streamside woodland area. The northern compartment, within the ancient woodland boundary, has been planted with Scots Pine (*Pinus sylvestris*) and here Cherry Laurel is also becoming increasingly established at the expense of the ground flora, which includes Bramble and Bracken.
Colchester Roman Walls	1.77 km north	The Roman town walls around Colchester are unique in the county and have developed a specialised flora, which includes several scarce species. Only the main remaining sections of the wall are indicated on the map, but the LoWS designation extends to any extant surfaces. The section between the upper and lower Castle Park is of particular significance. Rue-leaved Saxifrage (*Saxifraga tridactylites*), Black Spleenwort (*Asplenium adiantum-nigrum*), Wall Rue (*Asplenium ruta-muraria*), Maidenhair Spleenwort (*Asplenium trichomanes*), Lesser Calamint (*Clinopodium calamintha*), Flattened Meadow-grass (*Poa compressa*) and Subterranean Clover (*Trifolium subterraneum*) are of particular note, all featuring on the ERDL. Other characteristic species include Hart's-tongue Fern (*Asplenium scolopendrium*), Thyme-leaved Sandwort (*Arenaria serpyllifolia*), Common Whitlowgrass (*Erophila verna*), Thale Cress (*Arabidopsis thaliana*), Fern-grass (*Catapodium rigidum*), Red Fescue (*Festuca rubra*) and Pellitory-of-the-wall (*Parietaria diffusa*). Non-native species such as Wallflower (*Erysimum cheiri*), Red Valerian (*Centranthus ruber*) and Ivy-leaved Toadflax (*Cymbalaria muralis*) also contribute to the distinctiveness of the community. The lichen flora is exceptional and, amongst a taxonomically difficult group, may contain an as yet undescribed new species, discovered during earlier survey work. Where south-facing, areas of soft mortar support populations of solitary bees and wasps.
St. Andrew's Churchyard Greenstead	1.84 km north-east	This churchyard in the Greenstead area of Colchester retains unimproved grassland, although it is, for the most part, regularly mown. Although not species rich, the site has a diverse mix of common grasses and herbs including Red Fescue (*Festuca rubra*), Meadow grasses (*Poa* spp.), Common Bent (*Agrostis tenuis*), Yellow Oat-grass (*Trisetum flavescens*), Sheep's Sorrel (*Rumex acetosella*), Hairy Sedge (*Carex hirsuta*), Oxeye Daisy (*Leucanthemum vulgare*) and Common Knapweed (*Centaurea nigra*). Of note is a localised population of Lesser Calamint (*Clinopodium calamintha*), an Essex Red Data List species that occupies sunny locations near the church.
Manwood Chase	1.64 km south	This site is a complex of river flood plain marsh, grassland, scrub and woodland, which provides an extension to the adjacent SSSI. Manwood Grasslands This series of riverside grasslands and marsh are of extreme importance as an extensive tract of a rare and declining Essex habitat with good species diversity and also as part of the Roman River wildlife corridor, notably interlinking the two sections of the Roman River SSSI. The fields show little signs of agricultural improvement and include some notable marshland species including Meadowsweet (*Filipendula ulmaria*), Common Marsh-bedstraw (*Galium palustre*), Purple-loosestrife (*Lythrum salicaria*), Marsh Woundwort (*Stachys palustris*), Marsh Dock (*Rumex palustris*) and Trifid Bur-marigold (*Bidens tripartita*); the latter two being on the Essex Red Data List. The marsh comprises a patchwork of grasses, sedges and rushes, with the dominant species alternating between Reed Sweet-grass (*Glyceria maxima*), Common Reed (*Phragmites australis*), Sea Club-rush (*Bolboschoenus maritimus*), Floating Sweet-grass (*Glyceria* fluitans), pond-sedge (*Carex* sp.), Hard Rush (*Juncus inflexus*), Soft-rush (*Juncus effusus*), and Reed Canary-grass (*Phalaris arundinacea*), which in turn give way to Tufted Hair-grass (*Deschampsia cespitosa*) and rough grassland species on tussocky higher ground. Some areas are dominated by willow (*Salix* spp.) scrub. The southern-most (adjacent to Oxley Hill) and northern-most (north of Ball Lane) meadows are drier, situated on the banks of the valley and support species such as Lady's Bedstraw (*Galium verum*), Common Bird's-foot-trefoil (*Lotus corniculatus*), Common Knapweed (*Centaurea nigra*), Agrimony (*Agrimonia eupatoria*) and Meadow Vetchling (*Lathyrus pratensis*) amongst the tall grassland sward, which includes Meadow Barley (*Hordeum secalinum*) and Sweet Vernal-grass (*Anthoxanthum odoratum*). Disturbed areas hold Common Stork's-bill (*Erodium cicutarium*) and Sand Spurrey (*Spergularia rubra*) and structural diversity is provided by scattered scrub.

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
		Other notable species that have been recorded within Manwood grasslands are Sharp-flowered Rush (*Juncus acutiflorus*), Pepper Saxifrage (*Silaum silaus*) and Fine-leaved Water-dropwort (*Oenanthe aquatica*). A population of Glow Worms is present. <u>Man Wood</u> This ancient wood has been extensively replanted by conifers, particularly Scots Pine (*Pinus sylvestris*). Native species, predominantly found around the margins of the wood and old internal boundary features, include Pedunculate Oak (*Quercus robur*), Silver Birch (*Betula pendula*), Sweet Chestnut (*Castanea sativa*), with Hazel (*Corylus avellana*) and Holly (*Ilex aquifolium*) in the understorey and occasional Wild Service-tree (*Sorbus torminalis*). The ground flora is typical of light and well-drained soils, including Bracken (*Pteridium aquilinum*), Bramble (*Rubus fruticosus*), Bluebell (*Hyacinthoides non-scripta*) Wood Sage (*Teucrium scorodonia*) and Greater Stitchwort (*Stellaria holostea*). Other notable species are Wood Anemone (*Anemone nemorosa*), Climbing Corydalis (*Ceratocapnos claviculata*), Heath Speedwell (*Veronica officinalis*), Hairy Brome (*Bromopsis ramosus*), Slender St John's-wort (*Hypericum pulchrum*) and Remote Sedge (*Carex remota*). <u>Scrub and Woodland</u> The scrub and secondary woodland to the west of Man Wood, including Oxley Grove, exhibits a varied structure and composition of woody species, which includes large Pedunculate Oak standards and dense Silver Birch, Hazel coppice, Elder (*Sambucus nigra*) and Blackthorn (*Prunus spinosa*) along lower slopes. The underlying sand and gravels support associated species such as Broom (*Cytisus scoparius*), Gorse (*Ulex europaeus*), Bracken, Heath Speedwell, Sheep's-sorrel (*Rumex acetosella*), Foxglove (*Digitalis purpurea*) and Wood Sage. Bluebell, Primrose (*Primula vulgaris*) and Remote Sedge are also amongst the woodland flora. Other herbs found along disturbed tracks and open areas are Red Bartsia (*Odontites vernus*), Wild Carrot (*Daucus carota*), Agrimony, Common Centaury (*Centaurium erythraea*), Common Bird's-foot-trefoil and Hairy St John's-wort (*Hypericum hirsutum*). Parts of the site are used for clay pigeon shooting.
Wivenhoe Wood	1.8 km east	The central part of this site is ancient wood, the remainder consisting of more modern secondary cover of different ages, with a mosaic of scrub, grassland and parkland style scattered trees at Lower Lodge Farm to the north. The original canopy cover of the southern section comprises Pedunculate Oak (*Quercus robur*) and Ash (*Fraxinus excelsior*) but is now co-dominated by Silver Birch (*Betula pendula*) and Sycamore (*Acer pseudoplatanus*) following the great storm of 1987, which opened up the canopy to these invasive species. The ancient section includes a good deal of Sweet Chestnut (*Castanea sativa*), some of which has been recently coppiced. The ground flora is diverse, with Wood Sedge (*Carex sylvatica*), Scaly Male Fern (*Dryopteris affinis*), Bluebell (*Hyacinthoides non-scripta*), Hairy Wood-rush (*Luzula pilosa*) and Hart's-tongue Fern (*Asplenium scolopendrium*). Younger woodland blocks consist of Pedunculate Oak, Ash and Sycamore with Hawthorn and a ground flora dominated by Bramble, Nettles and Ivy. There is localised heavy trampling pressure, although it is recognised that this wood has an important role to play in the countryside experience of local residents. Within a clearing in the northern part of the site is an area of dry grassland With Sweet Vernal Grass (*Anthoxanthum odoratum*), Sheep's Sorrel (*Rumex acetosella*), Common Knapweed (*Centaurea nigra*) and Meadow Foxtail (*Alopecurus pratensis*). Lower Lodge Farm consists of amenity-mown and rough grassland sloping down to the railway line, with the tidal River Colne beyond. There are abundant, maturing Pedunculate Oaks scattered throughout the grassland giving a parkland feel. The rough grassland is variable, but in places includes species such as Wild Carrot (*Daucus carota*), Common Knapweed, Lesser Stitchwort (*Stellaria graminea*), Bird's-foot-trefoil (*Lotus corniculatus*), Meadow Buttercup (*Ranunculus acris*) and Field Scabious (*Knautia arvensis*) amongst Red Fescue (*Festuca rubra*), Timothy (*Phleum pratense*) and Creeping Bent (*Agrostis stolonifera*). At the top of the slope there is a strip of apparently old woodland containing some large Pedunculate Oaks, Wild Cherry (*Prunus avium*) and Field Maple (*Acer campestre*). Great Green Bush Cricket is present and a population of Common Lizards has been translocated to the site.
Haye Grove/Manwood Oaks	1.93 km south	**NOT INCLUDED IN THE 2015 LWS REVIEW REPORT (EECOS, 2017). DATA PROVIDED ONLY FROM DESK STUDY.**

Area Name	Approx. Distance and Direction from the Allocation Boundary	Summary of Designated Features
		Small grove, dominated by pedunculate oak *Quercus robur*, with an understorey of hawthorn *Crataegus monogyna*, holly *Ilex aquifolium*, blackthorn *Prunus spinosa* and bramble *Rubus fruticosus agg.* Diverse ground flora. The northern banks of the tributary support a varied canopy and ground flora.
Layer Brook Pasture	2.12 km south-west[26]	Layer Brook Pasture is a large area of sloping grassland which comprises a short sword composed of a good variety of grasses. Amongst the 14 species recorded are Sweet Vernal-grass (*Anthoxanthum odoratum*), Meadow Barley (*Hordeum secalinum*), Creeping Bent (*Agrostis stolonifera*), Crested Dog's-tail (*Cynosurus cristatus*), Yellow Oat-grass (*Trisetum flavescens*), Meadow Foxtail (*Alopecurus pratensis*) and Red Fescue (*Festuca rubra*). Field Wood-rush (*Luzula campestris*) and Soft-rush (*Juncus effusus*) are also present within the grassland sward. The dominance of grasses results in a poor assemblage of herbs, the most common of which are Meadow Buttercup (*Ranunculus acris*), Lesser Stitchwort (*Stellaria graminea*), Creeping Thistle (*Cirsium arvense*) and Creeping Cinquefoil (*Potentilla reptans*). A number of waxcap (*Hygrocybe* sp.) and earth tongue (*Geoglossum sp.*) fungi grow within the grassland, these being indicators of short, unimproved free-draining turf. A southern line of Pedunculate Oak (*Quercus robur*), including some large coppice stools, alongside Blackthorn (*Prunus spinosa*), Hawthorn (*Crataegus monogyna*) and Brambles (*Rubus fruticosus* agg.), is included as a complimentary habitat to the extensive grassland area.
Fingringhoe Churchyard	2.56 km south	**NOT INCLUDED IN THE 2015 LWS REVIEW REPORT (EECOS, 2017). DATA PROVIDED ONLY FROM DESK STUDY.** Range of grasses and herbs associated with unimproved grassland.
Barrage Marsh	2.79 km south-east	This horse grazed pasture exhibits shallow undulating topography characteristic of old ridge and furrow grassland sites, prior to which the site was likely claimed from former saltmarsh. The grassland is short grazed and relatively herb-poor, supporting species such as Meadow Barley (*Hordeum secalinum*), Dittander (*Lepidium latifolium*), a Nationally Scarce Essex Red Data List plant, and along a series of shallow damp drains to the west, Marsh Foxtail (*Alopecurus geniculatus*) and Hairy Buttercup (*Ranunculus sardous*). Included in the Local Wildlife Site is the adjacent sea wall, which supports herbs such as Greater Bird's-foot-trefoil (*Lotus pedunculatus*) and Common Century (*Centaurium erythraea*), and a small area of saltmarsh within the River Colne tidal range. Broom (*Cytisus scoparius*) and birch (*Betula* sp.) are becoming established along the seaward banks of the sea wall. The saltmarsh supports typical species such as glassworts (*Salicornia* agg.), Common Sea-lavender (*Limonium vulgare*), Annual Sea-blite (*Suaeda maritima*), Sea Wormwood (*Seriphidium maritimum*) and Sea Aster (*Aster tripolium*).

[26] Note that some LWS are located beyond the 2km boundary, as the data was originally purchased for land as far south as Weir Lane.

Appendix D Habitat Survey Results

D.1 Extended Phase 1 Habitat Survey

D.1.1 The habitat descriptions following the combined 2017 and 2020 extended Phase 1 habitat survey results are combined together given the 2020 survey sought primarily to update the 2017 results to ensure they remained current and accurate (and also extend the dataset to the south of Weir Lane. The results are shown on **Figure 7a.**

Semi-natural broad-leaved woodland (Allocation Boundary and Mitigation Land)

D.1.2 Semi-natural broad-leaved woodland was present to the north and south of Birch Brook and to the west of the rifle range. The species composition of these woodlands was influenced by the distance from the Brook. Ash *Fraxinus excelsior*, silver birch *Betula pendula* with locally frequent alder *Alnus glutinosa* were more frequent adjacent to the Brook. The understorey was well developed and diverse including goat and grey willow *Salix caprea* and *S.cinerea* close to the brook and also hawthorn *Crataegus monogyna*, hazel *Corylus avellana* and spindle *Euonymus europaea*.

D.1.3 Pedunculate oak *Quercus robur* and silver birch were more dominant in the canopy further away from the Brook with a more dominant understorey of bramble *Rubus fruticosus agg*. and frequent holly *Ilex aquifolium* and hazel also present. The presence of occasional to frequent ancient woodland indicators such as bluebell *Hyacinthoides non-scripta*, wych elm *Ulmus glabra*, butcher's broom *Ruscus aculeatus*, greater stitchwort *Stellaria holostea*, soft shield fern *Polystichum setiferum*, hart's tongue fern *Asplenium scolopendrium*, lady fern *Athyrium felix-feminina*, remote sedge *Carex remota*, wood sedge *Carex sylvatica*, creeping jenny *Lysimachia nemorosa* wood sorrel *Oxalis acetosella*, greater stitchwort *Stellaria holostea,* wood anemone *Anemone nemorosa* and the presence of numerous mature silver birch and likely veteran pedunculate oak strongly suggest this woodland may well fit the criteria of ancient woodland, although it is not included on the ancient woodland inventory.

Outgrown Tree Lines (shown on mapping as hedgerows (Mitigation Land))

D.1.4 Strips of woodland were present along field boundaries within the Mitigation Land. These areas of woodland are likely to have become established from mature or veteran pedunculate oak trees located on historic field boundaries. Some of the trees were located on earth banks, which further supports their remnant function as field boundary features. These woodlands were characterised by frequent pedunculate oak, silver birch with an understorey of bramble scrub. Ancient woodland indicators are rare but include greater stitchwort, holly and butcher's broom.

Semi-natural broad-leaved woodland (Allocation Boundary)

D.1.5 Smaller patches of woodland were located within the short grassland areas of the rife range, which were likely to have been planted or self-sown being of similar semi-mature age. English elm *Ulmus procera* was much more frequent in these younger woodland areas with pedunculate oak also present. The understorey and woodland edge comprised dense blackthorn *Prunus spinosa* and bramble scrub.

D.1.6 Similar areas of woodland were present to the north of the rifle range including a block of pedunculate oak dominated woodland with a bramble and holly understorey in the north-west of the Allocation Boundary and linear strips of woodland immediately north of the rifle range running north to south and linking with some smaller wooded areas within the range itself. These again were characterised by semi-mature pedunculate oak trees with frequent English

elm, particularly on the margins. Scrub outgrowth and understorey was also present including bramble, hawthorn and blackthorn.

Broadleaved plantation woodland (Allocation Boundary and Mitigation Land)

D.1.7 Planted broadleaved woodland was less evident but included a large open block of young pedunculate oak trees of similar age to the north of the fenced ranges. This was an open area of woodland with scattered hawthorn bushes and rank grassland below including species such as cock's-foot *Dactylis glomerata*, false oat-grass *Arrhenatherum elatius*, red fescue *Festuca rubra* and cow parsley *Anthriscus sylvestris* below. A linear block of pedunculate oak trees of similar age and shape indicating planted origin was recorded to the south of the fenced ranges on the southern edge of the Allocation Boundary. In addition to oak trees, this linear plantation woodland also supported occasional silver birch with some stands of holly present in the shrub layer (likely to have encroached into this area from the more established mature woodland further west. Bracken was locally abundant in this woodland parcel with occasional bramble and gorse also recorded.

D.1.8 A small planted woodland (confirmed by presence of old tree tubes and stakes around many of the trees) was also recorded in the central part of the wider Mitigation Boundary to the south of the Allocation Boundary. This was dominated by poplar species *Poplar* sp. with some pedunculate oak and cherry *Prunus sp*. present. An understory of elder *Sambucus nigra* was present with frequent clumps of bluebell suggesting this area may have been replanted over an area of historical woodland. Another linear planted woodland was present in the south-west of the Mitigation Land adjacent to Mersea Road. This contained frequent sycamore *Acer pseudoplatanus* along with holly, cherry, sweet chestnut *Castanea sativa*, beech *Fagus sylvatica*, hawthorn and some scots pine *Pinus sylvestris*.

Dense/ continuous scrub (Allocation Boundary and Mitigation Land)

D.1.9 Large areas of dense continuous gorse scrub were present to the south and south-east of the active (fenced) rifle range areas with frequent broom, hawthorn and bramble, and scattered semi-mature pedunculate oak trees and English elm. A similar area of gorse dominated scrub was present to the north-west of the fenced range area within the Allocation Boundary adjacent to a block of woodland. Some small areas of blackthorn scrub were also present to the east and the north of the fenced ranges.

D.1.10 Dense areas of bramble scrub were identified along the western and southern boundary of the Mitigation Land adjacent to the house on Sydney Street/Launceston Close in the west and mature woodland parcels to the south (in the landholding south of Weir Lane).

Scattered scrub (Allocation Boundary and Mitigation Land)

D.1.11 Scattered gorse scrub was present within areas of semi-improved acid grassland, in localised areas, particularly to the south of the fenced rifle ranges and in places to the east of the fenced ranges (blending into denser scrub moving south)

Scattered broadleaved trees (Allocation Boundary and Mitigation Land)

D.1.12 Individual and rows of scattered broadleaved trees were recorded in a number of locations including a few standard trees within the northern part of the fenced rifle range, as a linear strip of trees along the eastern edge of the Allocation Boundary extending south into the Mitigation Land and on field margins in the southern part of the Mitigation Land. These all tended to be characterised by mature or semi-mature pedunculate oak, often with growth of bramble and other scrub species such as blackthorn and hawthorn below.

Semi-improved acid grassland (Allocation Boundary and Mitigation Land)

D.1.13 The majority of the Middlewick rifle range (within the Allocation Boundary) comprised semi-improved acid grassland. The dominant grass species present were common bent *Agrostis capillaris* and sheep's fescue *Festuca ovina* with occasional Yorkshire fog *Holcus lanatus*, False oat-grass and cock's-foot, which were more frequent in less intensively managed areas.

D.1.14 The diversity of herbaceous species was low but there were some indicators of acid grassland that were occasional to locally frequent including mouse-ear hawkweed *Hieracium pilosella*, cat's-ear *Hypochaeris radicata* and sheep's sorrel *Rumex acetosella* with rare indicators including heath bedstraw *Galium saxatile* and field wood rush *Luzula campestris*. The moss *Pseudoscleropodium purum* formed a carpet in some areas that is indicative of acidic conditions.

D.1.15 Other wildflowers that were present but are not necessarily indicative of acidic conditions include common bird's-foot trefoil *Lotus corniculatus*, which was frequent in the intensively managed fenced rifle range. In addition, ribwort plantain *Plantago lanceolata*, yarrow *Achillea millefolium* were frequent throughout with field scabious *Knautia arvensis*, agrimony *Agrimonia eupatoria* and black knapweed *Centaurea nigra* occasional to locally frequent in longer grassland areas.

D.1.16 The grassland within the fenced rifle range (within the Allocation Boundary) was intensively managed and therefore supported a more diverse herb content and higher herb to grass ratio whereas the fields that were cut for hay once a year were noted to have more coarse grasses and fewer indicator species.

D.1.17 Areas of short sward semi-improved acidic grassland, likely grazed by rabbits, were present to the south of the rifle range which were associated with scattered gorse and broom scrub. These areas were noted to grow over a sandy substrate and had a lower grass cover than other areas of acid grassland and were noted to be colonised by pioneer mosses such *Polytrichum juniperum* and sheep's sorrel. This grassland type was recorded in more open areas within the gorse scrub immediately south of the fenced rifle range area as well as in some locations moving south-east of the fenced range (within the Allocation Boundary).

D.1.18 Semi-improved acid grassland was also present in the western end of the open field immediately south of the Allocation Boundary within the Mitigation Land. This had a similar character and botanical composition to the fenced ranges, although blended gradually into species-poor semi-improved grassland with a less obvious acid influence moving east (see below).

D.1.19 An additional area of semi-improved acid grassland was present in the southernmost portion of the Mitigation Land. A similar botanical species assemblage to that recorded on the ranges was present in this area.

Poor semi-improved grassland (Allocation Boundary and Mitigation Land)

D.1.20 The majority of the Mitigation Land to the east of the Allocation Boundary comprised poor semi-improved grassland. These grassland areas differed from the semi-improved acid grassland by the presence of red fescue rather than sheep's fescue, and a higher proportion of coarse grasses such as false oat-grass, cock's-foot, and Yorkshire fog. Herbaceous species were rare but include common sorrel *Rumex acetosa*, cat's-ear, common bird's-foot trefoil and yarrow. This type of grassland was also recorded to the south of the fenced ranges within the wider Mitigation Land, but to the north of the brook. It was noted that the grassland immediately south of the fenced ranges tended to show an increasing acid influence moving west (see above).

Arable (Mitigation Land)

D.1.21 The majority of the Mitigation Land to the south of the Allocation Boundary (to the south of the woodland parcel/Birch Brook) and Weir Lane further south of consisted of arable land. These areas had been sown with a rye-grass ley (likely Italian rye-grass *Lolium multiflorum*) and supported very few forbs or herbs. Given the recent origin of the grasslands on these areas and management as a hay or silage crop (i.e. regular disturbance) it is appropriate to classify these as arable.

Running Water (Allocation Boundary and Mitigation Land)

D.1.22 Birch Brook flows through the western area of the Allocation Boundary and east to west through the Mitigation Land. The channel was up to 2 m wide with natural earth banks up to 0.5 m in height. The water depth was shallow over a gravel channel base and sand banks. The water flow was largely slow but there were occasional riffles indicating faster water flow. Occasional marginal species were recorded along the brook include remote sedge *Carex remota*, skullcap *Scutellaria galericulata*, gypsywort *Lycopus europaeus*, fool's watercress *Apium nudiflorum* and brooklime *Veronica beccabunga*. Where the banks of the Brook had slumped, localised areas of swamp type vegetation had established.

Standing Water (Mitigation Land)

D.1.23 No ponds were located within the Allocation Boundary. However, five ponds were present within the Mitigation Land. These ponds were located within areas of woodland or strips of trees and were noted to be heavily shaded. All ponds held water at the time of the survey with connections to ditches present. However, the majority of vegetation surrounding the ditches and four of the five ponds did not suggest they hold water for any length of time as there were no marginal or wetland plants that are tolerant of shading.

D.1.24 One pond (Target Note 30) was located within the far west of the Mitigation Land and was surrounded by semi-natural deciduous woodland. This pond was heavily shaded and swamp vegetation had developed on its eastern edge. The water level was very high at the time of survey with botanical species present including abundant floating sweet-grass *Glyceria fluitans* and common duckweed *Lemna minor* with occasional bulrush *Typha latifolia*.

Tall herb and fern (Allocation Boundary and Mitigation Land)

D.1.25 An area of tall ruderal vegetation was present in the east of the Mitigation Land. This was characterised by unmanaged vegetation and consisted of common nettle, false oat-grass, creeping thistle, cow parsley, black knapweed and bramble. Continuous bracken was also recorded within the south west of the Allocation Boundary and in field margins in the south of the Mitigation Land.

Hedgerows (Mitigation Land)

D.1.26 Species poor hedgerows with blackthorn and hawthorn being dominant were recorded in a few places in the Mitigation Land, with one in the Allocation Boundary along the north-eastern boundary (adjacent to Abbot's Road). Two parallel species-rich hedgerows with mature ash and pedunculate oak trees were present along the track to the south-west of the Mitigation Land. These hedgerows comprised over seven woody species and were positioned parallel to each other along a footpath associated with a ditch. As such, it is likely that these hedgerows would be considered 'important' hedgerows as defined under the Hedgerow Regulations 1997. Another species rich-hedgerow with trees was present to the east of this double hedgerow (linked to the northern extent of the hedgerow). This hedgerow supported 9 woody species and it is also likely that this hedgerow would be considered 'important' hedgerows as defined under the Hedgerow Regulations 1997.

D.1.27 The field boundaries in the southernmost part of the Mitigation Land (south of Weir Lane) predominantly comprised native hedgerows with trees, with the majority being species-rich although a few species-poor hedgerows with trees were also present. Most of these hedgerows were 'defunct' with gaps or incomplete canopies meaning they would not form a barrier to livestock (if present). Pedunculate oak was the dominant component tree species with other species including ash, holly, bramble, hawthorn, blackthorn, elder, silver birch and ivy *Hedera helix*. Bracken was frequent along the base of these hedgerows in many places.

Bare ground (Allocation Boundary)

D.1.28 There are several areas of bare ground within the Allocation Boundary which comprise access tracks along the west and south of the ranges as well as south and north facing sandy banks (highly likely to be man-made) and flat areas to the south of the rifle range. Some of these (outside fenced areas) are evidently, at least in part, kept clear by regular informal use by walkers and dog walkers.

Buildings and hardstanding (Allocation Boundary)

D.1.29 Disused ammunition storage buildings (the Marker's Gallery) were present within the west of the Allocation Boundary. These were concrete and brick built one-storey buildings that were built into a bank of earth with vegetation covering the top and back of the buildings. They were accessible from the front but otherwise there was no other access or windows. Photos of these features are shown at Target Note 37 within **Appendix D.2**.

D.1.30 Further buildings are present within the Allocation Boundary, including single storey brick-built office buildings (Target Note 35) and a two- storey brick building with a pitched slate tile roof; all located at the entrance to Middlewick Ranges (Target Note 36). A disused pill box was present (Target Note 6) in the north east of the Allocation Boundary within an area of semi-natural woodland.

D.1.31 Areas of hardstanding area are present associated with the buildings and forming access tracks around the Allocation Boundary.

D.2 Extended Phase 1 Habitat Survey Target Notes and Photographs

Table 9: Extended Phase 1 Habitat Survey Target Notes and Photographs (Refer to **Figure 7a** for locations)

Target Note	Target Note Description	Photo
1	5 mature pedunculate oak (*Quercus robur*) trees ivy covered with moderate bat roost potential within woodland strip	

Target Note	Target Note Description	Photo
2	Likely veteran pedunculate oak tree with large vertical trunk cavity 2m high facing west. High bat roost potential	
3	Mature pedunculate oak tree with moderate bat roost potential within a woodland strip	
4	Mature pedunculate oak tree with high bat roost potential in cavities on lower side of branches	

Target Note	Target Note Description	Photo
5A	Woodland with understorey of Butcher's Broom (*Ruscus aculeatus*) understorey and frequent bluebells (*Hyacinthoides non-scripta*).	
5B	Mammal pathway in woodland and passing place under fence line into neighbouring gardens. Possibly badger evidence due to previous desk study records of badger in this location.	
6	Brick built pill box, flat concrete roof and recessed into ground. Three possible bat entry points 2 brick courses high into the enclosed building	
7	Mature pedunculate oak tree ivy covered with moderate bat roost potential	

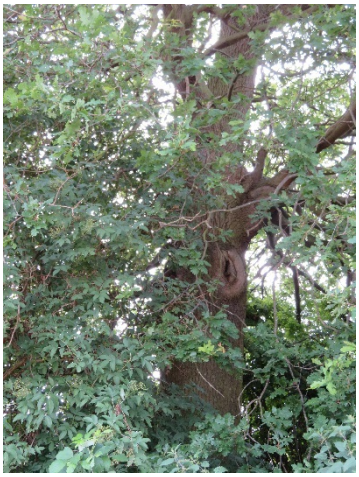
Target Note	Target Note Description	Photo
8	Likely veteran pedunculate oak tree with high bat roost potential. Standing dead wood, hollow in the middle and ivy covered	
9	Sand mound butts on rifle range, south facing and good burrowing for solitary bees and wasps	
10	Mature pedunculate oak tree with moderate bat roost potential	

Target Note	Target Note Description	Photo
11	Two likely veteran pedunculate oak trees with high bat roost potential.	
12	Redoubt (an old fort system) that is covered in gorse (*Ulex europaea*) scrub and bracken (*Pteridium aquilinum*) and scattered pedunculate oak trees with more open patches of tall semi-improved acid grassland	
13	Likely veteran pedunculate oak tree ivy covered with moderate bat roost potential	

Target Note	Target Note Description	Photo
14	Man-made badger tunnel under fence line for rifle range. Recently used as badger hair found in the entrance	
15	Woodland by brook with more mature pedunculate oak than woodland nearer the rifle range. Greater stitchwort (*Stellaria holostea*) in understorey.	
16	Acid grassland clearing within woodland with indicators including sheep's sorrel (*Rumex acetosella*), mouse-ear hawkweed *Heiracium pilosella*).	
17	Acid grassland indicator heath bedstraw (*Galium saxatile*) on woodland edge.	
18	Numerous mature pedunculate oak trees in woodland with ivy covering and providing moderate bat roost potential.	

Target Note	Target Note Description	Photo
19	Likely veteran pedunculate oak ivy covered with moderate bat roost potential	
20	Mature pedunculate oak tree within pasture field with high bat roost potential	
21	Likely veteran pedunculate oak with moderate bat roost potential	

Target Note	Target Note Description	Photo
22	Likely veteran pedunculate oak with moderate bat roost potential	
23	Bank within woodland possible ancient field boundary with mature pedunculate oak	
24	Likely veteran pedunculate oak with high bat roost potential in rot holes and broken branches	
25	Dry woodland pond/depression connected by a dry ditch. Negligible GCN potential. Vegetation does not suggest that the pond holds water for any length of time	

Target Note	Target Note Description	Photo
26	Dry woodland pond/depression connected by a dry ditch. Negligible GCN potential. Vegetation does not suggest that the pond holds water for any length of time	
27	Mature pedunculate oak tree within pasture field with high bat roost potential in rot holes	
28	Numerous mature pedunculate oak trees with moderate to high bat roost potential	
29	Badger outlier 1 hole sett used infrequently	
30	Pond with swamp vegetation on eastern edge. Not holding water at the time of survey but water level close to the surface. GCN potential	

Target Note	Target Note Description	Photo
31	Two pedunculate oak trees with moderate bat roost potential on woodland strip	
32	Tall ruderal vegetation and bramble scrub including black knapweed, common nettle, bracken and false oat grass	
33	Mature pedunculate oak trees in woodland strip with moderate bat roost potential	
34	Tall ruderals and bramble scrub on edge of field boundary. Mature oak are off site but root protection zones will extend into the site	
35	Single storey buildings at entrance to Middlewick Ranges with low bat roosting potential. Low potential under Fascia boards for crevice dwelling bat species	

Target Note	Target Note Description	Photo
36	Two- storey building at entrance to Middlewick Ranges with low bat roosting potential. Low potential under Fascia boards and slate roof tiles for crevice dwelling bat species	
37	Disused ammunition storage buildings	
		
		

Target Note	Target Note Description	Photo
38	Barn owl box	
39	Outlier badger sett	-

D.3 Botanical Survey

D.3.1 Figure 7a shows the grassland areas that were surveyed, labelled A – F to allow the plan to be cross-referenced with the text below. A brief description of each area is provided below, followed by a table (Table 10) summarising the status and value of the grassland according to various criteria.

Area A

D.3.2 This area contains the rifle ranges, bound by the fenceline. It is regularly mown to 100mm, every 3 weeks – 1 month between May and October. The arisings are left in situ.

D.3.3 The entire area has been re-worked over the years to form a series of bunds (firing lines), ditches and levelled areas (range floor). This reworking can be seen by a review of freely available historical mapping for the ranges which shows varying changes in the location and orientation of the ranges. Most recently, the remodelling included conversion to metric distance firing lines in 1986, and the 1990's when the peripheral ditches were dug. The grassland has therefore been heavily disturbed over the years, and whilst there is unlikely to have been improvement for agricultural purposes, the level of modification and type of use indicate the habitat should not be considered 'unimproved'.

D.3.4 Notwithstanding the ground disturbance levels, an acid grassland community has re-developed that is dominated by sheep's fescue *Festuca ovina* and common bent *Agrostis capillaris* grasses. Broad-leaved species cover is patchy, but is particularly noticeable on the firing lines, where mouse-ear hawkweed *Pilosella officinarum* forms dense carpets and is accompanied by buck's-horn plantain *Plantago coronopus* and sheep's sorrel *Rumex acetosella*. There is also a north-south trend with regard to species-richness, with the level areas to the north having a very low cover of broad-leaved species, but the southern end having a greater diversity of species (albeit patchy), including patches of heath grass *Danthonia decumbans* and bird's-foot trefoil *Lotus corniculatus*.

D.3.5 The NVC plant community present is U1 Festuca ovina – Agrostis capillaris - Rumex acetosella grassland.

D.3.6 Area A falls entirely within the Middlewick Ranges Local Wildlife Site boundary (Co122).

Area B and C

D.3.7 Areas B and C together comprise a single field. The sward is however very variable so it has been split into two areas for the purposes of this assessment, with Area B being more species-rich and showing more acidic tendencies. Area B is also included within the Co122 LWS, whereas Area C is not.

D.3.8 The field containing Areas C and C was unmown when visited and appears to be only very occasionally mown – once a year at most. This mirrors the DIO's understanding of the management of this land by the tenant farmer, which is to take a summer hay cut.

D.3.9 The grassland habitat of Area B is variable - with the dominance of grass species changing across the field. The eastern end appears drier and with acid tendencies indicated by the presence of sheep's fescue and sheep's sorrel, growing alongside abundant sweet vernal grass *Anthoxanthum odoratum* and Yorkshire fog *Holcus lanatus*. Further west, stands of red fescue and false oat-grass *Arrhenatherum elatius* are common, along with indicators of wetter ground such as pendulous sedge *Carex pendula* and fleabane *Pulicara dysenterica*. This section is more overgrown with stands of scrub developing. The scrub in this area appears to have been self-set, and includes silver birch and oak; the size of the scrub and presence of anthills indicates that this end of the field has not been cut for some years.

D.3.10 Area C is more uniform and species-poor with red fescue replacing sheep's fescue, along with Yorkshire fog, false oat-grass and common bent. Very few broad-leaved species are present in this section.

D.3.11 The mosaic nature of Area B/C does not allow a good fit to an NVC community, but the sandy substrate along with the presence of sheep's fescue/common bent/sheep's sorrel would suggest an acid grassland U1 community on the eastern part of Area B, which is developing into an MG1 –type community at the western part and on Area C through lack of management.

Area D

D.3.12 This is an expanse of tall infrequently managed grassland dominated by red fescue, with common bent also abundant. Broad-leaved species are present only in low numbers and include common knapweed *Centaurea nigra,* yarrow *Achillea millefolium* and common cat's ear *Hypochaeris radicata*.

D.3.13 It is likely given the sandy substrate that the grassland was once acid in character, but historical and present management has resulted in a sward with more neutral grassland characteristics developing. Consequently the grassland does not fit well into any NVC category. The closest fit is 'MG1 *Arrhenatherum elatius* grassland' a community that develops on infrequently grazed/mown sites.

D.3.14 Area D falls entirely within the Co122 Local Wildlife Site

Area E

D.3.15 This is a small area of tall infrequently managed grassland. Yorkshire fog, sweet vernal grass, common bent, red fescue, are all abundant with occasional false oat grass. Broadleaved

species are present in low numbers and include frequent ribwort plantain *Plantago lanceolata*, with occasional yarrow *Achillea millefolium*, common sorrel and ragwort.

D.3.16 As for Area D, it is likely given the sandy substrate that the grassland was once acid in character, but historical and present management has resulted in a sward with more neutral grassland characteristics developing. Consequently the grassland does not fit well into any NVC category. The closest fit is 'MG1 *Arrhenatherum elatius* grassland' a community that develops on infrequently grazed/mown sites.

D.3.17 Area E falls entirely within the Co122 Local Wildlife Site.

Area F

D.3.18 This is an area of tall infrequently managed grassland dominated by red fescue with abundant sweet vernal grass, Yorkshire fog and common bent. Broad-leaved species are rare.

D.3.19 As for Areas D and E, it is likely given the sandy substrate that the grassland was once acid in character, but historical and present management has resulted in a sward with more neutral grassland characteristics developing. Consequently the grassland does not fit well into any NVC category. The closest fit is 'MG1 *Arrhenatherum elatius* grassland' a community that develops on infrequently grazed/mown sites.

D.3.20 Area F falls entirely within the Co122 Local Wildlife Site.

Table 10: Summary of Status of Grassland Areas A – F following Botanical Survey

Area	Area (Ha)	NVC category	Revised Phase 1 Category (JNCC,2010)	UK BAP criteria for HPI	TIN110 indicators of HPI	Priority Habitat (as shown on MAGIC)?	Included within Co122?	LWS HC13[27]	Discussion	Relative Conservation Value of the Grassland (for botanical reasons)[28]
A	31.60	U1 Lowland acid grassland	Semi-improved Acid Grassland	**Yes** Meets criteria by being 'lowland acid grassland'	**Yes** Borderline when surveyed– 4 acid indicator species are present but with patchy distribution. A spring survey might pick up annual indicator species that are no longer in evidence in summer.	No	**Yes**	**Yes** Meets criteria by being 'lowland acid grassland'	Area A has functioned as a shooting range for at least 150 years and its topography has been remodelled to fit this function, with bunds, ditches and levelled areas. Consequently it cannot be considered 'unimproved grassland', but does still fit comfortably in the U1 lowland acid grassland community. As such it meets the Essex Local Wildlife Site Habitat Criterion 13. It also falls within the UK BAP Priority Habitat Description for acid grasslands (and therefore the definition of a Section 41 Habitat of Principal Importance (HPI)), which includes U1 within the definition without differentiating on quality. Natural England subsequently published a Technical Advice Note (TIN110) for use by assessors of the Environmental Stewardship Scheme, which sets a tighter definition for a HPI for created or restored lowland acid grassland. This provides a list of 'indicator species', of which 1 should be frequent and three occasional in the sward for the grassland to qualify as an HPI. During the walkover, 4 'indicator species' were noted, of which 1 was frequent (mouse-ear hawkbit). The other three were only locally occasional (most notably on the bunds). On this basis, Area A would be on the borderline of qualifying as HPI. However, Area A was heavily parched, following an extended period of hot dry weather and as such it is likely that a number of broadleaved species were no longer in evidence when the site was visited. The U1 NVC community includes a number of diminutive annual species that shrivel after flowering in spring. These	**County** On the basis that it qualifies as an Essex LWS based on its botanical community, as well as a HPI when considered against both the UK BAP habitat definitions and the TIN110 indicators. County level importance also considered appropriate given the size of the grassland in relation to the MAGIC estimates for Essex.

27 Local Wildlife Site Section Criteria, Habitat Criterion 13 (Heathland and Acid Grassland). Essex Local Wildlife Partnership (2010))

28 Using CIEEM September 2018 Geographic Frames of Reference. Note this assessment is based on current understanding of the grassland community.

Area	Area (Ha)	NVC category	Revised Phase 1 Category (JNCC,2010)	UK BAP criteria for HPI	TIN110 indicators of HPI	Priority Habitat (as shown on MAGIC)?	Included within Co122?	LWS HC13[27]	Discussion	Relative Conservation Value of the Grassland (for botanical reasons)[28]
									species include parsley-piert *Aphanes arvense*, Shepherd's-cress *Tessdalia nudicaulis* and common stork's-bill *Erodium cicutarium*. all of which are on the TIN110 'indicator species' list. On the basis that it is likely that a number of spring-flowering species were not in evidence during the visit, and that these could include the above 'indicator species' it is concluded that Area A also is likely to meet the TIN110 criteria for an HPI. The fact that this community persists -or is a product of - substantial ground remodelling over the years, suggests that there is good potential to recreate this habitat elsewhere on site, with a combination of soil translocation and appropriate management.	
B	4.98	U1 to east, patchy vegetation to west	Semi-improved Acid Grassland	**Yes** Meets criteria by being 'lowland acid grassland'	No Only 1 indicator species in evidence.	No	**Yes**	**Yes** Meets criteria by being 'lowland acid grassland'	The eastern portion of Area B can also be categorized as 'lowland acid grassland' as it includes the acidic species sheep's fescue and sheep's sorrel. However it lacks the 'indicator species' that would classify it as HPI under the TIN110 criteria.	**Local** On the basis that it qualifies as an Essex LWS based on its botanical community, however does not qualify as HPI using the TIN110 criteria. Local level importance also considered appropriate given the size of the grassland in relation to the MAGIC estimates for Essex.
C	5.54	No good fit – MG1 neural grassland is closest match.	Species – poor SI grassland. Is likely to be derived from acid grassland	No	No	No	**No**	No	Areas C –F, are likely to derive from acid grassland, assuming the sandy substrate is similar to Area A. However, there are no acidic plants in evidence in these areas, and the assemblage of species present is more akin to a neutral grassland MG1 community. As such these areas do not qualify under LWS HC13, or as HPI.	Negligible (less than Local using the CIEEM geographic frames of reference)

Area	Area (Ha)	NVC category	Revised Phase 1 Category (JNCC,2010)	UK BAP criteria for HPI	TIN110 indicators of HPI	Priority Habitat (as shown on MAGIC)?	Included within Co122?	LWS HC13[27]	Discussion	Relative Conservation Value of the Grassland (for botanical reasons)[28]
			but no longer any acid species present.							
D	11.32	No good fit – MG1 neural grassland is closest match.	Species – poor SI grassland. Is likely to be derived from acid grassland but no longer any acid species present.	No	No	No	**Yes**	No		Negligible (less than Local using the CIEEM geographic frames of reference)
E	2.25	No good fit – MG1 neural grassland is closest match.	Species – poor SI grassland. Is likely to be derived from acid grassland but no longer any acid species present.	No	No	No	**Yes**	No		Negligible (less than Local using the CIEEM geographic frames of reference)
F	5.98	No good fit – MG1 neural grassland is closest match.	Species – poor SI grassland. Is likely to be derived from acid grassland but no longer any acid species present.	No	No	No	**Yes**	No		Negligible (less than Local using the CIEEM geographic frames of reference)

D.4 Habitat Overview Photographs

D.4.1 Photograph locations are shown on **Figure 7b**.

Photo 1: Overview of grassland on firing range

Photo 2: Lines of trees on edge of firing range

Photo 3: Grassland to east of firing range (outside fencing)

Photo 4: Mosaic of gorse scrub and grassland to east of firing range

Photo 5: Scrub to south/south-east of firing range

Photo 6: Typical grassland and lines of trees to south/south-east of firing range

Photo 7: Acidic grassland and colonising scrub to south of firing range

Photo 8: Typical grassland in south of site beyond Birch Brook

Photo 9: Example small planted woodland in southern part of site

Photo 10: Example grassland areas with hedgerows in land south of Weir Lane

Photo 11: Example of open grassland dominating area south of Weir Lane

Photo 12: Mown grassland and hedgerows to north of firing range

Photo 13: Mosaic of scrub, grassland and young trees in area north of firing range

Photograph 14: Northern portion of woodland on western boundary

Photograph 15: Grassland and woodland edge in south-west of ranges.

Photograph 16: Habitat south of ranges

Photograph 17: Woodland to the south of the ranges

Photograph 18: Grassland in the south-west

Photograph 19: Centre of southern woodland parcel and brook corridor

Photograph 20: Southern grassland and treelines

Photograph 21: Hedgerow corridor in the south-west

Photograph 22: Grassland and hedgerow in the south-west

Photograph 23: Hedgerow and treeline in the south

Appendix E Dormouse Survey Results

E.1 Legal and Policy Protection

E.1.1 Dormouse is an EPS, meaning both individual dormice, as well as their habitats, are legally protected under the Conservation of Habitats and Species Regulations 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended). They are also a SPI under the NERC Act 2006 and an Essex priority species.

E.2 Desk Study Results

E.2.1 Three records of dormouse were returned by the EWT as part of the desk study. One of these is an unconfirmed record from a location within the Birch Brook woodland, 300m south of the Allocation Boundary. The record relates to the discovery of a chewed hazel nut with distinctive hazel dormouse feeding marks and was obtained in 2017. The remaining records of dormouse were obtained from Rowhedge (1.6 km south-east of the Allocation Boundary) and Salary Brook (c. 1.96 km north-east of the Allocation Boundary) and relate to nest tube and nest sightings during 2007 and 2017 respectively. Salary Brook is not connected to the Allocation Boundary by suitable habitat, however the Rowhedge record is connected to the Allocation Boundary by suitable habitat. There are no European Protected Species Licences (EPSL's) granted within Colchester for dormouse, as shown on MAGIC. The closest EPSL for dormice is c. 14km to the south east.

E.3 Nut Search (Field Survey) Results

E.3.1 The field survey completed in 2018 searching fruiting hazel was limited to small stands within the Birch Brook woodland where it borders the west of the Allocation Boundary with more extensive hazel coverage present where the Birch Brook LWS runs to the south of the Allocation Boundary (see Photographs 1 and 2). The location of hazel stands surveyed are shown on **Figure 8**. Hazel was not found elsewhere within the MOD Ownership Boundary of Birch Brook LWS. Hazel nuts were searched for in these areas; however, only the feeding remains of grey squirrels *Sciurus carolinensis* (see Photograph 3), bank vole *Myodes glareolus* and wood mice *Apodemus sylvaticus* were evident. No evidence of foraging dormice was identified.

E.4 Dormouse Survey Photographs

Table 11: Dormouse Survey Photographs

Photograph 1: Small area of coppiced hazel on the western boundary of the Site

Photograph 2: Hazel coppice in the south of the Site

Photograph 3: Hazel nuts gnawed open by grey squirrels in the south of the Site.

Appendix F Riparian Mammal Survey Results

F.1 Legal and Policy Protection

F.1.1 Otters are an EPS, meaning both otters and their places of shelter are afforded protection under the Conservation of Species and Habitats Regulations 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended). In broad terms these pieces of legislation jointly mean that the animals themselves are protected against killing, injury, taking (capture) and disturbance. In addition, their places of shelter are protected against damage, destruction and obstruction. Otters are also an SPI under the NERC Act 2006 and an Essex priority species.

F.1.2 Water voles and their habitats breeding and resting habitats receive protection under the Wildlife and Countryside Act, 1981 (as amended). Water voles are also classified as a SPI under the NERC Act 2006 and an Essex priority species.

F.2 Desk Study Results

F.2.1 A total of 22 records of otter, comprising field evidence (spraints and footprints) and sightings between 2007 and 2017, were returned by the EWT data search. These relate to offsite locations, largely along River Colne, Roman River and Salary Brook. Otters have a large home range (spanning tens of kilometres depending on catchment quality) (Chanin, 2003). The Allocation Boundary is connected to the above described watercourses via Birch Brook.

F.2.2 A total of 23 water vole *Arvicola amphibious* records, obtained between 2011 and 2015 were returned by the EWT data search. These comprise sightings and field evidence (in the form of droppings) obtained from offsite locations along the Salary Brook, at the University of Essex and at Wivenhoe Ferry Marsh. All records were located to the east of the River Colne separate from the Allocation Boundary by a distance of at least 1.14 km (“as the crow flies”) or 2.63 km along water courses (Birch Brook).

F.3 Field Survey Results

F.3.1 Evidence of otters (and other riparian mammals) was searched for along the Birch Brook during the otter survey. The Birch Brook had a channel width of between 2-4m with steep earth banks. The watercourse was shallow averaging 10-20cm in depth over a gravel substrate. Bankside vegetation comprised semi-natural broadleaved woodland; this resulted in over-shading of the entire length of the brook by trees where it passes through the Site. In channel vegetation was absent as a result of this over-shading (see Photographs 1 and 2 below).

F.3.2 No evidence of use of this watercourse by otters was identified during the survey. The brook was shallow at the time of survey and did not appear to support a sufficient population of fish upon which otters could prey. The Birch Brook is a tributary of the River Colne located to the east. The River Colne provides superior foraging, commuting and sheltering habitat for otters. It is possible that otters use the Birch Brook on a very occasional basis, with the woodland in the south and west of the Allocation Boundary also having the potential to provide laying up/holt sites (though none were noted). However, the brook is not connected to other watercourses to the north or west and therefore given this lack of connectivity it is considered that use of the brook is likely to be very limited.

F.3.3 Signs of other mammals were noted along and adjacent to the brook including deer, foxes *Vulpes vulpes* and badgers *Meles meles* (see Photographs 3 and 4). Target notes gathered during this survey are shown below and shown on **Figure 9.**

F.3.4 During the extended Phase 1 habitat survey, Birch Brook was noted to be heavily shaded by woodland and supported steep low banks. The shaded nature of the brook means that only small areas of potential feeding for water voles are present such that overall the Brook provides sub optimal habitat for water voles. American mink has been recorded within the River Colne backwaters and the Roman River, which is also likely to reduce the potential for water vole to be present within this catchment. The unsuitability of Birch Brook for water vole was noted again during the otter survey.

F.4 Riparian Mammal Survey Photographs

Table 12: Riparian Mammal Survey Photographs

Photograph 1: The Birch Brook with steep but low banks, shallow water and a gravel substrate.

Photograph 2: The Birch Brook where is passes through the south of the Site.

Photograph 3: Fox tracks in silt adjacent to the brook in the north of the Site (TN2)

Photograph 4: Badger tracks adjacent to the brook in the south of the Site (TN6)

F.5 Riparian Mammal Survey Target Notes

Table 13: Riparian Mammal Survey Target Notes

Target Note No.	Type	Species/Likely Species	Number	Location/Habitat	Notes
1	Run Through Vegetation	Badger	1	Adjacent habitat	With push under fence and path on woodland floor
2	Prints	Fox		In-channel	On dry gravel/silt bar
3	Run Through Vegetation	Badger	1	Bank	Steep run up and down bank
4	Prints	Fox	1	In-channel	Squirrel and/or rat prints also present
5	Prints	Deer		In-channel	
6	Prints	Badger		Bank	
7	Prints	Deer		Bank	

Appendix G Invertebrate Survey Results

G.1 Legal and Policy Protection

G.1.1 Legal protection of invertebrates under the Wildlife and Countryside Act 1981 (as amended) is typically limited to their sale, however several invertebrate species are listed as SPI under the NERC Act 2006, meaning Colchester Borough Council and the DIO/MOD have (as public bodies) a duty to consider their presence when discharging their duties. Several invertebrate species are also Essex Priority Species.

G.2 Site History and Context

G.2.1 The Invertebrate Survey Area (shown on **Figure 11**), located on the southern edge of Colchester and Middlewick Ranges has been in active military use since the mid-19th Century. Whilst it is known that firing ranges have been altered at a number of occasions (most recently in the 1980's and 1990's), the long-standing military use of land within the Allocation Boundary is relevant to consideration of its value to terrestrial invertebrates as it demonstrates the absence of intensive agricultural use.

G.2.2 Another important consideration for the relative value of the Invertebrate Survey Area for terrestrial invertebrates is management regime and level of public access. The security fencing precludes access to the firing ranges by members of the public, particularly dog walkers, which has meant the sward has avoided nutrient enrichment from dog faeces. This may have influenced the observed botanical distinction between the sward inside the range fence line, and that outside (refer to the **Appendix D** above ref botanical survey results. The grassland outside the range fence is regularly accessed by members of the public (including dog walkers) and is otherwise subject to an annual hay cut. South of the Birch Brook, the land is under the management of a tenant farmer and understood to be cut for sileage. In combination therefore, the current terrestrial invertebrate interest of the Invertebrate Study Area, is likely to have been variously influenced by the military history, and the dominant management regime(s).

G.3 Habitat Type

G.3.1 Detailed botanical survey work was completed in summer 2018, and is reported in **Appendix D**. This showed that two compartments A and B botanically conform to lowland acid grassland. This habitat type is relatively scarce in Essex and in the immediate vicinity of the Invertebrate Survey Area, and is therefore an important factor for the consideration of the value of the Invertebrate Survey Area, including the Allocation Boundary to terrestrial invertebrates.

G.3.2 Habitats other than the acid grassland are also likely to contribute to the consideration of the Invertebrate Survey Area's value for terrestrial invertebrates as variation in habitat structure, condition and composition provides diversity for different life stages and seasons.

G.4 Designated Areas

G.4.1 Middlewick Ranges Local Wildlife Site (LWS) is designated for its acid grassland vegetation communities and invertebrate fauna; particularly for its assemblage of seven Red Data Book (RDB), and eight Nationally Scarce species of solitary bees and wasps (aculeate Hymenoptera) [29]. The Middlewick Ranges LWS spans almost the entire Allocation Boundary

[29] There is a discrepancy between the LWS citation (2015) for the site and the dataset supplied by the Essex Field Club. The LWS citation refers to seven RDB species, and eight Nationally Scarce aculeate Hymenoptera noted within the assemblage.

(one small field in the eastern extent is excluded from the LWS). The LWS also extends south of the Allocation Boundary, to the edge of Birch Brook woodland.

G.4.2 The Birch Brook woodland corridor is also a LWS, and extends into the Allocation Boundary at the western extent. It has been designated for its woodland habitats, including a number of scarce plants in Essex. The woodland is considered to be a mix of semi-natural and plantation, with oak the dominant canopy-layer species. This woodland LWS is functionally connected via the mature hedgerows in the Mitigation Land to the Roman River Site of Special Scientific Interest (SSSI) which lies immediately south of Weir Lane. The SSSI has been designated for its important lowland acid grassland, woodland and wetland habitats, including a number of ancient woodland indicator species. Over thirty species of notable moth have been recorded at Roman River SSSI.

G.4.3 There are two further LWSs present within close proximity of the Invertebrate Survey Area: Donyland Wetlands LWS and Hythe Brownfield LWS. Donylands Wetlands LWS is located adjacent to the Invertebrate Survey Area, with Hythe Brownfield LWS located *c*. 0.27 km east of the Invertebrate Survey Area. All relevant designated areas are shown on **Figure 10.**

G.4.4 Hythe Lagoons lies beyond Hythe Brownfield, and are designated for key breeding bird species, as well as a roosting for coastal birds and feeding area for waders. There are notable botanical species present.

G.4.5 The Upper Colne Marshes Site of Special Scientific Interest (SSSI) also lies adjacent to Hythe Brownfield LWS, and is an area of grazing marsh, associated ditch and open water habitats and tidal salt marshes. The site is primarily designated for the scarce plants it supports, as well as the diversity in ditch types. Additional interest is provided by the terrestrial and aquatic invertebrates, as well as breeding and wintering birds. Invertebrates mentioned in the SSSI's citation include Roesel's bush cricket *Metrioptera roeselii*, which is cited as being Nationally Scarce. However, this species is now widespread in England, south-east of a line between the Humber and Severn estuaries. The most recent species status review for the group removed its nature conservation status. Other species mentioned include a ground beetle *Pterostichus macer*, which is a widespread species; as well as dragonflies and damselflies, and butterflies.

G.4.6 Hythe Brownfield LWS includes an old sand pit which supports Nationally important solitary bee and wasp assemblages. There is therefore commonality between the Middlewick Ranges LWS and Hythe Brownfield LWS in terms of its known invertebrate interest.

G.4.7 Donyland Wetlands is designated for the breeding amphibian population, also noting the shallow margins of the lakes which supports the great green bushcricket *Tettigonia viridissima* (an Essex Red Data List species).

G.4.8 **Figure 10** identifies the potential relationships between LWSs and the potential pathways (corridors) linking them, with possible interchange of species and populations.

G.5 Desk Study Records

G.5.1 A review of the desk study data provided by Essex Wildlife Trust and Essex Field Club identified that 318 species of invertebrate have been recorded within the Invertebrate Survey Area between 1981 and 2014 (using a basic distance search tool, given the resolution of the data provided)[30]. Of these, 173 species are moths, suggesting there has been a concerted moth-trapping effort, thus 145 species when moths are excluded. Of the 318 species

The Essex Field Club dataset lists 32 species of aculeate Hymenoptera recorded within the LWS, but only four are noted to be RDB and three Nationally Scarce species (records date from 2001). It should therefore be clarified, which other aculeate Hymenopetera have been recorded at this Site, to inform any impact assessment work required for a planning application.

[30] The figure of 318 species is based on the number of returns within a 0 km distance threshold of the Invertebrate Survey Area supplied to the Essex Field Club. No distinction is given to whether these records are within the two LWSs or land parcels outside the non-statutory sites.

recorded, 19 have a nature conservation status, including two moth species (see **Appendix G.7** for details). This represents approximately 6 % of the total invertebrate assemblage recorded, and 12 % excluding moths[31].

G.5.2 Whilst such an invertebrate assemblage is suggestive of potentially national level importance for terrestrial invertebrates, it is unknown how representative the survey work has been in terms of taxonomic coverage, temporal spread (i.e. across all seasons, or focussed on specific periods) and geospatial coverage. This dataset (when considered in the absence of a habitat appraisal considering current habitat conditions) is indicative that the Invertebrate Survey Area could have a terrestrial invertebrate assemblage of elevated nature conservation interest, beyond the County Level for which Middlewick Ranges LWS is already designated.

G.6 Field Visit

G.6.1 During the field survey, the Invertebrate Survey Area was split into a series of compartments to enable description of broadly comparable habitat types (from an invertebrate point of view). **Table 14** in **Section G.7** provides a description of each compartment with respect to the features of potential value to terrestrial invertebrates. **Table 14** should be read in conjunction with review of **Figure 11**, which provides a categorical appraisal of the various compartments with respect to their value for terrestrial invertebrates.

G.6.2 The compartments have been defined to enable a practical discussion around the relative value of areas of the Invertebrate Survey Area and were defined using a combination of physical boundaries or approximated gradations in habitat type. In practice a sharp, clear distinction in habitat type is not always visible on the ground; change in dominant species is more typically a gentle gradation, creating an ecocline. These ecoclines can be of high value for terrestrial invertebrates, as they tend to form more complex inter-relationships between vegetation communities, individual plant species (from stressed to vigorous), native geology/ made-ground, or topographical variations.

G.6.3 It is also important to note that the Invertebrate Survey Area's value to terrestrial invertebrates should be considered both in terms of its constituent elements, but also the sum of its parts. For example, the relative importance of the 'lower value' areas may be elevated when considered as part of the wider mosaic or network. In practical terms, the lesser valued habitats within the Invertebrate Survey Area may provide an important function for terrestrial invertebrates typically associated with the higher value areas, such as for overwintering or nocturnal roosting habitat in tussocks/ taller swards.

[31] As moths represent just over 50 % of the invertebrate species-richness recorded within the Invertebrate Study Area, suggesting a possible bias towards this group in terms of survey effort, it seems reasonable to exclude them, to provide a better context of the remaining assemblage. Moth-trapping is not typically undertaken when undertaking invertebrate surveys to inform Ecological Impact Assessment, unless there is a site-specific reason for doing so, such as known populations of rare species.

G.7 Invertebrate Survey Table

Table 14: Description of features within Invertebrate Survey Area of potential nature conservation value for terrestrial invertebrates (June 2019)

Compartment	Area (ha)	Description of features and relevance to terrestrial invertebrates with reference to target notes
The Ranges **- A**	30.3	**A1:** Extensive area of acid grassland across the majority of the compartment. Nectar resource variable, but a number of different flowering species within the Asteraceae (daisy family) were observed. Bare ground occurs as small patches, particularly on firing line ends/ edges. Firing lines were noticeably more species-rich and a greater proportion of flowering species (i.e. nectar resource) are present here, possibly reflecting shallower, more nutrient-poor soils. **A2:** Western margin of acid grassland expanse, adjacent to track leading from entrance off Mersea Road southwards is defined by a shallow, dry ditch. Grass sward very variable here, ranging from taller grassland with tussock-forming species more frequent, through to shorter vegetation with a greater abundance of flowering species and bare ground. Evidence of micro-cliffs, here defined as shallow (< 100 mm) exposures of substrate, occur. **A3:** Eastern margin a continuation of the acid grassland community that is prevalent throughout the compartment. Continues through into the adjacent Compartment D, though nectar resource declines (see Compartment D).
Old Heath Grasslands **- B to F**	1.7	**B1:** Open area of acid grassland, with scattered oak saplings, gorse and bramble scrub, forming mosaics, with still-air habitat ('sun-traps') and developing in to an ecocline towards the Birch Brook LWS woodland to the south. The western apex of this triangular field will receive the early morning sun and so will warm up quickly.
	6.3	**C1:** Eastern end of the same triangular field that includes Compartment B. Taller grassland swards with scattered bramble scrub.
	12.9	**D1:** Tall grassland sward, grading rapidly from acid grassland in A1-A3 into structurally homogeneous grassland with limited floristic species richness. **D2:** Scattered gorse and denser, more extensive stands of bramble. Mosaics of scrub and grasslands on outer edges of these larger stands.
	2.1	**E:** Tall grassland sward, structurally homogenous with limited floristic species-richness.
	5.8	**F:** Tall grassland sward, structurally homogenous with limited floristic species-richness.
North of Birch Brook **- G**	11.9	**G1:** Tall grassland sward, structurally homogenous with limited floristic species-richness.
Habitat Mosaics **- H**	14.4	**H1:** Bare ground, short perennial vegetation, acid grassland, gorse and bramble scrub (from small saplings through to taller shrubs) and shrubby oaks forming a complex mosaic of habitats, structurally heterogeneous on a varied topography and aspects. Warm still-air habitat, abundant nesting habitat for solitary bees, wasps and their cuckoos; in addition to a wide range of warmth-seeking invertebrates from a variety of taxa. **H2:** Some evidence of burning, apparently caused by ricocheting ammunition sparking localised fires. This may, in the short to medium term, maintain small patches of open ground that are eventually vegetated over; though this may introduce nutrients into the substrate (ash) that allow invasion by coarser grasses. Some possible evidence of this was observed. **H3:** Scattered and some denser stands of gorse and broom and linear oak scrub creating embayments with acid grassland swards. Occurs on a varied topography.
Birch Brook Woodland **- BB**	32.5	**BB1:** Scrubby oak, gorse and bramble on edge of more established oak woodland. Latter has an understorey of holly *Ilex aquifolium* and leaf-litter. Limited wood decay and no standards. Likely a fairly recent plantation supplemented by natural growth. **BB2:** Structurally uniform oak-dominated woodland; again, likely to be a plantation where self-sown saplings have developed. Structurally homogenous with bramble understorey. Limited wood decay and no mature trees. **BB3:** Mature oak-dominated woodland with birch *Betula* spp. and willows *Salix* spp., latter especially on edge of Birch Brook. Standing and lying dead wood, and wood decay evident in the older trees. Likely to be a semi-natural woodland following a watercourse within a natural channel. Holly, bracken *Pteridium aquilinum* and bramble understorey with a woodland ground flora (largely gone over at time of visit).

Compartment	Area (ha)	Description of features and relevance to terrestrial invertebrates with reference to target notes
		Waterbody indicated on 1:10,000 OS map (Target Note 30, **Figure 7a**) no longer present but discernible from lusher vegetation within its footprint.
Land to the south of Birch Brook **- I**	73.1	**I1:** Arable fields managed for silage that had been cut on the day of the visit. Structurally homogenous and likely to be nectar-resource poor. **I2:** Field margins comprising a narrow strip of tall ruderal/ competitor species such as common nettle *Urtica dioica* and other similar flora of agricultural field margins, including tussock-forming taller grasses. Structurally more complex, and associated with mature hedgerows with a range of woody species including gorse, hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa*, thus a nectar resource, as well as providing additional woody habitat. Excellent connectivity with woodlands to the south, linking the Birch Brook woodland corridor with the Roman River SSSI to the south of Weir Lane.

G.8 Interpretation of Invertebrate Records

Table 15: Notable invertebrate species historically recorded within the Invertebrate Survey Area based on Essex Field Club data (data received March 2019).

Order	Family	Species	Conservation status (Key in footnote)[32]	Habitat	Further Notes on Species Distribution and Habitat (from these sources[33])	Suitable Habitat Present within the Allocation Boundary or Mitigation Ranges?
Araneae	Linyphiidae	*Typhochrestus digitatus*	Nationally Scarce	Short sward & bare ground	**Distribution**: Widespread but patchy across Britain. Widespread in north west and central Europe. **Habitat**: Principally a winter-active species associated with bare or sparsely vegetated calcareous grasslands, heathlands and sandy grasslands.	Yes
Araneae	Linyphiidae	*Walckenaeria dysderoides*	Nationally Scarce	Tall sward & scrub	**Distribution:** Widespread in England but with few scattered records in Wales and Scotland. It is widespread in north-western and central Europe. **Habitat**: The spider is found on southern heathlands, especially in open, stony areas, but has also been recorded in pine needles and moss in woodlands, and on both acidic and calcareous grassland.	Yes
Araneae	Linyphiidae	*Walckenaeria monoceros*	Nationally Scarce	Short sward & bare ground	**Distribution**: The species has a widespread but patchy distribution in Britain. Widespread in north-western and central Europe. **Habitat**: The spider occurs under stones and detritus, on sand-hills and open habitats inland.	Yes

[32] **Key**

- pNationally Scarce = potentially Nationally Scarce.
- Na = Notable A ; an indication of the number of hectads (i.e. 10x10 km squares) in Britain in which a species has been recorded: <10 hectads
- Nb = Notable B; an indication of the number of hectads (i.e. 10x10 km squares) in Britain in which a species has been recorded: 10-100 hectads.
- RDB = Red Data Book:
  - RDB 1 – species appear in the Red Data Book and are categorised as endangered;
  - RDB 2 – species appear in the Red Data Book and are categorised as vulnerable;
  - RDB 3 – species appear in the Red Data Book and are categorised as rare;
- Section 41 Priority Species = Species of Principle Importance.
- […] = Use of square brackets denotes where status is considered to be out of date, and likely to be downgraded, but no formal species status review has been published.

Taken from Pantheon (Webb et al., 2018; version 3.7.6)

[33] http://srs.britishspiders.org.uk/; https://www.coleoptera.org.uk/; https://www.britishbugs.org.uk/; https://www.bwars.com/; https://www.ukbutterflies.co.uk/;
Falk, S.J. and Pont, A.C. (2017) *A Provisional Assessment of the Status of Calyptrate flies in the UK.* Natural England Commissioned Reports Number 234;
Falk, S.J. Ismay, J.W. and Chandler, P.J. (2016) *A Provisional Assessment of the Status of Acalyptrate flies in the UK.* Natural England Commissioned Reports Number 217;
Else, G.R. and Edwards, M. (2018) *Handbook of the Bees of the British Isles. Volumes 1 and 2.* The Ray Society, London.

Order	Family	Species	Conservation status (Key in footnote)[32]	Habitat	Further Notes on Species Distribution and Habitat (from these sources[33])	Suitable Habitat Present within the Allocation Boundary or Mitigation Ranges?
Araneae	Miturgidae	*Cheiracanthium virescens*	Nationally Scarce	Short sward & bare ground	**Distribution:** Scattered distribution in Britain as far north as central Scotland, but is widespread only in parts of southern and eastern England. It is widespread in western and central Europe. **Habitat**: The spider occurs under stones, or low vegetation such as heather, in dry, sandy or sparsely vegetated areas in open habitats such as heathland, waste-ground and dunes. Although mostly uncommon it is probably the *Cheiracanthium* species most often found on heathland and particularly on young heather.	Yes
Coleoptera	Chrysomelidae	*Podagrica fuscicornis*	Nationally Scarce	Tall sward & scrub	**Distribution**: Local, mainly in southern & eastern England; rare in Wales, not recorded from Scotland or Ireland. **Habitat**: Various; host, food and overwintering plant likely to be mallows *Malvaceae*.	Yes
Diptera	Micropezidae	*Micropeza lateralis*	Nationally Scarce	Short sward & bare ground	**Distribution**: Mainly recorded from south-east England where it is local. Elsewhere, there are scattered records in Yorkshire and older records (from the 1930s and 1980s) in Scotland. **Habitat**: Mainly heathland, with a possible association with broom *Cytisus scoparius* which could be its larval foodplant.	Yes
Diptera	Sarcophagidae	*Miltogramma germari*	pNationally Scarce	Short sward & bare ground	**Distribution**: Scattered and uncommon in southern England, from Cornwall to Kent; and north to Oxfordshire and Norfolk. It has also been recorded in south Wales. Most records are concentrated in south-west Britain at coastal sites. Apart from a few records in Kent, Suffolk and Norfolk, the majority of recent localities are in the south-west and south Wales. **Habitat**: Sand dunes, sandy area on heaths and sparsely vegetated areas on calcareous grassland where its hosts (various ground nesting solitary bees) are plentiful.	Yes
Hemiptera	Alydidae	*Alydus calcaratus*	Nationally Scarce	Short sward & bare ground	**Distribution**: Although widely distributed across England and parts of Wales, it is local and found primarily on dry heathland. Also found on brownfield sites in the Thames Gateway. **Habitat**: Dry heathland; the larvae resemble ants and may develop within ant nests.	Yes

Order	Family	Species	Conservation status (Key in footnote)[32]	Habitat	Further Notes on Species Distribution and Habitat (from these sources[33])	Suitable Habitat Present within the Allocation Boundary or Mitigation Ranges?
Hymenoptera	Chrysididae	*Hedychrum niemelai*	[RDB 3]	Short sward & bare ground	**Distribution**: Southern England (recorded from Cornwall to Kent and north to Oxfordshire, Norfolk and Lincolnshire. Also found in Jersey). Widespread in Europe. **Habitat:** Open sandy localities: lowland heaths, coastal dunes, cliffs with sandy deposits, and other disturbed locations, for example sandpits, footpaths and railway cuttings. Known to visit clary *Salvia spp.,* goldenrod *Solidago virgaurea*, woundwort *Stachys spp.,* and yarrow *Achillea millefolium*.	Yes
Hymenoptera	Crabronidae	*Cerceris quadricincta*	RDB 1; Section 41 Priority Species	Short sward & bare ground	**Distribution**: A rare wasp with UK distribution in Essex and Kent. **Habitat**: The species appears to be associated with light, sandy soils in which it excavates its nesting burrows.	Yes
Hymenoptera	Crabronidae	*Cerceris quinquefasciata*	[RDB 3]; Section 41 Priority Species	Short sward & bare ground	**Distribution**: Although widely distributed in southern England (especially in the south-east), this is a rare species. The majority of records are old, the most recent including individuals collected in Kent, Essex, Suffolk, Norfolk and Oxfordshire. Where found, this wasp may be quite common. **Habitat**: The biology of this species is much less well known than that of *C. arenaria*, but is likely to be very similar. Nests are often aggregated and tend to occur in relatively hard sandy soil, such as paths (Hamm & Richards, 1930). Visits bramble *Rubus fruticosus agg*. and creeping thistle *Cirsium arvense* flowers.	Yes
Hymenoptera	Crabronidae	*Philanthus triangulum*	[RDB 2]	Short sward & bare ground	**Distribution:** Records for the last few years indicate that currently the species is locally common to abundant in a steadily increasing number of sites in southern England, with a single record for north Wales (Else, 1993a, 1995a,b,e). **Habitat**: Generally, sand dunes and lowland heaths. However, nesting aggregations have recently been found in a park in Ipswich, Suffolk, and on the Battersea Bridge roundabout, Greater London. This wasp nests in both level sandy exposures and in vertical soil faces. Nectar sources include bramble, sea-holly *Eryngium maritimum,* heather *Calluna vulgaris*, thrift *Armeria maritima*, pale toadflax *Linaria repens*, common ragwort *Senecio jacobaea*, hemp-agrimony *Eupatorium cannabinum* and creeping thistle.	Yes

Order	Family	Species	Conservation status (Key in footnote)[32]	Habitat	Further Notes on Species Distribution and Habitat (from these sources[33])	Suitable Habitat Present within the Allocation Boundary or Mitigation Ranges?
Hymenoptera	Halictidae	*Sphecodes reticulatus*	[Na]	Short sward & bare ground	**Distribution**: Species is confined to southern Britain, from Kent to Devon, north to Staffordshire and Yorkshire. Sporadically recorded in Wales; widespread on the Channel Islands. **Habitat**: Heaths and other sandy sites where it is a cuckoo of various solitary bee species, though the precise ecology is unknown. A wide range of flowers are visited for nectar, including wild carrot *Daucus carota*, wild parsnip *Pastanica sativa* and other Apiaceae; forget-me-nots *Myosotis* spp. and various Asteraceae.	Yes
Hymenoptera	Melittidae	*Dasypoda hirtipes*	[Nb]	Short sward & bare ground	**Distribution**: Locally frequent in southern England between Kent and Cornwall, the Thames Gateway and East Anglia. Scattered records inland in the West Midlands and coastal Wales. **Habitat**: Restricted to sandy soils, particularly on heathlands and coastal dunes. Females mainly excavate their nests in sandy, sparsely vegetated, level soil. Oligolectic on Asteraceae; plants visited include common ragwort, fleabane *Pulicaria dysenterica*, creeping thistle, cat's-ear *Hypochoeris radicata*, hawkbit *Leontodon hispidus*, perennial sow-thistle *Sonchus arvensis* and smooth hawk's-beard *Crepis capillaris*, though further confirmation of these being forage species is required. This bee is especially associated with yellow Asteraceae flowers.	Yes
Hymenoptera	Mutillidae	*Smicromyrme rufipes*	Nb	Short sward & bare ground	**Distribution**: In England from Dorset to Kent, including the Isle of Wight, and north to Oxfordshire, Bedfordshire, Cambridgeshire and Norfolk. Also the Channel Islands. Overseas, found in many parts of mainland Europe (Norway, Sweden, Finland, Denmark, The Netherlands, France, Germany, Italy and Hungary). **Habitat**: Open sandy areas in warm, sunny situations both on the coast, for example sand dunes, and inland, for example heathland and sand pits. Males have been found on umbellifers and ragwort.	Yes
Lepidoptera	Geometridae	*Peribatodes secundaria*	RDB 3	Arboreal	**Distribution**: An immigrant species which is now also resident in parts of Kent, where it was first noticed in 1981. Migrants have turned up in various locations along the south coast. **Habitat**: The foodplants are various coniferous trees, including Norway spruce *Picea abies*.	Yes
Lepidoptera	Lasiocampidae	*Malacosoma castrensis*	[RDB 3]	Saltmarsh	**Distribution:** A very local species in the British Isles, restricted to parts of the south-eastern coastal counties. **Habitat**: They feed on a range of saltmarsh plants such as sea wormwood *Artemisia maritima* and sea-lavender *Limonium vulgare*.	No, although such habitat is present in the Upper Colne Marshes, to the east of the Site.

Order	Family	Species	Conservation status (Key in footnote)[32]	Habitat	Further Notes on Species Distribution and Habitat (from these sources[33])	Suitable Habitat Present within the Allocation Boundary or Mitigation Ranges?
Lepidoptera	Nymphalidae	*Coenonympha pamphilus*	Near Threatened; Section 41 Priority Species	Short sward & bare ground	**Distribution:** This is a widespread butterfly and can be found over most of the British Isles, with the exception of Orkney and Shetland and mountainous regions. **Habitat**: This species can be found in many different habitats, especially those that are more open, such as grassland, heathland, railway embankments, disused quarries, meadows and sand dunes. It occurs only sparingly in woodland where it can be found in ones and twos along wide woodland rides. Wherever it occurs, the adults prefer a shorter grass sward than closely related species. The primary larval foodplants are bents (various) *Agrostis spp*., Fescues (various) *Festuca spp*. and meadow-grasses (various) *Poa spp*.. Adults feed primarily on bramble, buttercups *Ranunculus spp*., devil's-bit scabious *Succisa pratensis*, fleabane *Pulicaria dysenterica*, greater stitchwort *Stellaria holostea*, kidney vetch *Anthyllis vulneraria*, ragwort, tormentil *Potentilla erecta* and yarrow *Achillea millefolium.*	Yes
Lepidoptera	Nymphalidae	*Lasiommata megera*	Near Threatened; Section 41 Priority Species	Short sward & bare ground	**Distribution**: Confined to primarily-coastal regions and has been lost from many sites in central, eastern and south-east England. In Scotland it is confined to coastal areas in the south-west of the country. It is also found on the Isle of Man and Channel Islands. **Habitat**: This species is now found primarily in coastal areas, especially unimproved grassland, wasteland, cliff edges and hedgerows. The primary larval foodplants are bents (various), cock's-foot *Dactylis glomerata*, false brome *Brachypodium sylvaticum*, tor-grass *Brachypodium pinnatum*, wavy hair-grass *Deschampsia flexuosa* and Yorkshire-fog *Holcus lanatus*. Adults feed primarily on daisy *Bellis perennis*, fleabane, hawkweeds Hieracium/Hypochoeris, knapweeds *Centaurea spp*., marjoram *Origanum vulgare*, ragged robin *Lychnis flos-cuculi,* ragwort, thistles *Cirsium spp*. and *Carduus spp*., water Mint *Mentha aquatica* and yarrow.	Yes

Appendix H Breeding Bird Habitat Appraisal Survey Results

H.1 Legal and Policy Protection

H.1.1 All wild birds, their active nests and eggs receive protection under the Wildlife and Countryside Act 1981 (as amended) in respect of intentional killing and injury or damage and destruction. Species listed on Schedule 1 of the Act are protected from disturbance whilst nesting. A number of bird species are listed as SPI, with the Red and Amber lists providing further indicators of conservation status within the UK. Some species, including skylark and song thrush are Essex priority species.

H.2 Desk Study

H.2.1 Records of 53 bird species were returned by the EWT data search. These included nightingale, skylark *Arlauda arvensis*, song thrush *Turdus philomelos*, fieldfare *Turdus pilaris*, and grasshopper warbler *Locustella naevia* which are all included on the Red list of Bird of Conservation Concern (BoCC) (Hayhow, 2017). The desk study identified that notable or Schedule 1 species (as listed under the Wildlife and Countryside Act 1981 (as amended)) including nightingale have been recorded from within 2km of the Allocation Boundary in Friday Wood (c. 1.7km west). In addition, nightingale are known to be present within the Roman River SSSI (given its inclusion within the designation criteria), immediately south of the Mitigation Land. However, this species has never been incidentally recorded at the Allocation Boundary or Mitigation Land during its use by the MOD (pers. Comm Pete Chamberlain, DIO).

H.3 Field Survey (Habitat Appraisal)

H.3.1 The results are detailed below, which should be read in conjunction with review of **Figures 12 – 15**. Review of **Figure 2** may also be required to enable cross reference of parts of the Breeding Bird Habitat Appraisal Survey Area.

Middlewick Firing Ranges

H.3.2 The Middlewick Firing Ranges itself (from here on in this section referred to as the 'ranges') is a large open area within the middle of the Allocation Boundary, and is an area of regularly mown grassland largely devoid of trees and shrubs. This provides potential nesting conditions for a selection of ground-nesting species such as skylark *Alauda arvensis* and meadow pipit *Anthus pratensis* as well as foraging habitat for species such as corvids (crow species), woodpigeons *Columba palumbus* and gull species. The suitability of these areas are however diminished due to the regular (3 weekly) and short (100mm) mowing during the breeding season; in reality therefore successful breeding is likely limited to the fringes of the ranges. The In addition, the open grassland has some potential to be used by crepuscular and nocturnal hunting species such as barn owls *Tyto alba* and little owl *Athene noctua*, although the rather uniform sward limits the potential value of the grassland as it is unlikely to support high numbers of small mammals (lacking a deep litter layer in many areas). Levels of disturbance of the ranges themselves (as a result of the almost daily firing, and frequent (3 weekly) mowing) may in practice limit the number of successful breeding pairs each year, in comparison to the potential numbers of breeding pairs (given habitat size). In addition, the short sward and current management limits the likely range of species that may use the ranges during the breeding season. The ranges provide extremely limited opportunities for breeding by non-ground nesting species. The largely uniform structure and lack of wetter areas (for example) does not favour species such as lapwing *Vanellus vanellus* or other waders that nest on the ground in open pasture.

Woodland to the north of the ranges

H.3.3 To the north of the ranges, inside the Allocation Boundary is a small area of planted woodland and gorse *Ulex europaeus* scrub with characteristics of heathland or woodland edge habitats. This area is small in size and has fairly open structure, so is likely to provide conditions for a selection of common and widespread species such as thrushes, tits and finches. Species favouring heathland scrub and denser scrub such as linnet *Linaria cannabina* and common whitethroat *Sylvia communis* may occur, but the overall species diversity (and number of territories) is likely to be limited due to the small size of the habitat parcels present.

Grassland surrounding the ranges

H.3.4 To the north of the woodland block mentioned above (in the northern limit of the Allocation Boundary) and to the east (in the Allocation Boundary) and south-east of the ranges (outside the Allocation Boundary), the landscape is characterised by areas of less intensively managed grassland interspersed with hedgerows, small areas of scrub and small wooded copses or groups of trees. Being located outside the range fencing, these areas are frequented by public dog walkers and other pedestrians. Although the grassland has some potential to be used by ground nesting species (e.g. skylark and meadow pipit) as well as foraging diurnal and nocturnal birds, the regular presence of people (and particularly dogs) may preclude or limit nesting as well as reduce the potential value to foraging birds. A selection of common and widespread species would likely occur around the areas of tree, hedgerow and scrub cover. However, these areas are generally too small to support more specialist woodland species.

South of the ranges

H.3.5 Immediately south of the ranges is a banked area dominated by gorse scrub which also extends further east (inside the Allocation boundary). This area has a heathland character (although lacks heather or dwarf gorse species) and contains a mixture of scrub, young woodland and grassland habitat creating a mosaic of vegetation (extending outside the Allocation Boundary). As such, it has potential to support species associated with these types of habitat such as linnet, as well as possibly species more typical of true heathland and sandy scrub habitats such as stonechat *Saxicola rubicola*. Consideration was also given to the potential for Dartford warbler *Sylvia undata* to occur here given the presence of gorse scrub which is a favoured nesting habitat. However, the distribution of this species is concentrated in southern Britain south of the Thames and further west (some distance south of the Allocation Boundary, or remainder of the breeding bird habitat appraisal survey area) as well as along the Suffolk coast further north. As such, the breeding bird habitat appraisal survey area falls outside the usual range of this species so its presence is unlikely, particularly given the small area of suitable habitat present relative to other habitat types.

Birch Brook Woodland

H.3.6 A narrow woodland is present to the west of the ranges (inside the Allocation Boundary) also extending immediately south of the ranges (adjacent to the area dominated by gorse scrub described above) (inside the Allocation Boundary). This woodland joins a more extensive belt of woodland either side of a stream (Birch Brook) running west to east through the central part of the breeding bird habitat appraisal survey area (outside the Allocation Boundary). At its north-western extent, the woodland habitat is characterised by secondary woodland with young and semi-mature trees and a dense understory in places. This is likely to support a range of common and widespread species of birds associated with scrub, woodland and ‘garden’ habitats, although the lack of more mature trees may limit nesting potential, particularly for more woodland specialist species such as woodpeckers and nuthatch *Sitta europaea*. However, moving south and through the central part, the woodland contains a greater proportion of mature and semi-mature broadleaved trees and has a well-established woodland character. This habitat has the potential to support a range of bird species including generalists, a variety of warblers, more woodland specialist species and species such as

tawny owls *Strix aluco*, buzzards *Buteo buteo* and possibly other raptors. To the western and eastern ends of the central established woodland are areas of dense scrub (e.g. blackthorn; *Prunus spinosa*) understorey. These areas provide increased potential cover for nesting species including nightingale and bullfinch *Pyrrhula pyrrhula*.

Land to the South of Birch Brook Woodland

H.3.7 The landscape south of the central woodland belt is again characterised by areas of open grassland (arable ley grassland) interspersed with hedgerows, clumps of trees and some scrub. Although similar to the areas north of the woodland, the land to the south is more open with the individual grassland areas tending to be larger (particularly moving south-west) and with a less diverse sward (both in terms of grass species and structure), having a more 'improved' grassland appearance (managed as a silage ley). As such, these grasslands have an even lower potential to support ground nesting species, although occasional use by species such as skylark is possible in places. The boundary features and scrub here again have the potential to support generalist species of birds, with the more mature and semi-mature trees present in places providing nesting potential for species such as woodpeckers, owls, raptors and other woodland birds. Although the grassland is limited in terms of potential value as foraging habitat for species such as barn owls, the presence of potential nest sites in trees may have some value to this species (and others) as part of a wider territorial range (if present locally). Some of the denser areas of out-grown hedgerow and scrub on the boundaries of the grassland have the potential to support species such as nightingale and warblers, as well as generalist species.

H.4 Nightingale BTO Data Review

H.4.1 The BTO nightingale survey data from 2012 includes a total of 36 singing males from tetrad[34] TM02A (the tetrad containing the land south of the Birch Brook woodland/south of the ranges). Tetrad TM02B which contains the ranges and land immediately to the west, north and east held a total of 12 singing males in 2012. The two remaining tetrads for which data was supplied (TM02F and TM02G) both held 5 singing males each in 2012; these tetrads include land just beyond the survey area to the east, so were requested for additional context.

H.4.2 The data indicates that, in 2012, the southern part of the breeding bird habitat appraisal survey area held a relatively high number of singing nightingales compared to other habitat in the local area. The area including the ranges themselves also held a population of this species, with numbers being lower than the land to the south of Birch Brook, but still higher (in total) than both adjacent tetrads to the east. Overall, this indicates that parts of the breeding bird habitat appraisal survey area were of value to nightingale, at least in 2012. However, despite the time that has passed since this data was collected, it is possible that a similar pattern of distribution of nightingale would occur, as there is no reason to indicate that habitat conditions have significantly changed.

H.4.3 The mapping data supplied by the BTO gives approximate territory centres for singing males in 2012. This gives a better indication of the numbers recorded within the breeding bird habitat appraisal survey area itself (as opposed to within tetrads) as well as the areas of habitat used by this species at that time. The mapping data indicates a total of 19 singing male nightingales were present within the breeding bird habitat appraisal survey area boundary in 2012. These were distributed within scrub and small areas of woodland immediately south of the ranges (3 territories), within the established woodland in the centre of the survey area (6 territories), particularly toward its western extent, and within areas of scrub and hedgerows to the south-east of the ranges (3 territories) and in the land to the south of the central woodland (7 territories). Other territories were located close to, but beyond, the breeding bird habitat appraisal survey area to the east and south. In the wider landscape (based on the 4 tetrads supplied only), clusters of territories were recorded in large areas of woodland further south of

[34] A tetrad is a 2km by 2km grid

the breeding bird habitat appraisal survey area and in a large area of scrub and woodland to the south-west of the breeding bird habitat appraisal survey area. Considering the distribution of nightingale records from the 2012 BTO survey, Birch Brook and the Mitigation Land appear to support the greatest number of territories, with the mosaic at the base of the ranges (within the Allocation Boundary) also supporting a small number of territories. The 2012 survey did not record any territories in the northern parts of the Allocation Boundary.

H.4.4 Based on the results of the national nightingale survey in 2012, the BTO estimated a mean UK population size of 5,542 territories. The total number of territories within the 4 tetrads analysed (58 territories) therefore represents just over 1% of this population (1.04%). The 19 territories within the breeding bird habitat appraisal survey area represents approximately 0.34% of the 2012 UK population estimate. This number is significantly less if the territories within the Allocation Boundary alone are considered. Of the 19 territories within the Allocation Boundary and breeding bird habitat appraisal survey area, there are 6 territories within the Allocation Boundary; this equates to 0.1% of the 2012 UK population estimate. All territories are located in the southern part of the Allocation Boundary; i.e. the mosaic habitat at the south of the ranges and in Birch Brook woodland.

H.4.5 This suggests the local area including the breeding bird habitat appraisal survey area is of value to nightingale. Within this context, parts of the breeding bird habitat appraisal survey area are likely to also be of value to this species; particularly the Birch Brook woodland in the central part of the breeding bird habitat appraisal survey area (south of the ranges) and areas of outgrown hedgerow and scrub to the south and east of the ranges. However, based on the habitat appraisal and results of the most recent nightingale survey, the ranges themselves (being largely unsuitable habitat) are unlikely to be of particular value to this species. The areas of open grassland dominating the breeding bird habitat appraisal survey area to the north, east and south of the ranges are also of negligible potential value to nightingale. However, areas of scrub and hedgerows within and around these areas may be used by this species. The relative suitability of habitat within the breeding bird habitat appraisal survey area for nightingale are shown on **Figure 15**.

Appendix I Bat Survey Results

I.1 Legal and Policy Protection

I.1.1 Bats are EPS, meaning both bats and their places of shelter (roosts) are afforded protection under the Conservation of Species and Habitats Regulations 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended). In broad terms these pieces of legislation jointly mean that the animals themselves are protected against killing, injury, taking (capture) and disturbance. In addition, their places of shelter are protected against damage, destruction and obstruction. Several bat species are also an SPI under the NERC Act 2006 and an Essex priority species.

I.2 Desk Study

I.2.1 Two granted Natural England ESPLs in relation to bats were identified within 2 km of the Allocation Boundary from a review of the MAGIC website. These were granted during 2011 for the destruction of common pipistrelle *Pipsitrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus* and brown long-eared *Plectous auritus* resting places and both licences were located >1.7km to the west of either the Allocation Boundary or the Mitigation Land.

I.2.2 A total of 53 bats records were returned by the EWT data search. These comprised seven identified bat species including: common and soprano pipistrelle, Nathusius' pispitrelle *Pipistrellus nathusii,* brown long-eared, serotine *Eptesicus serotinus,* noctule *Nyctalus noctula* and Daubenton's bat *Myotis daubentonii* as well as unidentified long-eared, myotis and pipistrelle bat species. The records were largely field records obtained from offsite locations within Colchester cemetery, Castle Park, and the University of Essex grounds between 2007 and 2015. The records included a pipistrelle bat roost (species unknown) from 2007 within a building in Fingringhoe, approximately. The record resolution is 1km, and so exact distances cannot be measured, however likely to be approximately 2.7 km from the Allocation boundary given the location description associated with the records.

I.3 September and October Bat Activity Survey

Walked Activity Transects

I.3.1 An assemblage of at least 6 bat species were recorded during the activity transects undertaken in September and October 2018. Species recorded included:

- Barbastelle Barbastella barbastellus;
- Myotis bats Myotis sp.;
- Noctule Nyctalus noctula;
- Common pipistrelle Pipistrellus pipistrellus,
- Soprano pipistrelle *Pipistrellus pygmaeus*; and
- Long-eared bats *Plecotus sp.*

I.3.2 The calls recorded during the transect surveys are summarised in **Table 16** below. Locations of bats encountered during the transect surveys are shown on **Figure 17a and 17b**.

Table 16: Bat Activity Transect Results

Month	Transect No.	No. Barbastelle calls	No. *Myotis* bat calls	No. Noctule Calls	No. Common Pipistrelle Calls	No. Soprano Pipistrelle Calls	No. Long-eared bat calls	Total
September	1	0	1	5	8	44	2	**60**
	2	5	1	3	9	18	2	**38**
September Total		*5*	*2*	*8*	*17*	*62*	*4*	***98***
October	1	0	0	0	23	32	3	**58**
	2	3	0	1	40	23	0	**67**
October Total		*3*	*0*	*1*	*63*	*55*	*3*	***125***
Grand Total		**8**	**2**	**9**	**80**	**117**	**7**	**223**
Percentage of Calls		**3.59**	**0.9**	**4.04**	**35.87**	**52.47**	**3.13**	**100**

I.3.3 The data gathered during the activity transect surveys was dominated by pipistrelle bats (common and soprano) with 88.34% of calls recorded attributed to these species. This is to be expected as these species are common and widespread throughout the UK (Dietz *et al*, 2009). Activity was focussed within woodland parcels to the west and south, along the woodland edge habitat and along established hedgerows and treelines. Both pipistrelle species rarely forage over open landscapes as this increases their susceptibility to predation (Dietz *et al*, 2009, Verboom & Spoelstra, 1999). Lower levels of activity of barbastelle (a rare species), myotis bats, noctule bats and long-eared bats (most likely to be brown long-eared *Plecotus auritus* given the limited known UK distribution of the much rarer grey long-eared bat *Plecotus austriacus*) were also recorded during the transects. A further brief interpretation relating to these species is discussed below.

Automated Static Detector Surveys

I.3.4 The automated static detectors recorded an assemblage of at least 9 species of bats. These are listed below:

- Barbastelle;
- Long-eared bats;
- Leisler's Nyctalus leisleri;
- Myotis bats;
- Noctule;
- Common pipistrelle;
- Soprano pipistrelle;
- Nathusius' pipistrelle *Pipistrellus nathusii*;
- Serotine Eptesicus serotinus.

I.3.5 The bat data recorded during the static monitoring periods each month are summarised in **Table 17.**

Table 17: Automated Bat Static Detector Results

Month	Detector	No. Barbastelle calls	No. Long-eared bat calls	No. Leislers' calls	No. Myotis bat calls	No. Noctule calls	No. Nyctalus sp. Calls	No. Pipistrelle (40kHz) calls	No. Common pipistrelle calls	No. Soprano pipistrelle calls	No. Nathusius' pipistrelle calls	No. Serotine calls	No. Pipistrelle (50 kHz) calls	Total
September	S1	0	7	0	29	2	0	0	138	187	0	0	0	**363**
	S2	0	0	2	0	1	0	0	11	5	0	0	0	**19**
	S3	0	17	0	2	5	1	1	13	18	0	0	0	**57**
	S4	1	8	0	3	1	0	0	102	49	6	4	0	**174**
	S5	0	0	0	0	6	0	0	1	2	0	0	0	**9**
	S6	1	0	0	5	3	45	0	0	12	0	0	0	**66**
September Total		*2*	*32*	*2*	*39*	*18*	*46*	*1*	*265*	*273*	*6*	*4*	*0*	***688***
October	S1	0	0	0	70	0	0	0	92	277	0	0	25	**464**
	S2	0	0	0	0	0	0	0	0	3	2	0	0	**5**
	S3	2	6	0	4	1	0	0	4	0	0	0	0	**17**
	S4	4	4	0	2	0	1	0	87	88	0	0	17	**203**
	S5	0	0	0	0	1	0	0	1	0	0	0	0	**2**
	S6	0	0	0	10	0	1	0	0	0	0	0	8	**19**
October Total		*6*	*10*	*0*	*86*	*2*	*2*	*0*	*184*	*368*	*2*	*0*	*50*	***710***
Grand Total		**8**	**42**	**2**	**125**	**20**	**48**	**1**	**449**	**641**	**8**	**4**	**50**	**1398**
Percentage of Calls		**0.57**	**3.01**	**0.14**	**8.94**	**1.43**	**3.43**	**0.07**	**32.12**	**45.85**	**0.57**	**0.29**	**3.58**	**100**

General Bat Activity

I.3.6 As the survey data in **Table 17** shows, activity was highest at detectors S1 (within woodland) and S4 (on an established hedgerow/treeline). Activity was lowest at S2 sited in young scrub/tree habitat to the north and in S5 in the south-east of the Site. Activity in the open grassland in the centre of the Site (S3) was also relatively low which is to be expected as a lack of vegetation cover would increase susceptibility to predation.

I.3.7 A varied assemblage of species was recorded including two species considered to be relatively rare in the UK (barbastelle and Nathusius' pipistrelle). For male barbastelle bats, the peak foraging period/metabolic demand is likely to be in autumn and early winter, coinciding with mating activity (Greenaway, 2004). This possibly accounts for the activity levels of this species recorded during September and October as barbastelles increase foraging levels to maximise energy levels in preparation for mating/hibernation. Nathusius' pipistrelles are known to migrate seasonally across Europe between maternity and hibernation sites, with migration to hibernation sites occurring in the autumn (September and October) (Dietz *et al*, 2009). It is thought that this species migrates to the UK to exploit foraging habitats and avoid harsh climatic winter conditions in north-eastern Europe, or it is possible that bats hibernating in south-western Europe come to the UK to breed and migrate back to south-west Europe to hibernate in the autumn (Russ *et al*, 2001). The data gathered during the automated static detector surveys suggested that the Nathusius' pipistrelle activity recorded was indicative of an individual/small numbers of this species passing through and using the Bat Activity Survey Area on a very occasional/rare basis possibly on passage/migration during the late summer/autumn.

Notes on Scope

I.3.8 Current best practice guidance states that for high suitability habitat "*up to two survey visits per month (April to October) in appropriate weather conditions for bats*" should be conducted (Collins, 2016).Given the mix of both moderate and high quality habitat within the Bat Activity Survey Area and that the Birch Brook LWS woodland (high quality habitat) is to be retained and protected it was considered that undertaking two transects per month was not necessary in this instance, and therefore only one survey per month was required. Three static detector locations were sampled per transect (the equivalent of survey effort for a high suitability site) and it is considered that this will provide sufficient data regarding the usage of the Bat Activity Survey Area by foraging and commuting bats.

I.4 Hibernation Survey Results

Bat Dropping DNA Analysis

I.4.1 The analysis of the bat droppings revealed the presence of three species of bat:

- Brown long-eared bat *Plecotus auritus*
- Natterer's bat *Myotis natterei*
- Barbastelle Barbastella barbastellus

I.4.2 Due to the presence of DNA from the rare barbastelle bat, the result was confirmed in three separate tests of the DNA sample.

Hibernation Surveys (Inspection)

I.4.3 All areas/crevices within the interior of the toilet block were searched for hibernating bats. No bats or signs of use by hibernating bats were identified during either of the detailed inspections of the structure.

Automated Static Detector Survey

I.4.4 Acoustic information was recorded periodically over the monitoring period. However, due to the small dimensions of the structure there were limitations to the clarity of the calls recorded (likely due to the obstructions and refraction of sounds bouncing off walls within the structure before being picked up by the detector). Also, given the open nature of the structure it is considered that some of the calls recorded were as a result of small numbers of bats flying outside of the structure on milder nights over the winter period. Given these issues, only a very small number (two calls) could be confirmed as being of bat origin; others were suspected to be rat / other small mammals. The parameters of the two bat calls were indicative of *Myotis* bats, although the exact species could not be ascertained due to the overlapping call parameters characteristic of this genus, as described in the Methods section above. No bat calls were recorded which conclusively indicated internal use of the structure by bats during the monitoring period.

I.4.5 The recorded acoustic information was independently assessed by Helen Evriviades (a bat licensed ecologist with 20 years' experience in ecological consultancy, and who has extensive experience analysing bat calls). Helen also came to the conclusion that no bat calls were recorded which conclusively indicated internal use of the structure by bats during the monitoring period.

I.4.6 The static detector data therefore reinforces the findings of the internal inspection surveys which found no evidence of bats, or further bat use. However, despite this, given its suitability and the presence of bat droppings (indicating previous use by bats in some capacity) the use of this structure by hibernating bats in future years cannot be entirely ruled out.

Photographs – Hibernation Survey

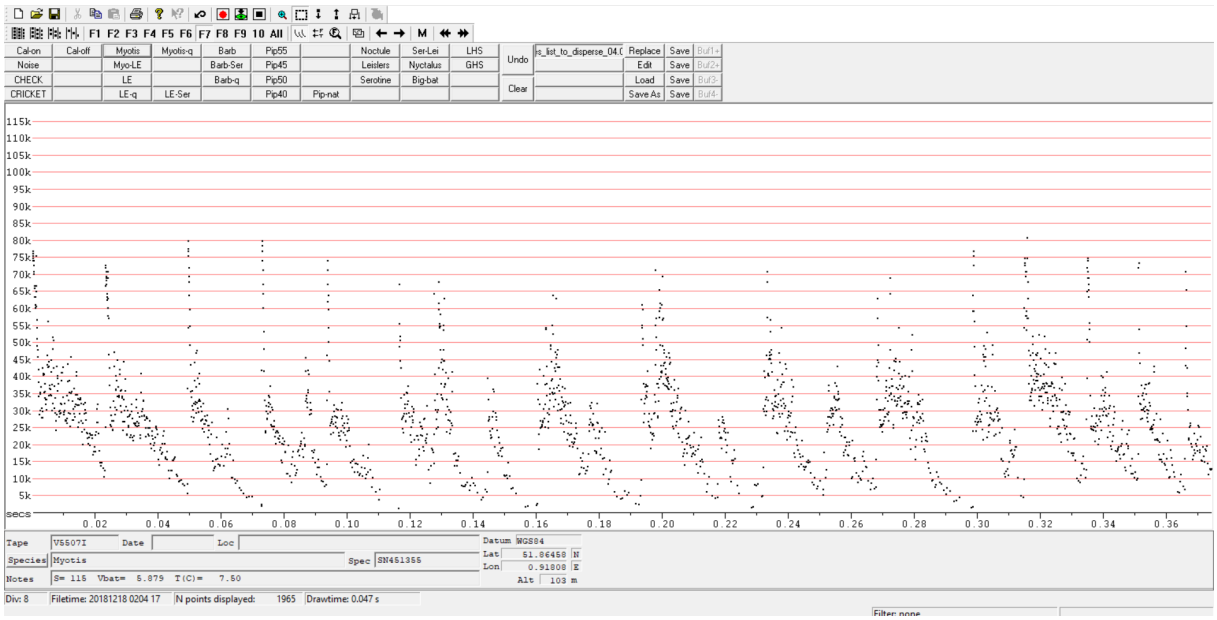
Table 18: Bat Hibernation Survey Photographs

Target Note/ Photo Number	Description	Photo
P1	Potential hibernation site within a dilapidated toilet within the Marker's Gallery	

P2	The interior of the toilet. The star denotes the static bat detector which was placed around the corner in order to minimise recording calls of bats flying past outside of the toilet. The red circle denotes the location of a small pile of bat droppings found in autumn 2018.	
P3	The interior of the toilet close to the entrance. The red circle denotes the main pile of bat droppings located beneath a piece of crumbling paint on the ceiling on which bats potentially cling to.	
P4	The pile of bat droppings from the location shown in P3 collected for DNA analysis to determine the species present.	

Example Bat Call

A call recorded on 18th January 2019. This is likely a Myotis bat flying past the exterior of the structure.



I.5 Bat Habitat Appraisal

I.5.1 In light of the bat hibernation survey findings (i.e. the presence of barbastelle droppings), a bat habitat appraisal was completed to consider the suitability of habitat for foraging, roosting and commuting bats, including barbastelle.

Barbastelle Bat Ecology and Status

I.5.2 Barbastelle is an Annex II species under the Conservations of Habitats and Species Regulations 2017 (i.e. is a criteria for designation of Special Areas of Conservation (SAC)). For clarity, this species is considered to be significantly under-recorded, and it is distributed throughout Europe (with some exceptions).

I.5.3 The barbastelle is considered to be rare in Britain, and only sparsely distributed through its range in Europe (Altringham, 2003). Its characteristic short and directional echolocation call (Denzinger et al., 2001), and fast and far-travelling flight (Dietz et al., 2009) are likely to reduce detection levels. This species tends to forage in woodland where its summer roost sites are usually associated with splits and cracks in trees or occur beneath raised bark (Dietz et al, 2009).

I.5.4 The foraging area for this species covers an area of approximately 8.8 ha around the roost (Dietz, et al, 2009). For male barbastelle bats, the peak foraging period/metabolic demand is likely to be in autumn and early winter, coinciding with mating activity (Greenaway, 2004). This species tends to emerge from a roost between 25 and 60 minutes after sunset (Russ, 2012). The barbastelle has a strong aversion to well-lit areas; however, it emerges early to enable it to cover the often large distances separating their roosting and foraging areas during the relatively short summer nights. In order to avoid possible predation by birds, barbastelles remain in dark, shaded woodland habitats, woodland rides and close to overgrown hedgerows flying close to the ground (1-2 m high). This strategy allows them to cover large distances before darkness has fully arrived (Greenaway, 2004). The Allocation Boundary and Mitigation Land therefore offers, roosting, foraging and commuting habitat of potential value to barbastelle bats, the large mature woodland parcels in particular.

I.5.5 In the UK barbastelle is limited to southern England and Wales, with the SACs for this species in the UK predominantly comprising maternity and hibernation roosts.

Habitat Appraisal

I.5.6 Parcels of habitat within the Bat Habitat Appraisal Survey Area was were split into discrete areas (numbered Areas 1-14) and their potential to support roosting, foraging and commuting barbastelle bats (and other species) was evaluated. Linear features within the Bat Habitat Appraisal Survey Area (i.e. hedgerows and treelines) were also evaluated in the same way (Numbered H1-H17). The locations of these areas/linear features are shown on **Figure 19 - 20** with a brief description of each area and its value to roosting, foraging and commuting bats included in **Table 19** below. Trees identified during the survey as being examples with moderate/high roosting potential are also included within **Table 19** and shown on **Figure 19**. A selection of photographs is provided in below.

I.5.7 The open grassland of the ranges and the land to the east and south covering the majority of the Bat Habitat Appraisal Survey Area was considered to be of limited value to foraging and commuting barbastelle (and other bat species), lacking cover and structural diversity (though individuals are likely to pass through these areas on occasion). The scrub/young woodland in the north of the Bat Habitat Appraisal Survey Area was considered to be of negligible to low value to roosting bats with value as a foraging resource also low given the higher levels of ambient lighting (street lighting) in this part of the Bat Habitat Appraisal Survey Area. Despite this there were a small number of mature standard oak trees within isolated copses/tree lines in the north of the Bat Habitat Appraisal Survey Area that had moderate/high value to support roosting barbastelle bats and other species.

I.5.8 The woodland parcel on the western boundary of the Bat Habitat Appraisal Survey Area (Area 10) (enclosing the northern extent of the Birch Brook where it passes through the Bat Habitat Appraisal Survey Area, within the fenced area of the ranges) supported a mixture of young oak with some mature standards further to the south. A dense understorey of holly, hazel and bramble/gorse scrub was present in places with open rides also within the woodland. A number of trees were noted with moderate to high levels of potential to support roosting barbastelle bats with the woodland rides (particularly along the brook) offering moderate/high potential value to commuting/foraging barbastelle as well as other bat species. The potential value of this parcel of woodland is slightly reduced given that it does not connect to any further suitable habitat to the north, with this parcel terminating at Mersea Road with residential development beyond.

I.5.9 Two parcels of young oak woodland surrounded by heath/gorse scrub were present adjacent to the marker's gallery at the south of the ranges (Areas 8 and 9). These parcels were densely planted but had very little woodland understorey/shrub layer. These younger trees were generally in good condition, lacking suitable features for supporting roosting bats; however, roosting within this area cannot be ruled out at this stage. The potential value of this area to foraging and commuting barbastelle was assessed as being of moderate-high value.

I.5.10 The remainder of the Birch Brook woodland further to the south (from east to west, Area 11) supports the highest quality potential habitat for barbastelle bats (and other species) within the Bat Habitat Appraisal Survey Area with large numbers of mature oaks supporting suitable roosting features (lifted bark, splits and crevices in the trunk and branches) for barbastelle. The composition of the woodland also provides a high-quality potential commuting and foraging resource for this species with the Birch Brook flowing through the woodland, a diverse shrub layer and numerous open rides through the woodland favouring the ecology of this species. This woodland also provides connectivity to the wider landscape with a fishing lake to the west (providing a foraging resource) and numerous hedgerows/treelines to the south providing linkage to other mature woodland parcels in the local landscape (i.e. the extensive woodland parcel to the south of Weir Lane (Area 14)). Many of the treelines within the grassland to the south also supported trees with the potential to support roosting barbastelle bats and other species whilst also providing connectivity between offsite and onsite woodland parcels and areas of high-quality potential foraging habitat including the lake offsite to the east.

I.5.11 During the survey a pillbox was noted on the eastern boundary of the Bat Habitat Appraisal Survey Area that has the potential be used by hibernating bats. The entrance to this pillbox has been buried (assumedly to keep out members of the public); however, open windows could still provide access/egress to hibernating bats.

I.5.12 In summary, the open area of the ranges and other areas of grassland are considered to be of limited potential value to bats with the larger woodland parcels and linking hedgerow features likely of highest potential value to barbastelle bats and other species.

Habitat Appraisal Detailed Results

Table 19: Bat Habitat Appraisal Results

Area/Linear Feature/Tree	Description	Potential Value to Roosting Barbastelle bats	Potential Roosting Value to Other Species of Bats	Potential Value to Commuting and Foraging Barbastelle Bats	Potential Commuting and Foraging Value to Other Species of Bats
Area 1	Scattered young and semi-mature trees interspersed with areas of scrub including gorse, bramble and broom.	Negligible-Low	Low	Low-Moderate	Moderate
Area 2	Open grassland within the Bat Habitat Appraisal Survey Area. This grassland was generally intensively managed.	Negligible	Negligible.	Low	Low
Area 3	Small copse of predominantly pedunculate oak supporting young and semi-mature trees.	Negligible-Low	Low	Low	Low
Area 4	Small linear copse of woodland dominated by oak with an understorey of blackthorn. Some mature trees were present.	Low-Moderate	Moderate	Moderate	Moderate
Area 5	Small copse of semi-mature and young trees.	Low-Moderate	Moderate	Moderate	Moderate
Area 6	Very small copse of semi-mature oak close Abbots Road in the north of the Bat Habitat Appraisal Survey Area.	Low	Low	Low	Low
Area 7	A large area of gorse scrub and heathland habitat to the south of the ranges supporting a small number of young and semi-mature oaks.	Negligible-Low	Low	Low-Moderate	Moderate
Area 8	A copse of semi-mature trees on the southern edge of Area 7.	Low-Moderate	Moderate	Moderate	Moderate
Area 9	A parcel of woodland to the west of Area 7 adjoining an extensive parcel of woodland (Area 10) present to the west. This parcel supported predominantly young and semi-mature trees.	Low-Moderate	Moderate	Moderate-High	High
Area 10	A large parcel of mature and semi-mature woodland on the western edge of the Bat Habitat Appraisal Survey Area. This parcel supports a number of mature tree specimens with a small, wet ditch present in the west.	Moderate-High	High	Moderate-High	High
Area 11	An extensive area of mature woodland with an established shrub layer and understorey. A watercourse flowed through the centre of this woodland parcel with a pond in the south of the woodland and a large lake present offsite to the east.	High	High	High	High
Area 12	A copse of woodland supporting some mature specimens adjoined to the extensive woodland parcel Area 11 present to the north.	Moderate-High	High	High	High
Area 13	A small copse of trees linked to other more extensive areas of woodland by linear features (hedgerows).	Moderate	Moderate	High	High
Area 14	The northern extent of a mature woodland parcel offsite to the south. This woodland supports mature oak and ash with an established shrub layer. This woodland is linked to other woodland parcels within the Bat Habitat Appraisal Survey Area by hedgerows.	High	High	High	High

Area/Linear Feature/Tree	Description	Potential Value to Roosting Barbastelle bats	Potential Roosting Value to Other Species of Bats	Potential Value to Commuting and Foraging Barbastelle Bats	Potential Commuting and Foraging Value to Other Species of Bats
H1	A hawthorn hedgerow along the northern boundary of the Survey Area. The northern side of this hedgerow is well lit by adjacent street-lighting	Negligible	Negligible	Negligible-Low	Low
H2	A line of established oaks in the north of the Bat Habitat Appraisal Survey Area.	Low	Low	Low-Moderate	Moderate
H3	A mature treeline/hedgerow in the east of the Bat Habitat Appraisal Survey Area supporting some mature oaks.	Low-Moderate	Moderate	Moderate	Moderate
H4	A mature treeline supporting a number of oaks in the east of the Bat Habitat Appraisal Survey Area.	Low-Moderate	Moderate	Moderate	Moderate
H5	Oak treeline/hedgerow supporting some mature specimens providing connectivity between H3 and H4 to the north and Area 11 to the south.	Moderate	Moderate	High	High
H6	Established treeline/hedgerow with some mature specimens connected to H5, H7 and H8 and providing connectivity to the offsite lake to the east.	Low-Moderate	Moderate	High	High
H7	Established hedgerow with some mature specimens providing connectivity to neighbouring hedgerows and Area 11 to the south.	Moderate	Moderate	High	High
H8	A mature hedgerow on the eastern boundary of the Bat Habitat Appraisal Survey Area providing connectivity to the offsite lake and Area 11. A number of mature trees were present in this linear feature.	Moderate	Moderate	High	High
H9	A hedgerow supporting young tree saplings on the south-eastern boundary of the Bat Habitat Appraisal Survey Area. This hedgerow provides connectivity between Areas 11 and 14.	Negligible	Negligible	Moderate	Moderate
H10	A length of hedgerow providing connectivity between Areas 13 and 14. A small number of mature trees were present in the northern extent of this hedgerow.	Low	Low	High	High
H11	A hedgerow running along the southern boundary of the Bat Habitat Appraisal Survey Area. Some mature trees were present in this hedgerow.	Moderate	Moderate	High	High
H12	A length of hedgerow connecting Areas 13 and 12. This hedgerow supported a small number of mature trees.	Low-Moderate	Moderate	High	High
H13	A “scrubby” hedgerow supporting a number of mature/veteran oaks providing linkage between Areas 11 and 12.	Moderate	Moderate	High	High
H14	A managed hedgerow linking Areas 11 and 12.	Negligible	Negligible	Moderate	Moderate

Area/Linear Feature/Tree	Description	Potential Value to Roosting Barbastelle bats	Potential Roosting Value to Other Species of Bats	Potential Value to Commuting and Foraging Barbastelle Bats	Potential Commuting and Foraging Value to Other Species of Bats
H15	A hedgerow supporting young and semi-mature trees connected to H16 to the north and the southern boundary of the Bat Habitat Appraisal Survey Area.	Low	Low	Moderate	Moderate
H16	Established tree line providing linkage between the south-western boundary of the Bat Habitat Appraisal Survey Area (and residential development) and Area 11.	Low-Moderate	Moderate	Moderate	Moderate
H17	A length of hedgerow with some mature tree specimens connecting Area 12 and H13.	Low-Moderate	Moderate	High	High
T1	Mature pedunculate oak with a hollow trunk and numerous rot holes.	Moderate	High	N/A	N/A
T2	Mature pedunculate oak with multiple splits in the branches.	Moderate	High	N/A	N/A
T3	Mature pedunculate oak with splits in the trunk.	High	High	N/A	N/A
T4	Mature pedunculate oak with multiple splits in the trunk and branches.	High	High	N/A	N/A
T5	Mature oak with lots of cracks and splits in branches and lifted bark.	High	High	N/A	N/A
T6	Mature oak with multiple woodpecker holes and lifted bark.	High	High	N/A	N/A
T7	Mature oak with multiple woodpecker holes and lifted bark.	High	High	N/A	N/A
T8	Oak with dead branches and lots of lifted bark.	High	High	N/A	N/A

Bat Habitat Appraisal Photographs

Table 20: Bat Habitat Appraisal Photographs

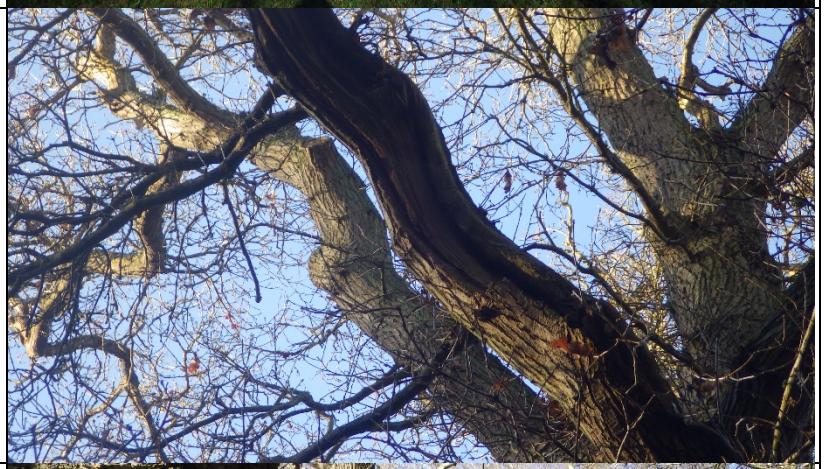
Target Note/ Photo Number	Description	Photo
P1	Area 1 in the north of the Bat Habitat Appraisal Survey Area	
P2	Area 2; open grassland within the Bat Habitat Appraisal Survey Area of limited value to bats	
P3	Area 3 in the north of the Bat Habitat Appraisal Survey Area	

P4	Area 4 in the north of the Bat Habitat Appraisal Survey Area	
P5	Area 5 in the north of the Bat Habitat Appraisal Survey Area	
P6	Area 6 in the north of the Bat Habitat Appraisal Survey Area	

P7	Area 7 south of the ranges.	
P8	Area 8 to the south of the ranges.	
P9	Area 9 to the south of the ranges.	

P10	Area 10 on the west of the Bat Habitat Appraisal Survey Area.	
P11	Area 11, high quality habitat for roosting, foraging and commuting bats	
P12	Area 12 in the south of the Bat Habitat Appraisal Survey Area	

P13	Area 13 in the south of the Bat Habitat Appraisal Survey Area	
P14	Area 14 on the southern boundary of the Bat Habitat Appraisal Survey Area .	
P15	H5 supporting some mature tree specimens capable of supporting roosting bats.	

P16	H13 in the south of the Bat Habitat Appraisal Survey Area providing a good quality roosting and foraging resource.	
P17	T5 in Area 11 offering numerous crevices for roosting bats	
P18	T7 within Area 13 offering roosting opportunities to bats (woodpecker holes).	

P19	Pond within the south of Area 11 offering good foraging opportunities to bats.	
P20	Pillbox on the eastern boundary of the Bat Habitat Appraisal Survey Area .	

I.6 Advanced Survey Techniques: Bat Trapping and Tracking

Trapping Survey

I.6.1 Three bat trapping survey sessions were undertaken in the forest/treeline areas of Birch Brook (**Figure 20** and **Table 21** below) during June, August and September 2019. Two trapping teams undertook a total of nine trap night surveys (18 trap nights) using harp traps and mist nets.

I.6.2 A total of 234 bats of seven different species were captured during the 18 trapping surveys. Detailed trapping data is presented in **Table 25** below, with a summary of tagged bats provided in **Table 22**. **Chart 1** provides the species proportions of captures during the nine trapping nights using mist nets and harp traps. The majority of captures were of soprano pipistrelle (44%) followed by Daubenton's (18%). Other species captured includes noctule, Natterer's, brown long-eared and common pipistrelle. Barbastelle bat made up 1% of the total captures and included three individuals including a juvenile bat captured in August, and a juvenile and female adult captured in September.

I.6.3 The primary role of the trapping surveys was to capture barbastelle bats for subsequent radio tracking. However, the capture data is able to provide some important data on the use of the area by other bat species.

I.6.4 Although statistical comparisons are not possible due to differing trapping sites being used on each survey (within the same trapping site), the bat trapping data does provide qualitative species assemblage and temporal information. For instance, capture rates varied through the

summer/autumn with both Daubenton's bat and soprano pipistrelle being captured in greater numbers during August compared to June and September. Common pipistrelle was captured in proportionately high numbers in June and August with low numbers in September. A high proportion of juveniles were amongst the captures of these species indicating the possible proximity of breeding roosts to these trapping areas. Only two Natterer's bats were captured in June and August, with 15 individuals being captured in September, and similar capture rate pattern over the summer/autumn was evident for brown long-earted bat, suggesting a greater role for these species during the mating period. Noctule bats were only captured in August.

Chart 1: Species proportions of captured bats during 2019 advanced bat surveys.

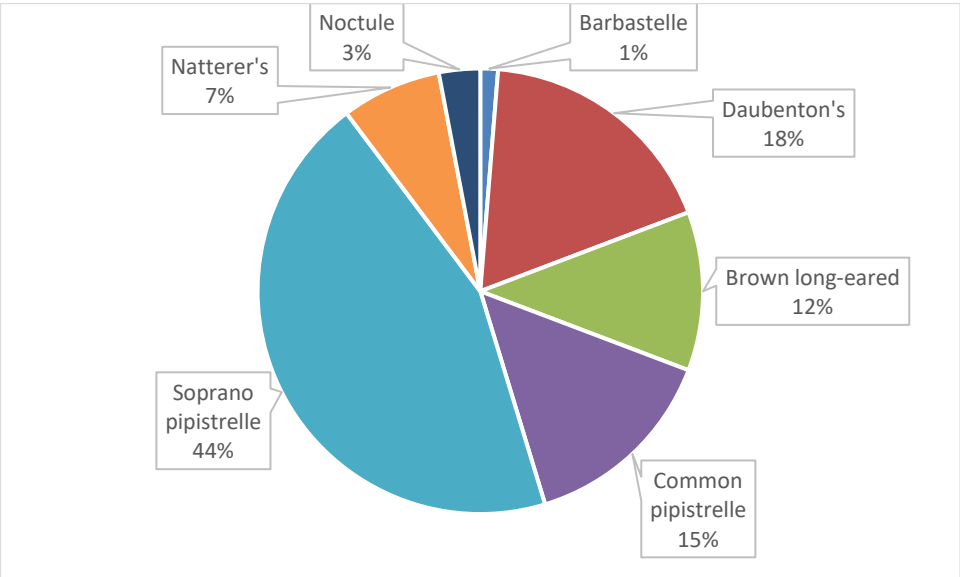


Table 21: Summary of bats captured by location and date during advanced bat surveys

Trapping Area (reference to **Figure 21**)	Trapping Night	Bats Trapped
1	16/06/2019 12/08/2019 15/09/2019	50 bats of six species; common pipistrelle, soprano pipistrelle, brown long-eared, noctule, Daubenton's and Natterer's.
2	17/06/2019 18/06/2019 11/08/2019 13/08/2019 16/09/2019	25 bats of six species; common pipistrelle, soprano pipistrelle, barbastelle, noctule, Daubenton's and Natterer's.
3	17/06/2019 18/06/2019	59 bats of six species; common pipistrelle, soprano pipistrelle, brown long-eared, noctule, Daubenton's and Natterer's.

Trapping Area (reference to Figure 21)	Trapping Night	Bats Trapped
	13/08/2019 16/09/2019	
4	13/08/2019 17/09/2019	100 bats of seven species; common pipistrelle, soprano pipistrelle, brown long-eared, barbastelle, noctule, Daubenton's and Natterer's.

Radio Tracking Surveys

Table 22: Summary details of tagged bats (n=6) 2019 during advanced bat surveys

Bat ID	Capture Area	Date captured	Species	Sex	Age Class	Breeding status
237065*	3	17/06/2019	Daubenton's	Female	Adult	Pregnant
238318*	3	17/06/2019	Natterer's	Male	Adult	
240327	2	11/08/2019	Barbastelle	Male	Juvenile	
240267*	1	15/09/2019	Natterer's	Male	Adult	
239875	4	17/09/2019	Barbastelle	Female	Adult	Nulliparous
239853	4	17/09/2019	Barbastelle	Male	Juvenile	

*Roost finding priority

I.6.5 A total of six bats were fitted with radio transmitters during the surveys. This included a Daubenton's and Natterer's bat in June, one male juvenile barbastelle in August, and two barbastelle (adult female and male juvenile) and one male natterers' in September 2019.

I.6.6 The Daubenton's and Natterer's bats were primarily tagged to find roost sites, and this was generally undertaken during daylight hours. Although tagged bats of this species were monitored if in the area of the tagged barbastelle bats to ensure tags remained functional. The priority for full night time radio tracking was given to the barbastelle bats to locate roosts, determine home ranges and night flying patterns.

I.6.7 Three barbastelles therefore were subject to full night time radio tracking. Table 23 provides a summary of home range data for each bat and Figure 22 provides the associated spatial information including the location of roost sites, objective core areas (where bats spent the majority of their flying time) and their wider home ranges (all the area the bats sued during the tracking).

I.6.8 The juvenile barbastelle 240327 was captured in the Birch Brook woodland area in August and subsequently tracked to a tree roost site (R4) in the Donyland Woods complex. It was roosting with 17 other bats following a number of emergence surveys. This confirmed the roost as a maternity roost. Its foraging and flying behaviour spanned over 5.3km and with core areas located south of the Donyland Woods complex and it was recorded regularly flying (assumed foraging) along tree lines east of Langenhoe.

I.6.9 The female adult barbastelle 239875 was captured in the Donyland wood complex and subsequently tracked to a tree roost (R5) in the south western part of Donyland Wood. Her ranges spanned approximately 3.7km south east of the Donyland wood complex, with core areas including woodland and treelines to the east and south of Fingringhoe. 239875 was

roosting by herself following the emergence survey undertaken. This bat was captured late in the survey so only a short period of tracking was undertaken.

I.6.10 The male juvenile barbastelle 239853 was also captured in Donyland wood complex and was subsequently tracked to a roost (R6) in a presumed stable block to the north east of Donyland Wood. Core foraging and flying areas spanned approximately 2km and included the Donyland Woods complex and the eastern part of the Birch Brook woodland (**Figure 22**). Emergence surveys on this bat could not be undertaken due to land access restrictions.

Table 23: Summary of home range data for three barbastelle bats radio-tracked in and around Middlewick Ranges.

Bat ID	Sex	Number of Fixes	MCP area (ha)	Objective cores- % of locations used	Total core area(ha)	MCP Range Span (m)
240327	Male (J)	118	819.1	94	67.4	5345.4
239875	Female (A)	44	383.3	93	12.9	3697.8
239853	Male (J)	41	156.0	82	5.9	1980.9

Roost Use

I.6.11 Six roosts were located through the radio tracking of six bats. In June 2019 one male Natterer's bat was tagged (bat 237065) from which two roosts (R1 and R3) were located in close proximity to each other in the Birch Brook wood area.

I.6.12 A breeding female Daubenton's bat was tagged in June 2019 and located in a tree in the eastern part of the Birch Brook woodland. An emergence survey confirmed the presence of 23 bats indicating a maternity roost for this species.

I.6.13 As detailed earlier, the barbastelle bats tagged in August and September used tree roosts in Donyland Wood and one juvenile in September used a stable block.

Table 24: Roost use by radio-tagged bats. Emergence counts given are the highest number of bats recorded exiting the roost at dusk, see **Figure 22** for roost locations.

Roost ID	Location OSGR	Date Found	Roost Type	Roost Feature	Peak Count	Bat (ID) recorded at roost
R1	TM0170521873	18/06/2019	Oak Tree	Scar	1	240318
R2	TM0191321845	18/06/2019	Oak Tree	Woodpecker	23	237065
R3	TM0170321874	18/06/2019	Goat Willow	Woodpecker	2	240318
R4	TM0170821291	13/08/2019	Oak Tree	Loose Bark	17	240327
R5	TM0140620824	17/09/2019	Oak Tree	Loose Bark	1	239875
R6	TM0253022027	18/09/2019	Stable block	Unknown	Unknown	239853

Raw Trapping Data

Table 25: Raw Trapping Data during advanced bat surveys

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
16/06/2019	*Pipistrellus pipistrellus*	M	Adult		TM0061522514	1	
16/06/2019	*Pipistrellus pipistrellus*	M	Adult		TM0061522514	1	
16/06/2019	*Pipistrellus pipistrellus*	M	Adult		TM0061522514	1	
16/06/2019	*Pipistrellus pipistrellus*	M	Adult		TM0067722570	1	
2019-06-16	Pipistrellus pipistrellus	F	Adult	Lactating	TM 00612 22689	1	
2019-06-16	Pipistrellus pipistrellus	M	Adult		TM 00547 22760	1	
2019-06-16	Pipistrellus pipistrellus	M	Adult		TM 00547 22760	1	
2019-06-16	Pipistrellus pipistrellus	M	Adult		TM 00493 22832	1	
2019-06-16	Pipistrellus pipistrellus	M	Adult		TM 00493 22832	1	
16/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0061522514	1	
16/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0066822372	1	
16/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0061522514	1	
16/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0061522514	1	
16/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0067722570	1	
16/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0061522514	1	
2019-06-16	Pipistrellus pygmaeus	F	Adult	Lactating	TM 00493 22832	1	
2019-06-16	Pipistrellus pygmaeus	F	Adult	Lactating	TM 00547 22760	1	
2019-06-16	Pipistrellus pygmaeus	F	Adult	Pregnant	TM 00547 22760	1	
2019-06-16	Pipistrellus pygmaeus	F	Adult	Lactating	TM 00493 22832	1	
16/06/2019	*Plecotus auritus*	F	Adult	Nulliparous	TM0061522514	1	
16/06/2019	*Plecotus auritus*	M	Adult		TM0061522514	1	
11/08/2019	Nyctalus noctula	F	Juvenile		TM0068922274	1	
11/08/2019	Pipistrellus pygmaeus	F	Adult	Nonparous	TM0068922274	1	
11/08/2019	Myotis daubentonii	M	Adult	Testes 0	TM0073822327	1	
12/08/2019	*Myotis daubentonii*	Female	Adult	Nonparous	TM0067122422	1	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
12/08/2019	Myotis nattereri	M	Adult		TM0054822749	1	
12/08/2019	Pipistrellus pipistrellus	F	Adult	Nulliparous / Primiparous	TM0062222688	1	
12/08/2019	Pipistrellus pipistrellus	M	Adult		TM0054822749	1	
12/08/2019	Pipistrellus pipistrellus	M	Juvenile		TM0054822749	1	
12/08/2019	*Pipistrellus pipistrellus*	Male	Adult	Testes 1	TM0061522514	1	
12/08/2019	*Pipistrellus pipistrellus*	Female	Adult	Post-lactating	TM0061522514	1	
12/08/2019	*Pipistrellus pipistrellus*	Female	Adult	Nonparous	TM0061522514	1	
12/08/2019	*Pipistrellus pipistrellus*	Male	Juvenile		TM0061522514	1	
12/08/2019	Pipistrellus pygmaeus	M	Adult		TM0054822749	1	
12/08/2019	*Pipistrellus pygmaeus*	Male	Adult	Testes 2	TM0061522514	1	
12/08/2019	*Pipistrellus pygmaeus*	Male	Adult	Testes 2	TM0067722570	1	
12/08/2019	*Pipistrellus pygmaeus*	Male	Juvenile		TM0061522514	1	
12/08/2019	*Pipistrellus pygmaeus*	Female	Adult	Post-lactating	TM0067122422	1	
12/08/2019	*Pipistrellus pygmaeus*	Male	Adult	Testes 2	TM0067122422	1	
12/08/2019	*Plecotus auritus*	Male	Y.Adult	Testes 0	TM0061522514	1	
12/08/2019	*Plecotus auritus*	Male	Adult	Testes 0	TM0067722570	1	
12/08/2019	*Plecotus auritus*	Male	Juvenile		TM0067722570	1	
15/09/2019	*Myotis nattereri*	M	Adult	Testes 0	TM0074122374	1	240267
15/09/2019	*Myotis nattereri*	M	Adult	Testes 1	TM0074122374	1	
15/09/2019	Pipistrellus pipistrellus	M	Adult		TM0054922751	1	
15/09/2019	Pipistrellus pipistrellus	M	Adult		TM0063122676	1	
15/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0068822423	1	
15/09/2019	*Plecotus auritus*	F	Adult	Post-lactating	TM0062722528	1	
15/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0074122374	1	
15/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0068822423	1	
2019-06-17	Pipistrellus pipistrellus	F	Adult	Lactating	TM 00874 22053	2	
2019-06-17	Pipistrellus pipistrellus	F	Adult	Lactating	TM 00874 22053	2	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
2019-06-17	Pipistrellus pipistrellus	M	Adult		TM 00874 22053	2	
2019-06-17	Pipistrellus pipistrellus	F	Adult	Pregnant	TM 00848 22244	2	
2019-06-17	Pipistrellus pipistrellus	F	Adult	Lactating	TM 00874 22053	2	
2019-06-17	Pipistrellus pipistrellus	M	Adult		TM 00848 22244	2	
2019-06-17	Pipistrellus pygmaeus	F	Adult	Pregnant	TM 00848 22244	2	
2019-06-17	Pipistrellus pygmaeus	M	Adult		TM 01170 22223	2	
2019-06-17	Pipistrellus pygmaeus	F	Adult	Pregnant	TM 00848 22244	2	
2019-06-17	Pipistrellus pygmaeus	M	Adult		TM 01170 22223	2	
2019-06-17	Pipistrellus pygmaeus	F	Adult	Lactating	TM 00874 22053	2	
2019-06-17	Pipistrellus pygmaeus	M	Adult		TM 00874 22053	2	
2019-06-18	Pipistrellus pygmaeus	M	Adult		TM 00911 21998	2	
11/08/2019	Barbastella barbastellus	M	Juvenile		TM0083822132	2	240327
11/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0089922075	2	
11/08/2019	Nyctalus noctula	M	Adult		TM0083822132	2	
11/08/2019	Pipistrellus pipistrellus	M	Adult		TM0089922075	2	
11/08/2019	Pipistrellus pipistrellus	M	Adult		TM0089922075	2	
11/08/2019	Pipistrellus pipistrellus	M	Juvenile		TM0089922075	2	
11/08/2019	Pipistrellus pipistrellus	M	Juvenile		TM0089922075	2	
11/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0089922075	2	
13/08/2019	*Pipistrellus pygmaeus*	Female	Adult	Post-lactating	TM0188321881	2	
16/09/2019	Myotis nattereri	M	Adult		TM0082722123	2	
16/09/2019	Myotis nattereri	M	Adult		TM0082722123	2	
16/09/2019	Myotis nattereri	F	Adult	Nulliparous / primiparous	TM0081422204	2	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	237065
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0188321881	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0181021943	3	
17/06/2019	*Myotis daubentonii*	F	Adult	Pregnant	TM0181021943	3	
17/06/2019	*Myotis nattereri*	M	Adult		TM0181021943	3	238318
17/06/2019	*Pipistrellus pipistrellus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Pipistrellus pipistrellus*	M	Adult		TM0155822096	3	
17/06/2019	*Pipistrellus pipistrellus*	F	Adult	Pregnant	TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Pipistrellus pygmaeus*	F	Adult	Lactating	TM0155822096	3	
17/06/2019	*Plecotus auritus*	M	Adult		TM0155822096	3	
17/06/2019	*Plecotus auritus*	F	Adult	Pregnant	TM0188321881	3	
18/06/2019	*Pipistrellus pygmaeus*	M	Adult		TM0170021807	3	
13/08/2019	*Myotis daubentonii*	Male	Juvenile		TM0188321881	3	
13/08/2019	*Myotis daubentonii*	Female	Juvenile		TM0188321881	3	
13/08/2019	*Myotis daubentonii*	Female	Y.Adult	Nonparous	TM0155822096	3	
13/08/2019	*Myotis daubentonii*	Female	Juvenile		TM0181021943	3	
13/08/2019	*Myotis daubentonii*	Female	Adult	Nonparous	TM0155822096	3	
13/08/2019	*Myotis daubentonii*	Male	Juvenile		TM0155822096	3	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
13/08/2019	*Nyctalus noctula*	Female	Juvenile		TM0155822096	3	
13/08/2019	*Nyctalus noctula*	Female	Juvenile		TM0155822096	3	
13/08/2019	*Nyctalus noctula*	Female	Juvenile		TM0155822096	3	
13/08/2019	*Pipistrellus pygmaeus*	Female	Juvenile		TM0188321881	3	
13/08/2019	*Pipistrellus pygmaeus*	Female	Adult	Nonparous	TM0188321881	3	
13/08/2019	*Pipistrellus pygmaeus*	Male	Adult	Testes 0	TM0188321881	3	
13/08/2019	*Pipistrellus pygmaeus*	Male	Y.Adult	Testes 0	TM0181021943	3	
13/08/2019	*Pipistrellus pygmaeus*	Female	Adult	Post-lactating	TM0155822096	3	
13/08/2019	*Pipistrellus pygmaeus*	Female	Juvenile		TM0155822096	3	
16/09/2019	*Myotis daubentonii*	F	Adult	Non-parous	TM0188321881	3	
16/09/2019	*Myotis daubentonii*	F	Juvenile		TM0188321881	3	
16/09/2019	*Myotis daubentonii*	F	Juvenile		TM0188321881	3	
16/09/2019	*Myotis nattereri*	M	Juvenile		TM0185021841	3	
16/09/2019	*Myotis nattereri*	F	Adult	Postlactating	TM0188321881	3	
16/09/2019	*Myotis nattereri*	F	Juvenile		TM0185021841	3	
16/09/2019	*Myotis nattereri*	F	Adult	Postlactating	TM0185021841	3	
16/09/2019	*Myotis nattereri*	M	Adult	Testes 1	TM0185021841	3	
16/09/2019	*Myotis nattereri*	M	Juvenile		TM0185021841	3	
16/09/2019	*Pipistrellus pygmaeus*	M	Juvenile		TM0188321881	3	
16/09/2019	*Plecotus auritus*	F	Adult	Postlactating	TM0185021841	3	
16/09/2019	*Plecotus auritus*	M	Adult	Testes 1	TM0188321881	3	
16/09/2019	*Plecotus auritus*	M	Juvenile		TM0185021841	3	
16/09/2019	*Plecotus auritus*	F	Juvenile		TM0155822096	3	
16/09/2019	*Plecotus auritus*	M	Juvenile		TM0155822096	3	
16/09/2019	*Plecotus auritus*	F	Juvenile		TM0155822096	3	
16/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0185021841	3	
16/09/2019	*Plecotus auritus*	M	Juvenile		TM0155822096	3	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
16/09/2019	*Plecotus auritus*	F	Juvenile		TM0155822096	3	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Myotis daubentonii	F	Adult	Nulliparous / Primiparous	TM0187221220	4	
13/08/2019	Myotis daubentonii	M	Adult		TM0178521263	4	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Myotis daubentonii	F	Juvenile	Nulliparous / Primiparous	TM0184321373	4	
13/08/2019	Myotis daubentonii	F	Juvenile	Nulliparous	TM0184321373	4	
13/08/2019	Myotis daubentonii	M	Juvenile		TM0178521263	4	
13/08/2019	Myotis daubentonii	M	Adult		TM0176521218	4	
13/08/2019	Myotis daubentonii	M	Adult		TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Juvenile		TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Juvenile		TM0176521218	4	
13/08/2019	Myotis daubentonii	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Nyctalus noctula	M	Juvenile		TM0176521218	4	
13/08/2019	Nyctalus noctula	F	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pipistrellus	F	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile	Primiparous	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0178521263	4	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0187221220	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Nulliparous / Primiparous	TM0187221220	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0187221220	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Nulliparous / Primiparous	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Nulliparous / Primiparous	TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile	Nulliparous	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0178521263	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult	Post lactating	TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Adult		TM0176521218	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	F	Juvenile		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	M	Adult		TM0184321373	4	
13/08/2019	Pipistrellus pygmaeus	M	Juvenile		TM0178521263	4	
13/08/2019	Plecotus auritus	M	Adult		TM0187221220	4	
17/09/2019	*Barbastella barbastellus*	M	Juvenile		TM0199721381	4	239853
17/09/2019	*Barbastella barbastellus*	F	Adult	Nonparous	TM0200921296	4	239875
17/09/2019	*Myotis daubentonii*	F	Adult	Post-lactating	TM0200921296	4	
17/09/2019	Myotis daubentonii	F	Adult	Post lactating	TM0177721234	4	
17/09/2019	Myotis daubentonii	M	Adult		TM0177721234	4	
17/09/2019	Myotis daubentonii	F	Adult	Post lactating	TM0177721234	4	
17/09/2019	*Myotis nattereri*	F	Adult	Nonparous	TM0199721381	4	

Date (at start)	Species	Sex	Age (class)	Breeding status	Trap location	Trap area	BatID
17/09/2019	*Myotis nattereri*	F	Adult	Post-lactating	TM0192221220	4	
17/09/2019	*Myotis nattereri*	F	Adult	Nonparous	TM0192221220	4	
17/09/2019	Myotis nattereri	M	Adult		TM0183821370	4	
17/09/2019	*Pipistrellus pipistrellus*	M	Adult	Testes 0	TM0192221220	4	
17/09/2019	Pipistrellus pipistrellus	M	Adult		TM0177721234	4	
17/09/2019	*Pipistrellus pygmaeus*	M	Adult	Testes 0	TM0200921296	4	
17/09/2019	*Pipistrellus pygmaeus*	M	Adult	Testes 1	TM0192221220	4	
17/09/2019	*Pipistrellus pygmaeus*	M	Juvenile		TM0192221220	4	
17/09/2019	*Pipistrellus pygmaeus*	M	Juvenile		TM0199721381	4	
17/09/2019	*Pipistrellus pygmaeus*	M	Adult	Testes 1	TM0200921296	4	
17/09/2019	Pipistrellus pygmaeus	M	Adult		TM0177721234	4	
17/09/2019	Pipistrellus pygmaeus	M	Adult		TM0177721234	4	
17/09/2019	Pipistrellus pygmaeus	M	Adult		TM0177721234	4	
17/09/2019	Pipistrellus pygmaeus	M	Adult		TM0175521357	4	
17/09/2019	*Plecotus auritus*	F	Adult	Nonparous	TM0199721381	4	
17/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0192221220	4	
17/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0192221220	4	
17/09/2019	*Plecotus auritus*	M	Adult	Testes 1	TM0192221220	4	
17/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0199721381	4	
17/09/2019	*Plecotus auritus*	M	Adult	Testes 0	TM0192221220	4	

Appendix J Other Legally Protected Species

J.1 Reptiles

J.1.1 A total of 39 reptile records, comprising two records of slow worm *Anguis fragilis*, a single record of grass snake and the remainder of common lizard were returned by the EWT data search. The majority of lizard records were obtained from Lower Lodge Farm, which lies c. 1.65 km to the east of the Allocation Boundary, beyond the River Colne, during 2007 and 2008. Two lizard and two slow worm records were obtained at a property in Colchester in 2013, c.150 m east of the Allocation Boundary. One lizard record and the grass snake record were obtained at the University of Essex Meadows in 2015 (c.1.38 km north-east of the Allocation Boundary, beyond the River Colne).

J.1.2 There is high habitat suitability for all four common reptile species (common lizard, slow worm, grass snake and adder *Vipera berus*) to be present within suitable habitats in the Allocation Boundary and in the Mitigation Land beyond. Indeed, incidental sightings of grass snake and adder were reported by users of the Allocation Boundary. Diverse habitats in these areas provide varied shelter and foraging opportunities for reptiles provided by the scrub, short acid grassland, bare sandy ground and woodland areas.

J.1.3 Reptiles are legally protected from intentional killing and injury under the under the Wildlife and Countryside Act 1981 (as amended); reptiles are also an SPI under the NERC Act 2006.

J.2 Great Crested Newts

J.2.1 Two granted Natural England EPSLs in relation to great crested newt were identified within 2 km of the Allocation Boundary from a review of the MAGIC website. These were both granted for the damage and/or destruction of ponds to the south of Donyland House, approximately 300m to the south-east of the Mitigation Land (c. 1.4km south of the Allocation Boundary). A single great crested newt record was returned by the EWT data search. This was obtained in 2010 from a location at the Anglian Water Treatment Works, approximately 0.52km east of the Allocation Boundary.

J.2.2 The single pond that held water within the Birch Brook woodland corridor (Target Note 30 on **Figure 7a**) and supported marginal vegetation, provides suitable aquatic breeding habitat for great crested newt. The two remaining ponds that were likely to remain dry throughout the year provide limited opportunities for great crested newts and thus provide sub optimal breeding habitat for this species. Suitable habitat for great crested newts during their terrestrial phase is present throughout the Allocation Boundary and Mitigation Land, comprising areas of grassland, scrub and woodland.

J.2.3 Great crested newts are an EPS, and both individuals and their habitat are legally protected under the Conservation of Habitats and Species Regulations 2017 (as amended) and the Wildlife and Countryside Act 1981 (as amended). Great crested newts are also an SPI under the NERC Act 2006 and an Essex priority species.

J.3 Badgers

J.3.1 A total of 13 badger records were returned by EWT as part of the data search. These largely relate to the same location at Bourne Court, Colchester (c. 0.57 km north of the Allocation Boundary). At this location, active and inactive holes belonging to at least one badger sett were recorded alongside badger latrines during 2015 and 2016.

J.3.2 The woodland, hedgerows and scrub areas within the Allocation Boundary and the Mitigation Land provide suitable opportunities for badgers for sett building. On-site grassland, hedgerows, scrub and woodland offer suitable habitat for foraging and commuting badger. Badger activity was recorded within the Allocation Boundary during the extended Phase 1 habitat survey in the form of badger hair recorded from a man-made tunnel passing under the rifle range fence (Target Note 14 on **Figure 7a**) and a badger outlier sett recorded in the woodland to the west of the rifle ranges in 2017 (Target Note 29 on **Figure 7a**), with a further outlier sett recorded in 2020 (Target Note 39 on **Figure 7a**). Note this is unlikely to be an exhaustive list of badger setts as a badger survey has not been completed, given the legal protection afforded to badgers relates to their welfare only, and as such is not a consideration for allocation.

J.3.3 Badgers (and their setts) are protected under the Protection of Badgers Act 1992. All mammals receive limited protection in relation to the welfare of individual animals under the Wild Mammals (Protection) Act, 1996 (as amended).

Appendix K Non-Key Ecological Considerations

K.1.1 This section provides a summary of the non-key ecological considerations; i.e. those which may require consideration for a planning application (due to their ecological value, legal protection and/ or policy requirements), however are not a key consideration for the purposes of determining whether the allocation can be delivered in an ecologically viable manner (refer to **Section 1.6** for a distinction between ecological survey and assessment requirements for allocation vs planning application).

K.1.2 These non-key considerations are acknowledged as being relevant to planning including EcIA. Note, that 'key' considerations relate only to defining a viable developable area and masterplan for the purposes of allocation. This should not be considered a proxy or synonymous with 'important' ecological receptors as part of any future EcIA. An ecological feature can be both 'important' in EcIA terms (for the purposes of impact assessment work at a planning application) but not 'key' to defining the viable developable area for allocation.

K.1.3 An understanding of the location, designation criteria, habitat requirements, likely distribution (UK and within the Allocation Boundary/Mitigation Land) and nature conservation importance of the varying non-key ecological considerations, mitigation will focus on legal and policy compliance. Such measures will not affect the overall developable area (i.e. this can be achieved through detailed design) or deliverability of the scheme.

K.1.4 The following are the non-key ecological considerations pertinent to the future stages of planning development at Middlewick Ranges (in relation to both the process and the procedure):

- UK Statutory Designated Sites (except Roman River SSSI);
- Non-Statutory Designated Sites (all remaining sites);
- Hedgerows;
- Other Habitats;
- Dormouse;
- Riparian Mammals;
- Aquatic Invertebrates;
- Wintering Birds;
- Amphibians;
- Reptiles; and
- Badger.

Appendix L Considerations for Acid Grassland Creation

L.1 Summary of Literature Review

L.1.1 The table below provides a summary of the documents reviewed when considering the preparation of the acid grassland creation strategy.

Table 26: Key Findings from Document Review

Type of Reference	Author / Date	Title	Links	Key Points / Notes Relevant to Middlewick
Acid Grassland Creation				
Paper	Owen and Marrs (2000)	Acidifying arable soils for the restoration of acid grasslands	N/A	Relates to Minsmere. Arable land purchased to create heathland and acid grassland. Three constraints identified – depauperate seed bank, high pH, vigorous ruderal growth. Experiments to assess 1) adding seed typical of acid grassland, 2) adding amendments (elemental sulphur, litter of Pteridium aquilinum and pine chippings) to acidify the soil. The results confirmed that ruderal growth was high on unamended plots, but this could be reduced by addition of acidic amendments. Where the cover of ruderals was reduced, the cover of the sown species increased. The sown species colonized adjacent unsown subplots naturally and this was most pronounced where the acidity had been reduced by treatment. The most effective treatment was 2 t S/ha, which gave the optimal reduction in soil pH, controlled ruderal growth and provided a reasonable cover of the sown species. The addition of Pteridium litter or pine chippings gave good establishment of sown species, but control of the ruderals was less effective. Details of varied sulphur rates (0, 1, 2, 4, 8. 10 and 12 tS/ha). Soil amendment powder form. Rotavated to 5-10cm depth. Plant materials – Pteridium litter and pine chippings. Stored for c. 3 months pre chipping, and applied after a further month. 0, 2, 4 and 10cm depths. Species mix seeded was U1 representative. Issues noted included spatial heterogeneity in volume of sulphur needed to reduce pH, and impacts of acification through depth profile, localised waterlogging, rabbit grazing. Seed established well between 1 and 2 tS/ha, but ruderals decreased at 2tS/ha. Where 8tS/ha applied, conditions too severe for arable weeds or sown species (in the most part). → 2tS/ha most appropriate rate of application for balance acid grassland community. Variable response to plant material approach – makes generalised conclusions hard. Acid grasslands are plagioclimax communities (need management) – this was not tested here.
Paper	Marris, Snow, Owen and Evans (1998)	Heathland and acid grassland creation on arable soils at Minsmere: identification of potential problems and a test of cropping	Hyperlink	158ha arable land to heathland and acid. Three soil factors were identified as potential constraints; the arable soils had a much greater soil pH and higher concentrations of exchangeable calcium and extractable phosphorus than heathland soils, almost certainly from previous lime and fertilizer additions. In the initial stages the RSPB project followed the prescription adopted by MAFF for the re-establishment of heathland on arable soils within the Breckland Environmentally Sensitive Area. This involved an arable cropping regime designed to reduce 'soil fertility'.

Type of Reference	Author / Date	Title	Links	Key Points / Notes Relevant to Middlewick
		to impoverish soils		The cropping removed more nutrients from the system than measured inputs, but there have been no appreciable reductions in soil pH or available nutrients. There was a slight indication that the exchangeable calcium concentrations may be declining after seven years, but no reduction in soil pH was found. Accordingly, cropping must be viewed as a medium to long-term option (> 7 years) for impoverishing the arable soils at Minsmere.
Paper	Ausden and Kemp (2005)	Creating acid grassland by adding sulphur and re-seeding at Minsmere RSPB Reserve, Suffolk, England	Hyperlink	**Summary**: Former arable land at Minsmere RSPB Reserve, eastern England, was treated with sulphur, herbicide was applied to control weeds, and seeds were sown in an attempt to create acid grassland. Soil pH was reduced and acid grassland target species dominated the vegetation three years after seeding. Ploughed to 15cm (April 96) Power harrowed (October 96) Addition of elemental sulphur at 2.58 tonnes / ha. Spray (glyphosate and MCPA) (September 99 and August 2000) Sown 20kg/ha in September 2000 (acid grassland mix) Random sampling for soil and vegetation monitoring, alongside acid grassland control site monitoring. Sulphur and bracken litter reduced pH from 7 → 4.5 between 1996 and 2000. **(NOTE whilst consequences of this paper refers to bracken addition, it is suspected that this is incorrect as it was not mentioned in methods (and use of bracken is subject of a separate paper)).** Species richness highest after a reseed in 2000 (due to dominance of non target species).
Paper	Ausden (2005)	Using sulphur and iron oxide to aid creation of acid grassland at Minsmere RSPB Reserve, Suffolk, England	Hyperlink	**Summary**: Nine samples of soil were taken from former arable land at Minsmere RSPB Reserve, eastern England. Sulphuric acid and iron was added. The pH of the soil was reduced, but the iron addition did not appear to have an affect on reducing the quantity of extractable phosphorus. Addition of the sulphuric acid reduced the pH of the soil from 5.3 to 3.8 and increased the quantity of extractable phosphorus from 30 mg/l to approximately 40 mg/l. There was no evidence from these initial tests, that addition of different quantities of iron II oxide or iron III oxide had any substantive effect of reducing the quantity of extractable phosphorus. No further work was undertaken involving the addition of iron oxide.
Paper	Ausden and Kemp (2005)	Creating acid grassland by adding sulphur, bracken Pteridium litter and heather Calluna cuttings at Minsmere RSPB Reserve, Suffolk, England.	Hyperlink	**Summary**: An attempt was made to convert a former arable field to acid grassland. Elemental sulphur, bracken Pteridium aquilinum litter and heather Calluna vulgaris clippings were added and the area grazed with sheep. Over seven years the target acid grassland species cover increased considerably to 60.7%. Adjacent existing acid grassland had 85.6% cover of these species April 96 - herbicide treatment, ploughed to 15cm, and pressed with roller. 2.5cm of bracken litter, and 3.38 tonnes / ha of sulphur applied. 5-10 trailers of heather clippings and litter spread April 98 and May 99. Random sampling for soil and vegetation monitoring, alongside acid grassland control site monitoring. Addition of the sulphur and bracken litter significantly reduced the pH of the upper 15 cm of soil.

Type of Reference	Author / Date	Title	Links	Key Points / Notes Relevant to Middlewick
Paper	Ausden and Kemp (2005)	Creating acid grassland by sheep grazing and natural reversion at Minsmere RSPB Reserve, Suffolk, England.	Hyperlink	**Summary**: On former arable land at Minsmere RSPB Reserve, eastern England, sheep grazing was introduced with the objective of creating acid grassland. Seven years after the introduction of a grazing regime, the fields had lower cover and species-richness than the existing adjacent acid grassland. Year round sheep grazing, sheep, since 1999. 1.3-1.6 sheep/ha. Ragwort control meant weed wipe or mowing required in some locations. Random sampling for soil and vegetation monitoring, alongside acid grassland control site monitoring. Both the natural reversion fields still had a significantly lower cover and species-richness of target acid grassland plant species compared to the existing acid grassland in 2003.
Blog	Gill German (Undated)	Creation and Management of Lowland Dry Acid Grassland	Hyperlink	Organic matter may be required to improve water-holding capacity and nitrogen, phosphorous and potassium levels should be optimised, however creating habitat within local landscape characteristics is more sustainable. There are 4 options for establishment: • Natural colonisation – the simplest and most successful method of creating natural habitats appropriate to local conditions but a slow process with areas of bare ground remaining and prone to invasive species • Turf inoculants from local donor sites following sowing of a nurse grass to stabilise the substrate. • Green-hay strewing of local lowland acid grassland, removing hay from the receptor site after a few weeks, once seed has dropped. • Seeding with seed collected from local acid grassland using a brush harvester or bought from a reputable seed house and of local provenance. Management important (grazing preferred vs cutting).
Best Practice	Hicks and Doick (2014) Forest Research	Best Practice Guidance Note for Land Regeneration No. 16: Lowland Acid Grassland – Creation and Management in Land Regeneration	Hyperlink	Table 3 - Characteristics of soil suitable for acid grassland establishment

Type of Reference	Author / Date	Title	Links	Key Points / Notes Relevant to Middlewick
				 **Parameter** / **Level** Topsoil depth: 150–250 mm Drainage: Moderate to Rapid pH: Strongly acid to acid (pH 4.0–5.5) Available phosphorus[a]: 25 mg l^{-1} (7–14 mg l^{-1}) Organic matter[b]: 3% (3–9%) Total nitrogen[b]: 0.15% (0.12–0.4%) [a] Acceptable upper limit. A level of available phosphorus of less than 10 mg kg^{-1} is ideal to maximise floristic diversity within unimproved, semi-natural grassland communities (Marrs and Gough, 1989). While values of 11 to 25 mg kg^{-1} have potential, expect reduced floral diversity and increased risk of competition from rank and pioneer species. [b] Acceptable lower limit. While values for upper limits are not available the values in parentheses serve as a useful guide. Values in parentheses are primary data collected from example sites – Devils Punch Bowl, Surrey (SSSI), and Black Heath, London Borough of Greenwich (Site of Metropolitan Importance). Table 3 and photo kindly provided by Tim O'Hare Associates, Oxfordshire. Four methods - dependent upon substrate, time, site proximity to grassland area: -Natural colonisation -Turf inoculants -Green Hay strewing -Seeding Management - cutting vs grazing. Evaluation of management required. Factors should include ground cover, bald patches, leaf little, grass to her ratio, positive indicator species, negative indicator species, species with local distinctiveness.
2015 National Heathland Conference Talk	J Davis, P Putwain, S Lewis (2015)	"Robust" interventions: The re- creation of dry heathland and habitat for a nationally threatened butterfly at Prees Heath	-	Butterfly Conservation purchased part of the Prees Heath Common in Shropshire to safeguard a silver-studded blue (butterfly) population and to undertake a re-creation of lowland heathland in an attempt to ensure its persistence. Through major interventions to the soil profile and chemistry heathland vegetation has been established on sandy soil enriched by previous arable cultivations and associated uses. After 8 years the aim of greatly increasing the area of suitable habitat by creating dry dwarf shrub heathland and acid grassland mosaic communities is progressing well. The techniques used involved soil profile inversion through deep-ploughing, chemical acidification, and sowing by spreading recently harvested heather brash. Control of invasive plants such as Creeping Thistle

Type of Reference	Author / Date	Title	Links	Key Points / Notes Relevant to Middlewick
		Common Reserve, Shropshire		(Cirsium arvense), Common Ragwort (Senecio jacobaea), Rosebay Willowherb (Epilobium angustifolium) and Silver Birch (Betula pendula) has been essential. Full soil profile (2006) and analysis informed deep plough approach, alongside acidification, and application of seed from heather brash. Deep plough was completed (2007) to 900mm. Surface rolled and glyphosate sprayed. The aim of the deep plough was to invert the profile (i.e. bring sands to surface, and bury nutrient rich topsoil. In practice, the inversion profile was not uniform, and it did not lower pH to levels conducive to heather establishment. Elemental sulhphur was used, as per at Minsmere. 1.25t/ha of pelletised sulphur applied. Surface disturbed by harrow to facilitate prill uptake. pH sampling completed 2007 – 2014. Further acidification using heather brash (ripe seed capsules) was completed (100 tonnes of brash over 6.47ha). Soil pH declined progressively from the initial pre-ploughing value (7.0) to the typical pH range for heathland by June 2008, a period of 20 months. After this time pH fluctuated within a narrow range (3.4–4.1) from October 2008 to June 2014. Soil pH tends to fluctuate seasonally and these fluctuations probably reflected the seasonal variation. The effect of sulphur treatment in Hangars Field measured over a period of 3 years from August 2007 to August 2010 was to reduce soil pH by more than two units. This brought soil acidity close to the typical range of values found in many lowland heath soils in the UK (Owen & Marrs, 2000). Variation in pH indicates patchiness in acidity increase. Changes in extractable soil phosphorus, calcium (mg l-1) and ammonium nitrogen (mg kg-1) plus soil organic matter content for the Hangars Field were monitored following the deep plough (which had a strong effect on key chemicals and organic matter). - Sulphur prill was successful at increasing acidity within just over a year. - The acidification of the exposed sandy surface by natural leaching observed over the first 20 months suggests that this process could also be used to achieve this modification. However the exposed raw sand surface is very prone to wind-blow and invasion by ruderal species if left un-vegetated. - The scattered heather brash leaves woody remains on the surface for a number of years and this material can help attenuate wind-blow problems and is considered to have helped the heather seedling establishment by providing shelter and possibly some protection from rabbit browsing
Background	Hertfordshire Environmental Forum	Hertfordshire BAP	Hyperlink	Note this is a Herfordshire document. Management of acid grassland - grazing.
N.B. Notes on horticultural application of elemental sulphur not included here, as documents and reference material was drawn on to support base understanding of some soil chemistry elements described in the above papers.				

L.2 Soil Sampling Results

Introduction

L.2.1 Geoenvironmental soil testing was undertaken by Chemtest Ltd under instruction of Stantec on the thirteen composite soil samples.

L.2.2 The full laboratory testing results and soil classification documentation can be found below.

Laboratory Testing Results

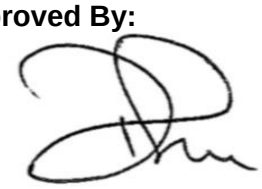
L.2.3 A summary table of the laboratory results can be found on the following page of this report (**Table 26**) with the same data included in **Table 27**, with additional interpretation comments with respect to the suitability of the fields for acid grassland creation.

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Amended Report

Report No.:	20-03017-3		
Initial Date of Issue:	07-Feb-2020	**Date of Re-Issue:**	17-Feb-2020
Client	Stantec UK Limited		
Client Address:	3rd Floor 50-60 Station Road Cambridge Cambridgeshire CB1 2JH		
Contact(s):	Chris Radbone Oliver Belson		
Project	40472 Middlewick Range		
Quotation No.:	Q19-18979	**Date Received:**	29-Jan-2020
Order No.:	31729	**Date Instructed:**	30-Jan-2020
No. of Samples:	13		
Turnaround (Wkdays):	10	**Results Due:**	12-Feb-2020
Date Approved:	05-Feb-2020		

Approved By:



Details: Darrell Hall, Director

Results - Soil

Project: 40472 Middlewick Range

Client: Stantec UK Limited		**Chemtest Job No.:**			20-03017	20-03017	20-03017	20-03017	20-03017	20-03017	20-03017	20-03017	20-03017
Quotation No.: Q19-18979		**Chemtest Sample ID.:**			961758	961759	961760	961761	961762	961763	961764	961765	961766
		Client Sample ID.:			1	1	1	1	1	1	1	1	1
		Sample Location:			FIELD 19	FIELD 20	FIELD 20A	FIELD 21	FIELD 22	FIELD 1	FIELD 3	FIELD 4	FIELD 7
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Date Sampled:			27-Jan-2020	27-Jan-2020	27-Jan-2020	27-Jan-2020	27-Jan-2020	28-Jan-2020	28-Jan-2020	28-Jan-2020	28-Jan-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Moisture	N	2030	%	0.020	21	16	18	17	18	16	18	18	16
Natural Moisture Content	N	2030	%	0.020	26	20	23	20	23	19	22	23	19
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Loam	Loam	Loam	Loam	Loam	Sand	Loam	Loam	Loam
pH	M	2010		4.0	5.8	6.5	7.1	6.8	6.9	6.9	6.9	6.8	6.8
Nitrogen (Total)	N	2115	%	0.010	0.27	0.29	0.26	0.27	0.31	0.27	0.27	0.27	0.23
Potassium (Extractable)	N	2400	mg/l	2.0	60	49	70	85	85	65	60	55	50
Magnesium (Extractable)	N	2400	mg/l	2.0	95	47	60	60	75	40	38	40	33
Phosphorus (Extractable)	N	2420	mg/l	0.50	7.2	3.7	7.2	7.2	11	10	7.8	7.8	7.2
Organic Matter BS1377	N	2930	%	0.10	4.1	2.9	3.4	3.6	3.8	3.3	3.5	3.2	2.7

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 40472 Middlewick Range

Client: Stantec UK Limited		**Chemtest Job No.:**			20-03017	20-03017	20-03017	20-03017
Quotation No.: Q19-18979		**Chemtest Sample ID.:**			961767	961768	961769	961770
		Client Sample ID.:			1	1	1	1
		Sample Location:			FIELD 11	FIELD 12	FIELD 14	FIELD 17
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Date Sampled:			29-Jan-2020	29-Jan-2020	29-Jan-2020	29-Jan-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Moisture	N	2030	%	0.020	17	19	16	15
Natural Moisture Content	N	2030	%	0.020	21	23	19	17
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Loam	Sand	Sand
pH	M	2010		4.0	7.3	6.9	6.7	6.7
Nitrogen (Total)	N	2115	%	0.010	0.28	0.28	0.26	0.27
Potassium (Extractable)	N	2400	mg/l	2.0	55	70	55	55
Magnesium (Extractable)	N	2400	mg/l	2.0	25	41	45	44
Phosphorus (Extractable)	N	2420	mg/l	0.50	7.2	6.5	6.0	11
Organic Matter BS1377	N	2930	%	0.10	2.9	3.5	3.2	3.1

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961758
Client Sample Ref.:
Sample Location: FIELD 19
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 27-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				9.7				
Silt content	%				19				
Sand content	%				71				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961759
Client Sample Ref.:
Sample Location: FIELD 20
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 27-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				11				
Silt content	%				24				
Sand content	%				65				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961760
Client Sample Ref.:
Sample Location: FIELD 20A
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 27-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				13				
Silt content	%				32				
Sand content	%				55				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961761
Client Sample Ref.:
Sample Location: FIELD 21
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 27-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				9.7				
Silt content	%				27				
Sand content	%				63				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961762
Client Sample Ref.:
Sample Location: FIELD 22
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 27-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				11				
Silt content	%				31				
Sand content	%				58				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961763
Client Sample Ref.:
Sample Location: FIELD 1
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 28-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				9.7				
Silt content	%				27				
Sand content	%				63				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961764
Client Sample Ref.:
Sample Location: FIELD 3
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 28-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				13				
Silt content	%				34				
Sand content	%				53				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961765
Client Sample Ref.:
Sample Location: FIELD 4
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 28-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				11				
Silt content	%				31				
Sand content	%				58				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961766
Client Sample Ref.:
Sample Location: FIELD 7
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 28-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				9.7				
Silt content	%				21				
Sand content	%				69				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961767
Client Sample Ref.:
Sample Location: FIELD 11
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 29-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				15				
Silt content	%				27				
Sand content	%				58				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961768
Client Sample Ref.:
Sample Location: FIELD 12
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 29-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				11				
Silt content	%				29				
Sand content	%				60				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

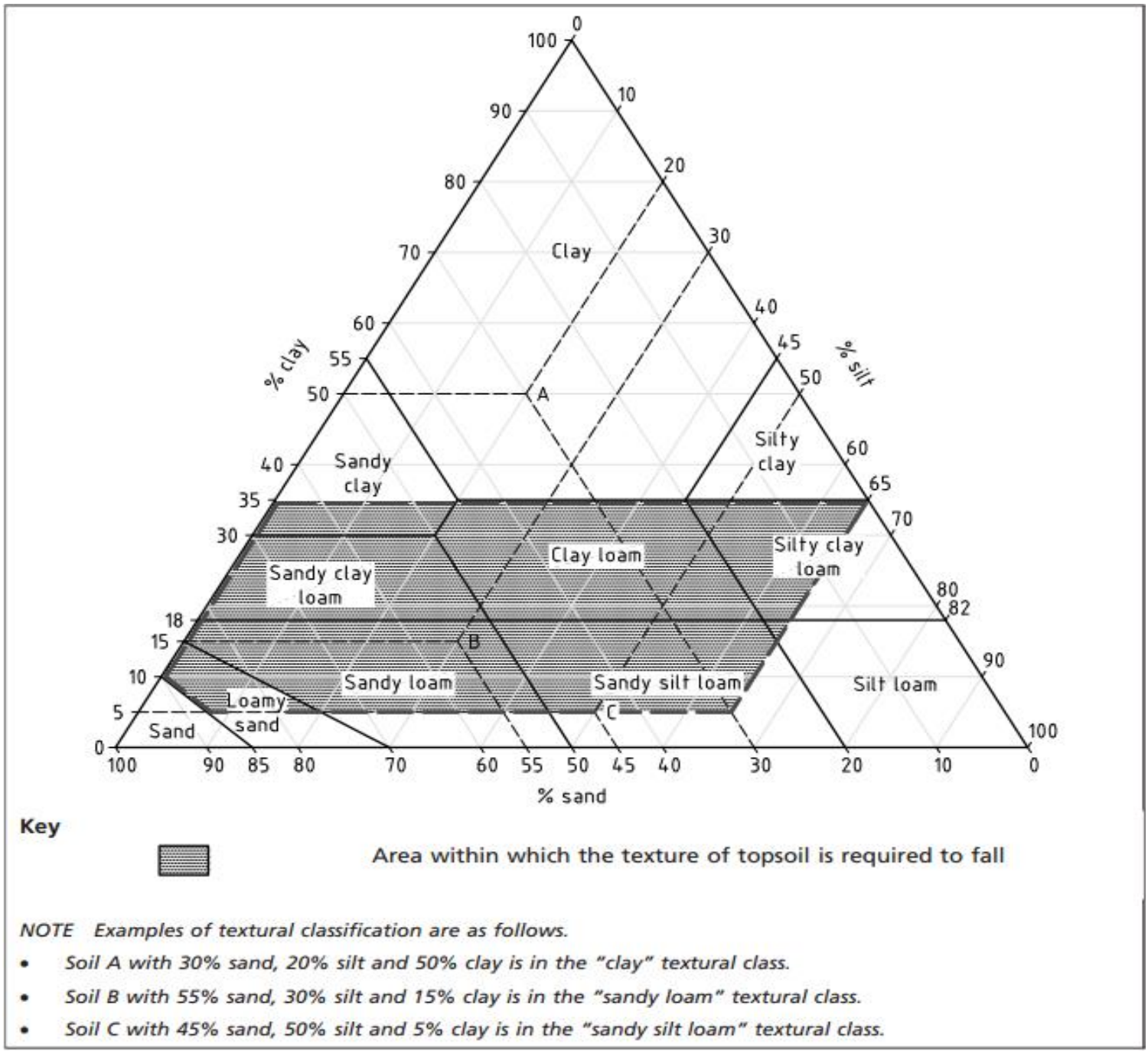
Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961769
Client Sample Ref.:
Sample Location: FIELD 14
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 29-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				13				
Silt content	%				29				
Sand content	%				58				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Chemtest Job No.: 20-03017
Chemtest Sample ID.: 961770
Client Sample Ref.:
Sample Location: FIELD 17
Client Sample ID.: 1
Top Depth (m):
Bottom Depth (m):
Date Sampled: 29-Jan-2020
Time Sampled:

Parameter	Units	Multipurpose Range			Result	Compliant with Multipurpose Range? (Y/N)	Compliant with Specific Purpose Range? (Y/N)		
Texture							**Acid**	**Low F**	**Calc.**
Clay content	%				9.7				
Silt content	%				23				
Sand content	%				68				
Soil texture class		See Attached Chart			Sandy Loam	YES			
Mass Loss on Ignition									
Clay 5-20%		3.0-20				NO	NO	NO	NO
Clay 20-35%		5.0-20							
Stone Content	**% m/m**								
>2mm		0-30				NO			
>20mm		0-10				NO			
>50mm		0				NO			
Soil pH value		5.5-8.5				NO	NO	NO	NO
Carbonate (Calcareous only)	%								NO
Electrical Conductivity	µS/cm	If >3300 do ESP				NO			
Available Nutrient Content									
Nitrogen %		>0.15				NO	NO		NO
Extractable phosphorus	mg/l	16-140				NO	NO	NO	NO
Extractable potassium	mg/l	121-1500				NO	NO		NO
Extractable magnesium	mg/l	51-600				NO	NO		NO
Carbon : Nitrogen Ratio		<20:1				N/A	N/A	N/A	N/A
Exchangeable sodium	**%**	<15							
Available Calcium	mg/l								
Available Sodium	mg/l								
Phytotoxic Contaminants (by soil pH)		**< 6.0**	**6.0-7.0**	**> 7.0**					
Zinc (Nitric Acid extract)	mg/kg	<200	<200	<300		YES			
Copper (Nitric Acid extract)	mg/kg	<100	<135	<200		YES			
Nickel (Nitric Acid extract)	mg/kg	<60	<75	<110		YES			
Visible Contaminants	**% mm**								
>2mm		<0.5				YES			
….. of which plastics		<0.25				YES			
….. man-made sharps		zero in 1kg				NO			

Topsoil: Texture Classification Chart



Key

Area within which the texture of topsoil is required to fall

NOTE Examples of textural classification are as follows.

- *Soil A with 30% sand, 20% silt and 50% clay is in the "clay" textural class.*
- *Soil B with 55% sand, 30% silt and 15% clay is in the "sandy loam" textural class.*
- *Soil C with 45% sand, 50% silt and 5% clay is in the "sandy silt loam" textural class.*

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2115	Total Nitrogen in Soils	Nitrogen	Determination by elemental analyser
2400	Cations	Cations	ICP-MS
2420	Phosphate	Phosphate	Spectrophotometry - Discrete analyser
2930	Organic Matter	Organic Matter	Acid Dichromate digestion/Titration

Chemtest
The right chemistry to deliver results

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Table 27: Summary of Geoenvironmental Soil Testing

SAMPLE ID	Moisture content %	Soil Texture (Lab output)	Soil Texture Percentage			pH	Nitrogen (Total) %	Potassium (Extractable) mg/l	Magnesium (Extractable) mg/l	Phosphorus (Extractable) mgl/l	Organic Matter %
			Clay	Silt	Sand						
FIELD 1	19	Sand	9.7	27	63	6.9	0.27	65	40	10	3.3
FIELD 3	22	Loam	13	34	53	6.9	0.27	60	38	7.8	3.5
FIELD 4	23	Loam	11	31	58	6.8	0.27	55	40	7.8	3.2
FIELD 7	19	Loam	9.7	21	69	6.8	0.23	50	33	7.2	2.7
FIELD 11	21	Sand	15	27	58	7.3	0.28	55	25	7.2	2.9
FIELD 12	23	Loam	11	29	60	6.9	0.28	70	41	6.5	3.5
FIELD 14	19	Sand	13	29	58	6.7	0.26	55	45	6.0	3.2
FIELD 17	17	Sand	9.7	23	68	6.7	0.27	55	44	11	3.1
FIELD 19	26	Loam	9.7	19	71	5.8	0.27	60	95	7.2	4.1
FIELD 20	20	Loam	11	24	65	6.5	0.29	49	47	3.7	2.9
FIELD 20A	23	Loam	13	32	55	7.1	0.26	70	60	7.2	2.4
FIELD 21	20	Loam	9.7	27	63	6.8	0.27	85	60	7.2	3.6
FIELD 22	23	Loam	11	31	58	6.9	0.31	85	75	11	3.8

Table 28: Commentary and RAG assessment of soil sampling results the context of acid grassland creation

SAMPLE ID (Field)	Moisture content %	Location	Soil Texture (Lab output)	Soil Texture [35]	Comments on Soil Texture	Soil Texture Percentage			Comments on soil composition	pH	Comments on PH [36]	Nitrogen (Total) %	Comments on Nitrogen	Potassium (Extractable) mg/l	Comments on Potassium	Magnesium (Extractable) mg/l	Comments on Magnesium	Phosphorus (Extractable) mg/l	Comments on Phosphorous	Organic Matter %	Comments on Organic Matter
						Clay	Silt	Sand													
South of Birch Brook, north of Weir Lane																					
1	19	South of Birch Brook, north of Weir Lane	Sand	Sandy Loam	Acceptable for acid grassland creation	9.7	27	63	All have a high sand %	6.9	Calcareous	0.27	All within acceptable range.	65	Not relevant to sward	40	Not relevant to sward	10	Low phosphorous (<10) is good for floristic diversity	3.3	Most within acceptable limits. pH easier to adjust when organic matter low.
3	22		Loam			13	34	53		6.9		0.27		60		38		7.8		3.5	
4	23		Loam			11	31	58		6.8		0.27		55		40		7.8		3.2	
7	19		Loam			9.7	21	69		6.8		0.23		50		33		7.2		2.7	
South of Weir Lane																					
11	21	South of Weir Lane	Sand	Sandy Loam	Acceptable for acid grassland creation	15	27	58	All have a high sand %	7.3	Calcareous	0.28	All within acceptable range.	55	Not relevant to sward	25	Not relevant to sward	7.2	Low phosphorous (<10) is good for floristic diversity	2.9	Most within acceptable limits. pH easier to adjust when organic matter low.
12	23		Loam			11	29	60		6.9		0.28		70		41		6.5		3.5	
14	19		Sand			13	29	58		6.7		0.26		55		45		6		3.2	
17	17		Sand			9.7	23	68		6.7		0.27		55		44		11		3.1	
Allocation Boundary																					
19	26	Ranges	Loam	Sandy Loam	Acceptable for acid grassland creation	9.7	19	71	All taken from range floor, so pH is higher than if samples were taken on firing lines.	5.8	Mesotrophic	0.27	All within acceptable range.	60	Not relevant to sward	95	Not relevant to sward	7.2	Low phosphorous (<10) is good for floristic diversity	4.1	Lack of organic implies the pH should be responsive to change.
20	20	South of the Ranges (in LWS)	Loam			11	24	65		6.5		0.29		49		47		3.7		2.9	
North of Birch Brook, outside Allocation Boundary																					
20 A	23	South of the Range (out LWS)	Loam	Sandy Loam	Acceptable for acid grassland creation	13	32	55	All have a high sand %	7.1	Calcareous	0.26	All within acceptable range.	70	Not relevant to sward	60	Not relevant to sward	7.2	Low phosphorous (<10) is good for floristic diversity	2.4	Most within acceptable limits. pH easier to adjust when organic matter lower
21	20		Loam			9.7	27	63		6.8		0.27		85		60		7.2		3.6	
22	23		Loam			11	31	58		6.9		0.31		85		75		11		3.8	

[35] Revised based on detailed soil texture triangles

[36] pH is logarithmic, so a difference of pH 1 is ten times

Appendix M Acid Grassland Creation Strategy – Letter from Dr Philip Putwain

ECOLOGICAL RESTORATION SOLUTIONS (UK)

www.ecorestorationsolutions.co.uk e-mail: philp@liverpool.ac.uk

Assessment of an Acid Grassland Creation Strategy: a key component of a High Level Mitigation Strategy proposed by Stantec for Middlewick Ranges Colchester

The purpose of this letter is to provide a critical review of the Acid Grassland Creation Strategy proposed by Stantec UK Limited that is contained within Middlewick Ranges Local Plan Housing Allocation: Ecological Evidence Base Report (Project Ref: 40472, May 2020).

I, Dr Philip Putwain have direct experience of creating acid grassland and heathland habitats, with a fifty-year career in academic research and practical application. My CV is provided at the end of this letter which summarises pertinent elements of my career of relevance to this project. Also of note, I am a full member of the Chartered Institute of Ecological and Environmental Management (CIEEM) and as such am bound by a code of professional conduct obligating me to (of particular relevance to this project); (1) Uphold the reputation of the profession; (2) Only undertake work that I have competence to do; and (3) exercise sound professional judgement in my work, identifying clearly the limitations and applying objectivity, relevance, accuracy, proportionality and impartiality to information and professional advice I provide.

Colchester Borough Council's advising ecologist requested Stantec seek an independent specialist opinion on the high level acid grassland strategy, further to the draft evidence base prepared in May 2020 in relation to the proposed allocation of Middlewick Training Area, Colchester for future development (strategic housing allocation)within the defined Allocation Boundary in Colchester Borough Council's Emerging Local Plan.

Lowland dry acid grassland will inevitably be lost from development within the Allocation Boundary, and therefore one of the key ecological considerations for the site's allocation was a requirement to create lowland acid grassland habitat to compensate for the loss of this habitat and create new habitat within the designated Mitigation Land. Lowland dry acid grassland is identified as a Habitat of Principal Importance and as an Essex Biodiversity Action Plan habitat, thus creation of new acid grassland habitat is a necessary requirement to be included in site masterplanning from the outset. In addition, due consideration needs to be given to the technical viability of such an exercise (i.e. acid grassland creation) to give confidence such that the impacts of the development proposals can be offset.

The high level strategy for acid grassland creation on the sandy loam soils in military ownership immediately beyond the site was based on document review, soil sampling results and the restoration target acid grassland plant community (the reference vegetation). The field investigations involved topsoil sampling and analysis and botanical survey. My assessment of the high level strategy and the evidence supporting it is discussed in the following paragraphs.

The review of relevant literature contained in the Ecological Evidence Base Report (documents are listed in Table 26, Appendix L) included peer reviewed journal papers describing the methodology for creation of acid grassland and outcomes at RSPB Minsmere Nature Reserve which is highly relevant to the proposed acid grassland creation at Middlewick Ranges. In addition, Best Practice Guidance (Forest Research) and a National Heathland Conference paper which provided valuable information about methods of acid grassland (and also heathland) creation plus useful evidence about successful outcomes in relation to the

restoration process. Each paper was summarised very clearly in relation to the proposed restoration requirements for Middlewick Ranges. Other relevant literature was also reviewed. I am satisfied that the literature review was sufficiently rigorous and very adequate for the purpose of informing the Evidence Base Report. There is modest scope for further detailed literature review focussed on acid grassland restoration and provision of rigorous evidence for consideration in later stages of the project (such as a planning application).

The soil sampling strategy undertaken by Stantec was sufficient for the high level mitigation strategy and the particular objectives of this. The sampling procedure was organised in a logical way using best practice methodology for collecting topsoil samples and organising the soil analysis with a UKAS accredited laboratory. All soils tested contained a high percentage sand content and relatively low percentage clay. The soil texture classification of all samples was 'sandy loam'. All soils tested were relatively infertile with very low or low extractable phosphorous and potassium in all samples (ADAS Index 0-1). Soil texture was sandy loam in all samples with percentage sand content in the range 53-71%. Field 19 (Area A) within the Allocation Boundary had the highest percentage sand content. The sand content of fields within the Mitigation Land was lower than Field 19 but nevertheless was sufficiently high to provide confidence that natural leaching by precipitation combined with intervention habitat creation will create acid grassland species assemblages. Overall these data provide an excellent starting point for the acid grassland habitat creation method proposed by Stantec, as a general approach.

Stantec have suggested (Table 5, Ecological Evidence Base Report) that further investigation of Mitigation Land soils, in particular, examining the full topsoil/subsoil profile might further enhance prospects for successful habitat creation if higher percentage sand content subsoil occurs which could be brought to the surface by deep ploughing. This approach could be implemented at later stages of the project and is strongly supported by evidence from heathland (and acid grassland) restoration at Prees Heath, Shropshire.

Stantec have correctly identified soil pH as a critical factor in determining the success or otherwise of acid grassland creation. Soil pH is in the range 6.7-7.3 within the Mitigation Land which contrasts with pH 5.8 within the Allocation Boundary where there is widespread occurrence of acid grassland. It is however known that pH in the Mitigation Land has been artificially increased for agricultural purposes through application of lime. Soil acidification has been identified by Stantec as a necessary component of habitat creation for creation of acid grassland. This is based on academic studies and practical experience of large scale acid grassland or mosaics including dry heathland habitat creation works which have proved successful.

Stantec's highly skilled staff undertook Extended Phase 1 Habitat surveys in May 2017 and March 2020 and a botanical survey in June 2018. Together these surveys gave a very clear description of habitat types and the species composition of grasslands within the Allocation Boundary and within the Mitigation Land. The data clearly demonstrated the existence of NVC U1 Lowland Acid Grassland, relatively widespread within the Allocation Boundary (Area A), but particularly associated with the raised firing lines which are composed of more disturbed sandy soils. Thus NVC U1 acid grassland was identified as the target plant community for habitat creation within the Mitigation Land. It is likely that some areas of acid grassland will remain in the undeveloped portion of Area A and also in part of Area B. These should be designated as reference plant communities for evaluating habitat creation outcomes in the future.

The Ecological Evidence Base Report clearly identifies the remaining areas of acid grassland as source areas for seed and green hay which would be used in habitat creation on the Mitigation Land. The strategy within the Evidence Base suggests that transfer of acid grassland turves from the Allocation Area to the designated habitat creation sites within the

Mitigation land could occur before (and possibly during) the development works commenced. Other local source sites (e.g. Roman River SSSI) could also be used for collection of seed and possibly green hay (with appropriate permission from the landowner). All of these actions are common sense good practice and a logical approach for habitat creation.

The combination of evidence from the literature, soils data and botanical survey enabled Stantec to develop a high level strategy for the restoration of lowland acid grassland at Middlewick Ranges Mitigation Land. A set of key stages was proposed as general principles which would be refined further in the event that a planning application was to be prepared.

The key stages are as follows;

- Cessation of lime application on target habitat creation areas,
- Application of a sand mix and incorporation of sulphur,
- Possible deep ploughing to expose high percentage sand subsoil and incorporation of sulphur as an alternative to applying a sand mix,
- Regular testing of soil pH at intervals of 4-6 months to determine the impact of sulphur addition,
- Application of brush harvested seed and green hay from nearby SSSI acid grassland (in MOD's ownership), translocation of turves from acid grassland that will be lost from the Allocation boundary and supplementation with commercial grass seed mix (origin from known UK sources) if necessary as a supplementary option,
- Regular botanical monitoring using an annual survey of vegetation development (twice per year for the initial two years),
- Cutting undesirable perennial or biennial weeds just before flowering with supplementary spot herbicide treatment (glyphosate) as a final option.

Stantec suggested that preparation of trial areas for acid grassland creation in advance of the main works, would be beneficial to inform or refine the later stages of the strategy. Assuming that time allows, this approach will greatly enhance the final outcome because it will provide the opportunity to test variables such as amount of sulphur per unit area, application rate of seed or green hay and deep ploughing or not. Results will inform large scale works.

Stantec suggested commencement of soil preparation in the Mitigation Area prior to commencement of development activities, to give time for the soil conditions to respond to changes in pH. This is an excellent approach.

I fully endorse this entire habitat creation methodology as being a best practice strategy that has been carefully thought out and has the best possible likelihood of succeeding. Based on my previous experience (academic research and medium to large scale grassland and heathland habitat creation), the acid grassland restoration strategy proposed by Stantec has a very high probability of successfully creating a functioning acid grassland ecosystem that will have very close similarity with the existing reference acid grassland occurring within the Allocation Boundary. This can be achieved within 10 years and possibly within 5-7 years.

Dr Philip Putwain. 29th September 2020.

CURRICULUM VITAE Philip Daniel PUTWAIN

Qualifications:	B.Sc. with Honours (Class 1) in Agricultural Botany (University of Wales 1963) Ph.D. Plant ecology (University of Wales 1969)

Career Outline:

2005-to date:	Honorary Research Fellow, University of Liverpool. Principal Consultant and Director, Ecological Restoration Consultants Ltd (from 1st November 2016, Ecological Restoration Solutions (UK)).
2012-to 2018:	Director and Trustee, Cass Foundation Limited.
2000-2004:	Director of the MSc. Programme in Restoration Ecology of Terrestrial and Aquatic Environments, Liverpool University,
1969-2005:	Lecturer/Senior Lecturer in the School of Biological Sciences, Liverpool University.
1975-2006	External examiner for BSc and MSc degree programmes in the environmental sector at seven UK Universities and external examiner of ecological PhD degrees at 25+ UK and overseas Universities.

Professional Memberships:

Member of the Chartered Institute of Ecology (ERHC-SIG Committee) and Environmental Management (MCIEEM), retired status from 2019, Member of the Society for Ecological Restoration.

Professional expertise:

- Fifty years academic research and practical experience in plant ecology, ecological restoration and land regeneration. 125 mainly peer-reviewed and other published conference papers and 100+ commissioned reports to national government, local authorities, government organisations, civil engineering and industrial companies;
- Ecological restoration of high conservation value grassland, woodland, heathland wetland and riparian habitats on a variety of disturbed sites, quarry and mining wastes, on urban and rural brownfield development sites and closed landfills;
- Enhancing and rebuilding biodiversity and carbon sequestration and storage on post-industrial, urban and other brownfield land through habitat creation.
- Sampling and evaluation of soils, soil forming materials and soil development on brownfield/development projects and ecosystem restoration in rural landscapes;
- Research and practical landscape scale implementation of the use of composts and digestates for brownfield land restoration, remediation and creation of green infrastructure with enhanced provision of ecosystem services;
- Research on bioavailability of metal contaminants and phytoremediation on terrestrial and wetland (derelict canal) sites;

Sample habitat creation case study projects past ten years:
Habitat creation for species-rich grassland and transfer of a bee orchid population: Liverpool City Council. (2020)

This project, designed and supervised by ERS, involves creation of a low fertility, calcium-rich substrate utilising recycled concrete for establishment of species-rich grassland at a coastal location and including rescue and transfer of a bee orchid population.

The re-creation of dry heathland with acid grassland mosaic habitat for a nationally threatened butterfly at Prees Heath Common Reserve, Shropshire: Butterfly Conservation. (2007-2020).

The project was large scale creation (>16ha) of dry dwarf shrub heathland and acid grassland mosaic communities on sandy soil enriched by years of arable cultivations. The techniques used involved soil profile inversion through deep-ploughing, chemical acidification (sulphur), and sowing by spreading recently harvested heather brash. Heathland and acid grassland mosaic has been created successfully over the entire treated areas providing new habitat for the last remaining population silver-studded blue butterfly in the English midlands.

Northern Roots, Snipe Clough:TEP Ltd. (2020)

Ecological Restoration Solutions (UK) has developed a soil sampling strategy which will inform the masterplan for the Snipe Clough project through creation of a soil remediation strategy, inform requirements for soil building in the crop growing zone and define soil amendment requirements in eco-park areas where enhanced biodiversity and carbon capture and storage are joint objectives.

Ness Botanic Gardens creation of species-rich meadow grassland (NVC MG5): Liverpool University. (2008-2020).

This restoration project led by Phil Putwain involved deep ploughing (maximum depth 900mm) a fertile grassland (1.5 ha) comprising mainly competitive grasses in order to expose low fertility grassland. Seed from a commercial mix (23 species) supplemented with seed collected from Wirral meadows was introduced in several years. In 2015, 125 plant species had been recoded and >30,000 rosettes of cowslip were counted (sampling estimate). Twenty species of butterfly and 19 bee species have been recorded by Phil and a small volunteer group undertaking annual monitoring.

The re-creation of dwarf shrub heathland and acid grassland mosaic on china clay wastes in Cornwall. (2004-2013).

This work involved collaboration with English Nature and the china clay mining company Imerys. It was a development based on previous academic small scale experiments undertaken by Phil Putwain, scaled up to restore tens of hectares on various derelict mining wastes. The flagship site was Caerloggas Down near St Austell. Successful landscape scale creation of both heathland and acid grassland was achieved after 7 years on average. Further large scale trials were undertaken on Bodmin Moor for Defra's Waste and Resources Action Programme to determine whether small additions of organic matter would enhance the rate of restoration. The work concluded in 2013.

Simonswood Moss creation of acid grassland, heathland and fen vegetation/ reed beds on former peatland, Kirkby, Merseyside: White Moss Horticulture Ltd. (2012-2018).

This project involved creation of acid grassland, heathland, open water, fen vegetation and reed beds on former peat extraction areas, now worked out. Focus on floral and faunal biodiversity.

Appendix N Biodiversity Metric – Rationale, Methods and Results

N.1 Biodiversity Metric - Concept

N.1.1 Biodiversity is complex and therefore to simplify the quantification, metrics have been developed. Metrics use habitat features as a proxy measure for biodiversity. They use a simple calculation that takes into account the importance of these habitats features for nature, using criteria such as their size, distinctiveness and ecological condition. Metrics enable assessments to be made of the present and forecast future biodiversity value of a site, by calculating biodiversity gains and losses.

N.1.2 Metrics enable developers to better understand and quantify the current biodiversity value of a site, and how proposed changes to that site, will impact on that value. Metrics enable developers to see how they might be able to design a site in a way that increases its biodiversity value over time.

N.1.3 The use of a biodiversity metric assumes the principles of the mitigation hierarchy have been adopted and used when developing measures to address impacts on biodiversity receptors. The principles of the mitigation hierarchy are that, in order of preference, impacts on biodiversity should be subject to avoidance, mitigation, and compensation.

N.2 Biodiversity Net Gain

N.2.1 The UK Government's Natural Environment White Paper: '*The Natural Choice: securing the value of nature'* (HM Government 2011) introduced several policies to conserve the environment. One policy included the system of accounting, termed 'biodiversity offsetting'.

N.2.2 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2019) sets out a broad framework of policies for the planning system in England and how they should be applied. Underpinning the framework is the principal aim of 'sustainable development' which is to be pursued through the fulfilment of interdependent economic, social and environmental objectives.

N.2.3 Chapter 15 of the NPPF details core policy principles with respect to conserving and enhancing the natural environment. Securing 'net gains' for biodiversity, in accordance with the Government's '*A Green Future; Our 25 Year Plan to Improve the Environment'* paper is a key theme running through the chapter, whereby planning decisions are required to contribute to and enhance the natural environment by "*minimising impacts and providing net gains for biodiversity*", and plans should "*identify and pursue opportunities for securing measurable net gains for biodiversity*". The chapter also places planning decisions in the context of the mitigation hierarchy where, if impacts on biodiversity cannot be avoided, mitigated, or as a last resort compensated for, then planning permission should be refused.

N.2.4 The Government has committed (Spring Statement, 13 March 2019) to mandate Biodiversity Net Gain in England through the forthcoming Environment Bill, and the revision of the NPPF. The Government has also stated that forthcoming legislation will require development to achieve a 10% net gain for biodiversity (albeit the Environment Bill has not been passed through parliament at the time of writing).

N.2.5 In addition, Section 40 of the Natural Environment and Rural Communities (NERC) Act 2006 places duties on public bodies to have regard to the conservation of biodiversity in the exercise of their normal functions. Section 41 of the NERC Act 2006 defines Habitats and Species of Principal Importance to nature conservation in England which should be considered by all public bodies, including Local Planning Authorities, when carrying out their

Section 40 duties. 'Planning Practice Guidance for the Natural Environment' (Planning Portal 2014) and the 'British Standard for Biodiversity in Planning' (BS 42020:2013) both recommend the system of biodiversity offsetting as an appropriate mechanism of delivering biodiversity compensation.

N.2.6 Biodiversity Net Gain requires developers to ensure habitats for wildlife are enhanced and left in a measurably better state than they were pre-development. An assessment must be undertaken, using a biodiversity metric, of the type of habitat and habitat condition within the site before any development; and then it must be demonstrated how the development is improving biodiversity, such as through the creation of new habitats, or the enhancement of existing habitats. Biodiversity improvements on-site are preferable, but where this is not possible, habitat creation or enhancements can be provided off-site. The metric in this situation (i.e. for Middlewick Ranges allocation) seeks to provide an indication that a net gain for biodiversity is achievable using the Mitigation Land, and with the defined developable footprint.

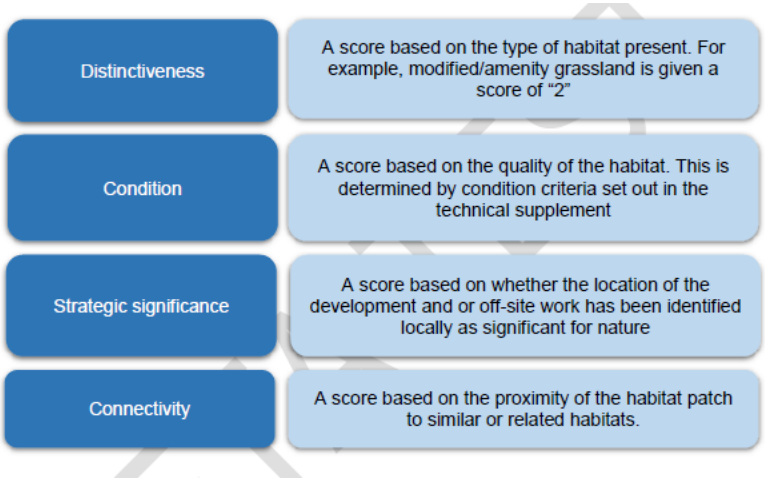
N.3 Biodiversity Metric 2.0

Methodology

N.3.1 The Biodiversity Metric 2.0 has an accompanying user guide, "The Biodiversity Metric 2.0: User Guide and Technical Supplement" (NEJP029) (Natural England, 2019).

N.3.2 The Biodiversity Metric 2.0 was published by Natural England in 2019. The metric calculates the biodiversity value of each parcel of habitat within the Site (measured as biodiversity units). Habitat area is used, except for linear habitats, where length is used (i.e. for hedgerows and watercourses). The value of each habitat type is adjusted to site specific circumstances, taking into account rarity, condition, connectivity and if the habitat parcel is located in an area identified as being of significance for nature, typically in a Local Plan. The components of habitat value are shown at **Plate 1**. A score is applied to each component, which is then multiplied to produce a score which represents the number of biodiversity units associated with each habitat parcel. The sum of these scores across the whole site represents the overall baseline or "pre-development" value in biodiversity units.

Plate 1. Components of the Biodiversity Net Gain Metric (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019 (NB note the current version remains a beta version).



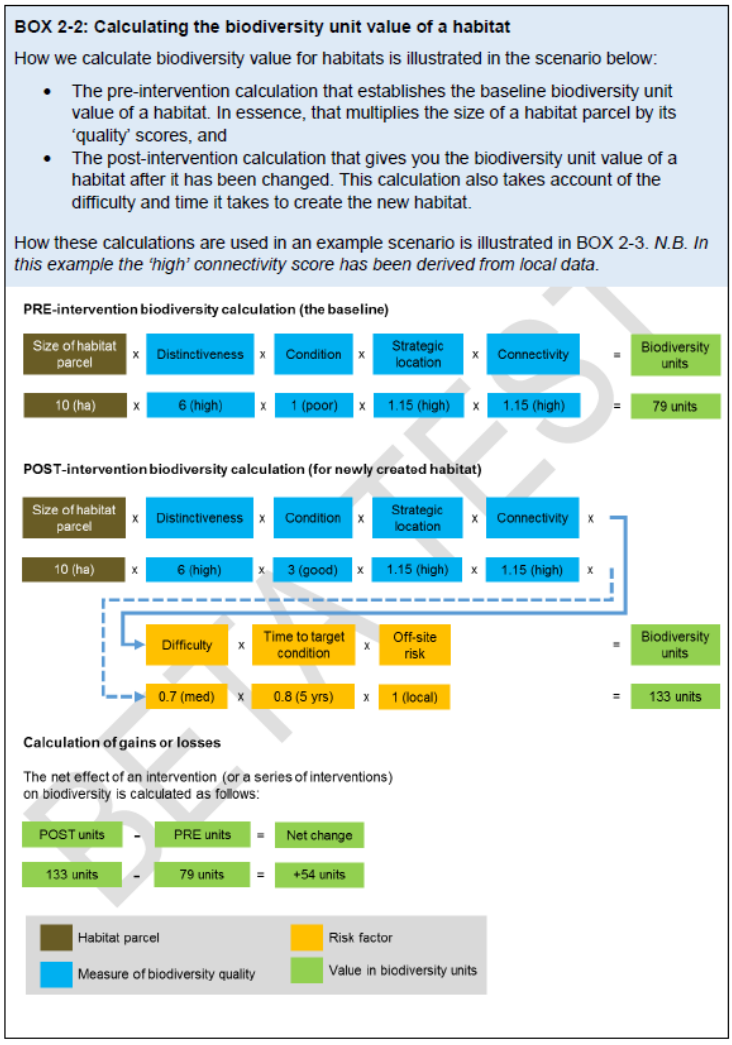
N.3.3 The post-intervention (or "post-development") units value is calculated in the same way, but with the addition of factors to take into account risks associated with creating, enhancing or restoring habitats. These factors are detailed in **Plate 2.**

Plate 2. Post-Development Risk Components of the Biodiversity Net Gain Metric (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019)

Difficulty of creating or restoring a habitat	A standard score based on how difficult the habitat type is to create
Temporal risk	A standard score based on how long the habitat type takes to establish.
Off-site risk	A score based on whether any compensation is undertaken sufficiently nearby to the site at which habitat is lost

N.3.4 The calculated value of the "post-development" biodiversity units is then deducted from the calculated value of the "pre-development" biodiversity units to give a net change biodiversity unit value. The complete calculation is summarised in **Plate 3.**

Plate 3. Summary of Biodiversity Net Gain Calculation (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019)



N.3.5 Where Biodiversity Net Gain is not achievable with the desired design on-site, then off-site compensation areas can be used, and the same calculation undertaken. The biodiversity unit value of the off-site habitats is calculated for the "pre-intervention" and "post-intervention"

stages. The “pre-intervention” units are then subtracted from the “post-intervention” units to work out how many biodiversity units will result from that habitat change.

Biodiversity Metric 2.0 CIEEM Webinar

N.3.6 In June 2020 a webinar was posted to YouTube[37] by The Chartered Institute of Ecology and Environmental Management (CIEEM) which covered ‘Frequently Asked Questions’ on the Biodiversity Metric 2.0; it was led by those heavily involved in the Biodiversity Metric 2.0’s creation. Alongside the frequently asked questions, it discussed shortcomings of the Beta Version of the Biodiversity Metric 2.0. This webinar included commentary on the ‘unfair’ discounting of some habitat types post development noting that this was a known issue and due to be resolved. This webinar was held in advance of the consultation response from Natural England was issued (see below).

Consultation on Biodiversity Metric 2.0

N.3.7 The Biodiversity Metric 2.0 was issued in 2019 as a ‘Beta’ version; i.e. issued for testing; the Natural England website[38] states *“Biodiversity Metric 2.0 is being published as a 'beta test' version to enable wider user feedback (see below). The metric comes with a free calculation tool designed to simplify and speed-up the whole calculation process….we would like feedback from users on how the metric works and how easy it and the ease of use of the tool and guidance. A summary document describing the approach used to inform Biodiversity Metric 2.0 was published in November 2018 alongside Defra’s consultation on mandatory net gain. Feedback from that publication was positive. Natural England has undertaken preliminary testing of this updated metric with selected stakeholders. We are now providing an opportunity for wider testing and feedback to help us fine-tune the metric and guidance. Please provide feedback via the survey on Citizen Space..:”.*

N.3.8 Natural England have subsequently (August 2020) published the results of a consultation on the Biodiversity Metric 2.0 which ran from July 2019 until February 2020. Natural England now plan to make a number of updates to the tool responding to the industry feedback on the tool. Updates re grouped into the following five categories:

- Metric scores – including specific concerns regarding woodland and intertidal habitats.
    - This included comments on how creation of high distinctiveness habitats (such as woodland) scored low, whereas conversely high scores were provided by low distinctiveness habitats. It has been acknowledged by Natural England that the time to target condition is too long for some habitats when being created; and will be revised in the next issue of the metric. Furthermore, the difficulty of creation of some habitats, including woodland types will be revised for the new issue.
- Metric components – accelerated succession and ecological connectivity
- Calculator use
- Guidance
- Condition assessment

N.3.9 The subsequent four categories had less of a direct impact for Middlewick, but will be revised for the next issue of the metric.

[37] https://www.youtube.com/watch?v=C6Qe3HuQDNM

[38] http://publications.naturalengland.org.uk/publication/5850908674228224

N.3.10 It should be noted that there is no ability to 'overwrite' the embedded data for time to target condition, or difficulty of creation in the beta version of the Biodiversity Metric 2.0, despite acknowledgement by Natural England that the values in the tool are currently inappropriate to the habitat types present (in some cases, such as woodland). Therefore at the time of writing, there is no resolution to the known issues using the Biodiversity Metric 2.0 as provided in its Beta mode.

'Very High Distinctiveness' Habitats

N.3.11 The Biodiversity Metric 2.0 is unable to process losses of 'very high distinctiveness habitats'. This is clearly expressed in the 'Trading summary' tab of the metric, which states 'total impact to be addressed through separate mechanism'. **Plate 4** below shows this.

Plate 4: Trading Summary Results Tab (Biodiversity Metric 2.0) - Very High Distinctiveness Habitats

Very high		
Habitat group	**Group**	**Existing area lost**
Grassland - Lowland dry acid grassland	Grassland	0.00
Heathland and shrub - Mountain heaths and willow scrub	Heathland and shrub	0.00
Sparsely vegetated land - Limestone pavement	Sparsely vegetated land	0.00
Wetland - Blanket bog	Wetland	0.00
Wetland - Depressions on Peat Substrates (H7150)	Wetland	0.00
Wetland - Fens (upland and lowland)	Wetland	0.00
Wetland - Lowland raised bog	Wetland	0.00
Wetland – Oceanic Valley Mire[1] (D2.1)	Wetland	0.00
Wetland - Purple moor grass and rush pastures	Wetland	0.00
Wetland - Transition mires and quaking bogs (H7140)	Wetland	0.00
Grassland - Lowland meadows	Grassland	0.00
Grassland - Upland hay meadows	Grassland	0.00
lakes - Aquifer fed naturally fluctuating water bodies	Lakes	0.00
Sparsely vegetated land - Calaminarian grasslands	Sparsely vegetated land	0.00
Rocky shore - High energy littoral rock - on bedrock	Rocky shore	0.00
Rocky shore - Moderate energy littoral rock - on bedrock	Rocky shore	0.00
Rocky shore - Low energy littoral rock - on bedrock	Rocky shore	0.00
Rocky shore - Features of littoral rock - on bedrock	Rocky shore	0.00
Intertidal sediment - Littoral sediments dominated by aquatic angiosperms - on bedrock	Intertidal sediment	0.00
Intertidal sediment - Littoral biogenic reefs - on bedrock	Intertidal sediment	0.00
Total impact to be addressed through separate mechanism		0.00

N.3.12 The inability of the Biodiversity Metric 2.0 to compute the loss of 'very high' distinctiveness habitats therefore triggers the requirement for a bespoke metric for Middlewick (regardless of the other issues raised above and below).

Specialist Knowledge

N.3.13 Whilst the aim of standardised data for both time to target condition and difficulty of creation (and other factors as well) is a sensible approach and avoids user bias, use of standardised timeframes are not always appropriate. For example, in the situation at Middlewick, an expert opinion on the timeframe and difficulty for creation of acid grassland is very different to the values in the metric. Revision of the timeframes is appropriate given the known soil conditions, experience of having completed such tasks previously, and knowing the history of the land. In summary, creation of acid grassland in the Mitigation Land at Middlewick is considerably 'easier' than creating it in an alternative location, with differing soil chemistry and history – e.g.

creating acid grassland in an area of naturally alkaline soils, with a high water table, clay soil consistency, and far from any other acid grassland habitat is going to be significantly harder, if not impossible. Whilst the Biodiversity Metric 2.0 attempts to capture this difficulty in general, one set of criteria are insufficient in certain circumstances. Specifically, the Biodiversity Metric 2.0 states that acid grassland creation is 'highly' difficult to create, and will take 25 – 30 years to create either a fairly good or good condition respectively (with moderate condition grassland taking 20 years and fairly poor condition grassland taking 15 years). In comparison, the expert opinion obtained for Middlewick's proposed grassland creation has stated that acid grassland can be created in 10 years or possible 5-7 years (refer to **Appendix O**). The difficulty of creation is also not considered to be 'high' at Middlewick, as the measures involved are readily accessible and not technically complicated (including factors such as cessation of lime application, deep plough, application of a sand and sulphur mix, and either seeding, turve translocation or use of green hay). Given the Biodiversity Metric 2.0 does not allow embedded data to be overwritten, the use of the tool for this habitat results in significant down-valuing of created acid grassland in comparison to values generated based on specialist knowledge (and is in addition to the downgrading of woodland creation as discussed above).

Consultation with CBC Ecologist

N.3.14 In response to the above factors, a bespoke metric was designed based on the principles and data within the Biodiversity Metric 2.0, in relation to providing confidence that net gain can be achieved at Middlewick at this allocation stage. The use of the bespoke metric for this purpose was discussed and agreed with the CBC Ecologist. Having reviewed the suggested bespoke metric, and approach CBC confirmed their agreement that the bespoke metric was an appropriate tool in this circumstance for the following key reasons:

- Inability of the Biodiversity Metric 2.0 to process loss of very high distinctiveness habitats, (meaning a bespoke metric is required in any case).
- Acknowledgement through the consultation response that updates to the Defra Metric 2.0 are expected in relation to the time to target condition and difficultly of creation for some habitat types.
- Inability to overwrite the data in the Biodiversity Metric 2.0 for the above issues, meaning a bespoke metric needs to be created to allow a reflective assessment to be undertaken.

N.3.15 It was further agreed that use of such a bespoke tool is appropriate given:

- The early stage of the proposals (i.e. allocation not application), meaning this metric is being used to provide an indication that a net gain to biodiversity can be achieved as part of any future development. A detailed metric will be required based on project proposals at later stages of the project (which can use the current Defra metric at that time, if deemed appropriate).
- The revised tool is not scheduled for release until December 2020; after the planned submission timeframe for the combined ecological Evidence Base for Middlewick Ranges to the Local Authority. It is also considered unlikely that any revised version will still prevent data override and so a bespoke metric would be required in any event.
- There is no clear understanding of whether the revised metric will be able to compute the loss of very high distinctiveness habitat, meaning a bespoke metric may still be required even after the release of the new version, planned for December 2020.

N.4 Bespoke Metric

N.4.1 The metric format agreed with the CBC Ecologist is almost entirely based on the Biodiversity Metric 2.0, with modifications in response to the points outlined above. The key points are as follows.

Pre-Development

N.4.2 The following are the key elements of populating the bespoke metric, in relation to the pre development stage:

- Pre development, phase 1 habitat data is taken from ArcGIS, together with the habitat area (i.e. Figure 25). The habitats are converted to UK Habitat Classification system, as per the Biodiversity Metric 2.0. As with the Biodiversity Metric 2.0, professional judgement is required to convert the phase 1 habitat types into the UK Habitat Classification system.
- The user enters whether or not the parcel is 'on site' or 'off site' in relation to the defined cut line (see below for further information on this).
- Using the Biodiversity Metric 2.0 embedded data, all data relevant to that habitat type is auto-populated. This includes factors such as habitat distinctiveness, ease of creation etc. Refer to the metric 'grey' cells for those which are auto-populated.
- The user inputs the following criteria, as per the Biodiversity Metric 2.0 tool (refer to the 'orange' cells in the metric):
    - Habitat condition (defined by the user, taking into consideration personal site experience, descriptions from the extended Phase 1 habitat surveys, botanical surveys, and aerial imagery – commentary is provided where necessary in the metric);
    - Ecological connectivity (refer below to **Section N.4.6**);
    - Strategic significance (refer below to **Section N.4.6**).
- ~~Any data which is overwritten from the Biodiversity Metric 2.0 embedded data is highlighted and the decision to overwrite explained. NOTE -~~ No data has been overwritten in the pre development state (c.f. the post development scenario – see below for further explanation). Grey cells indicate that which has been auto-calculated using Biodiversity Metric 2.0 embedded data, orange are those which have been inputted by the user.~~, and yellow are those which have been overwritten.~~
- The pre development biodiversity units are auto-calculated, using the same multiplication as in the Biodiversity Metric 2.0 (refer above to Plate 3). A summary of the total area and total units per habitat are then pulled into the results page.
- Hedgerows and watercourses (as linear features) are treated differently to polygons (as per the Biodiversity Metric 2.0) but again follow the Biodiversity Metric 2.0 tool approach and embedded data. For these habitats, a length unit (rather than an area) is inputted, and there are slight differences in the embedded data and factors considered.
- The key differences of the pre-development bespoke metric from the Biodiversity Metric 2.0 are:
    - The ability to override and justify deviations from the embedded data in Biodiversity Metric 2.0.

- The 'future' of each parcel is not determined in the pre-development tab as per Biodiversity Metric 2.0. In the Biodiversity Metric 2.0 tool, the proportion of each habitat to be retained, created, enhanced etc is defined which triggers cells to be auto-populated in a number of tabs in the post development scenario. In this bespoke metric a simpler approach of summing the pre development conditions for comparison with the summed post development habitats is used. This simpler approach is considered appropriate given it still provides a robust assessment of the habitat impacts overall allowing a comparison to be made pre and post development (see below), albeit in a simpler format.

Post Development

N.4.3 The following are the key elements of the bespoke metric, in relation to the post development stage:

- The same approach to pre development is taken; i.e. habitat type and area is exported from ArcGIS (Figure 26) and the embedded data auto-populates from the Biodiversity Metric 2.0 embedded dataset. Data is transferred by the user from phase 1 to UK Habitat Classification systems.
- The user enters whether or not the parcel is 'on site' or 'off site' in relation to the defined cut line (see below for further information on this).
- The user then inputs the following criteria, as per the Biodiversity Metric 2.0 tool:
  - Whether the habitat is retained, created or enhanced (note in the Biodiversity Metric 2.0 this is defined in the pre-development tab)
  - The target condition of the habitat;
  - Ecological connectivity (refer below to **Section N.4.6**);
  - Spatial Risk (refer below to **Section N.4.6**);
  - Strategic significance (refer below to **Section N.4.6**);
  - Time to Target Condition (Enhancement) and Multiplier. Note that whilst it was intended that this would be manually inputted using the embedded data in Biodiversity Metric 2.0, it was subsequently decided that no habitats would be marked as enhanced (i.e. all habitats would either be 'created' or 'retained') for the purposes of this high level metric. For that reason, these columns are effectively redundant, however they have been left in, should a future revision wish to incorporate enhancements of retained habitats.
- Any data which is overwritten from the Biodiversity Metric 2.0 embedded data is highlighted and the decision to overwrite explained. NOTE- the only data which has been overwritten in the post development state is the time to target condition, and difficulty of creation of the acid grassland based on the specialist's opinion, and the difficulty of creation for the same habitat. Grey cells indicate that which has been auto-calculated using Biodiversity Metric 2.0 embedded data, orange are those which have been inputted by the user, and yellow are those which have been overwritten.

N.4.4 Notable differences in the two metrics (i.e. the Middlewick bespoke metric vs Biodiversity Metric 2.0) are:

- No application of habitat enhancement post development (as described above, the metric allows for the application of enhancement but this function has not been utilised for Middlewick at this stage).

- No application of accelerated succession. This essentially means there has been no consideration of whether the created habitat is a natural result of the baseline habitat (once succession has occurred). For example, with time and a lack of management grassland naturally succeeds to scrub and eventually woodland, and therefore the Biodiversity Metric 2.0 acknowledges when habitat transition is mimicking succession (albeit in an accelerated manner through intervention) through the application of risk factors (refer to section 5.24 of The Biodiversity Metric 2.0 User Guide (Natural England, 2019)). This is applicable to a small number of the habitat parcels at Middlewick Ranges.

- Similar but different to the point above, there has also been no consideration of the starting point of habitats with respect to habitat continua – i.e. whether the habitat to be lost prior to creation of the new habitat is a similar habitat type from the same continuum. For example, creation of a neutral grassland from a species poor semi-improved grassland will be easier than, for example, creation from hardstanding, or arable habitat owing to the seed bank and soil conditions already present.

- In the Biodiversity Metric 2.0, the definition of 'on site' comprises the area to be negatively affected by the development footprint (not the planning application or Allocation Boundary). The boundary for on site and off site is to be determined on a case by case basis by the user, and should relate to the ecological impact area of the proposals with respect to habitats. Further to this separation of on site and off site habitats, the way in which the percentage net gain is calculated is different to a layman's or first principles approach. In the Biodiversity Metric 2.0, the percentage net gain is calculated by dividing the total change in biodiversity units (across all on site and of site habitats), by the on site pre development baseline only. This approach has been confirmed during the CIEEM training provided to the in-house MOD Ecologists on Biodiversity Net Gain and the Biodiversity Metric 2.0 (October 2020). The bespoke metric Scenarios 1 – 3 do not factor in any consideration of whether any given habitat is either on or off site; the premise in these scenarios is that the total value of habitats (whether on site or off site) pre development are totalled by type and their biodiversity units, and then compared to the same assessment, but for the post development scenario. Scenario 4 provides a comparison to the Biodiversity 2.0 approach, but calculating the net gain as a percentage of the pre development on site baseline[39]. Both approaches enable a robust assessment of whether a net gain to biodiversity has or has not been achieved (and the percentage gain or loss associated with it); Scenarios 1 – 3 provide a more precautionary assessment, whilst Scenario 4 provides an assessment in line with the current Biodiversity Metric 2.0. It should be noted that further clarity on this aspect of the metric is expected in the updated tool, due for release December 2020.

[39] For the purposes of this metric, the 'on site -off site' line has been defined on Figure 24 and 25; and this is broadly the northern boundary of woodland of Birch Brook. As described above, the boundary of on site or off site is not necessarily the Allocation / Application / Development Footprint, but is instead a boundary defined following ecological consideration. It was considered that this boundary is appropriate, given the potential for green community uses in the land up to the Birch Brook Woodland, such as a woodland cemetery, market farm, and BMX track. It is further expected that in these areas, there will be managed recreational use, such that careful consideration of localised impacts will be required, and a detailed mitigation strategy developed to manage the recreational impacts appropriately; through both design and management. This boundary can be re-defined at the planning application stage, based on a more detailed understanding of the development proposals, and therefore the ecological impact areas. Note, the smaller the 'on site' area, the 'easier' a net gain to biodiversity is achieved (given the way the Biodiversity Metric 2.0 calculates the gain), and therefore definition of the boundary as used in this version is not considered to be overly precautionary nor biased in favour of net gain.

Precautionary Worst Case

N.4.5 The metric has been completed in a precautionary worst case manner in the following ways:

- No retained habitats have been enhanced post development; they have all retained their existing condition, or been downgraded in condition post development. In reality, targeted enhancements to retained habitats would be made, however assuming this will not be the case is a precautionary approach to avoid artificially inflating the post development value at this early stage. Note, habitats immediately adjacent to the build footprint likely to be subject to high recreational pressure have been downgraded in condition.

- There has been no application of accelerated succession, whilst in practice some habitats to be created would align with the accelerated succession principles outlined in the Biodiversity Metric 2.0. this has resulted in greater risk factors being applied in the bespoke metric than if the Biodiversity Metric 2.0 was used.

- There has been no consideration of the starting point of the habitats present; for example where one type of grassland is created from another; this is in practice easier than creation of a new habitat completely from scratch. For example, grasslands are a continuum of conditions, with existing seed banks, and changes to the grassland type can be made through changes in management alone often, without the need to destroy the existing habitat and create a new habitat type.

- There has been no allowance made for any planting in the built development footprint; it is currently assumed (for the purposes of the metric) that this is 'blank' or 'ecologically benign' habitat, whereas in practice there will be residential gardens, parks and play areas, public open space, hedgerows, tree lines and other areas of planting which will all contribute to the final metric calculation in a way which will elevate the post development score further than that currently shown.

- The metric has been run using the full Allocation Boundary and Mitigation Land Boundary, which includes almost the entirety of the Birch Brook Woodland LWS (c. 26ha (of a total of 30ha) (Scenario 1 only). This has the natural effect of increasing the pre-development baseline by 466 units (just counting the woodland alone), which has two resulting impacts. The first, is that trying to achieve a net gain of woodland with a percentage target is much harder than if this woodland (which will not form part of the development proposals) is included. A target percentage increase on a smaller baseline is easier to achieve than on a larger baseline. This woodland has however been kept in the metrics for the current time to be fully transparent and reflecting the full Allocation and Mitigation Land boundaries. Following the same principle, achieving a target net gain overall is harder to achieve with the Birch Brook woodland left in the calculations than if this was excluded. Scenarios 2 and 3 remove the Birch Brook from the pre-development and post development totals for Biodiversity Units for comparison. Scenario 4 follows a different calculation approach for the percentage change, but does include Birch Brook habitats.

Notes on Bespoke Metric Completion

N.4.6 The following comments relate to the completion of the bespoke metric:

- The dry ditch habitat within Birch Brook has not been factored into the calculations pre or post development as this is considered to be a feature of the woodland rather than a habitat itself. Note that whilst this habitat is a Phase 1 habitat type, there is no corresponding UK Habitat Classification category. This has no bearing on the calculation as the same approach is taken to both development stages.

- Scattered trees have been assigned an average canopy radius of 3m and converted into polygons for the purposes of both the pre and post development calculations. This because

the Biodiversity Metric 2.0 has no 'point data' function. The conversion to polygon (and removal of habitat beneath to avoid double counting) allows the trees to be considered within the metric both pre and post development. The same approach has been applied to scattered scrub, where in Phase 1 habitat classification systems, this has been used a point. For scattered scrub, a radius of 2m has been applied.

- How to apply Strategic Significance was considered extensively, and the approach discussed with EECOS. The Defra guidance document states strategic significance to be a landscape scale consideration, which would ideally be summarised in a local strategic planning document which defines *'local priorities for targeting biodiversity and nature improvement areas*' such as '*Nature Recovery Areas, local biodiversity plans, and National Character Area objectives and green infrastructure strategies'*. The designation of some of the Allocation Boundary and Mitigation Land as Local Wildlife Site does not readily fit with this definition. Furthermore, in this instance, use of the LWS boundary is clear for the predevelopment situation, but is very unclear[40] for the post-development situation (and could easily result in over or under valuing habitat which may or may not be designated in the future), which is a complicated system relating to what is already designated versus what may or may not be designated in the future. It was therefore decided that in the absence of spatially clear objectives from the Essex Green Infrastructure Strategy[41], no nearby Nature Improvement Area (as shown in MAGIC), no nearby Nature Recovery Solution (as defined by Landscapes for Life[42]), and given the current absence of a defined Local Nature Recovery Strategies (in 2020 Natural England launched a pilot for five local areas[43]), and no clear policy document in the CBC local plan relating to Nature Recovery Areas that the same 'category' for this multiplier would be consistently applied to all habitats (thereby making it in effect redundant). If in later stages of the project there is a clear strategy against which to make use of this feature of the metric then it's use can be revised. The category used consistently for all habitats is *'Location ecologically desirable but not in local strategy'.* This is deemed to be appropriate, given the location in proximity to Birch Brook and Roman River SSSI. It should also be noted that the consultation response following the Beta test of the Biodiversity Metric 2.0, raises concern in relation to applying the strategic significance criteria, and is recognised that 'more clarity required regarding how to determine the strategic significance of an area or habitat', noting also that further clarity will be provided in the revised guidance.

- The Ecological Connectivity Tool (released by Defra alongside the Biodiversity Metric 2.0), has been described within the consultation response (Natural England, August 2020) as: *"Post-consultation we sought the views of users and our external "Sounding Board" and concluded that the connectivity tool was not being used. Those who have used the tool have found it unreliable to load and complicated to use. In addition it is only able to consider the connectivity of high and very high distinctness habitats Accordingly, we have taken the decision to fix connectivity at Low (x1 multiplier) for all habitats until the metric is next reviewed."* Given fixing connectivity to a multiplier of '1' essentially takes this entire factor out of consideration for the metric, the approach defined above is considered to be appropriate for the current time. Given the absence of a functional approach to Ecological Connectivity in the Connectivity Tool, an alternative approach has been used for Middlewick which is based on sound ecological principal. Ecological Connectivity has been applied consistently pre and post development, with the habitats within the north of the Allocation Boundary applied 'low' connectivity given the heavy influence of the built development of Colchester, Abbott's Road and Mersea Road; habitats between Birch

[40] Given the LWS boundary will need to be reduced in response to the final built footprint, but noting there is also scope to extend the LWS boundary in several other areas (in response to either existing habitat conditions, or those following completion of the compensatory habitat creation. It is the role of CBC to define the revised LWS boundary, either in response to a planning application or as part of a future LWS review.

[41] https://www.placeservices.co.uk/media/325323/EGIS_MainStrategy_09062020-LR.pdf

[42] https://landscapesforlife.org.uk/about-aonbs/nature-recovery-solutions

[43] https://www.gov.uk/government/news/five-local-authorities-announced-to-trailblaze-englands-nature-recovery-pilots

Brook and the mosaic to the north of the ranges applied 'medium' connectivity (as well as some habitats in the south, adjacent to Mersea Road); with then habitats south of Birch Brook assigned high connectivity given the lack of influence of built Colchester, and the hedgerow or woodland links to the Roman River SSSI to the south. Whilst the application of ecological connectivity does not mirror the approach taken in Biodiversity Metric, this approach is considered to follow different, but sound ecological justification by de-coupling the ecological connectivity from the habitat distinctiveness. Given the consistent approach to the application of connectivity both pre and post development, there is not considered to be any user bias in this alternative approach, but that it simply represents an alternative approach to categorising ecological connectivity in comparison to the Biodiversity Metric 2.0.

- The Spatial Risk Factor category "Compensation inside LPA or NCA, or deemed to be sufficiently local, to site of biodiversity loss" has been used for all created habitats as per the description (i.e. within the LPA).
- No weighting has been given to the suitability of habitats to support protected / notable species.
- Buildings have been listed as 'Urban – Developed Land; Sealed Surface' as a 'Buildings' category isn't available per se. Bare ground and hardstanding have also been listed as this habitat type. The same approach has been taken pre-and post development meaning there is no influence of these habitat types on the metric results (as the Biodiversity Metric 2.0 defines either or both of the 'habitat condition or the habitat distinctiveness as 0, which results in a biodiversity unit score of 0).
- The parcel numbers on Figure 25 and Figure 26 do not match one another; this is because the number is automatically generated by the ArcGIS system. Whilst some numbers may appear to refer to the same parcel, this is not the case throughout all the parcels. Some parcels are so small in extent that the label is not visible on either Figure 25 or 26; when preparing the metric data, the user was however able to accurately determine the location of these parcels for the purposes of entering the correct data.

N.5 Metric Results

N.5.1 **Table 29** shows the metric summary results for Scenario 1 below, with the full metric included in **N.6** below. Three scenarios are provided:

- Scenario 1 – Pre Development Habitats as Per Figure 25, Post Development Habitats as per Figure 26; Birch Brook woodland (semi-natural) left in the calculation (i.e. increases baseline biodiversity units); time to target condition for acid grassland 8 years (refer to **Appendix O** for expert's opinion on timeframes). Overall scenario 1 results in a 9% gain in habitats areas overall (split: areas – 9%, watercourses – 0%, hedgerows – -1%).
- Scenario 2 – Pre Development Habitats as Per Figure 25, Post Development Habitats as per Figure 26; Birch Brook woodland (semi-natural) removed from the calculation (both pre development and post development (i.e. reduces baseline biodiversity units); time to target condition for acid grassland 8 years (refer to **Appendix O** for expert's opinion on timeframes). Overall Scenario 2 results in an 12% gain in habitat area overall (split: areas – 12%, watercourses – 0%, hedgerows – -1%).
- Scenario 3 – Pre Development Habitats as Per Figure 25, Post Development Habitats as per Figure 26; Birch Brook woodland (semi-natural) removed from the calculation (both pre development and post development (i.e. reduces baseline biodiversity units); time to target condition for acid grassland 10 years (refer to **Appendix O** for expert's opinion on timeframes). Overall scenario 3 results in an 10% gain in habitats overall (split: areas – 10%, watercourses – 0%, hedgerows – -1%).

N.5.2 All these represent a 'precautionary worst case' approach, as factors described above under **Section 7.3.11** have not been ameliorated.

N.5.3 Scenario 4 takes a different approach to how the percentage change is calculated (i.e. it mirrors the Biodiversity Metric 2.0 approach. In Scenario 4, a 16% gain in habitat areas is achieved, with a 0% change in watercourses and a -19% change in hedgerows. Note, the habitat distribution has not changed, this is simply another approach to calculating the net gain percentage.

N.5.4 An overall net gain of either 9%, 10%, 12% or 16% for habitat areas (depending on the scenario) is broken down into gain by habitat grouping. The main loss from the development footprint is acid grassland and poor semi improved grassland, with smaller areas of woodland and scrub lost. The focus therefore was to create a sufficient gain in grassland types to demonstrably show a net gain in these habitat types, with a net gain also shown in the woodland and scrub grouping. It should be reiterated that that achieving a net gain in woodland is comparatively poorly scored given limitations in the Biodiversity 2.0 metric, and given the very high baseline level of woodland in the combined Allocation Boundary and Mitigation Land (relevant to Scenario 1 only). In Scenario 1 therefore, the overall 57% net gain in grassland types is considered a strong and appropriate target for this project, of which the gain in acid grassland types is 27%. The gain for woodland and scrub habitat is lower at 3% overall, however note this represents 25.69 ha of new woodland and scrub habitat types. To aid visualisation, 25.69 ha equates to 31 full sized UK football pitches of new woodland and scrub habitat types over the Allocation Boundary and Mitigation Land (in comparison to the small area lost as part of the proposals). Comparatively, Scenario 2 results in a 7% gain in woodland and scrub habitats, with 57% gain on grassland types, and Scenario 3 results in a 7% gain for woodland and scrub habitats with a 53% gain in grassland. Whilst it takes a different approach to the calculation, Scenario 4 achieves a 9% gain in woodland and scrub types and 65% gain in grassland types. Should it be mandated, a 10% net gain in woodland and scrub habitats should be achievable in Scenarios 2 – 4 (but particularly Scenario 4) through enhancement of retained woodland and scrub habitats which will be detailed in later stages of the project.

Table 29: Metric Results - Scenario 1

Phase 1 Code	Phase 1 Habitat Type	Total Area Pre Development	Biodiversity Units Pre Development	Total Area Post Development	Biodiversity Units Post Development	Difference in Area (Ha/km)	Difference in Area (% of total pre development)	Difference in Biodiversity Units	Difference in Biodiversity Units (%)	Aggregated Difference in Biodiversity Units (%)	Notes
Woodland and Scrub											
A1.1.1	**Broadleaved woodland - semi-natural**	**31.45**	**563.74**	**30.42**	**547.32**	**-1.03**	**-3%**	**-16.43**	**-3%**		
A1.1.2	Broadleaved woodland - plantation	2.89	24.73	23.04	57.16	20.14	697%	32.43	131%		
A1.2.2 (point)	Coniferous woodland - Plantation (derived from point source)	0.07	0.98	0.04	0.57	-0.03	-42%	-0.41	-42%		
A1.3.1 (point)	Broadleaved scattered trees (derived from point source)	0.02	0.29	0.01	0.20	-0.01	-29%	-0.08	-29%	**3%**	Across all these habitat types, a 3% net gain in biodiversity units is predicted, and an increase of almost 26ha in extent. The intention is that the new woodland (defined for metric purposes as plantation) will mature to create a HPI, as the definition includes all native woodland. The enhancements provided contribute to an overall net gain, but also provide the required species specific enhancements (i.e. stronger linear connections). Note, this set of results includes the Birch Brook woodland which will be retained. Given the large size and existing biodiversity value of this habitat, this woodland significantly elevates the pre development baseline, which in turn makes it harder to achieve a % net gain.
A2.1	Scrub - dense/continuous	14.17	170.77	15.00	172.63	0.83	6%	1.86	1%		
A2.2 (point)	Scattered Scrub (derived from point source)	0.01	0.04	0.01	0.10	0.01	125%	0.06	125%		
A3.1	Parkland/scattered trees - broadleaved	3.04	33.80	8.82	39.23	5.77	190%	5.43	16%		
	Total					**25.69**	**50%**	**22.86**			
Grassland											
B1.2 (HPI)	**Acid grassland - semi-improved**	**32.72**	475.69	55.02	**627.16**	**22.30**	**68%**	**151.47**	**32%**		
B1.2 (Not HPI)	Acid grassland - semi-improved	7.11	51.63	6.26	45.44	-0.85	-12%	-6.19	-12%		Across the two acid grassland types, the area increases from c. 40ha to c. 60ha, with the biodiversity units increasing such that overall there is a 27% net gain in units. Importantly, this shows a net gain in the HPI quality acid grassland. An overestimate of the required net gain is considered appropriate at this stage given the early stage of the creation strategies; i.e. targeting a higher overall percentage of net gain of this habitat type builds in 'buffer' to the later strategy. This scenario assumes the created acid grassland can be achieved within 8 years, as a middle ground from the specialist's opinion, and applies a difficulty of creation of 'medium'.
B2.2	Neutral grassland - semi-improved	0.00	0.00	39.95	327.06	39.95	122%	233.03	64%	**57%**	Cells merged given there was no habitat present pre development of B2.2. Instead, consideration of the grassland together is considered more appropriate. The increase in neutral grassland is a strong enhancement in grassland units given it replaces the ecologically benign (comparatively) arable land.
B6	Poor semi-improved grassland	32.80	130.56	9.01	36.53						
C1.1	Bracken - continuous	0.66	6.42	0.63	6.07	-0.04	-5%	-0.35	-6%		There is a small loss of bracken habitat as a result of the current mitigation strategic (in unit terms). This is not considered to be an issue for the project as either (1) detailed design stages can provide a small additional area to provide no net loss or net gain of this habitat or (2) agreement that bracken provides a relatively low value habitat in the context of this project, and accept such a small loss (given project overall results in a net gain).
C3.1	Other tall herb and fern - ruderal	0.19	0.93	0.19	0.93	0.00	0%	0.00	0%		No change in this habitat extent condition or units proposed (i.e. post development area and condition is as per the pre development condition and area).
	Total					**61.36**	**84%**	**377.96**			
Water											
G1.1	**Standing water - eutrophic**	**0.10**	**1.00**	**0.10**	**1.00**	**0.00**	**0%**	**0.00**	**0%**	**0%**	All water bodies off site; no requirement to achieve a net gain in this habitat type
	Total					**0.00**	**0%**	**0.00**			
Cultivated / Man Made											
J1.1	Cultivated/disturbed land - arable	99.76	252.40	0.00	0.00	-99.76	-100%	-252.40	**-100%**	**-100%**	All arable land is lost to the provision of the ecological mitigation in the land south of Birch Brook. This habitat was purposefully targeted for the ecological enhancements as it is low ecological value.
J3.6	Buildings	0.17	0.00	0.17	0.00	0.00	0%	0.00	0%		These habitats change in area from pre development to post development, however given the metric assigns a value of 0 to the condition of such man-made habitats, there are no 'biodiversity units' in either the pre or post development scenario.
J4	Bare ground	0.45	0.00	0.45	0.00	0.00	0%	0.00	0%		
J5	Hardstanding	1.52	0.00	1.29	0.00	-0.23	-15%	0.00	0%		
	Total					**-99.99**	**-98%**	**-252.40**			
Watercourses											

Phase 1 Code	Phase 1 Habitat Type	Total Area Pre Development	Biodiversity Units Pre Development	Total Area Post Development	Biodiversity Units Post Development	Difference in Area (Ha/km)	Difference in Area (% of total pre development)	Difference in Biodiversity Units	Difference in Biodiversity Units (%)	Aggregated Difference in Biodiversity Units (%)	Notes
G2.1	**Running water - eutrophic**	**2.05**	**24.57**	**2.05**	**24.57**	**0.00**	**0%**	**0.00**	**0%**		All water courses are off site; no requirement to achieve a net gain in this habitat type
Hedgerows											
J2.3.1	Intact Hedge with Trees- Native Species Rich	2.37	15.41	2.37	15.41	0.00	0%	0.00	0%	-1%	One 110m stretch of species poor hedgerow will be lost for a junction on Abbotts Road. In this scenario, with no provision of new hedgerows, or enhancement of existing hedgerows, a -1% change results. This will be easily compensated at later stages of the project through enhancement of existing and retained hedgerows, and provision of new hedgerows within the development footprint.
J2.3.2	Intact Hedge with Trees- Native Species Poor	2.70	6.80	2.70	6.77	0.00	0%	-0.03	0%		
J2.1.2	Intact Hedge - Species Poor	0.34	0.77	0.23	0.53	-0.11	-33%	-0.25	-32%		

N.6 Metric Export

Results Scenario 1

Phase 1 Code	Phase 1 Habitat Type	Total Area Pre Development	Biodiversity Units Pre Development	Total Area Post Development	Biodiversity Units Post Development	Difference in Area (Ha/km)	Difference in Area (% of total pre development)	Difference in Biodiversity Units	Difference in Biodiversity Units (%)	Aggregated Difference in Biodiversity Units (%)	Notes
Woodland and Scrub											
A1.1.1	**Broadleaved woodland - semi-natural**	**31.45**	**563.74**	**30.42**	**547.32**	**-1.03**	**-3%**	**-16.43**	**-3%**		
A1.1.2	Broadleaved woodland - plantation	2.89	24.73	23.04	57.16	20.14	697%	32.43	131%		
A1.2.2 (point)	us woodland - Plantation (derived from poin	0.07	0.98	0.04	0.57	-0.03	-42%	-0.41	-42%		
A1.3.1 (point)	lleaved scattered trees (derived from point so	0.02	0.29	0.01	0.20	-0.01	-29%	-0.08	-29%	**3%**	Across all these habitat types, a 3% net gain in biodiversity units is predicted, and an increase of almost 26ha in extent (post-development). The intention is that the new woodland (defined for metric purposes as plantation) will mature to create a HPI, as the definition includes all native woodland. The enhancements provided contribute to an overall net gain, but also provide the required species specific enhancements (i.e. stronger linear connections). Note, this set of results includes the Birch Brook woodland which will be retained. Given the large size and existing biodiversity value of this habitat, this woodland significantly elevates the pre development baseline, which in turn makes it harder to achieve a % net gain.
A2.1	Scrub - dense/continuous	14.17	170.77	15.00	172.63	0.83	6%	1.86	1%		
A2.2 (point)	Scattered Scrub (derived from point source)	0.01	0.04	0.01	0.10	0.01	125%	0.06	125%		
A3.1	Parkland/scattered trees - broadleaved	3.04	33.80	8.82	39.23	5.77	190%	5.43	16%		
Total						**25.69**	**50%**	**22.86**			
Grassland											
B1.2 (HPI)	**Acid grassland - semi-improved**	**32.72**	475.69	55.02	**627.16**	**22.30**	**68%**	**151.47**	**32%**		
B1.2 (Not HPI)	Acid grassland - semi-improved	7.11	51.63	6.26	45.44	-0.85	-12%	-6.19	-12%		Across the two acid grassland types, the area increases from c. 40ha to c. 60ha (pre- to post-development), with the biodiversity units increasing such that overall there is a 27% net gain in units. Importantly, this shows a net gain in the HPI quality acid grassland. An overestimate of the required net gain is considered appropriate at this stage given the early stage of the creation strategies; i.e. targeting a higher overall percentage of net gain of this habitat type builds in 'buffer' to the later strategy. This scenario assumes the created acid grassland can be achieved within 8 years, as a middle ground from the specialist's opinion, and applies a difficulty of creation of 'medium'.
B2.2	Neutral grassland - semi-improved	0.00	0.00	39.95	327.06	39.95	122%	233.03	64%	**57%**	Cells merged given there was no habitat present pre development of B2.2. Instead, consideration of the grassland together is considered more appropriate. The increase in neutral grassland is a strong enhancement in grassland units given it replaces the ecologically benign (comparatively) arable land.
B6	Poor semi-improved grassland	32.80	130.56	9.01	36.53						
C1.1	Bracken - continuous	0.66	6.42	0.63	6.07	-0.04	-5%	-0.35	-6%		There is a small loss of bracken habitat as a result of the current mitigation strategic (in unit terms). This is not considered to be an issue for the project as either (1) detailed design stages can provide a small additional area to provide no net loss or net gain of this habitat or (2) agreement that bracken provides a relatively low value habitat in the context of this project, and accept such a small loss (given project overall results in a net gain) and (3) where bracken is lost, it is being replaced with grassland (which falls within the same broad habitat grouping).
C3.1	Other tall herb and fern - ruderal	0.19	0.93	0.19	0.93	0.00	0%	0.00	0%		No change in this habitat extent condition or units proposed (i.e. post development area and condition is as per the pre development condition and area).
Total						**61.36**	**84%**	**377.96**			
Water											
G1.1	**Standing water - eutrophic**	**0.10**	**1.00**	**0.10**	**1.00**	**0.00**	**0%**	**0.00**	**0%**	**0%**	All water bodies off site; no requirement to achieve a net gain in this habitat type
Total						**0.00**	**0%**	**0.00**			
Cultivated / Man Made											
J1.1	Cultivated/disturbed land - arable	99.76	252.40	0.00	0.00	-99.76	-100%	-252.40	**-100%**		All arable land is lost to the provision of the ecological mitigation in the land south of Birch Brook. This habitat was purposefully targeted for the ecological enhancements as it is considered to be of lower ecological value (particularly on this site).
J3.6	Buildings	0.17	0.00	0.17	0.00	0.00	0%	0.00	0%	**-100%**	
J4	Bare ground	0.45	0.00	0.45	0.00	0.00	0%	0.00	0%		These habitats change in area from pre development to post development, however given the metric assigns a value of 0 to the condition of such man-made habitats, there are no 'biodiversity units' in either the pre or post development scenario.
J5	Hardstanding	1.52	0.00	1.29	0.00	-0.23	-15%	0.00	0%		
Total						**-99.99**	**-98%**	**-252.40**			
Watercourses											
G2.1	**Running water - eutrophic**	**2.05**	**24.57**	**2.05**	**24.57**	**0.00**	**0%**	**0.00**	**0%**		All water courses are off site; no requirement to achieve a net gain in this habitat type
Hedgerows											
J2.3.1	Intact Hedge with Trees- Native Species Rich	2.37	15.41	2.37	15.41	0.00	0%	0.00	0%		One 110m stretch of species poor hedgerow will be lost for a junction on Abbotts Road. In this scenario, with no provision of new hedgerows, or enhancement of existing hedgerows, a -1% change results. This will be easily compensated at later stages of the project through enhancement of existing and retained hedgerows, and provision of new hedgerows within the development footprint.
J2.3.2	Intact Hedge with Trees- Native Species Poor	2.70	6.80	2.70	6.77	0.00	0%	-0.03	0%	-1%	
J2.1.2	Intact Hedge - Species Poor	0.34	0.77	0.23	0.53	-0.11	-33%	-0.25	-32%		

Overall Net Gain:	
Polygons	**9%**
Watercourses	**0%**
Hedgerows	**-1%**

Note, this assessment includes the following variables:
- Birch Brook Woodland included (i.e. high baseline makes % net gain more difficult)
- Acid grassland to be created defined as 8 year timeframe to achieve target condition, and medium difficulty to create.

Results Scenario 2

Phase 1 Code	Phase 1 Habitat Type	Total Area Pre Development	Biodiversity Units Pre Development	Total Area Post Development	Biodiversity Units Post Development	Difference in Area (Ha)	Difference in Area (% of total pre development)	Difference in Biodiversity Units	Difference in Biodiversity Units (%)	Aggregated Difference in Biodiversity Units	Notes
Woodland and Scrub											
A1.1.1	**Broadleaved woodland - semi-natural**	**5.76**	**97.47**	**4.73**	**81.05**	**-1.03**	**-18%**	**-16.43**	**-17%**		Across all these habitat types, a 7% net gain in biodiversity units is predicted, and an increase of almost 26ha in extent (post-development). The intention is that the new woodland (defined for metric purposes as plantation) will mature to create a HPI, as the definition includes all native woodland. The enhancements provided contribute to an overall net gain, but also provide the required species specific enhancements (i.e. stronger linear connections). Note, this scenario excludes 25.69ha of Birch Brook semi-natural woodland from the calculator (both pre and post development). Given the large size and existing biodiversity value of this habitat, this woodland significantly elevates the pre development baseline (as per Scenario 1), which in turn makes it more difficult to achieve a % net gain.
A1.1.2	Broadleaved woodland - plantation	2.89	24.73	23.04	57.16	20.14	697%	32.43	131%		
A1.2.2 (point)	us woodland - Plantation (derived from point	0.07	0.98	0.04	0.57	-0.03	-42%	-0.41	-42%		
A1.3.1 (point)	dleaved scattered trees (derived from point sc	0.02	0.29	0.01	0.20	-0.01	-29%	-0.08	-29%	**7%**	
A2.1	Scrub - dense/continuous	14.17	170.77	15.00	172.63	0.83	6%	1.86	1%		
A2.2 (point)	Scattered Scrub (derived from point source)	0.01	0.04	0.01	0.10	0.01	125%	0.06	125%		
A3.1	Parkland/scattered trees - broadleaved	3.04	33.80	8.82	39.23	5.77	190%	5.43	16%		
Total						**25.69**	**99%**	**22.86**			
Grassland											
B1.2 (HPI)	**Acid grassland - semi-improved**	**32.72**	475.69	55.02	**627.16**	**22.30**	**68%**	**151.47**	**32%**		Across the two acid grassland types, the area increases from c. 40ha to c. 60ha (pre- to post-development), with the biodiversity units increasing such that overall there is a 27% net gain in units. Importantly, this shows a net gain in the HPI quality acid grassland. An overestimate of the required net gain is considered appropriate at this early stage of the creation strategies; i.e. targeting a higher overall % net gain for this habitat type provides a 'buffer' to the future grassland creation strategy. This scenario assumes that characteristic features of acid grassland can be achieved within 8 years, as a middle ground from the specialist's opinion (7 to 10 years), and applies a difficultty of creation of
B1.2 (Not HPI)	Acid grassland - semi-improved	7.11	51.63	6.26	45.44	-0.85	-12%	-6.19	-12%		
B2.2	Neutral grassland - semi-improved	0.00	0.00	39.95	327.06	39.95	122%	233.03	64%	**57%**	Cells merged given there was no habitat present pre development of B2.2. Instead, consideration of the grassland together is considered more appropriate. The increase in neutral grassland is a strong enhancement in grassland units given it replaces the ecologically benign (comparatively) arable land.
B6	Poor semi-improved grassland	32.80	130.56	9.01	36.53						
C1.1	Bracken - continuous	0.66	6.42	0.63	6.07	-0.04	-5%	-0.35	-6%		There is a small loss of bracken habitat as a result of the current mitigation strategic (in unit terms). This is not considered to be an issue for the project as either (1) detailed design stages can provide a small additional area to provide no net loss or net gain of this habitat or (2) agreement that bracken provides a relatively low value habitat in the context of this project, and accept such a small loss (given project overall results in a net gain) and (3) where bracken is lost, it is being replaced with grassland (which falls within the same broad habitat grouping).
C3.1	Other tall herb and fern - ruderal	0.19	0.93	0.19	0.93	0.00	0%	0.00	0%		No change in this habitat extent condition or units proposed (i.e. post development area and condition is as per the pre development condition and area).
Total						**61.36**	**84%**	**377.96**			
Water											
G1.1	**Standing water - eutrophic**	**0.10**	**1.00**	**0.10**	**1.00**	**0.00**	**0%**	**0.00**	**0%**	**0%**	All water bodies off site; no requirement to achieve a net gain in this habitat type
Total						**0.00**	**0%**	**0.00**			
Cultivated / Man Made											
J1.1	Cultivated/disturbed land - arable	99.76	252.40	0.00	0.00	-99.76	-100%	-252.40	**-100%**		All arable land is lost to the provision of the ecological mitigation in the land south of Birch Brook. This habitat was purposefully targeted for the ecological enhancements as it is considered to be of lower ecological value (particularly on this site).
J3.6	Buildings	0.17	0.00	0.17	0.00	0.00	0%	0.00	0%	**-100%**	These habitats change in area from pre development to post development, however given the metric assigns a value of 0 to the condition of such man-made habitats, there are no 'biodiversity units' in either the pre or post development scenario.
J4	Bare ground	0.45	0.00	0.45	0.00	0.00	0%	0.00	0%		
J5	Hardstanding	1.52	0.00	1.29	0.00	-0.23	-15%	0.00	0%		
Total						**-99.99**	**-98%**	**-252.40**			
Watercourses											
G2.1	**Running water - eutrophic**	**2.05**	**24.57**	**2.05**	**24.57**	**0.00**	**0%**	**0.00**	**0%**		All water courses are off site; no requirement to achieve a net gain in this habitat type
Hedgerows											
J2.3.1	Intact Hedge with Trees- Native Species Rich	2.37	15.41	2.37	15.41	0.00	0%	0.00	0%		One 110m stretch of species poor hedgerow will be lost for a junction on Abbotts Road. In this scenario, with no provision of new hedgerows, or enhancement of existing hedgerows, a -1% change results. This will be easily compensated at later stages of the project through enhancement of existing and retained hedgerows, and provision of new hedgerows within the development footprint.
J2.3.2	Intact Hedge with Trees- Native Species Poor	2.70	6.80	2.70	6.77	0.00	0%	-0.03	0%	-1%	
J2.1.2	Intact Hedge - Species Poor	0.34	0.77	0.23	0.53	-0.11	-33%	-0.25	-32%		

Overall Net Gain:	
Polygons	**12%**
Watercourses	**0%**
Hedgerows	**-1%**

Note, this assessment includes the following variables:
- Birch Brook Woodland excluded (i.e. lower baseline makes % net gain less difficult)
- Acid grassland to be created defined as 8 year timeframe to achieve target condition, and medium difficulty to create.

Results Scenario 3

Phase 1 Code	Phase 1 Habitat Type	Total Area Pre Development	Biodiversity Units Pre Development	Total Area Post Development	Biodiversity Units Post Development	Difference in Area (Ha)	Difference in Area (% of total pre development)	Difference in Biodiversity Units	Difference in Biodiversity Units (%)	Aggregated Difference in Biodiversity Units	Notes
Woodland and Scrub											
A1.1.1	**Broadleaved woodland - semi-natural**	**5.76**	**97.47**	**4.73**	**81.05**	**-1.03**	**-18%**	**-16.43**	**-17%**		Across all these habitat types, a 7% net gain in biodiversity units is predicted, and an increase of almost 26ha in extent (post development). The intention is that the new woodland (defined for metric purposes as plantation) will mature to create a HPI, as the definition includes all native woodland. The enhancements provided contribute to an overall net gain, but also provide the required species specific enhancements (i.e. stronger linear connections). Note, this scenario excludes 25.69ha of Birch Brook semi-natural woodland from the calculator (both pre and post development). Given the large size and existing biodiversity value of this habitat, this woodland significantly elevates the pre development baseline (as per Scenario 1), which in turn makes it more difficult to achive % net gain.
A1.1.2	Broadleaved woodland - plantation	2.89	24.73	23.04	57.16	20.14	697%	32.43	131%		
A1.2.2 (point)	us woodland - Plantation (derived from point	0.07	0.98	0.04	0.57	-0.03	-42%	-0.41	-42%		
A1.3.1 (point)	dleaved scattered trees (derived from point so	0.02	0.29	0.01	0.20	-0.01	-29%	-0.08	-29%	**7%**	
A2.1	Scrub - dense/continuous	14.17	170.77	15.00	172.63	0.83	6%	1.86	1%		
A2.2 (point)	Scattered Scrub (derived from point source)	0.01	0.04	0.01	0.10	0.01	125%	0.06	125%		
A3.1	Parkland/scattered trees - broadleaved	3.04	33.80	8.82	39.23	5.77	190%	5.43	16%		
Total						**25.69**	**99%**	**22.86**			
Grassland											
B1.2 (HPI)	**Acid grassland - semi-improved**	**32.72**	475.69	55.02	**599.20**	**22.30**	**68%**	**123.52**	**26%**		Across the two acid grassland types, the area increases from c. 40ha to c. 60ha (pre- to post-development), with the biodiversity units increasing such that overall there is a 27% net gain in units. Importantly, this shows a net gain in the HPI quality acid grassland. An overestimate of the required net gain is considered appropriate at this early stage of the creation strategies; i.e. targeting a higher overall % net gain for this habitat type provides a 'buffer' to the future grassland creation strategy. This scenario assumes that characteristic features of acid grassland can be achieved within 10 years, as a middle ground from the specialist's opinion (7 to 10 years), and applies a difficultty of creation of
B1.2 (Not HPI)	Acid grassland - semi-improved	7.11	51.63	6.26	45.44	-0.85	-12%	-6.19	-12%		
B2.2	Neutral grassland - semi-improved	0.00	0.00	39.95	327.06	39.95	122%	233.03	64%	**53%**	Cells merged given there was no habitat present pre development of B2.2. Instead, consideration of the grassland together is considered more appropriate. The increase in neutral grassland is a strong enhancement in grassland units given it replaces the ecologically benign (comparatively) arable land.
B6	Poor semi-improved grassland	32.80	130.56	9.01	36.53						
C1.1	Bracken - continuous	0.66	6.42	0.63	6.07	-0.04	-5%	-0.35	-6%		There is a small loss of bracken habitat as a result of the current mitigation strategic (in unit terms). This is not considered to be an issue for the project as either (1) detailed design stages can provide a small additional area to provide no net loss or net gain of this habitat or (2) agreement that bracken provides a relatively low value habitat in the context of this project, and accept such a small loss (given project overall results in a net gain) and (3) where bracken is lost, it is being replaced with grassland (which falls within the same broad habitat grouping).
C3.1	Other tall herb and fern - ruderal	0.19	0.93	0.19	0.93	0.00	0%	0.00	0%		No change in this habitat extent condition or units proposed (i.e. post development area and condition is as per the pre development condition and area).
Total						**61.36**	**84%**	**350.01**			
Water											
G1.1	**Standing water - eutrophic**	**0.10**	**1.00**	**0.10**	**1.00**	**0.00**	**0%**	**0.00**	**0%**	**0%**	All water bodies off site; no requirement to achieve a net gain in this habitat type
Total						**0.00**	**0%**	**0.00**			
Cultivated / Man Made											
J1.1	Cultivated/disturbed land - arable	99.76	252.40	0.00	0.00	-99.76	-100%	-252.40	**-100%**	**-100%**	All arable land is lost to the provision of the ecological mitigation in the land south of Birch Brook. This habitat was purposefully targeted for the ecological enhancements as it is considered to be of lower ecological value (particularly on this site).
J3.6	Buildings	0.17	0.00	0.17	0.00	0.00	0%	0.00	0%		These habitats change in area from pre development to post development, however given the metric assigns a value of 0 to the condition of such man-made habitats, there are no 'biodiversity units' in either the pre or post development scenario.
J4	Bare ground	0.45	0.00	0.45	0.00	0.00	0%	0.00	0%		
J5	Hardstanding	1.52	0.00	1.29	0.00	-0.23	-15%	0.00	0%		
Total						**-99.99**	**-98%**	**-252.40**			
Watercourses											
G2.1	**Running water - eutrophic**	**2.05**	**24.57**	**2.05**	**24.57**	**0.00**	**0%**	**0.00**	**0%**		All water courses are off site; no requirement to achieve a net gain in this habitat type
Hedgerows											
J2.3.1	Intact Hedge with Trees- Native Species Rich	2.37	15.41	2.37	15.41	0.00	0%	0.00	0%		One 110m stretch of species poor hedgerow will be lost for a junction on Abbotts Road. In this scenario, with no provision of new hedgerows, or enhancement of existing hedgerows, a -1% change results. This will be easily compensated at later stages of the project through enhancement of existing and retained hedgerows, and provision of new hedgerows within the development footprint.
J2.3.2	Intact Hedge with Trees- Native Species Poor	2.70	6.80	2.70	6.77	0.00	0%	-0.03	0%	-1%	
J2.1.2	Intact Hedge - Species Poor	0.34	0.77	0.23	0.53	-0.11	-33%	-0.25	-32%		

Overall Net Gain:	
Polygons	**10%**
Watercourses	**0%**
Hedgerows	**-1%**

Note, this assessment includes the following variables:
- Birch Brook Woodland excluded (i.e. lower baseline makes % net gain more difficult)
- Acid grassland to be created defined as 8 year timeframe to achieve target condition, and medium difficulty to create.

Results Scenario 4

Phase 1 Code	Phase 1 Habitat Type	Total Area Pre Development ON SITE	Total Area Pre Development OFF SITE	Biodiversity Units Pre Development ON SITE	Biodiversity Units Pre Development OFF SITE	Total Area Post Development ON SITE	Total Area Post Development OFF SITE	Biodiversity Units Post Development ON SITE	Biodiversity Units Post Development OFF SITE	Difference in Area ON SITE (Ha)	Difference in Area OFF SITE (Ha)	Difference in Biodiversity Units ON SITE	Difference in Biodiversity Units OFF SITE	Difference in Biodiversity Units (%) COMPARED TO	Aggregated Difference in Biodiversity Units (%)	Notes
Woodland and Scrub																
A1.1.1	**Broadleaved woodland - semi-natural**	**5.20**	**26.25**	**85.06**	**478.69**	**4.17**	**26.25**	**68.61**	**478.71**	**-1.03**	**0.00**	**-16.45**	**0.02**	**-19%**		Across all these habitat types, a 9% net gain in biodiversity units is predicted, and an increase of almost 26ha in extent (post development). The intention is that the new woodland (defined for metric purposes as plantation) will mature to create a HPI, as the definition includes all native woodland. The enhancements provided contribute to an overall net gain, but also provide the required species-specific enhancements (i.e. stronger linear connections). Note, this scenario takes the differing approach to calculating net gain percentage as per the biodiversity metric 2.0. This alternative approach facilitates a higher percentage gain, as it is calculated against the on site baseline only, rather than the entire study area's baseline.
A1.1.2	Broadleaved woodland - plantation	2.34	0.55	20.60	4.12	1.49	21.55	4.15	53.01	**-0.85**	**21.00**	**-16.46**	**48.89**	**157%**		
A1.2.2 (point)	iferous woodland - Plantation (derived from point sou	0.06	0.01	0.90	0.08	0.03	0.01	0.49	0.08	**-0.03**	**0.00**	**-0.41**	**0.00**	**-45%**		
A1.3.1 (point)	roadleaved scattered trees (derived from point source	0.01	0.01	0.16	0.12	0.01	0.01	0.08	0.12	**-0.01**	**0.00**	**-0.08**	**0.00**	**-50%**	**9%**	
A2.1	Scrub - dense/continuous	11.40	2.78	137.24	33.54	7.36	7.64	88.06	84.57	**-4.04**	**4.87**	**-49.17**	**51.03**	**1%**		
A2.2 (point)	Scattered Scrub (derived from point source)	0.01	0.00	0.04	0.00	0.01	0.00	0.10	0.00	**0.01**	**0.00**	**0.06**	**0.00**	**125%**		
A3.1	Parkland/scattered trees - broadleaved	1.74	1.30	18.84	14.96	7.61	1.21	25.66	13.57	**5.87**	**-0.10**	**6.83**	**-1.39**	**29%**		
Total		**20.76**	**30.89**	**262.84**	**531.51**	**20.68**	**56.66**	**187.15**	**630.06**	**-0.08**	**25.77**	**-75.68**	**98.54**			
Grassland																
B1.2 (HPI)	**Acid grassland - semi-improved**	**31.77**	**0.94**	**461.37**	**14.32**	**14.21**	**40.81**	**206.34**	**420.82**	**-17.56**	**39.86**	**-255.03**	**406.50**	**33%**		Across the two acid grassland types, the area increases from c. 40ha to c. 60ha (pre- to post-development), with the biodiversity units increasing such that overall there is a 27% net gain in units. Importantly, this shows a net gain in the HPI quality acid grassland. An overestimate of the required net gain is considered appropriate at this early stage of the creation strategies; i.e. targeting a higher overall % net gain for this habitat type provides a 'buffer' to the future grassland creation strategy. This scenario assumes that characteristic features of acid grassland can be achieved within 8 years, as a middle ground from the specialist's opinion (7 to 10 years), and applies a difficulty of creation of 'medium', given the relatively straight forward techniques which will be used.
B1.2 (Not HPI)	Acid grassland - semi-improved	7.11	0.00	51.63	0.00	6.26	0.00	45.44	0.00	-0.85	0.00	-6.19	45.44	76%		
B2.2	Neutral grassland - semi-improved	0.00	0.00	0.00	0.00	7.01	32.94	55.35	271.71	-16.67	32.84	-38.16	271.19	179%	**65%**	Cells merged given there was no habitat present pre development of B2.2. Instead, consideration of the grassland together is considered more appropriate. The increase in neutral grassland is a strong enhancement in grassland units given it replaces the ecologically benign (comparatively) arable land.
B6	Poor semi-improved grassland	32.69	0.10	130.03	0.52	9.00	0.00	36.52	0.01							
C1.1	Bracken - continuous	0.31	0.35	3.01	3.42	0.17	0.46	1.66	4.41	-0.14	0.10	-1.34	0.99	-12%		There is a small loss of bracken habitat as a result of the current mitigation strategic (in unit terms). This is not considered to be an issue for the project as either (1) detailed design stages can provide a small additional area to provide no net loss or net gain of this habitat or (2) agreement that bracken provides a relatively low value habitat in the context of this project, and accept such a small loss (given project overall results in a net gain) and (3) where bracken is lost, it is being replaced with grassland (which falls within the same broad habitat grouping).
C3.1	Other tall herb and fern - ruderal	0.19	0.00	0.93	0.00	0.19	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0%		No change in this habitat extent condition or units proposed (i.e. post development area and condition is as per the pre development condition and area).
Total		**72.08**	**1.40**	**646.97**	**18.26**	**36.85**	**74.20**	**346.24**	**696.95**	**-35.23**	**72.80**	**-300.72**	**678.68**			
Water																
G1.1	**Standing water - eutrophic**	**0.00**	**0.10**	**0.00**	**1.00**	**0.00**	**0.10**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0%**	**0%**	All water bodies off site; no requirement to achieve a net gain in this habitat type.
Total		**0.00**	**0.10**	**0.00**	**1.00**	**0.00**	**0.10**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**			
Cultivated / Man Made																
J1.1	Cultivated/disturbed land - arable	**0.00**	**99.76**	**0.00**	**252.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**-99.76**	**0.00**	**-252.40**	**0%**	**0%**	All arable land is lost to the provision of the ecological mitigation in the land south of Birch Brook. This habitat was purposefully targeted for the ecological enhancements as it is considered to be of lower ecological value (particularly on this site). Due to the way this Scenario calculates the net gain percentage (refer to the full evidence base), the change is 0% as the sum of unit change (-252) is divided by the on site pre development baseline (0). The % change is therefore 0.
J3.6	Buildings	0.17	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%		These habitats change in area from pre development to post development, however given the metric assigns a value of 0 to the condition of such man-made habitats, there are no 'biodiversity units' in either the pre or post development scenario.
J4	Bare ground	0.45	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0%		
J5	Hardstanding	0.36	1.16	0.00	0.00	0.33	0.96	0.00	0.00	-0.03	-0.20	0.00	0.00	0%		
Total		**0.98**	**100.92**	**0.00**	**252.40**	**0.95**	**0.96**	**0.00**	**0.00**	**-0.03**	**-99.97**	**0.00**	**-252.40**			
Watercourses																
G2.1	**Running water - eutrophic**	**0.00**	**2.05**	**0.00**	**24.57**	**0.00**	**2.05**	**0.00**	**24.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0%**		All water courses are off site; no requirement to achieve a net gain in this habitat type
Hedgerows																
J2.3.1	Intact Hedge with Trees- Native Species Rich	0.19	2.19	0.92	14.49	0.19	2.19	0.92	14.49	0.00	0.00	0.00	0.00	0%		
J2.3.2	Intact Hedge with Trees- Native Species Poor	0.00	2.70	0.00	6.80	0.00	2.70	0.00	6.77	0.00	0.00	0.00	-0.03	0%		
J2.1.2	Intact Hedge - Species Poor	0.26	0.08	0.57	0.20	0.15	0.08	0.32	0.20	-0.11	0.00	-0.25	0.00	-43%	**-19%**	One 110m stretch of species poor hedgerow will be lost for a junction on Abbotts Road. In this scenario, with no provision of new hedgerows, or enhancement of existing hedgerows, -19% change results (as there are very few baseline units of hedgerow present on site). Whilst -19% appears to be a lot, it will be easily compensated at later stages of the project through enhancement of existing and retained hedgerows, and provision of new hedgerows within the development footprint.

Overall Net Gain:	
Polygons	**16%**
Watercourses	**0%**
Hedgerows	**-19%**

This takes the Biodiversity 2.0 approach to % change, i.e. where the total change is divided by the on site baseline only. Onsite relates not only to a particular allocation or application boundary, but to the area in which impacts are likely to occur. This is shown on Figures 25 and 26. Given the distinction between on site and off site habitats in this approach, a higher overall net gain is achieved than in comparison to Scenarios 1 - 3. Due also to the way in which the gain is calculated it results in a comparatively more 'dramatic' loss for the same 110m of hedgerow removal. As described above though this will easily be ameliorated, and relates to distinction between on site and off site hedgerows in calculating percentage change.

In this scenario, Birch Brook is included in the calculations (off site), and the time to maturity of acid grassland is 8 years.

Appendix O Confirmation of Military Acceptance of Ecological Enhancement Strategy

Defence Infrastructure Organisation

DIO OR & DTE – DTE EAST
West Tofts Camp
THETFORD
IP26 5EP

Telephone:
MOD: 94650 5230
Civilian: 01842 855230
Mobile: 07583308751
E-mail: nigel.parker133@mod.gov.uk

To Whom it May Concern

14 Oct 20

MIDDLEWICK RANGE COMPLEX AND FRIDAYWOODS DRY TRAINING AREA

As the Commander and Head of Establishment for the Defence Training Estate in the East of England (which includes the existing Middlewick Range Complex), I can confirm that the military have been consulted on the design of the masterplan for the land that will be retained as dry training areas south of the Birch Brook. I am content that the proposed 'post development habitats' align with anticipated military training needs.

[ELECTRONICALLY SIGNED]

N R M Parker
Lt Col
Comd