
The Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) Order

6.2 Environmental Statement: Volume II: Chapter 8. Ecology and Nature Conservation

Planning Act 2008

Infrastructure Planning

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009


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This document is submitted in relation to the application for a proposed development by Norfolk County Council to the Planning Inspectorate, under the Planning Act 2008.

The application is for the Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) Order, to grant development consent for the construction of a new highway running west-east between the A1067 Fakenham Road and the A47 Trunk Road at Postwick, including improvements to the existing highway network to the north and north east of Norwich.

This document comprises part of the application documents and relates to Regulation 5(2)(a) and 5(2)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009.

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A. Designated Site Citations

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX.22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.
2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 7, 2nd edition, as amended by COP9 Resolution IX.1 Annex B). A 3rd edition of the Handbook, incorporating these amendments, is in preparation and will be available in 2006.
3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

Joint Nature Conservation Committee

Monkstone House

City Road

Peterborough

Cambridgeshire PE1 1JY

UK

Telephone/Fax: +44 (0)1733 – 562 626 / +44 (0)1733 – 555 948

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DD MM YY

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Designation date

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Site Reference Number

2. Date this sheet was completed/updated:

Designated: 21 September 1994

3. Country:

UK (England)

4. Name of the Ramsar site:

Broadland

5. Designation of new Ramsar site or update of existing site:

This RIS is for: Updated information on an existing Ramsar site

6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area:

**** Important note:** If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

7. Map of site included:

Refer to Annex III of the *Explanatory Notes and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

- i) **hard copy** (required for inclusion of site in the Ramsar List): *yes* ✓ -or- *no* ☐;
- ii) **an electronic format** (e.g. a JPEG or ArcView image) *Yes*
- iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** *yes* ✓ -or- *no* ☐;

b) Describe briefly the type of boundary delineation applied:

e.g. the boundary is the same as an existing protected area (nature reserve, national park etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The site boundary is the same as, or falls within, an existing protected area.

For precise boundary details, please refer to paper map provided at designation

8. Geographical coordinates (latitude/longitude):

52 43 56 N 01 36 00 E

9. General location:

Include in which part of the country and which large administrative region(s), and the location of the nearest large town.

Nearest town/city: Great Yarmouth

Located in eastern Norfolk, part of East Anglia.

Administrative region: Norfolk; Suffolk

10. Elevation (average and/or max. & min.) (metres): **11. Area** (hectares): 5488.61

Min. -2

Max. 4

Mean 1

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

Broadland is a low-lying wetland complex straddling the boundaries between east Norfolk and northern Suffolk. The area includes the river valley systems of the Bure, Yare and Waveney and their major tributaries. The open distinctive landscape comprises a complex and interlinked mosaic of wetland habitats including open water, reedbeds, carr woodland, grazing marsh and fen meadow. The region is important for recreation, tourism, agriculture and wildlife.

13. Ramsar Criteria:

Circle or underline each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11).

2, 6

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Ramsar criterion 2

The site supports a number of rare species and habitats within the biogeographical zone context, including the following Habitats Directive Annex I features:

H7210	Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> Calcium-rich fen dominated by great fen sedge (saw sedge).	
H7230	Alkaline fens	Calcium-rich springwater-fed fens.
H91E0	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>) and the Annex II species	Alder woodland on floodplains,
S1016	<i>Vertigo moulinsiana</i>	Desmoulin's whorl snail
S1355	<i>Lutra lutra</i>	Otter
S1903	<i>Liparis loeselii</i>	Fen orchid.

The site supports outstanding assemblages of rare plants and invertebrates including nine British Red Data Book plants and 136 British Red Data Book invertebrates.

Ramsar criterion 6 – species/populations occurring at levels of international importance.

Qualifying Species/populations (as identified at designation):

Species with peak counts in winter:

Tundra swan , <i>Cygnus columbianus bewickii</i> , NW Europe	196 individuals, representing an average of 2.4% of the GB population (5 year peak mean 1998/9-2002/3)
Eurasian wigeon , <i>Anas penelope</i> , NW Europe	6769 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)
Gadwall , <i>Anas strepera strepera</i> , NW Europe	545 individuals, representing an average of 3.1% of the GB population (5 year peak mean 1998/9-2002/3)
Northern shoveler , <i>Anas clypeata</i> , NW & C Europe	247 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)

Species/populations identified subsequent to designation for possible future consideration under criterion 6.

Species with peak counts in winter:

Pink-footed goose , <i>Anser brachyrhynchus</i> , Greenland, Iceland/UK	4263 individuals, representing an average of 1.7% of the population (5 year peak mean 1998/9-2002/3)
Greylag goose , <i>Anser anser anser</i> , Iceland/UK, Ireland	1007 individuals, representing an average of 1.1% of the population (Source period not collated)

Contemporary data and information on waterbird trends at this site and their regional (sub-national) and national contexts can be found in the Wetland Bird Survey report, which is updated annually. See www.bto.org/survey/webs/webs-alerts-index.htm.

15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

Atlantic

b) biogeographic regionalisation scheme (include reference citation):

Council Directive 92/43/EEC

16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Soil & geology	acidic, basic, neutral, clay, alluvium, peat, nutrient-rich, sedimentary
Geomorphology and landscape	lowland, valley, floodplain
Nutrient status	eutrophic, highly eutrophic, mesotrophic, oligotrophic
pH	acidic, alkaline, circumneutral
Salinity	brackish / mixosaline, fresh
Soil	mainly mineral, mainly organic
Water permanence	usually permanent, usually seasonal / intermittent
Summary of main climatic features	Annual averages (Lowestoft, 1971–2000) (www.metoffice.com/climate/uk/averages/19712000/sites/lowestoft.html) Max. daily temperature: 13.0° C Min. daily temperature: 7.0° C Days of air frost: 27.8 Rainfall: 576.3 mm Hrs. of sunshine: 1535.5

General description of the Physical Features:

Broadland is a low-lying wetland complex in eastern England. The Broads are a series of flooded medieval peat cuttings within the floodplains of five principal river systems. The area includes the river valley systems of the Bure, Yare and Waveney and their major tributaries. The distinctive open landscape comprises a complex and interlinked mosaic of wetland habitats including open water, reedbeds, carr woodland, grazing marsh and fen meadow, forming one of the finest marshland complexes in the UK. The differing types of management of the vegetation for reed, sedge and marsh hay, coupled with variations in hydrology and substrate, support an extremely diverse range of plant communities.

17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, general land use, and climate (including climate type).

Broadland is a low-lying wetland complex in eastern England. The Broads are a series of flooded medieval peat cuttings within the floodplains of five principal river systems. The area includes the river valley systems of the Bure, Yare and Waveney and their major tributaries. The distinctive open landscape comprises a complex and interlinked mosaic of wetland habitats including open water, reedbeds, carr woodland, grazing marsh and fen meadow, forming one of the finest marshland complexes in the UK.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

Recharge and discharge of groundwater, Flood water storage / desynchronisation of flood peaks, Maintenance of water quality (removal of nutrients)

19. Wetland types:

Inland wetland

Code	Name	% Area
U	Peatlands (including peat bogs swamps, fens)	30
TP	Freshwater marshes / pools: permanent	30
W	Shrub-dominated wetlands	15
Xf	Freshwater, tree-dominated wetlands	10
O	Freshwater lakes: permanent	10
Q	Saline / brackish lakes: permanent	3
M	Rivers / streams / creeks: permanent	2

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

The peatland areas of this site support: alder woodland on the floodplain dominated by *Alnus glutinosa* and the *Betula-Dryopteris cristata* community; mixed tall-herb fen typical of calcareous conditions are dominated by *Phragmites australis* and *Cladium mariscus*. The very wet mires are dominated by *Carex* spp. and *Juncus* spp., and spring-fed fens with *Schoenus nigricans*, *Carex dioica* and *Pinguicula nigricans*. Open waters are mostly highly eutrophic; however, some plant-rich mesotrophic and eutrophic examples remain, dominated by *Chara* sp., *Najas marina* and *Ceratophyllum demersum*. The ditch systems within the drained grasslands support Magnopotamion and Hydrocharition vegetation, often with *Stratiotes aloides*.

Ecosystem services

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 12. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc. Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.

Nationally important species occurring on the site.**Higher Plants.**

Nationally Rare:

S1903 *Liparis loeselii* Fen orchid.

S1831 *Luronium natans* Floating water-plantain.

Najas marina, *Potamogeton acutifolius*, *Dryopteris cristata*

Nationally Scarce: *Althaea officinalis*, *Dactylorhiza traunsteineri*, *Potamogeton compressus*, *Potamogeton trichoides*, *Pyrola rotundifolia*, *Sonchus palustris*, *Cicuta virosa*, *Carex appropinquata*, *Thelypteris palustris*, *Lathyrus palustris*, *Potamogeton coloratus*, *Sium latifolium*, *Stratiotes aloides*, *Myriophyllum verticillatum*.

Lower Plants.

Nationally Rare: *Chara intermedia*, *Nitellopsis obtusa*, *Chara connivens*, *Chara intermedia* and *Cinclidium stygium*

Nationally scarce: *Chara curta*, *Drepanocladus vernicosus*, *Chara pendunculata*, *Campyllum elodes*,
Chara aspera, *Ricciocarpus natans*, *Tolypella glomerata*.

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 12. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Birds

Species currently occurring at levels of national importance:

Species regularly supported during the breeding season:

Eurasian marsh harrier , <i>Circus aeruginosus</i> , Europe	16 pairs, representing an average of 10.5% of the GB population (5 year mean 1987/8-1991/2)
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Species with peak counts in spring/autumn:

Common coot , <i>Fulica atra atra</i> , NW Europe	3112 individuals, representing an average of 1.7% of the GB population (5 year peak mean 1998/9- 2002/3)
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Species with peak counts in winter:

Great cormorant , <i>Phalacrocorax carbo carbo</i> , NW Europe	273 individuals, representing an average of 1.1% of the GB population (5 year peak mean 1998/9- 2002/3)
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Great bittern , <i>Botaurus stellaris stellaris</i> , W Europe, NW Africa	2 individuals, representing an average of 2% of the GB population (5 year peak mean 1998/9- 2002/3)
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Bean goose , <i>Anser fabalis fabalis</i> , NW Europe - wintering	238 individuals, representing an average of 59.5% of the GB population (5 year peak mean for 1996/7-2000/01)
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Greater white-fronted goose , <i>Anser albifrons albifrons</i> , NW Europe	351 individuals, representing an average of 6% of the GB population (Source period not collated)
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Eurasian teal , <i>Anas crecca</i> , NW Europe	2934 individuals, representing an average of 1.5% of the GB population (5 year peak mean 1998/9- 2002/3)
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Common pochard , <i>Aythya ferina</i> , NE & NW Europe	800 individuals, representing an average of 1.3% of the GB population (5 year peak mean 1998/9- 2002/3)
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Smew , <i>Mergellus albellus</i> , NW & C Europe	10 individuals, representing an average of 2.7% of the GB population (5 year peak mean 1998/9- 2002/3)
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Hen harrier, <i>Circus cyaneus</i> , Europe	22 individuals, representing an average of 2.9% of the GB population (5 year peak mean 1987/8- 1991/2)
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Water rail , <i>Rallus aquaticus</i> , Europe	23 individuals, representing an average of 5.1% of the GB population (5 year peak mean 1998/9- 2002/3)
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Ruff , <i>Philomachus pugnax</i> , Europe/W Africa	82 individuals, representing an average of 11.7% of the GB population (5 year peak mean 1998/9- 2002/3)
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Species Information

Species occurring at levels of international importance.

Invertebrates.

S1016 <i>Vertigo moulinsiana</i>	Desmoulin's whorl snail
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Assemblage.

This site supports a diverse assemblage of invertebrates including:

Aeshna isosceles, *Papilio machaon britannicus*.

136 British Red Data Book invertebrate species have been recorded on the site.

Nationally important species occurring on the site.**Mammals.**

S1355 *Lutra lutra* Otter

23. Social and cultural values:

Describe if the site has any general social and/or cultural values e.g. fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values.

Aesthetic

Aquatic vegetation (e.g. reeds, willows, seaweed)

Archaeological/historical site

Environmental education/ interpretation

Fisheries production

Forestry production

Livestock grazing

Non-consumptive recreation

Scientific research

Sport fishing

Sport hunting

Tourism

Transportation/navigation

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning? No

If Yes, describe this importance under one or more of the following categories:

- i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:
- ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:
- iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:
- iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:

Ownership category	On-site	Off-site
Non-governmental organisation (NGO)	+	
Local authority, municipality etc.	+	
National/Crown Estate	+	

Private	+	+
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25. Current land (including water) use:

Activity	On-site	Off-site
Nature conservation	+	+
Tourism	+	+
Recreation	+	+
Current scientific research	+	+
Collection of non-timber natural products: commercial	+	
Commercial forestry	+	+
Cutting/coppicing for firewood/fuel	+	+
Cutting of vegetation (small-scale/subsistence)	+	+
Fishing: commercial	+	+
Fishing: recreational/sport	+	+
Permanent arable agriculture		+
Rough or shifting grazing	+	+
Permanent pastoral agriculture	+	+
Hay meadows	+	+
Hunting: recreational/sport	+	+
Sewage treatment/disposal		+
Flood control	+	+
Irrigation (incl. agricultural water supply)		+
Mineral exploration (excl. hydrocarbons)		+
Transport route		+
Domestic water supply		+
Urban development		+
Non-urbanised settlements		+

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

Explanation of reporting category:

1. Those factors that are still operating, but it is unclear if they are under control, as there is a lag in showing the management or regulatory regime to be successful.
2. Those factors that are not currently being managed, or where the regulatory regime appears to have been ineffective so far.

NA = Not Applicable because no factors have been reported.

Adverse Factor Category	Reporting Category	Description of the problem (Newly reported Factors only)	On-Site	Off-Site	Major Impact?
No factors reported	NA				

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For category 2 factors only.

What measures have been taken / are planned / regulatory processes invoked, to mitigate the effect of these factors?

Is the site subject to adverse ecological change? NO

27. Conservation measures taken:

List national category and legal status of protected areas, including boundary relationships with the Ramsar site; management practices; whether an officially approved management plan exists and whether it is being implemented.

Conservation measure	On-site	Off-site
Site/ Area of Special Scientific Interest (SSSI/ASSI)	+	
National Nature Reserve (NNR)	+	
Special Protection Area (SPA)	+	
Land owned by a non-governmental organisation for nature conservation	+	+
Management agreement	+	+
Site management statement/plan implemented	+	
Other	+	+
Environmentally Sensitive Area (ESA)	+	+
Special Area of Conservation (SAC)	+	

b) Describe any other current management practices:

The management of Ramsar sites in the UK is determined by either a formal management plan or through other management planning processes, and is overseen by the relevant statutory conservation agency. Details of the precise management practises are given in these documents.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

No information available

29. Current scientific research and facilities:

e.g. details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

Contemporary.

Flora.

The entire site has had a vegetation survey, primarily fen, wet woodland and open water areas, lakes plus ditch systems, and this is now on GIS.

Monitoring is undertaken on the site, particularly freshwater and fen habitats.

Completed.

Fauna.

Wintering and breeding bird survey of all drained marshland area completed, results on a GIS.

Some species survey and monitoring, e.g. *Liparis loeselii*, *Luronium natans* and a number of molluscs.

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitor centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

Many nature trails and footpaths with information boards and leaflets plus five visitor centres at Ranworth, Hickling, Strumpshaw, How Hill and Carlton Colville.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Activities.

The area attracts large numbers of tourists predominantly during the summer, many of which are water-borne. The river and broads (lakes) both within and adjacent to the site carry large numbers of power and sail craft which results in large-scale erosion and loss of fringing reedswamp. Speed limits have been imposed, however boat numbers remains too high.

Facilities provided.

Land-based recreation within the site is well managed, directing people to facilities where boardwalks are provided.

Seasonality.

All year.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept. of Agriculture/Dept. of Environment, etc.

Head, Natura 2000 and Ramsar Team, Department for Environment, Food and Rural Affairs, European Wildlife Division, Zone 1/07, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6EB

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Site Designations Manager, English Nature, Sites and Surveillance Team, Northminster House, Northminster Road, Peterborough, PE1 1UA, UK

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

Site-relevant references

Aldridge, DC & Müller, SJ (2001) The Asiatic clam, *Corbicula fluminea*, in Britain: current status and potential impacts. *Journal of Conchology*, **37**(2), 177-183

Baker, R, Clarke, K & Howlett, D (1999) A survey of the Broadland distribution of *Pseudamnicola confusa* (Frauenfeld). *English Nature Research Reports*, No. **319**

Bratton, JH (ed.) (1991) *British Red Data Books: 3. Invertebrates other than insects*. Joint Nature Conservation Committee, Peterborough

Cranswick, PA, Waters, RJ, Musgrove, AJ & Pollitt, MS (1997) *The Wetland Bird Survey 1995–96: wildfowl and wader counts*. British Trust for Ornithology, Wildfowl and Wetlands Trust, Royal Society for the Protection of Birds & Joint Nature Conservation Committee, Slimbridge McLeod, CR, Yeo, M, Brown, AE, Burn, AJ, Hopkins, JJ & Way, SF (eds.) (2004) *The Habitats Directive: selection of Special Areas of Conservation in the UK*. 2nd edn. Joint Nature Conservation Committee, Peterborough. www.jncc.gov.uk/SACselection

Musgrove, AJ, Pollitt, MS, Hall, C, Hearn, RD, Holloway, SJ, Marshall, PE, Robinson, JA & Cranswick, PA (2001) *The Wetland Bird Survey 1999–2000: wildfowl and wader counts*. British Trust for Ornithology, Wildfowl and Wetlands Trust, Royal Society for the Protection of Birds & Joint Nature Conservation Committee, Slimbridge. www.wwt.org.uk/publications/default.asp?PubID=14

Pritchard, DE, Housden, SD, Mudge, GP, Galbraith, CA & Pienkowski, MW (eds.) (1992) *Important Bird Areas in the United Kingdom including the Channel Islands and the Isle of Man*. Royal Society for the Protection of Birds, Sandy

- Ratcliffe, DA (ed.) (1977) *A Nature Conservation Review. The selection of biological sites of national importance to nature conservation in Britain*. Cambridge University Press (for the Natural Environment Research Council and the Nature Conservancy Council), Cambridge (2 vols.)
- Shirt, DB (ed.) (1987) *British Red Data Books: 2. Insects*. Nature Conservancy Council, Peterborough
- Stewart, NF (2004) *Important stonewort areas. An assessment of the best areas for stoneworts in the United Kingdom*. Plantlife International, Salisbury
- Stewart, NF & Church, JM (1992) *Red Data Books of Britain and Ireland: Stoneworts*. Joint Nature Conservation Committee, Peterborough
- Stroud, DA, Chambers, D, Cook, S, Buxton, N, Fraser, B, Clement, P, Lewis, P, McLean, I, Baker, H & Whitehead, S (eds.) (2001) *The UK SPA network: its scope and content*. Joint Nature Conservation Committee, Peterborough (3 vols.)
www.jncc.gov.uk/UKSPA/default.htm
- O'Riordan, AM (1976) *A Broadland bibliography*. Nature Conservancy Council, England, East Anglia Region, Norwich (Internal report, Rep.NC.162B)
- Tickner, M, Evans, C & Blackburn, M (1991) Restoration of a Norfolk Broad: a case study of Strumpshaw Fen. *RSPB Conservation Review*, **5**, 72-77
- Wiggington, M (1999) *British Red Data Books. 1. Vascular plants*. 3rd edn. Joint Nature Conservation Committee, Peterborough

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NATURA 2000**STANDARD DATA FORM**

FOR SPECIAL PROTECTION AREAS (SPA)

FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE (SCI)

AND

FOR SPECIAL AREAS OF CONSERVATION (SAC)

1. Site identification:**1.1 Type**

J

1.2 Site code

UK9009253

1.3 Compilation date

199409

1.4 Update

199806

1.5 Relationship with other Natura 2000 sites

U K 0 0 1 3 5 7 7

1.6 Respondent(s)

International Designations, JNCC, Peterborough

1.7 Site name

Broadland

1.8 Site indication and designation classification dates

date site proposed as eligible as SCI	
date confirmed as SCI	
date site classified as SPA	199409
date site designated as SAC	

2. Site location:**2.1 Site centre location****longitude****latitude**

01 36 00 E

52 43 56 N

2.2 Site area (ha)

5462.4

2.3 Site length (km)**2.5 Administrative region**

NUTS code	Region name	% cover
UK402	Norfolk	99.00%
UK403	Suffolk	1.00%

2.6 Biogeographic region☐

Alpine

☒

Atlantic

☐

Boreal

☐

Continental

☐

Macaronesia

☐

Mediterranean

3. Ecological information:**3.1 Annex I habitats**

Habitat types present on the site and the site assessment for them:

Annex I habitat	% cover	Representativity	Relative surface	Conservation status	Global assessment

3.2 Annex I birds and regularly occurring migratory birds not listed on Annex I

		Population			Site assessment				
		Resident	Migratory						
Code	Species name		Breed	Winter	Stage	Population	Conservation	Isolation	Global
A056	<i>Anas clypeata</i>			231 I		B		C	
A050	<i>Anas penelope</i>			10071 I		C		C	
A051	<i>Anas strepera</i>			240 I		B		C	
A021	<i>Botaurus stellaris</i>		>2 I			B		B	
A081	<i>Circus aeruginosus</i>		16 P			B		B	
A082	<i>Circus cyaneus</i>			22 I		B		C	
A037	<i>Cygnus columbianus bewickii</i>			>600 I		B		B	
A038	<i>Cygnus cygnus</i>			100 I		C		C	
A151	<i>Philomachus pugnax</i>			96 I		B		C	

4. Site description:

4.1 General site character

Habitat classes	% cover
Marine areas. Sea inlets	
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	2.5
Salt marshes. Salt pastures. Salt steppes	
Coastal sand dunes. Sand beaches. Machair	
Shingle. Sea cliffs. Islets	
Inland water bodies (standing water, running water)	10.0
Bogs. Marshes. Water fringed vegetation. Fens	25.0
Heath. Scrub. Maquis and garrigue. Phygrana	13.0
Dry grassland. Steppes	
Humid grassland. Mesophile grassland	41.0
Alpine and sub-alpine grassland	
Improved grassland	
Other arable land	
Broad-leaved deciduous woodland	8.5
Coniferous woodland	
Evergreen woodland	
Mixed woodland	
Non-forest areas cultivated with woody plants (including orchards, groves, vineyards, dehesas)	
Inland rocks. Scree. Sands. Permanent snow and ice	
Other land (including towns, villages, roads, waste places, mines, industrial sites)	
Total habitat cover	100%

4.1 Other site characteristics

Soil & geology:

Basic, Clay, Nutrient-rich, Peat, Sedimentary

Geomorphology & landscape:

Floodplain, Lowland, Valley

4.2 Quality and importance

ARTICLE 4.1 QUALIFICATION (79/409/EEC)

During the breeding season the area regularly supports:

Botaurus stellaris
(Europe - breeding)

at least 10% of the GB breeding population
Three year mean 1996-1998

<i>Circus aeruginosus</i>	10.2% of the GB breeding population 5 year mean, 1987/8-1991/2
Over winter the area regularly supports:	
<i>Circus cyaneus</i>	2.9% of the GB population 5 year peak mean 1987/8-1991/2
<i>Cygnus columbianus bewickii</i> (Western Siberia/North-eastern & North-western Europe)	at least 8.2% of the GB population Count, as at 1996/7
<i>Cygnus cygnus</i> (Iceland/UK/Ireland)	1.8% of the GB population Count, as at 1996/7

ARTICLE 4.2 QUALIFICATION (79/409/EEC)**Over winter the area regularly supports:**

<i>Anas strepera</i> (North-western Europe)	0.8% of the population 5 year peak mean, 1991/2-1995/6
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4.3 Vulnerability

The site has suffered from management neglect and natural succession during this century. This is slowly being reversed via conservation and other management works undertaken through a number of bodies. Sea level rise and reduced summer flows in the river Bure brought about by abstraction are resulting in increasing saline intrusion into the site and generally drier summer conditions. The Environment Agency, Broads Authority and English Nature are proceeding with a project, to investigate options to remedy this situation. The site also suffers from eutrophication, brought through the build up of nutrients over a long period, primarily through sewage outfalls and, to a lesser degree, agriculture. Some of the sewage works are now stripping phosphorus and there is a programme of mud pumping to remove enriched material from lakes.

The region as a whole is a centre for tourism and recreation, however this pressure is now starting to be brought under control by the Broads Authority via the Broads Plan. Efficient drainage within much of the reclaimed parts of the wetland has reduced the wildlife value. Water Level Management Plans and the ESA scheme are starting to raise water levels, revert arable areas back to grass and encourage sensitive management, particularly of the ditches. Flood defence works are carried out in accordance with the Environmental Agency Broads Strategy.

5. Site protection status and relation with CORINE biotopes:**5.1 Designation types at national and regional level**

Code	% cover
UK01 (NNR)	39.8
UK04 (SSSI/ASSI)	100.0

NATURA 2000**STANDARD DATA FORM**

FOR SPECIAL PROTECTION AREAS (SPA)

FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE (SCI)

AND

FOR SPECIAL AREAS OF CONSERVATION (SAC)

1. Site identification:**1.1 Type**

K

1.2 Site code

UK0013577

1.3 Compilation date

199601

1.4 Update

201102

1.5 Relationship with other Natura 2000 sites

U K 9 0 0 9 2 5 3

1.6 Respondent(s)

International Designations, JNCC, Peterborough

1.7 Site name

The Broads

1.8 Site indication and designation classification dates

date site proposed as eligible as SCI	199601
date confirmed as SCI	200412
date site classified as SPA	
date site designated as SAC	200504

2. Site location:**2.1 Site centre location**

longitude

latitude

01 36 13 E

52 44 07 N

2.2 Site area (ha)

5889.66

2.3 Site length (km)**2.5 Administrative region**

NUTS code	Region name	% cover
UK403	Suffolk	3.27%
UK402	Norfolk	96.73%

2.6 Biogeographic region☐

Alpine

☒

Atlantic

☐

Boreal

☐

Continental

☐

Macaronesia

☐

Mediterranean

3. Ecological information:

3.1 Annex I habitats

Habitat types present on the site and the site assessment for them:

Annex I habitat	% cover	Representativity	Relative surface	Conservation status	Global assessment
Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp.	2.98	A	A	A	A
Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> -type vegetation	4.96	A	B	A	B
<i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>)	0.99	B	C	A	C
Transition mires and quaking bogs	0.1	B	C	A	B
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	3.55	A	A	A	A
Alkaline fens	0.1	A	C	A	B
Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)	12.96	A	B	A	A

3.2 Annex II species

Species name	Population				Site assessment			
	Resident	Migratory			Population	Conservation	Isolation	Global
		Breed	Winter	Stage				
<i>Vertigo moulinsiana</i>	Present	-	-	-	C	A	C	A
<i>Triturus cristatus</i>	Present	-	-	-	D			
<i>Lutra lutra</i>	23	-	-	-	C	A	C	C
<i>Liparis loeselii</i>	251-500	-	-	-	C	B	A	B
<i>Anisus vorticulus</i>	Rare	-	-	-	B	B	C	B

4. Site description

4.1 General site character

Habitat classes	% cover
Marine areas. Sea inlets	
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	
Salt marshes. Salt pastures. Salt steppes	
Coastal sand dunes. Sand beaches. Machair	
Shingle. Sea cliffs. Islets	
Inland water bodies (standing water, running water)	16.0
Bogs. Marshes. Water fringed vegetation. Fens	19.0
Heath. Scrub. Maquis and garrigue. Phygrana	1.0
Dry grassland. Steppes	1.0
Humid grassland. Mesophile grassland	39.0
Alpine and sub-alpine grassland	
Improved grassland	
Other arable land	
Broad-leaved deciduous woodland	24.0
Coniferous woodland	
Evergreen woodland	
Mixed woodland	
Non-forest areas cultivated with woody plants (including orchards, groves, vineyards, dehesas)	
Inland rocks. Scree. Sands. Permanent snow and ice	
Other land (including towns, villages, roads, waste places, mines, industrial sites)	
Total habitat cover	100%

4.1 Other site characteristics

Soil & geology:

Alluvium, Basic, Clay, Nutrient-poor, Nutrient-rich, Peat

Geomorphology & landscape:

Floodplain, Lowland, Valley

4.2 Quality and importance

Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

- for which this is considered to be one of the best areas in the United Kingdom.

Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation

- for which this is considered to be one of the best areas in the United Kingdom.

Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)

- for which the area is considered to support a significant presence.

Transition mires and quaking bogs

- for which this is considered to be one of the best areas in the United Kingdom.

Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*

- which is considered to be rare as its total extent in the United Kingdom is estimated to be less than 1000 hectares.

- for which this is considered to be one of the best areas in the United Kingdom.

Alkaline fens

- for which this is considered to be one of the best areas in the United Kingdom.

Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

- for which this is considered to be one of the best areas in the United Kingdom.

Vertigo moulinsiana

- for which this is considered to be one of the best areas in the United Kingdom.

Lutra lutra

- for which the area is considered to support a significant presence.

Liparis loeselii

- for which this is one of only three known outstanding localities in the United Kingdom.

- which is known from 15 or fewer 10 x 10 km squares in the United Kingdom.

Anisus vorticulus

- for which this is considered to be one of the best areas in the United Kingdom.

4.3 Vulnerability

The site has suffered from management neglect and natural succession during the 20th century. This is slowly being reversed through conservation and other management works undertaken by a number of bodies. Climate change is increasing saline intrusion into the site. The Environment Agency, Broads Authority and Natural England are working together to make the site more robust to such impacts. The site also suffers from eutrophication caused by release of nutrients from the sediment (historically deposited by sewage outfalls) and diffuse water pollution from a variety of sources. All main sewage works in the northern rivers are now phosphorus stripping and there is a programme of mud-pumping to remove the historic nutrient burden from lakes. Diffuse Water Pollution (DWP) Plans have been drawn up between the Environment Agency and Natural England to identify and address the problems of diffuse water pollution. Pressure from tourism and recreation is now being considered by the Broads Authority through the Broads Plan. Water Level Management Plans and Environmental Stewardship schemes are starting to raise water levels, revert arable areas back to grass and encourage sensitive management, particularly of the ditches, to address problems brought about by drainage in the past. Appropriate standards of flood defence are necessary for the wetland and works are currently proceeding under the Environment Agency's Broadland Flood Alleviation Project and Coastal Protection Strategy.

5. Site protection status and relation with CORINE biotopes:

5.1 Designation types at national and regional level

Code	% cover
UK01 (NNR)	35.7
UK04 (SSSI/ASSI)	100.0

NATURA 2000

STANDARD DATA FORM

FOR SPECIAL PROTECTION AREAS (SPA)

FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE (SCI)

AND

FOR SPECIAL AREAS OF CONSERVATION (SAC)

1. Site identification:

1.1 Type

B

1.2 Site code

UK0012647

1.3 Compilation date

200103

1.4 Update

1.5 Relationship with other Natura 2000 sites

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1.6 Respondent(s)

International Designations, JNCC, Peterborough

1.7 Site name

River Wensum

1.8 Site indication and designation classification dates

date site proposed as eligible as SCI	200103
date confirmed as SCI	200412
date site classified as SPA	
date site designated as SAC	200504

2. Site location:

2.1 Site centre location

longitude

latitude

00 59 38 E

52 43 04 N

2.2 Site area (ha)

381.74

2.3 Site length (km)

2.5 Administrative region

NUTS code	Region name	% cover
UK402	Norfolk	100.00%

2.6 Biogeographic region

☐
Alpine

☒
Atlantic

☐
Boreal

☐
Continental

☐
Macaronesia

☐
Mediterranean

3. Ecological information:

3.1 Annex I habitats

Habitat types present on the site and the site assessment for them:

Annex I habitat	% cover	Representativity	Relative surface	Conservation status	Global assessment
Water courses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation	20	B	C	B	B
Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	0.5	D			
Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)	0.5	D			

3.2 Annex II species

Species name	Population				Site assessment			
	Resident	Migratory			Population	Conservation	Isolation	Global
		Breed	Winter	Stage				
<i>Vertigo moulinsiana</i>	Common	-	-	-	C	B	C	C
<i>Austropotamobius pallipes</i>	Common	-	-	-	C	B	B	B
<i>Lampetra planeri</i>	Common	-	-	-	C	B	C	C
<i>Cottus gobio</i>	Common	-	-	-	C	B	C	C

4. Site description

4.1 General site character

Habitat classes	% cover
Marine areas. Sea inlets	
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	
Salt marshes. Salt pastures. Salt steppes	
Coastal sand dunes. Sand beaches. Machair	
Shingle. Sea cliffs. Islets	
Inland water bodies (standing water, running water)	42.0
Bogs. Marshes. Water fringed vegetation. Fens	12.0
Heath. Scrub. Maquis and garrigue. Phygrana	
Dry grassland. Steppes	
Humid grassland. Mesophile grassland	40.0
Alpine and sub-alpine grassland	
Improved grassland	
Other arable land	
Broad-leaved deciduous woodland	6.0
Coniferous woodland	
Evergreen woodland	
Mixed woodland	
Non-forest areas cultivated with woody plants (including orchards, groves, vineyards, dehesas)	
Inland rocks. Scree. Sands. Permanent snow and ice	
Other land (including towns, villages, roads, waste places, mines, industrial sites)	
Total habitat cover	100%

4.1 Other site characteristics

Soil & geology:

Alluvium, Basic, Clay, Neutral, Nutrient-rich, Peat, Sand, Sedimentary

Geomorphology & landscape:

Floodplain, Lowland, Valley

4.2 Quality and importance

Water courses of plain to montane levels with the *Ranunculon fluitantis* and *Callitricho-Batrachion* vegetation

- for which this is considered to be one of the best areas in the United Kingdom.

Vertigo moulinsiana

- for which the area is considered to support a significant presence.

Austropotamobius pallipes

- for which this is considered to be one of the best areas in the United Kingdom.

Lampetra planeri

- for which the area is considered to support a significant presence.

Cottus gobio

- for which the area is considered to support a significant presence.

4.3 Vulnerability

A stepped profile, with alternating fast- and slow-moving reaches, was imposed on the river with the construction of water-mills. Habitat diversity has been reduced by the modification of the channel form. The input of silt and agricultural chemicals as a result of arable farming practices are a concern and the reversion of arable fields to low-input grassland should be encouraged. A strategy should be devised for silt management in the river and catchment to minimise disturbance to the channel and bankside. Further development on the flood plain might alter the flow regime of the river.

More detailed studies on groundwater resources should be carried out so as to determine suitable flow objectives to ensure that the river's ecology is not threatened by water abstraction. At adjacent sewage treatment works, phosphorous removal will be a statutory requirement by 2004. However, a holistic strategy is needed to identify further mechanisms for the control of eutrophication.

Any increase in the distribution of *Pacifastacus leniusculus* within the catchment would threaten the long-term viability of *Austropotamobius pallipes*. Populations of *Lampetra planeri* and *Cottus gobio* are dependent on the maintenance of riffle habitats and might also be vulnerable to the introduction of non-native fish species. Populations of *Vertigo moulinsiana* are susceptible to interference with the emergent bank-side vegetation in which they occur.

5. Site protection status and relation with CORINE biotopes:

5.1 Designation types at national and regional level

Code	% cover
UK04 (SSSI/ASSI)	100.0

Date of Notification: 4 February 1993

COUNTY: Norfolk

SITE NAME: RIVER WENSUM

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981, section 17 of the Water Resources Act 1991, Section 4 of the Water Industry Act 1991 and Section 13 of the Land Drainage Act 1991.

National Rivers Authority Region: Anglian

International Drainage Board: River Wensum

Water Company: Anglian Water Plc

Local Planning Authorities: North Norfolk District Council, Norfolk County Council, Kings Lynn & West Norfolk District Council, South Norfolk District Council, Breckland District Council, Broadland District Council

National Grid Reference: TF 942246 to TG 250078

Length of River SSSI: Approx 71km Area: 393.31 (ha) 971.9 (ac)

Ordnance Survey Sheet 1:50,000: 132 133 134 1:10,000: TF 82 SE NE NW, TF 93 SE, TF 92 SE NE NW, TF 83 SE, TG 01 NE NW, TG 02 SW, TG 11 SE SW NW

Date of Notification (under 1981 Act): 1993

Other Information:
New site.

Description and Reasons for Notification:

Key features

The Wensum has been selected as one of a national series of rivers of special interest as an example of an enriched, calcareous lowland river. With a total of over 100 species of plants, a rich invertebrate fauna and a relatively natural corridor, it is probably the best whole river of its type in nature conservation terms, although short stretches of other similar rivers may show a slightly greater diversity of species.

The upper reaches are fed by springs that rise from the chalk and by run-off from calcareous soils rich in plant nutrients. This gives rise to dense beds of submerged and emergent vegetation characteristic of a chalk stream. Lower down, the chalk is overlain with boulder clay and river gravels, resulting in aquatic plant communities more typical of a slow-flowing river on mixed substrate. Diversity of plant species is further enhanced by mills and weirs; upstream the river slows to produce characteristic deep water plant communities, whilst below the barriers they are replaced by species tolerant of swirling and turbulent water.

Unusually for a lowland river in England, much of the adjacent land is still traditionally managed for hay crops and by grazing, giving a wide spectrum of grassland habitats some of which are seasonally inundated. The mosaic of meadow and marsh habitats, including one of the most extensive reedbeds in the country outside the Broads, provide niches for a wide variety of specialised plants and animals.

The River itself supports an abundant and diverse invertebrate fauna including the native freshwater crayfish *Austropotamobius pallipes* as well as a good mixed fishery. Brown trout *Salmo trutta fario* form the major component of the fish community of the upper

Wensum, whilst the middle and lower reaches are dominated by chub *Leuciscus cephalus*, pike *Esox lucius*, eel *Anguilla anguilla* and barbel *Barbus barbus*. Kingfisher *Alcedo atthis* and little grebe *Tachybaptus ruficollis* breed along the River, whilst the adjacent wetlands have good populations of reed warblers *Acrocephalus scirpaceus*, sedge warblers *Acrocephalus schoenobaenus* and barn owls *Tyto alba*.

Flora

In the upper reaches on gravel substrates lesser water-parsnip *Berula erecta* and the brook water-crowfoot *Ranunculus penicillatus* form a large component of the flora. Where silt has been deposited, spiked water milfoil *Myriophyllum spicatum*, blue water-speedwell *Veronica anagalis-aquatica*, opposite leaved pondweed *Groenlandia densa*, willow moss *Fontinalis antipyretica* and the nationally rare short-leaved starwort *Callitriche truncata* occur.

The middle and lower stretches of the river are characterised by rich lowland plant communities. The dominants are yellow water-lily *Nuphar lutea*, flowering rush *Butomus umbellatus*, fennel pondweed *Potamogeton pectinatus*, perfoliate pondweed *Potamogeton perfoliatus*, arrowhead *Sagittaria sagittifolia* and unbranched bur-reed *Sparganium erectum*. Variations in the aquatic plant community reflect the alternation of fast-flowing shallows with deep slow-moving water. Other species with widespread distribution along the Wensum include rigid hornwort *Ceratophyllum demersum*, spiked water-milfoil *Myriophyllum spicatum*, fan-leaved water-crowfoot *Ranunculus circinatus*, branched bur-reed *Sparganium erectum*, common club-rush *Scirpus lacustris*, horned pondweed *Zannichellia palustris* and the nationally scarce river water-dropwort *Oenanthe fluviatilis*.

The marginal and bankside communities are typical of lowland rivers. Often there are dense and continuous stands of reeds or sedges. Reed sweet-grass *Glyceria maxima* is dominant in the lower reaches. Elsewhere stands of reed canary-grass *Phalaris arundinacea*, greater pond-sedge *Carex riparia*, reedmace *Typha latifolia* and common reed *Phragmites australis* are widespread. Where edges are not dominated by tall emergents, straggling or low-growing herbs such as fool's water-cress *Apium nodiflorum*, water-mint *Mentha aquatica*, water forget-me-not *Myosotis scorpioides* and brooklime *Veronica becaabunga* occur.

Of the semi-natural habitats associated with the River, the most frequently occurring are acidic or neutral unimproved wet grasslands. The flora of these grasslands is typified at Helhoughton and Turf Common by bogbean *Menyanthes trifoliata*, marsh marigold *Caltha palustris*, yellow rattle *Rhinanthus minor*, ragged robin *Lychnis flos-cuculi*, southern marsh orchid *Dactylorhiza praetermissa*, common spotted orchid *Dactylorhiza fuchsii*, water mint *Mentha aquatica* and yellow iris *Iris pseudacorus*.

Elsewhere the land is seasonally inundated so that grazing is restricted; extensive areas of reedbed and tall mixed fen communities have developed which provide valuable breeding and hunting grounds for birds such as the barn owl *Tyto alba* and hen harrier *Circus cyaneus*. Examples include Guist Common which is reed dominated; Goggs Mill Reserve near Fakenham which has a mixed fen community with species such as meadowsweet *Filipendula ulmaria*, angelica *Angelica sylvestris* and meadow rue *Thalictrum flavum*, and Sculthorpe Moor, which although gradually being invaded by willow *Salix* spp. scrub has a fen community of saw sedge *Cladium mariscus* and black bog-rush *Schoenus nigricans*. Although there are several areas of alder swamp interspersed with the above communities, Guist Carr forms the main example of wet woodland within the SSSI.

All of the habitats within the SSSI are intrinsically linked to and dependent on the River for their continued existence. Appropriately, in times of drought, these adjacent wetlands have a vital role in buffering the river against low flows; in wetter periods they absorb river flood waters and become swamp-like in nature.

Two tributaries have been included in the SSSI, the Tat and the Langor Drain. They are both major flow contributors to the main river; historically, the Tat may have been the

original Wensum. The Langor valley comprises an extensive area of semi-natural habitat which is dominated by fen vegetation. The specific composition ranges from almost exclusively reed to a mixture of meadowsweet and sedge species. Parts of Little Ryburgh Common are grazed, having bittersweet *Solanum dulcamara*, branched bur-reed *Sparganium erectum*, water cress *Rorippa nasturtium-aquaticum*, greater tussock sedge *Carex paniculata*, lesser water parsnip *Berula erecta*, water mint *Mentha aquatica*, and marsh marigold *Caltha palustris* as elements in their flora. The vegetation of the drier areas of Little Ryburgh Common includes bracken *Pteridium aquilinum*, honeysuckle *Lonicera periclymenum*, field scabious *Knautia arvensis*, harebell *Campanula rotundifolia* and soft rush *Juncus effusus*.

Invertebrates

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

County Wildlife Site
(Ref No. 2070)

Site Name: River Wensum Pastures, Morton Hall

**Parish: Morton on the
Hill/Ringland**

Grid Reference: TG 132 157

Area: 37.0 ha

Site description:

A moderately large, open area of predominately improved cattle-grazed pasture adjacent to the River Wensum SSSI, crossed by a network of drains supporting a species-rich flora associated with aquatic habitats.

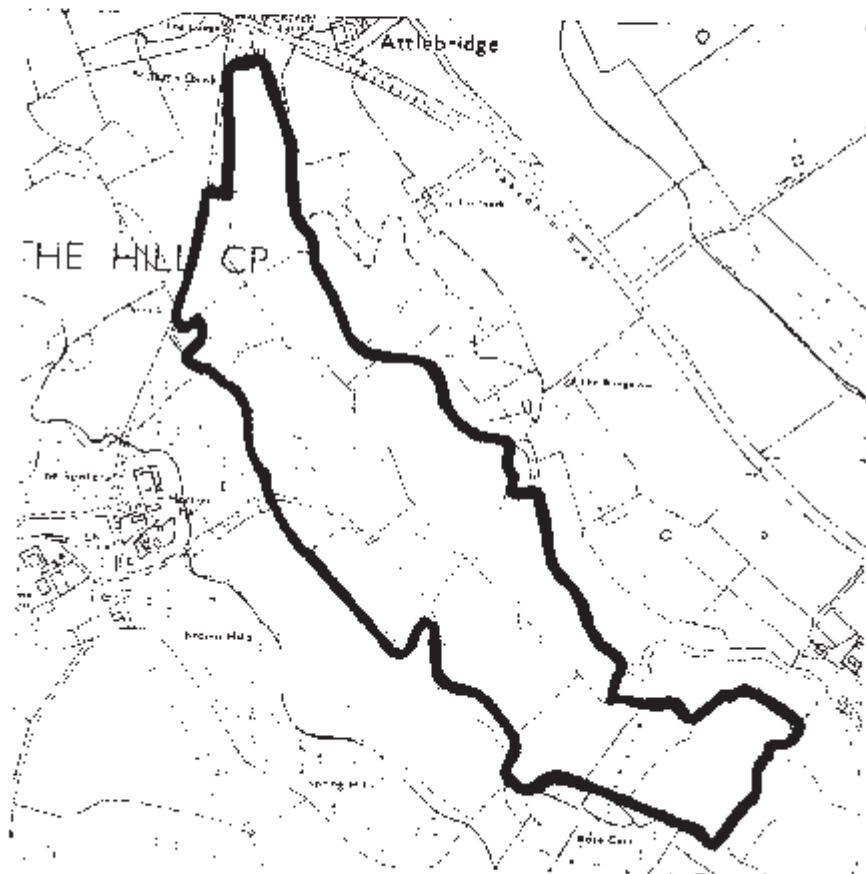
The site lies within the Broads ESA and constitutes part of the Morton Estate. It lies on the flat Wensum floodplain and is subject to periodic flooding. Parts of the site are undulating in relief and ephemeral ponds form in some of the hollows.

Low lying neutral grassland is dominated by coarse grasses to a short sward. Yorkshire fog (*Holcus lanatus*), cock's foot (*Dactylis glomerata*) and perennial rye grass (*Lolium perenne*) are predominant, with frequent creeping bent (*Agrostis stolonifera*). At the peripheries, the vegetation is frequently taller and less intensively grazed, with nettle (*Urtica dioica*), and creeping thistle (*Cirsium arvense*) and there are patches of damper grassland where finer herbs, including silverweed (*Potentilla anserina*), meadow buttercup (*Ranunculus acris*) and creeping cinquefoil (*Potentilla reptans*) are frequent. The grassland is wetter towards the southeastern end of the site, with patches of dominant tufted hair grass (*Deschampsia cespitosa*) and creeping buttercup (*Ranunculus repens*).

There are tree lines and occasional trees and scrub scattered across the site. Species include grey poplar (*Poplar x canescens*), oak (*Quercus robur*) and crack willow (*Salix fragilis*). A low lying loop adjacent to the river holds standing surface water with emergent reed sweet grass (*Glyceria maxima*) and patches of water starwort (*Callitriche*), with pink water speedwell (*Veronica catenata*), water pepper (*Polygonum hydropiper*) and whorl grass (*Catabrosa aquatica*).

A flowing, tributary drain bisects the site, running parallel with the river, from which stems a network of lateral and sub-lateral drains. The drains hold standing surface water and support a species rich marginal aquatic flora. Reed sweet grass is dominant in places and there are large patches of common reed (*Phragmites australis*). Water starwort, Canadian pond weed (*Elodea canadensis*), water crow foot (*Ranunculus*), fool's water cress (*Apium nodiflorum*), branched bur reed (*Sparganium erectum*) and small pond weed (*Potamogeton berchtoldii*) are present, with water cress (*Nasturtium officinale*) and lesser water parsnip (*Berula erecta*) in shallow, fast flowing sections of the principle drain. Marginal species include meadowsweet (*Filipendula ulmaria*), great willowherb (*Epilobium hirsutum*), wild angelica (*Angelica sylvestris*), hemp agrimony (*Eupatorium cannabinum*), common marsh bedstraw (*Galium palustre*), ragged robin (*Lychnis flos-cuculi*), purple loosestrife (*Lythrum salicaria*), water mint (*Mentha aquatica*), water figwort (*Scrophularia auriculata*), green figwort (*Scrophularia umbrosa*), marsh woundwort (*Stachys palustris*) and common meadow rue (*Thalictrum flavum*), reed canary grass (*Phalaris arundinacea*), cyperus sedge (*Carex pseudocyperus*), greater tussock sedge (*Carex paniculata*), pond sedge (*Carex*) and jointed rush (*Juncus articulatus*). Trees, including alder (*Alnus glutinosa*), white willow (*Salix alba* agg), grey willow (*Salix cineria*), oak and ash (*Fraxinus excelsior*) line the banks of the drains in places.

Survey date: 31.07.1998



Local Authority No. 076260

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Norfolk County Council
County Hall
Norwich

Date

**County Wildlife Site
(Ref No: 1343)**

Site Name: Attlebridge Hills

Parish: Attlebridge

Grid Reference: TG 143152

Area: 24.0 ha

Site Description:*

This site is a varied structure, broad-leaved semi-natural woodland.

The canopy is dominated by mature oak (*Quercus robur*), sycamore (*Acer pseudoplatanus*), sweet chestnut (*Castanea sativa*) with extensive areas of mixed coppice of hazel (*Corylus avellana*), sycamore and sweet chestnut.

The ground flora is typical of such woodlands but also contains red campion (*Silene dioica*), viper's bugloss (*Echium vulgare*), nipplewort (*Lapsana communis*) and common centaury (*Centaureum erythraea*).

*Based on the Wensum Valley Project 1993 Survey.

**County Wildlife Site
(Ref No: 1344)**

Site Name: Triumph and Foxburrow Plantations

Parish: Attlebridge

Grid Reference: TG 145165

Area: 50.4 ha

Site Description:*

This site is a mixed broad-leaved woodland with good rides. The site is bordered by arable land to the east and west and a tip to the south. A pheasant track runs along the edge of the wood in parts.

The woodland canopy is dominated by sweet chestnut (*Castanea sativa*), oak (*Quercus robur*) and birch (*Betula* spp.) with the occasional larch (*Larix* spp.) and pine (*Pinus* spp.). The coppice layer is mostly hazel (*Corylus avellana*) while some of the sweet chestnut coppices may be a century old.

The ground flora is a mixture of red campion (*Silene dioica*), herb-Robert (*Geranium robertianum*) wood sage (*Teucrium scorodonia*) and on the open grassy rides marsh cudweed (*Gnaphalium uliginosum*) is found.

*Based on the Wensum Valley Project 1993 Survey.

**County Wildlife Site
(Ref No: 1351)**

Site Name: Walsingham Plantation

Parish: Taverham

Grid Reference: TG 155153

Area: 8.9 ha

Site Description:*

This site is a broad-leaved semi-natural woodland adjacent to the A1067.

The canopy is predominantly oak (*Quercus robur*) with silver birch (*Betula pendula*), beech (*Fagus sylvatica*), and sycamore (*Acer pseudoplatanus*). The canopy is high and broken in places. The coppice layer is slight and mainly elder (*Sambucus nigra*).

The ground flora is bracken (*Pteridium aquilinum*), and bramble (*Rubus fruticosus* agg.), ivy (*Hedera helix*) and ground-ivy (*Glechoma hederacea*) is most common. Moschatel (*Adoxa moschatellina*), climbing corydalis (*Corydalis claviculata*) and herb-Robert (*Geranium robertianum*), red campion (*Silene dioica*) and wood avens (*Geum urbanum*) are also found.

*Based on the 1985 habitat survey (NWT).

**County Wildlife Site
(Ref No: 2176)**

Site Name: Marriott's Way

Parish: Various

Grid Reference: TG 196103-195265

Area: 69 ha

Site Description:

Marriott's Way follows a disused railway line which closed finally in 1985, and is now used by walkers, cyclists and horse-riders. A firm track has been laid along its whole length. There are numerous access points with steps to the track and small roadside parking bays. This citation covers the 35km from Hellesdon to Aylsham, via Reepham, though the path does continue into Norwich city centre.

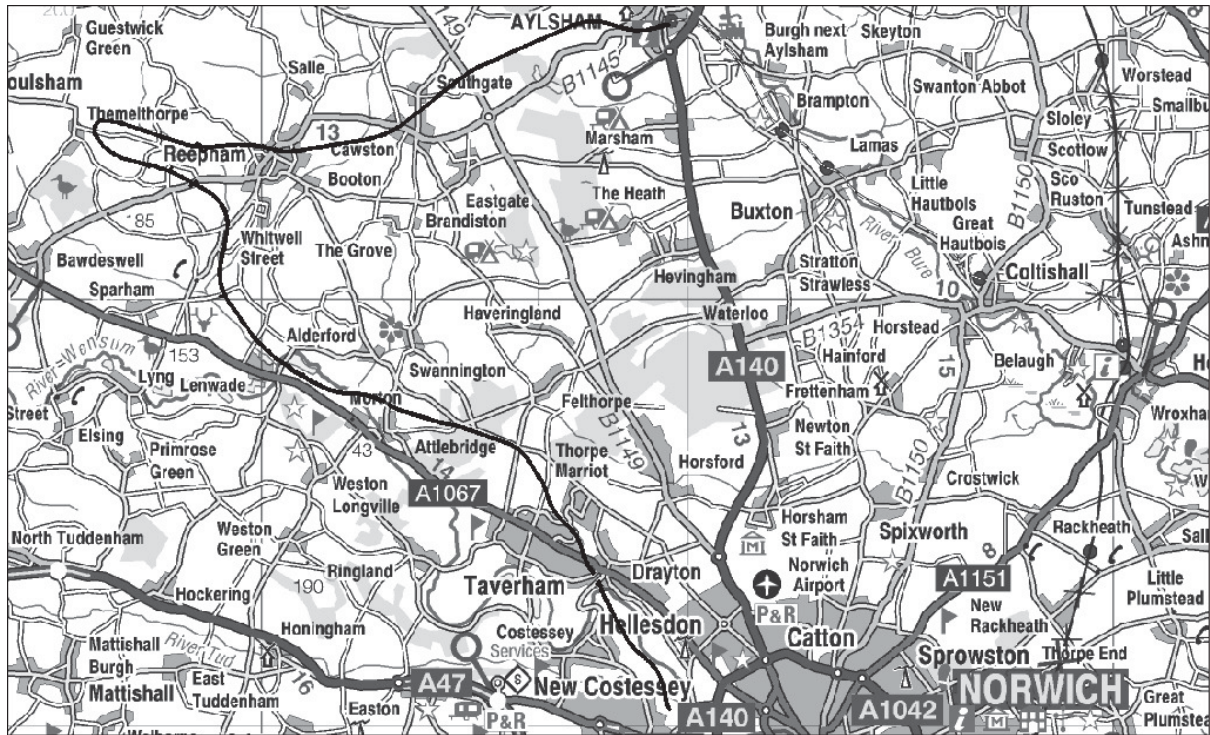
The central track is generally unvegetated. However, the track edges present one type of habitat and each side of the track up to the railway fence offers another. These aspects all vary along the path, with cuttings and embankments, different soils and the influence of water on the vegetation. The arrival of the railway was an imposition on the land, with some watercourses being piped under the track but other, smaller, ones being left to create wet areas alongside the embanked track. In some places, the track sliced through woodlands, as in Attlebridge Woods and New Plantation, Reepham. In others it has cut off the corner of a field, which has since become scrub. Cuttings and embankments often have a more diverse flora: possibly as relics of a woodland flora with plants such as sanicle *Sanicula europaea*, yellow archangel *Lamiastrum galeobdolon*, bluebell *Hyacinthoides non-scripta* and moschatel *Adoxa moschatellina*, or wetland plants and trees which may grow in damp or wet ground, often at the base of an embankment, such as grey willow *Salix cinerea*, common reed *Phragmites australis*, great horsetail *Equisetum telmateia* and hemp agrimony *Eupatorium cannabinum*. Often loose stones, cinders and coal lie on embankment slopes, and in places fallen trees and shrubs help in the diversification of woodland habitats.

Trees and scrub are the dominant vegetation along Marriott's Way, forming an almost continuous corridor as far as Reepham, with a more scattered coverage eastward to Aylsham. Oak *Quercus robur* and hawthorn *Crataegus monogyna* occur all the way along the path, with occasional other locally frequent species such as sweet chestnut *Castanea sativa* in the woods at Attlebridge, or alder *Alnus glutinosa* at Whitwell Common, and other species occurring with varying frequency. New Plantation at Reepham is included within the County Wildlife Site. It is a semi-natural broadleaved woodland of ash *Fraxinus excelsior*, sycamore *Acer pseudoplatanus* and sweet chestnut with a ground flora including common twayblade *Listera ovata*, yellow archangel, wood anemone *Anemone nemorosa*, bluebell and dog's mercury *Mercurialis perennis*.

Grassland and forbs growing within it form the greatest component of the vegetation. Much of Marriott's Way is on acidic ground, with light, sandy soil but plants also found in neutral and basic soils seem to occur alongside one another. Species such as greater knapweed *Centaurea scabiosa*, field scabious *Knautia arvensis*, mouse-ear hawkweed *Pilosella officinarum* and wild carrot *Daucus carota* are characteristic of basic grassland; these occur alongside neutral grassland species such as germander speedwell *Veronica chamaedrys*, common sorrel *Rumex acetosa*, knapweed *Centaurea nigra* and false oat grass *Arrhenatherum elatius* and acidic grassland plants including bracken *Pteridium aquilinum*, wood sage *Teucrium scorodonia* and creeping cinquefoil *Potentilla reptans*.

Some less common plants that occur along Marriott's Way include yellow archangel, basil thyme *Clinopodium acinos*, wild marjoram *Origanum vulgare*, hellebores along the track edge, moschatel, maidenhair spleenwort *Asplenium trichomanes ssp quadrivalens* and locally abundant sanicle.

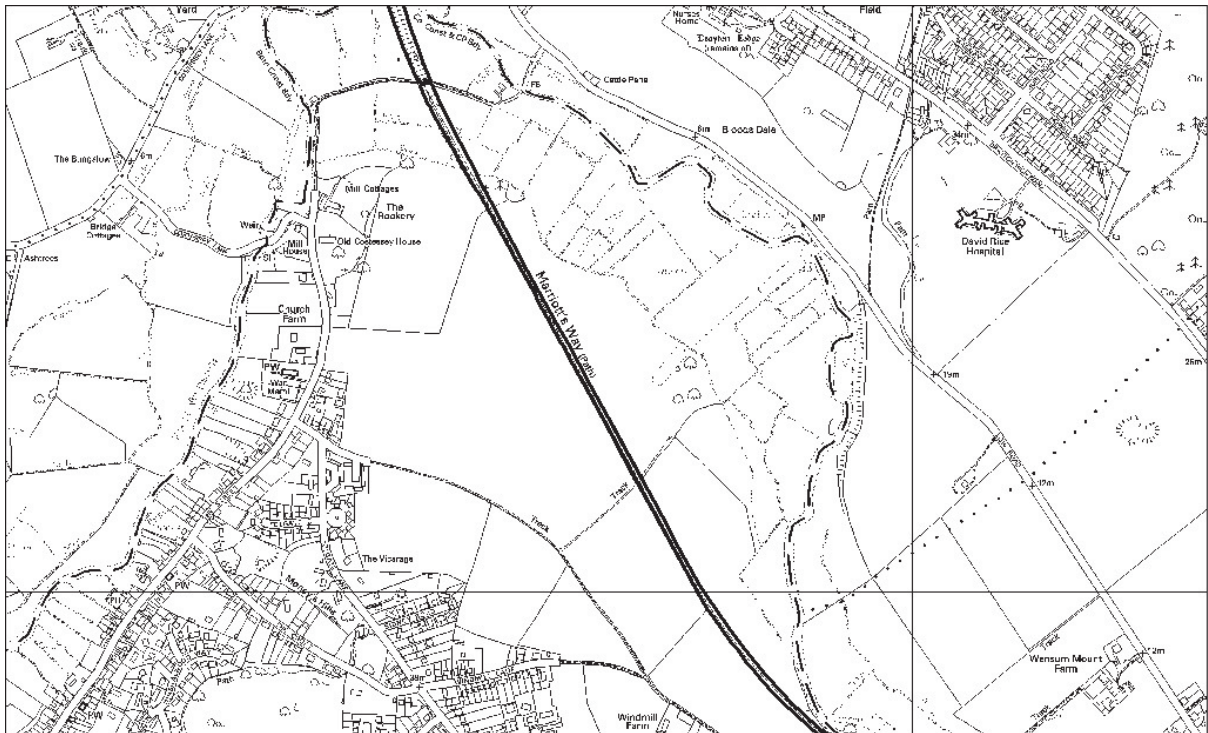
Badger setts occur and bats are known to roost beneath bridges and use the route for commuting and foraging.



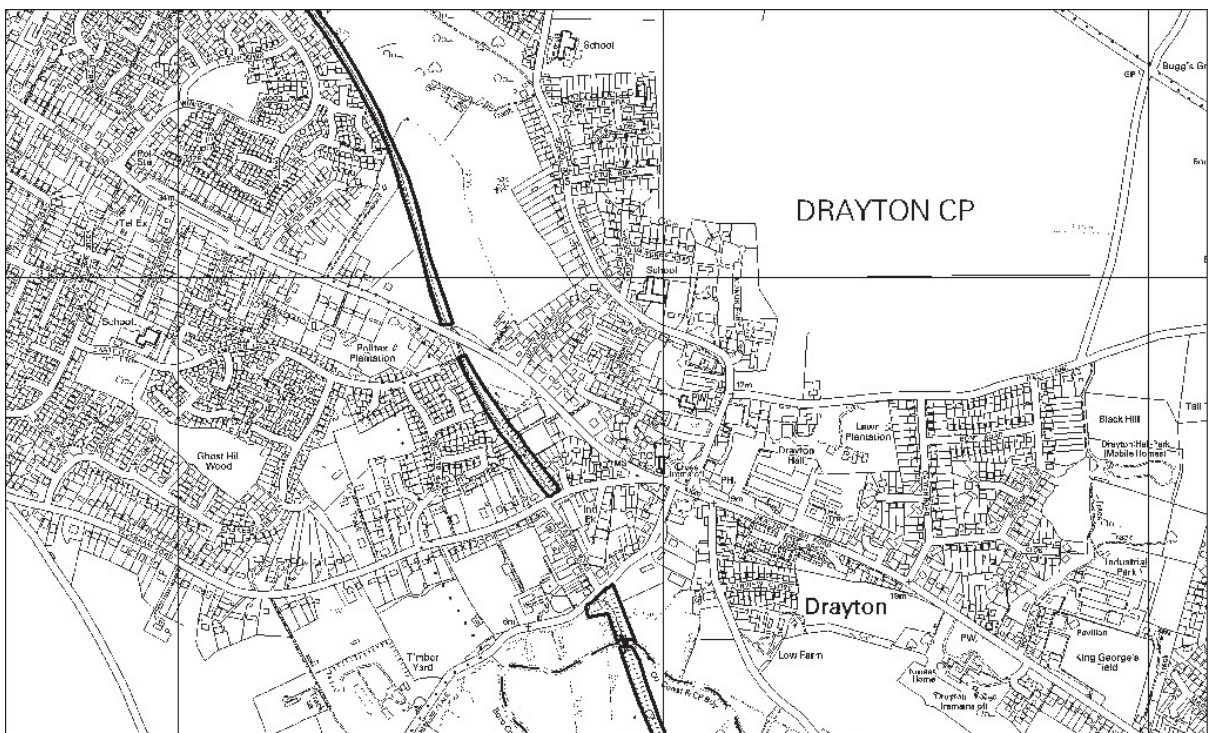
Marriott's Way, overview



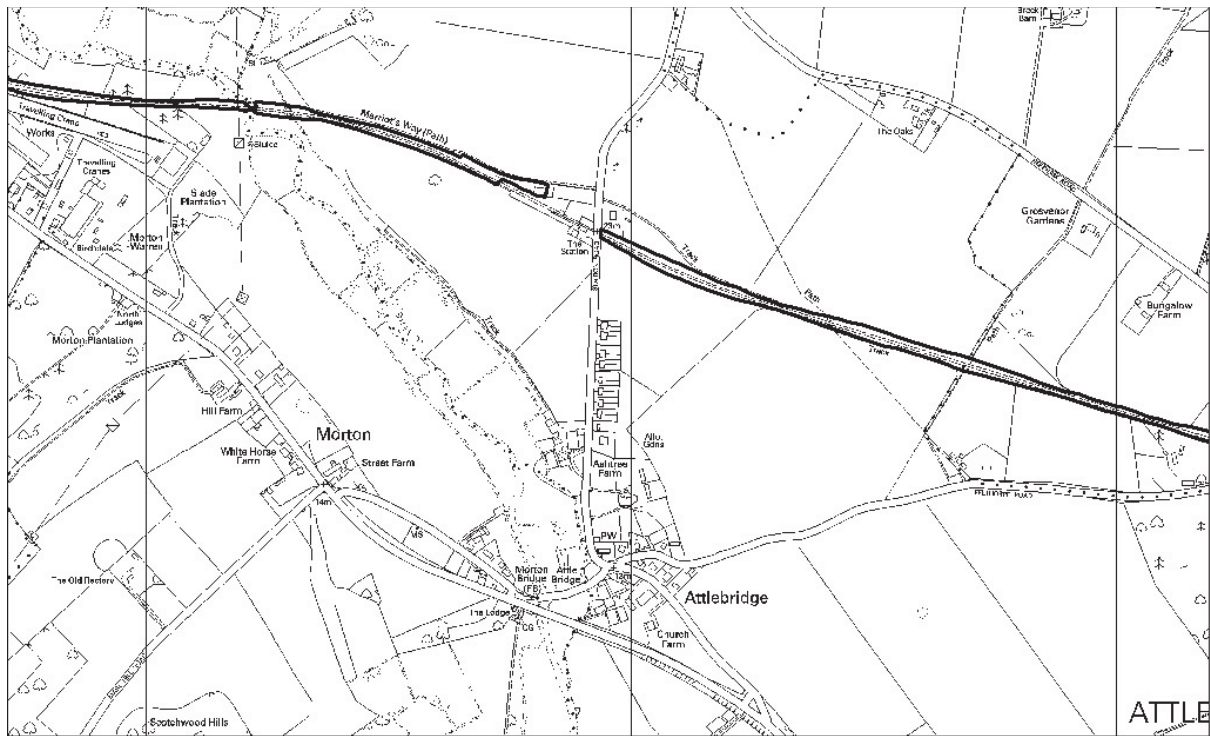
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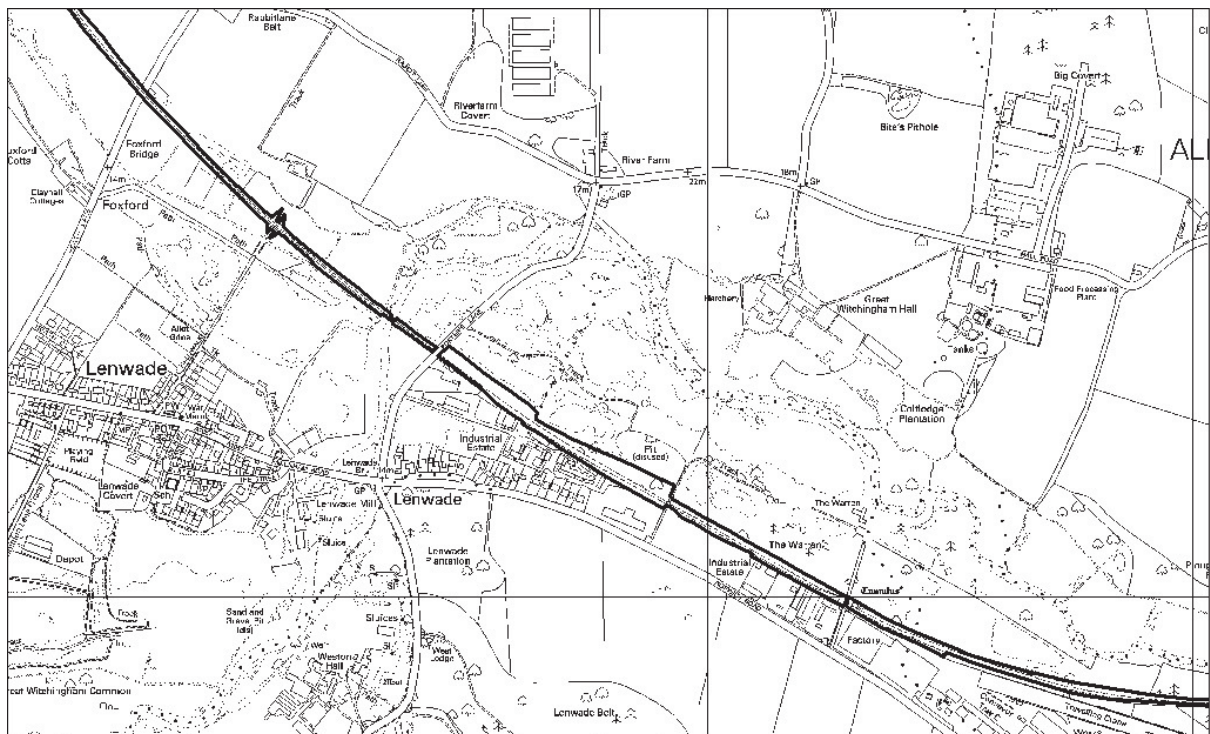
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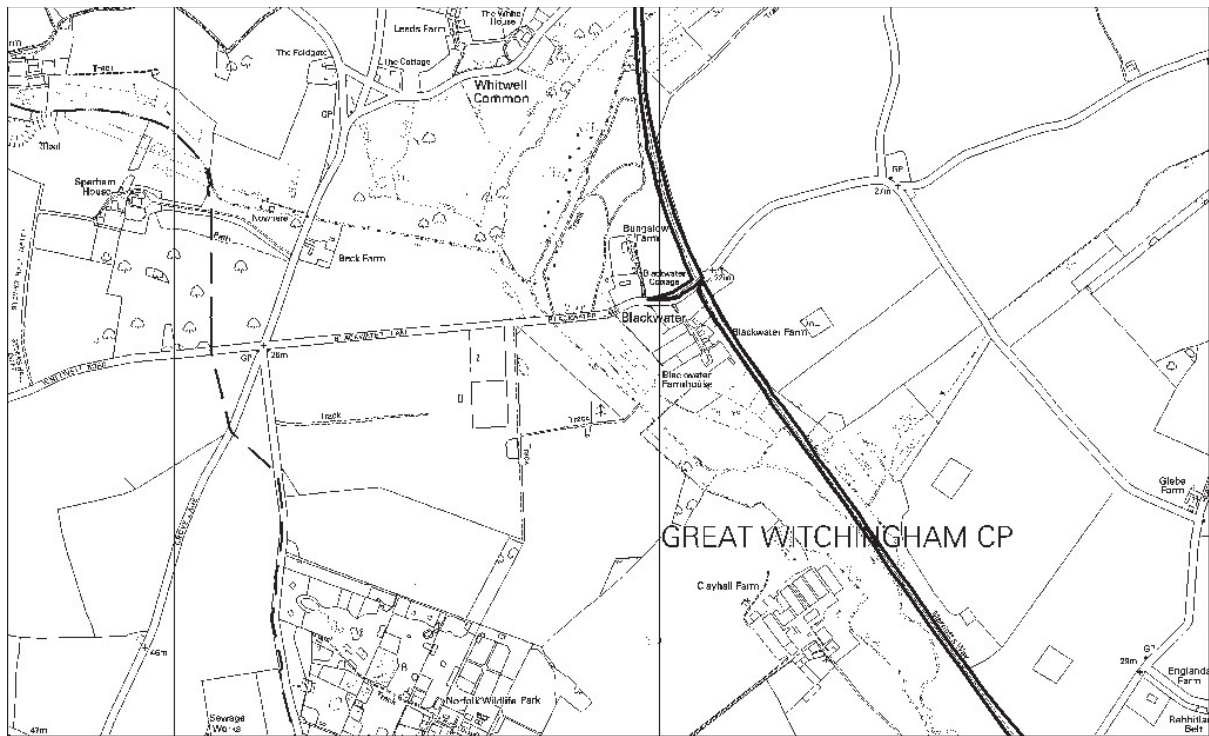
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Section 6



Section 7



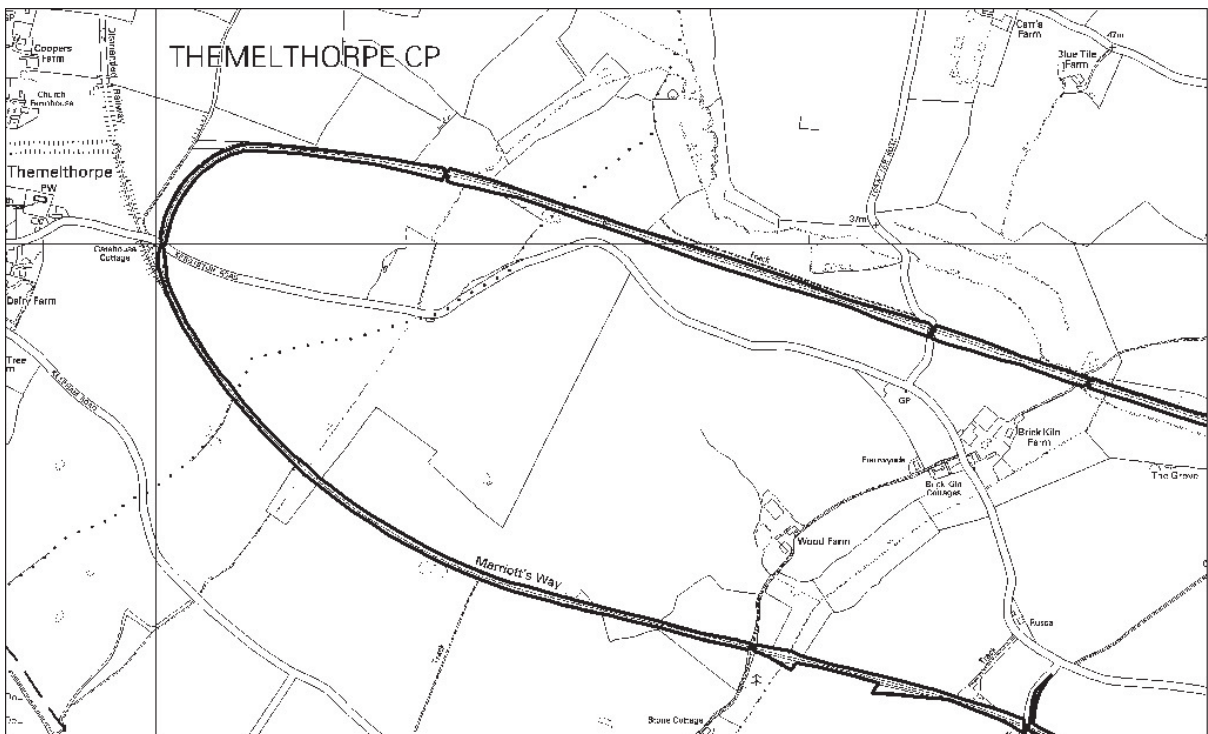
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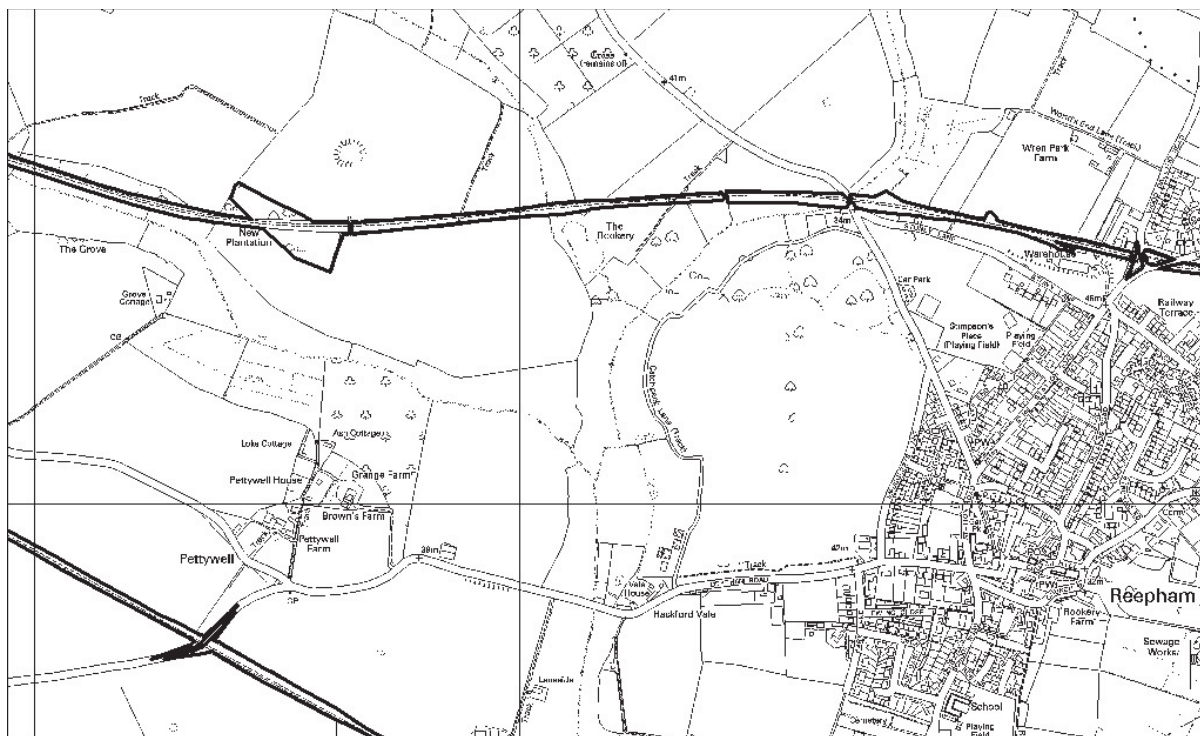
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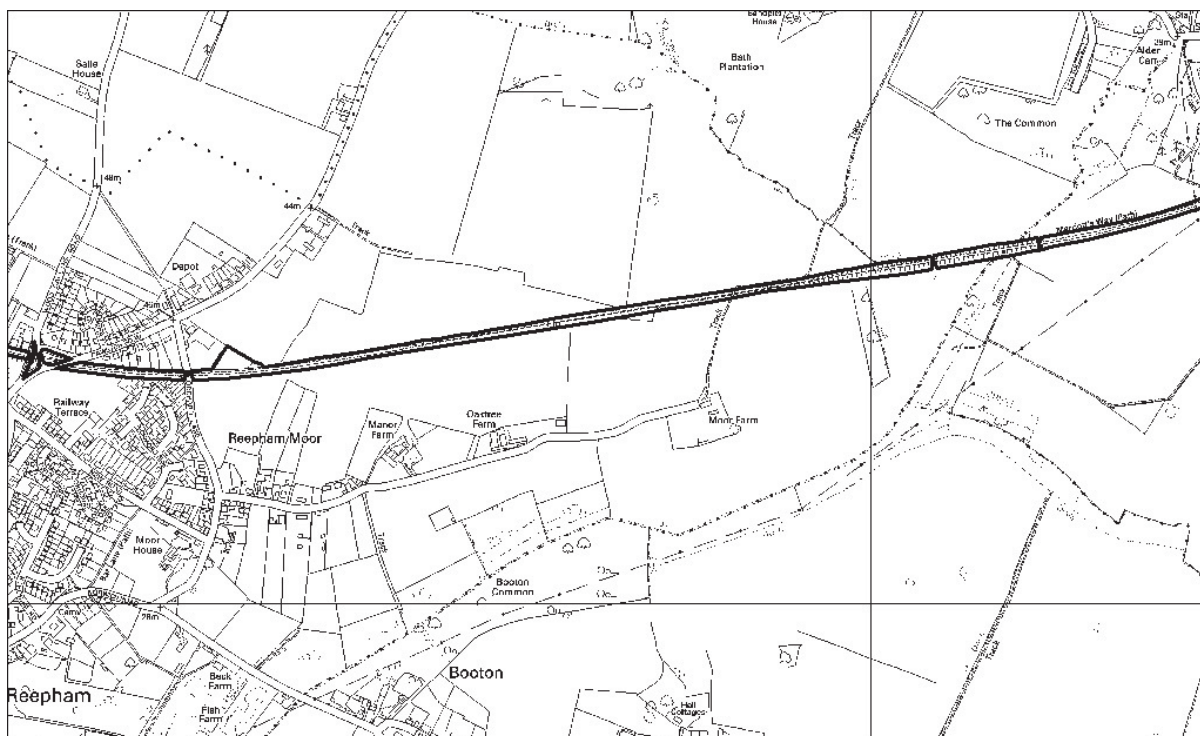
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Section 11



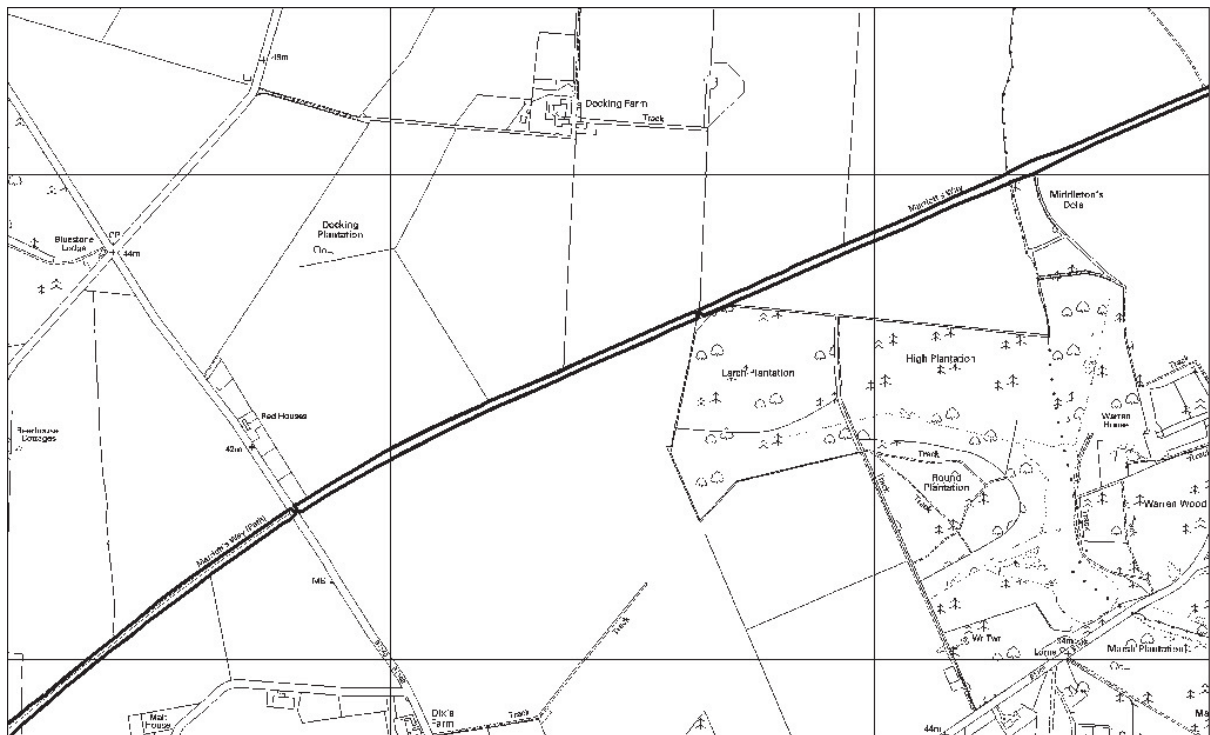
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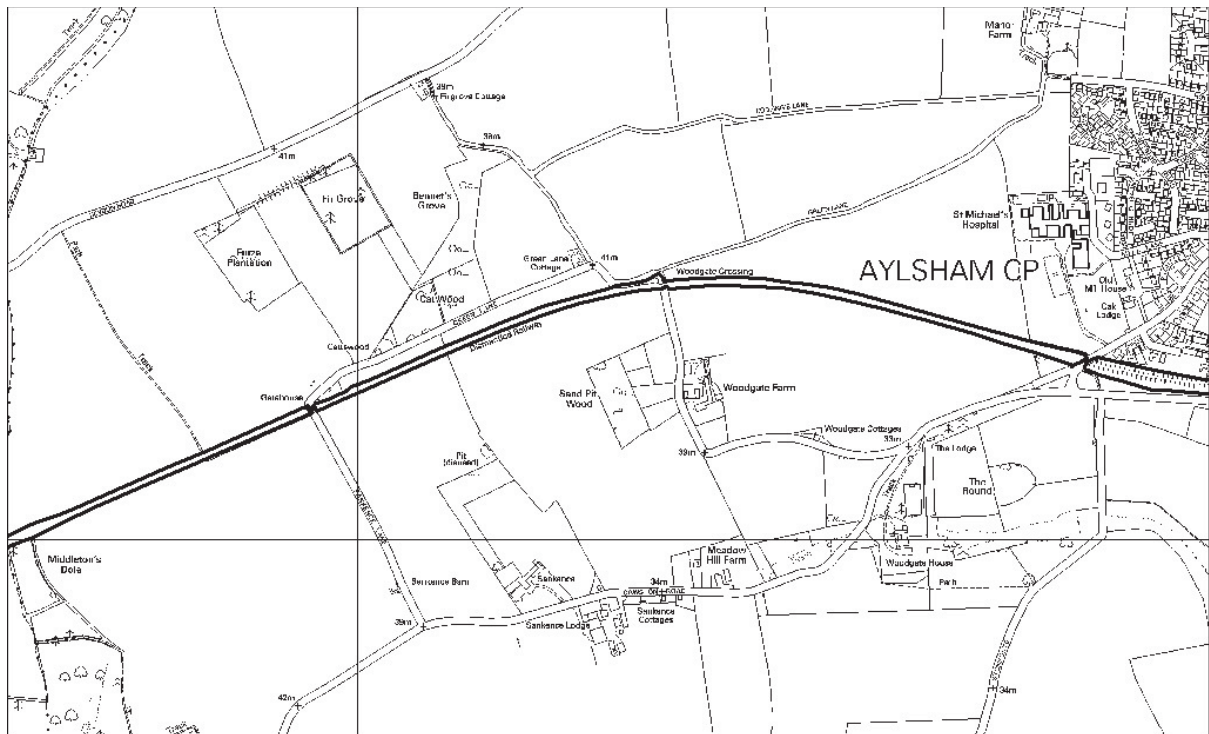
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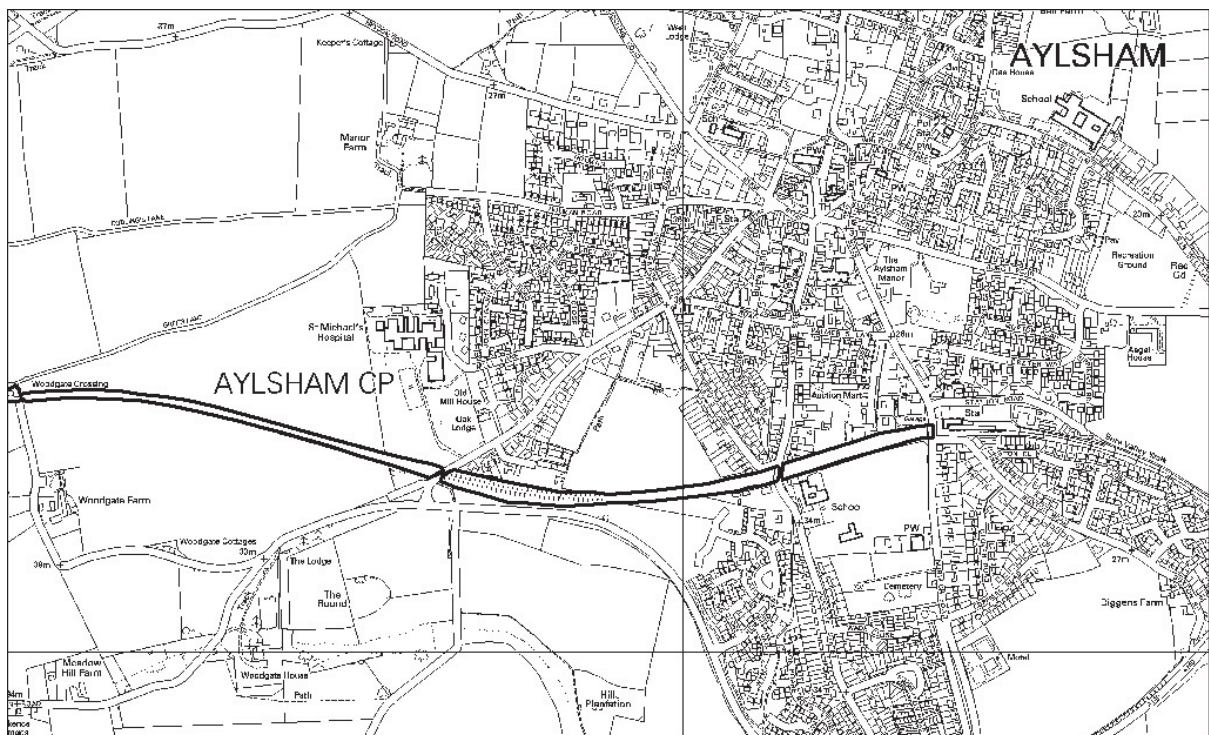
Section 14



Section 15



Section 16



Section 17

**County Wildlife Site
(Ref No: 1352)**

Site Name: Whinny Hills and Commons

**Parish: Felthorpe/
Horsford/Drayton**

Grid Reference: TG 178170

Area: 57.6 ha

Site Description:

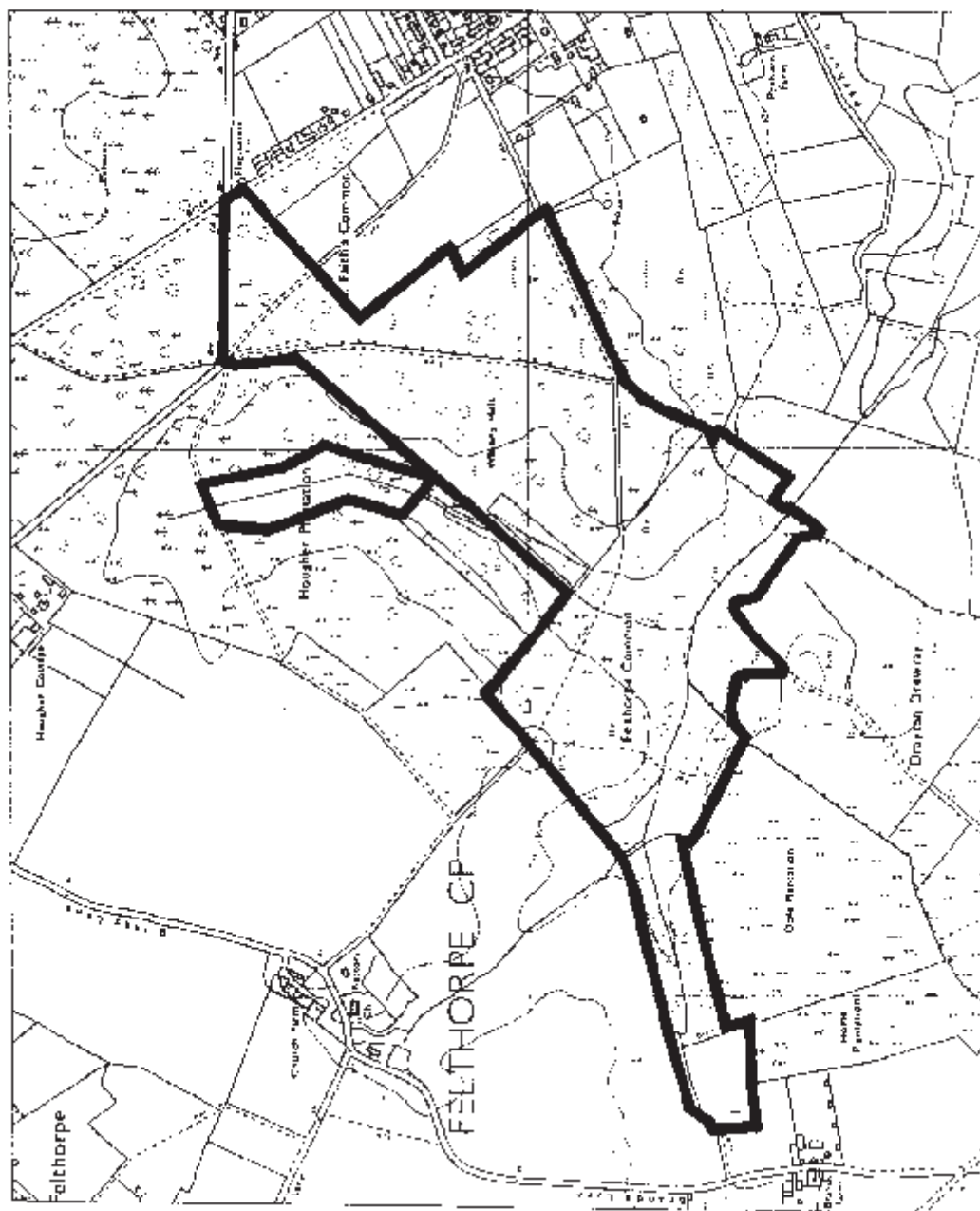
This site is a large area of common land. Formerly most would have been heathland but the area now supports mature acid woodland, although patches of heathland do still occur within the site. On lower marshy ground, older areas of woodland support alder (*Alnus glutinosa*) whilst in other areas sweet chestnut (*Castanea sativa*) coppice occurs.

On the higher, dry ground the canopy consists of a mixture of mature and semi-mature trees. Silver birch (*Betula pendula*) is most common with frequent oak (*Quercus robur*) and rowan (*Sorbus aucuparia*), the latter often occurring as saplings. In mixed areas pine (*Pinus* sp.) is present and has possibly been planted, whilst holly (*Ilex aquifolium*) is scattered throughout. The ground flora is not diverse and both bramble (*Rubus fruticosus* agg.) and bracken (*Pteridium aquilinum*) are common. Heather (*Calluna vulgaris*) is abundant in places as a remnant of the former habitat.

In wetter areas the woodland has a different character with a canopy dominated by mature coppiced alder. Ash (*Fraxinus excelsior*) is common here and completes the canopy over a shrub layer of elder (*Sambucus nigra*), bird-cherry (*Prunus padus*), red currant (*Ribes rubrum*) and guelder-rose (*Viburnum opulus*). The ground flora is diverse with bryophytes which are often important. Large carpets of moss (*Sphagnum* sp.) are present locally whilst elsewhere water mint (*Mentha aquatica*), primrose (*Primula vulgaris*), meadowsweet (*Filipendula ulmaria*), gipsywort (*Lycopus europaeus*) and nettle (*Urtica dioica*) occur together. More locally are found ferns (*Dryopteris* spp.), marsh marigold (*Caltha palustris*) and greater pond-sedge (*Carex riparia*). Open spring flushes support jointed rush (*Juncus articulatus*), Yorkshire fog (*Holcus lanatus*) and common sorrel (*Rumex acetosa*).

The centre of the site is derelict sweet chestnut coppice over a poor ground flora with no heather.

To the north-east of the site is an area of wet heath with abundant tall heather and dense tussocks of purple moor-grass (*Molinia caerulea*). Patches of cross-leaved heath (*Erica tetralix*) and common cotton-grass (*Eriophorum angustifolium*) occur locally. The area is not grazed and there is some encroachment of scrub. Lower down the heath grades into marshy grassland.



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County Wildlife Site
(Ref No: 1395)

Site Name: Black Park & The Thicket

Parish: Horsford

Grid Reference: TG 208162

Area: 32.52 ha

Site Description:

This is a large area of oak *Quercus robur* dominated acid woodland types. The ground flora is varied with a wide range of species. The eastern end of the site has several ponds, some very large with their own flora. There are a number of wet and dry ditches, and many old hedgebanks and old boundaries. CWS 1394, The Wilderness, is adjacent to the east. An ancient monument, Castle Hill, is a separate small site to the south. A public footpath passes through the north-western corner.

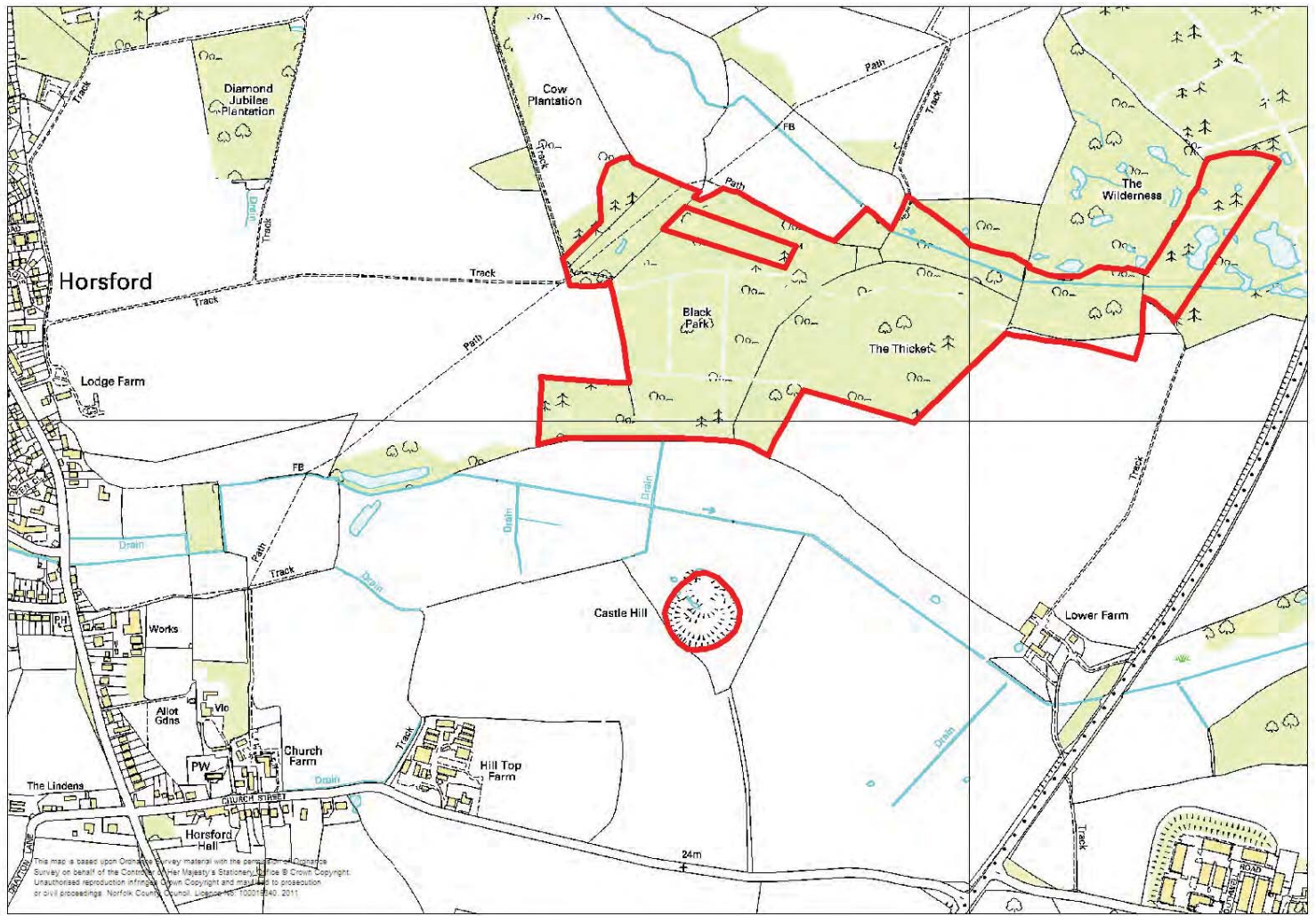
The main part of the site is dry oak-dominated woodland, with many standard trees and a big area of well-spaced mature trees to the north. Scot's pine *Pinus sylvestris* grow occasionally. Hazel *Corylus avellana* and silver birch *Betula pendula* make up most of the understorey, with sometimes one or the other becoming more dominant. Additional species include rowan *Sorbus aucuparia*, rhododendron *Rhododendron ponticum* and holly *Ilex aquifolium*, with locally abundant broad buckler fern *Dryopteris dilatata*. The ground flora is dominated by bracken *Pteridium aquilinum*, but parts of the site are floristically-rich, with species including bluebell *Hyacinthoides non-scripta*, yellow pimpernel *Lysimachia nemorum*, dog's mercury *Mercurialis perennis*, bugle *Ajuga reptans*, wood anemone *Anemone nemorosa*, primrose *Primula vulgaris*, pignut *Conopodium majus*, creeping corydalis *Ceratocarpus claviculata* and three-nerved sandwort *Moehringia trinervia*, with locally frequent areas of wood sorrel *Oxalis acetosella*. Wood sage *Teucrium scorodonia* and greater stitchwort *Stellaria holostea* also occur on the woodland edges.

The Thicket has a lot of planted broadleaf trees, mainly oak, with a few Scot's pine. The ground flora here includes creeping soft-grass *Holcus mollis*, sweet vernal-grass *Anthoxanthum odoratum*, creeping corydalis and three-nerved sandwort.

There are numerous small, and several large, ponds in the south-eastern part of the site. Although some of the Scots pine have been cleared from here, leaving oak and birch to dominate the woodland, this is still the most coniferous part of the wood. Alder *Alnus glutinosa*, hazel, rowan and grey willow *Salix cinerea* also occur, with abundant bracken beneath. Marginal vegetation is dominated by common bulrush *Typha latifolia* and yellow iris *Iris pseudacorus* with surrounding species including brown sedge *Carex disticha*, great yellow-cress *Rorippa amphibia*, remote sedge *Carex remota* and tufted sedge *Carex elata*.

Both wet and dry ditches occur around the site, with the wet ditches supporting species such as remote sedge, alder, fool's water-cress *Apium nodiflorum* and bugle. A line of spindle *Euonymus europaeus* edges a wet ditch in the middle of the wood.

There are a number of old boundary banks within the wood, often with old oak pollards and hazel on them, or old hawthorn *Crataegus monogyna* hedge. Hazel edges the wood in the south-west.



**County Wildlife Site
(Ref No: 2178)**

Site Name: Horsham Meadows

Parish: Horsham St Faith

Grid Reference: TG 214155

Area: 8.5ha

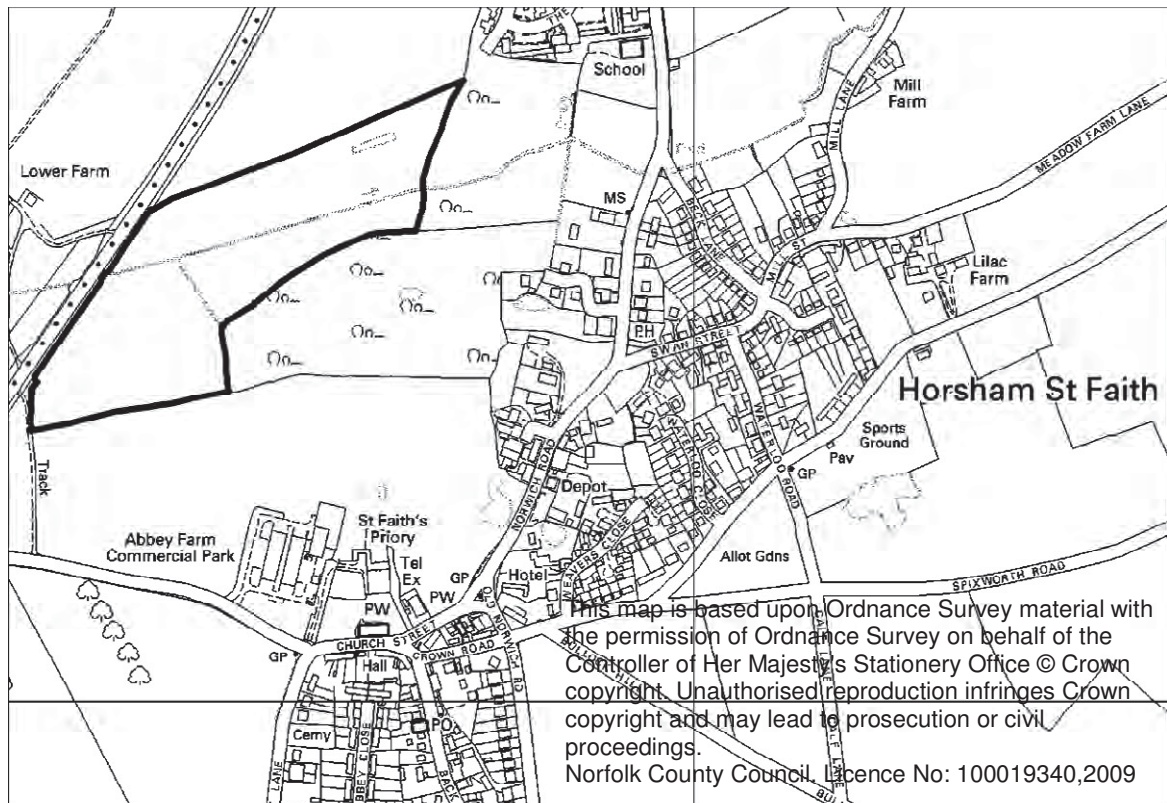
Site Description:

This site consists of three fields of cattle-grazed pasture, over heavily undulating terrain. A small stream runs from west to east.

A number of large, shallow hollows, believed to be either fossil pingos or thermokarst hollows, are a significant feature of the site. Many hold water during the winter months, and support a very diverse, often fen-like flora. Some are dominated by a single or narrow range of species, such as flote-grasses (*Glyceria* spp.) or a single sedge; while others are more diverse, with species such as jointed rush (*Juncus articulatus*), soft rush (*Juncus effusus*), hard rush (*Juncus inflexus*), compact rush (*Juncus compressus*), common spike rush (*Eleocharis palustris*), reed sweet-grass (*Glyceria maxima*), common sedge (*Carex nigra*), lesser spearwort (*Ranunculus flammula*), greater bird's-foot trefoil (*Lotus corniculatus*), silverweed (*Potentilla anserina*) and hairy sedge (*Carex hirta*). The vegetation in some hollows is akin to fen meadow, with abundant ragged robin (*Lychnis flos-cuculi*), lesser spearwort, southern marsh orchid (*Dactylorhiza praetermissa*), greater bird's-foot trefoil, water-mint (*Mentha aquatica*), red clover (*Trifolium pratense*), marsh thistle (*Cirsium palustre*), square stalked St John's wort (*Hypericum tetrapterum*), meadow vetchling (*Lathyrus pratensis*), lady's smock (*Cardamine pratense*), and hard and soft rush. In the north meadow, the depressions are more typical of true fen, with species such as purple loosestrife (*Lythrum salicaria*), fool's watercress (*Apium nodiflorum*), large bitter-cress (*Cardamine amara*), lesser water-parsnip (*Berula erecta*), lesser pond sedge (*Carex acutiformis*) and fen bedstraw (*Galium uliginosum*).

The grassland surrounding the hollows is generally less diverse, and frequently damp and tussocky. The dominant species are Yorkshire fog (*Holcus lanatus*), creeping buttercup (*Ranunculus repens*), locally abundant sweet vernal grass and occasional field horsetail (*Equisetum arvense*). False oat-grass (*Arrhenatherum elatius*) dominates along the streamsides, while damper areas support frequent to abundant hard and soft rush and hairy sedge. Interspersed are locally frequent square-stalked St John's wort, lesser stitchwort (*Stellaria graminea*), self-heal (*Prunella vulgaris*), cinquefoil (*Potentilla reptans*), white clover (*Trifolium repens*) and occasional ragged robin, common spotted (*Dactylorhiza fuchsii*) and southern marsh orchids, meadow vetchling, meadow buttercup and lady's-smock. Areas of tall ruderal vegetation also occur at some of the field margins.

An area of tall reed grading into mature willow scrub and more mature tree cover occupies a narrow block at the north-east corner of the site. The small stream which bisects the site is mainly sluggish and silted, becoming briefly faster-flowing and shallower close to the junction with the ditch. It is unvegetated apart from a small quantity of starwort (*Callitriche* sp.) at the western end.



County Wildlife Site
(Ref No: 2205)

Site Name: Spixworth Bridge Meadows

Parish: Spixworth

Grid Reference: TG 089 165

Area: 37.22 ha

Site Description:

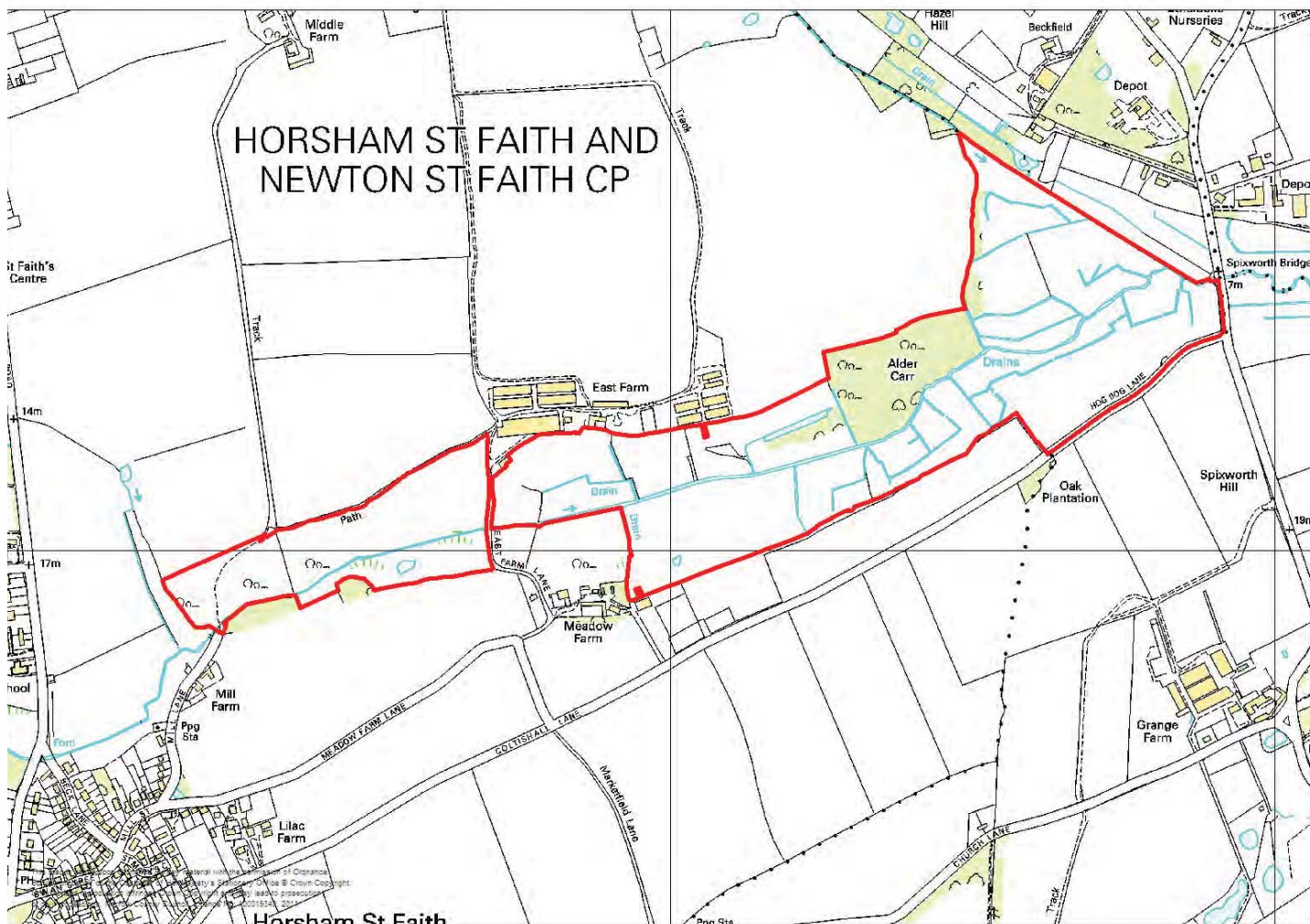
This is a large area of mixed grassland, some very species-rich, extending west of Spixworth Bridge by a busy minor road. The land is in a valley with Spixworth Beck running through. There are many wet, damp and dry ditches. The land has multiple-ownership and so management differs through the site, though much is grazed. CWS 1396 lies east of Spixworth Bridge.

An area of alder *Alnus glutinosa* carr occurs on the northern edge of the site. The two fields at the western end of the site and much of the land north of the beck are ungrazed, unimproved neutral grassland which is long and rank. The west is dominated by tall false oat-grass *Arrhenatherum elatius*, with other forbs including pignut *Conopodium majus* and locally frequent lady's bedstraw *Galium verum*. There is occasional higher ground with a more acidic flora of locally frequent sheep's sorrel *Rumex acetosella*, hairy sedge *Carex hirta* and common hemp-nettle *Galeopsis tetrahit*. North of the beck, the grassland is tall and rank with rare marsh species. Further east, very tall reed sweet-grass *Glyceria maxima*, reed *Phragmites australis*, reed canary-grass *Phalaris arundinacea* and greater pond sedge *Carex riparia* become dominant. The fields immediately adjacent to Coltishall Lane at the top of the slope are dry, heavily-grazed and low in species.

There is abundant species-rich marshy grassland in the low-lying parts of the site. Species include blunt-flowered rush *Juncus subnodulosus*, ragged robin *Silene flos-cuculi*, brown sedge *Carex disticha*, water horsetail *Equisetum fluviatile*, fen bedstraw *Galium uliginosum*, brookweed *Samolus valerandi*, bog pimpernel *Anagallis tenella*, common spike rush *Eleocharis palustris*, marsh arrow-grass *Triglochin palustris*, common valerian *Valeriana officinalis*, yellow rattle *Rhinanthus minor*, and hundreds of early marsh-orchid *Dactylorhiza incarnata*, with fine sedges such as carnation *Carex panicea*, glaucous *Carex flacca* and common sedge *Carex nigra*, and a large patch of greater tussock sedge *Carex paniculata*. The field to the west of these is similar but also has wet depressions which are still grassy but hold locally frequent species including lesser water-plantain *Baldellia ranunculoides*, marsh pennywort *Hydrocotyle vulgaris* and lesser spearwort *Ranunculus flammula*. The landholding immediately west of the bridge is largely damp and unimproved; grass species here include Yorkshire fog *Holcus lanatus*, meadow foxtail *Alopecurus pratensis*, smooth meadow-grass *Poa pratensis* and red fescue, with abundant jointed rush *Juncus articulatus*, plicate sweet-grass *Glyceria notata*, soft and hard rush *Juncus inflexus*. Frequent forbs include ragged robin, fen bedstraw and lesser spearwort *Ranunculus flammula*.

There are numerous ditches on the site, containing varying amounts of water. Spixworth Beck flows eastwards through the site, with many small ditches feeding into it, with some alder lining the banks and elsewhere a more varied flora including water forget-me-not *Myosotis scorpioides*, blue water-speedwell *Veronica anagallis-aquatica*, and water-cress *Nasturtium officinale*.

There are some stretches of hawthorn *Crataegus monogyna* hedge, often over-grown, with standard trees throughout the site. The southern boundary of the site along Coltishall Lane has some fine mature oaks *Quercus robur*, with a varied hedge of hawthorn, hazel *Corylus avellana*, blackthorn *Prunus spinosa*, field maple *Acer campestre*, apple *Malus domestica*, dog rose *Rosa canina* and honeysuckle *Lonicera periclymenum*, with dog's mercury *Mercurialis perennis* growing beneath.



**County Wildlife Site
(Ref No: 1335)**

Site Name: Canham's Hill

Parish: Drayton

Grid Reference: TG 194135

Area: 7.7 ha

Site Description:

Canham's Hill is an area of rough unmanaged ground, a mixture of self-seeded mature woodland, some bracken (*Pteridium aquilinum*) and a small open area of unimproved neutral grassland. The south-east end has been extensively used for dumping rubble and earth.

Most of the hill is covered by recent woodland, a tall mixture of oak (*Quercus robur*) and silver birch (*Betula pendula*) with frequent sycamore (*Acer pseudoplatanus*) and very occasionally beech (*Fagus sylvatica*). The shrub layer is not well developed with occasional hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*) and hazel (*Corylus avellana*) with willow (*Salix cinerea*) in the north west. The wood grades into thick mature scrub and thick bracken at its edges. All have similar flora although a few woodland species are present, sparsely represented by herb-Robert (*Geranium robertianum*), wood avens (*Geum urbanum*) and common dog-violet (*Viola riviniana*) within wooded areas. A few mature and over mature trees are present on the site, mainly associated with old boundaries. The southern blocks of scrub have abundant gorse (*Ulex europaeus*) in places.

Open areas of grassland to the south are diverse although rather tall and rank perhaps partly maintained by deer and rabbit grazing. The sward is a mixture of tussocky false oat-grass (*Arrhenatherum elatius*) and Yorkshire fog (*Holcus lanatus*) with red fescue (*Festuca rubra*) and common bent (*Agrostis capillaris*). Herbs are abundant, including most prominently wild parsnip (*Pastinaca sativa*), common bird's-foot trefoil (*Lotus corniculatus*) and marsh cinquefoil (*Potentilla reptans*) with also ribwort plantain (*Plantago lanceolata*), wild privet (*Ligustrum vulgare*) and yarrow (*Achillea millefolium*). Part of the grassland lies over disturbed areas of rubble and sand. Sandy areas have frequent viper's bugloss (*Echium vulgare*), bugloss (*Anchusa arvensis*) and common cudweed (*Filago vulgaris*) where the ground has been disturbed.

**County Wildlife Site
(Ref No: 1393)**

Site Name: Ladies Wood, Church Carr and Springs

**Parish: Sprowston/
Rackheath/
Beeston St.Andrew**

Grid Reference: TG 268143

Area: 14.7 ha

Site Description:

This site has various woodland, grassland and standing water habitats. The lakes are generally species poor and fringed by willow (*Salix cinerea*) dominated carr. There are two areas of marshy grassland and one improved grassland strip. Apart from an area of lime (*Tilia x vulgaris*) coppice the woodlands are dominated by oak (*Quercus robur*) and sweet chestnut (*Castanea sativa*). There has been some planting of deciduous trees throughout, otherwise no other discernible management. Part of this wood is ancient woodland.

The majority of the site is oak dominated with a frequent sycamore understorey with occasional sweet chestnut, birch (*Betula* sp) and willow. Hazel (*Corylus avellana*), elder (*Sambucus nigra*) and bird cherry (*Prunus padus*) further north form the shrub layer. The ground flora is dense bracken (*Pteridium aquilinum*) and bramble (*Rubus fruticosus*) with frequent raspberry (*Rubus idaeus*) in the south and abundant bluebell (*Hyacinthoides non-scripta*). Wetter areas occur, dominated by soft rush (*Juncus effusus*).

At the southern narrow end is a dense area of willow carr with undergrowth dominated by common reed (*Phragmites australis*), greater bulrush (*Typha latifolia*), yellow iris (*Iris pseudacorus*) and great willowherb (*Epilobium hirsutum*). Adjacent and slightly north is mature common lime coppice with occasional oak. The ground flora is relatively species rich with abundant dog's mercury (*Mercurialis perennis*), ground-ivy (*Glechoma hederacea*), herb-Robert (*Geranium robertianum*), wood avens (*Geum urbanum*), frequent bramble (*Rubus fruticosus*) and occasional red campion (*Silene dioica*), red-currant (*Ribes rubrum*), primrose (*Primula vulgaris*) and bluebell. Sycamore (*Acer pseudoplatanus*) becomes dominant further north, hawthorn (*Crataegus monogyna*) and elder form the shrub layer.

Open area of uncut grassland which is dominated by grasses such as cock's-foot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*), creeping bent (*Agrostis stolonifera*) and false oat-grass (*Arrhenatherum elatius*) with hogweed (*Heracleum sphondylium*) and rosebay willowherb (*Chamerion angustifolium*).

There is a large lake partly fringed by grey willow. Floating vegetation is restricted to yellow water-lily (*Nuphar lutea*). Marginal vegetation is scattered lesser pond-sedge (*Carex acutiformis*) with bulrush, great willowherb, brooklime (*Veronica beccabunga*) and celery-leaved buttercup (*Ranunculus sceleratus*). There are also two ponds.

The marshy grassland with scattered willow is dominated by branched bur-reed (*Sparganium erectum*) with frequent great willowherb and redshank (*Polygnum persicaria*) with meadowsweet, marsh thistle (*Cirsium palustre*) and rosebay willowherb. It extends into a strip with hairy sedge (*Carex hirta*) and silverweed (*Potentilla anserina*), but is dominated by perennial rye-grass (*Lolium perenne*), Yorkshire fog, hogweed and white clover (*Trifolium repens*) further north.

**County Wildlife Site
(Ref No: 2021)**

Site Name: Tollshill Wood

Parish: Sprowston/Rackheath

Grid Reference: TG 266 132

Area: 10.0 ha

Site Description:

Ancient, broad-leaved semi-natural woodland situated on the parish boundary. It is under private ownership and is managed predominantly as high forest.

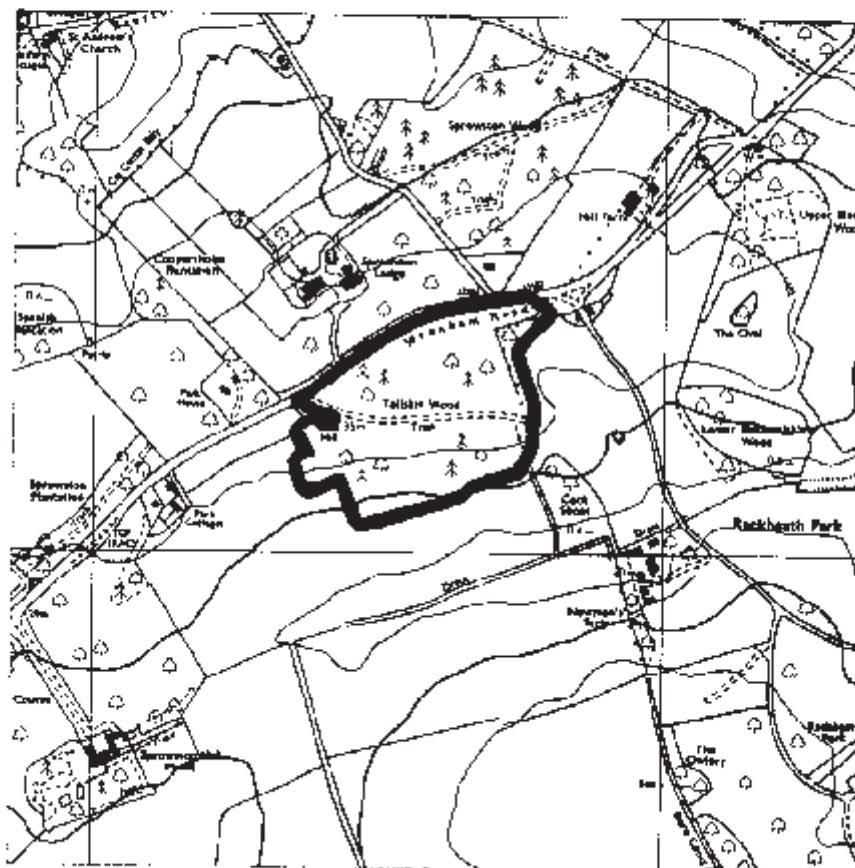
Recent management has included ride creation, larch plantation clear-felling, and scattered under-planting with native, broad-leaved trees. Evidence of past management includes several large coppice regrowths. A huge hornbeam (*Carpinus betulus*) and small-leaved lime (*Tilia cordata*) on the western boundary are particularly notable. A former drive to Rackheath Hall forms the wood's main ride, and at its eastern end the wood encompasses a section of the defunct parish boundary ditch.

The wood is sited on former heathland east of Norwich and is generally dry in character, lying on light, acidic, sandy soils. There are open areas at the eastern end, one being created by treefall during the 1987 autumnal storm.

The canopy is varied in structure and density, and is dominated by sycamore (*Acer pseudoplatanus*) and sweet chestnut (*Castanea sativa*), with frequent oak (*Quercus robur*) and beech (*Fagus sylvatica*). A small proportion of exotic conifers is interspersed throughout, including grand fir (*Abies grandis*) and scots pine (*Pinus sylvestris*). There is an open, well-developed understorey and shrub layer in places, with seedling generation in evidence. Species include sweet chestnut, sycamore, and bird cherry (*Prunus padus*).

The ground flora includes areas of dense bluebell (*Hyacinthoides non-scripta*), particularly along the rides, wood anemone (*Anemone nemorosa*), with bramble (*Rubus fruticosus* agg.) and bracken (*Pteridium aquilinum*) which are co-dominant in places. Patches of climbing corydalis (*Corydalis claviculata*) are dispersed throughout, with foxglove (*Digitalis purpurea*), wood avens (*Geum urbanum*), yellow pimpernel (*Lysimachia nemorum*), wood dock (*Rumex sanguineus*), red campion (*Silene dioica*), and hedge woundwort (*Stachys sylvatica*). Wild daffodil (*Narcissus pseudonarcissus*) is also known to occur.

There are two open areas at the eastern end of the wood. One has been planted up with native broad-leaved trees, predominantly oak. Its periphery supports vestiges of a dry grassland flora which includes sheep's sorrel (*Rumex acetosella*), with wood sage (*Teucrium scorodonia*), wild strawberry (*Fragaria vesca*), pignut (*Conopodium majus*) and primrose (*Primula vulgaris*) also occurring. The second area, adjacent to the parish boundary ditch, has remained open for a longer period and is dominated by bracken, with patches of colonising silver birch (*Betula pendula*), goat willow (*Salix caprea*) and grey willow (*Salix cinerea*).



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County Hall
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Date

**County Wildlife Site
(Ref No: 1392)**

Site Name: Paine's Yard Wood, The Owlery & March Covert Parish: Rackheath

Grid Reference: TG 279123

Area: 17.4 ha

Site Description:*

Paine's Yard Wood and The Owlery are varied woodlands of largely native species and of a varied structure, including abundant deadwood and stored coppice. Mature ash (*Fraxinus excelsior*) is a dominate species throughout, much of it arising from large coppice stools. Oak (*Quercus robur*) and birch (*Betula pendula*) are frequent and hazel (*Corylus avellana*) coppice dominates some areas; there are a number of non-native tree species in the canopy, including sweet chestnut (*Castanea sativa*) and sycamore (*Acer pseudoplatanus*). Elm (*Ulmus procera*) occurs in occasional dense stands, mostly in the form of young suckers. Rhododendron (*Rhododendron ponticum*) also occurs on the southern boundary, whilst holly (*Ilex aquifolium*) and rowan (*Sorbus aucuparia*) are rare throughout. Ornamental conifer species occur to the north.

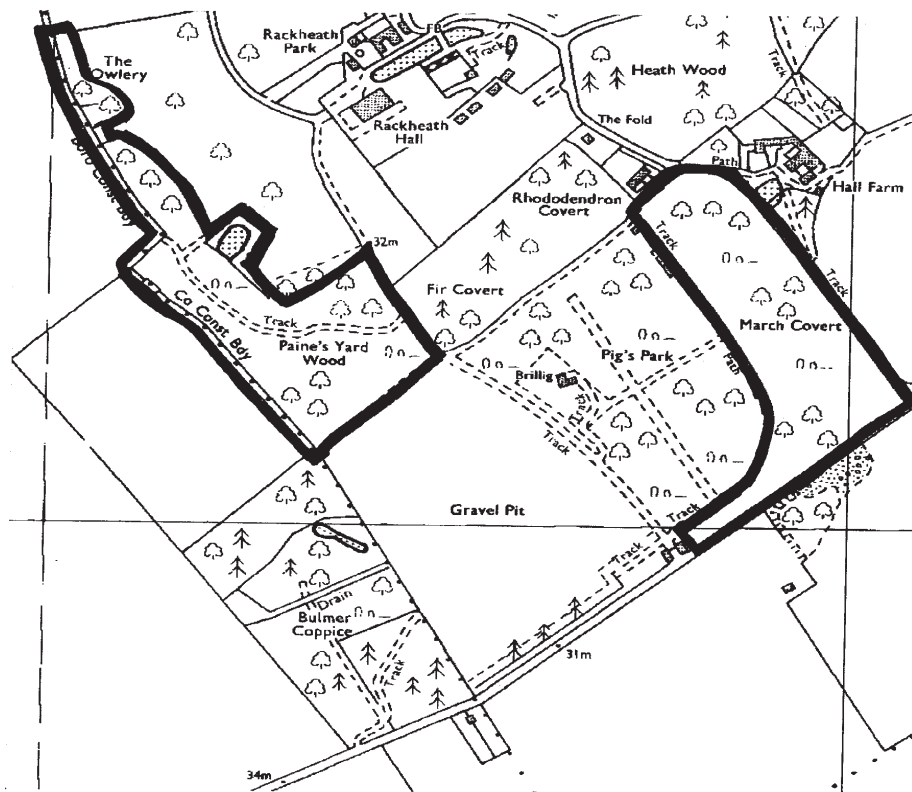
In some areas, the ground flora is dominated by large stands of bluebell (*Endymion non-scriptus*), with bracken (*Pteridium aquilinum*), soft rush (*Juncus effusus*) male fern and broad buckler fern common throughout. A small clearing to the south is dominated by bracken, with Yorkshire fog and climbing cordaylis being common. Elsewhere, wood avens, foxglove, herb Robert, honeysuckle, hedge woundwort and bramble occur. Wood melick is occasional throughout.

A derelict pond occurs on the eastern boundary.

Paine's Yard Wood narrows dramatically to the north, where the woodland follows the parish boundary, which is marked by a bank and impressive oaks, which occur as pollards and coppice stools. A mature hedge also follows the boundary and links the wood with The Owlery. The hedge is composed of dense stands of blackthorn, with some elder and occasional ash coppice. Hedgerow plants include upright hedge parsley, cow parsley, ground ivy and bramble.

The Owlery is a small areas of woodland to the north of Paine's Yard and linked to it by the hedge mentioned above. The Owlery contains mature beech, probably the remnants of a larger plantation, as well as mature ash. Bluebell dominates the ground layer, with frequent red campion and bramble, as well as occasional bracken.

In March Covert, Oak (*Quercus robur*) dominates a tight canopy with chestnut (*Aesculus sativa*) and sycamore (*Acer pseudoplatanus*) also present. The shrub layer is mainly hazel (*Corylus avellana*) occasionally blackthorn (*Prunus spinosa*) and holly (*Ilex aquilinum*). Bramble (*Rubus fruticosus*) dominates the ground floor with patches of primrose (*Primula vulgaris*). Information on March Covert is based on the 1985 habitat survey (NWT).



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**County Wildlife Site
(Ref No: 2212)**

Site Name: Whitlingham Marsh

Parish: Kirby Bedon

Grid Reference: TG 277080

Area: 7.02 ha

Site Description:

This site is an area of inundated swamp, consisting mostly of sedgebeds, in a spur of land between the River Yare which forms runs parallel to the site to the north, and the A47 trunk road to the south. The marsh is bisected from north to south by a line of alders *Alnus glutinosa* and a small pond lies close to the centre of the site.

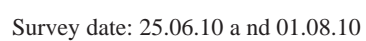
The entire site is dominated by greater pond-sedge *Carex riparia*, with a greater degree of diversity in the western half than to the east. On the eastern side are some occasional to locally abundant patches of reed sweet-grass *Glyceria maxima*, particularly to the south and around the margins of the site where ditches have been dug. Marsh-bedstraw *Galium palustre*, stinging nettle *Urtica dioica*, cleavers *Galium aparine*, hedge bindweed *Calystegia sepium*, gypsywort *Lycopus europaeus* and water -mint *Mentha aquatica* also occur occasionally.

In the western half, hemp-agrimony *Eupatorium cannabinum* is abundant in some large patches, particularly towards the centre and north-west of the site, while greater reedmace *Typha latifolia* is dominant around the pond. Patches of reed sweet-grass *Glyceria maxima*, mixed with occasional reed canary-grass *Phalaris arundinacea*, are locally abundant and there is occasional marsh horsetail *Equisetum palustre*, gypsywort, marsh bedstraw, bittersweet *Solanum dulcamara*, water-mint, hedge bindweed, meadow buttercup *Ranunculus acris*, purple loosestrife *Lythrum salicaria*, marsh woundwort *Stachys palustris*, meadowsweet *Filipendula ulmaria*, ragged-robin *Lychnis flos-cuculi* and water forget-me-not *Myosotis scorpioides*. At the base of this tall swamp vegetation is occasional ground ivy *Glechoma hederacea* and lesser water-parsnip *Berula erecta*.

A number of tree species occur around the site, including alder, white willow *Salix alba* and crack willow *Salix fragilis*. Other species include elder *Sambucus nigra*, ash *Fraxinus excelsior*, hawthorn *Crataegus monogyna* and hazel *Corylus avellana*. Buddleja *Buddleja davidii* is also present with guelder rose *Viburnum opulus*.

The ditches around the site contain a number of species including occasional to frequent reed sweet-grass, frogbit *Hydrocharis morsus-ranae*, common fleabane *Pulicaria dysenterica*, duckweed *Lemna* sp., reed canary-grass, hard rush *Juncus inflexus*, lesser water-parsnip, common reed *Phragmites australis*, arrowhead *Sagittaria saggitifolia*, yellow flag *Iris pseudacorus* and greater reedmace. White water lily *Nymphaea alba* grows in the pond at the centre of the site.

Whitlingham Marsh is a designated Local Nature Reserve (LNR).



**County Wildlife Site
(Ref No: 279)**

Site Name: Whitlingham Fen

Parish: Kirby Bedon

Grid Reference: TG 283075

Area: 6.3 ha

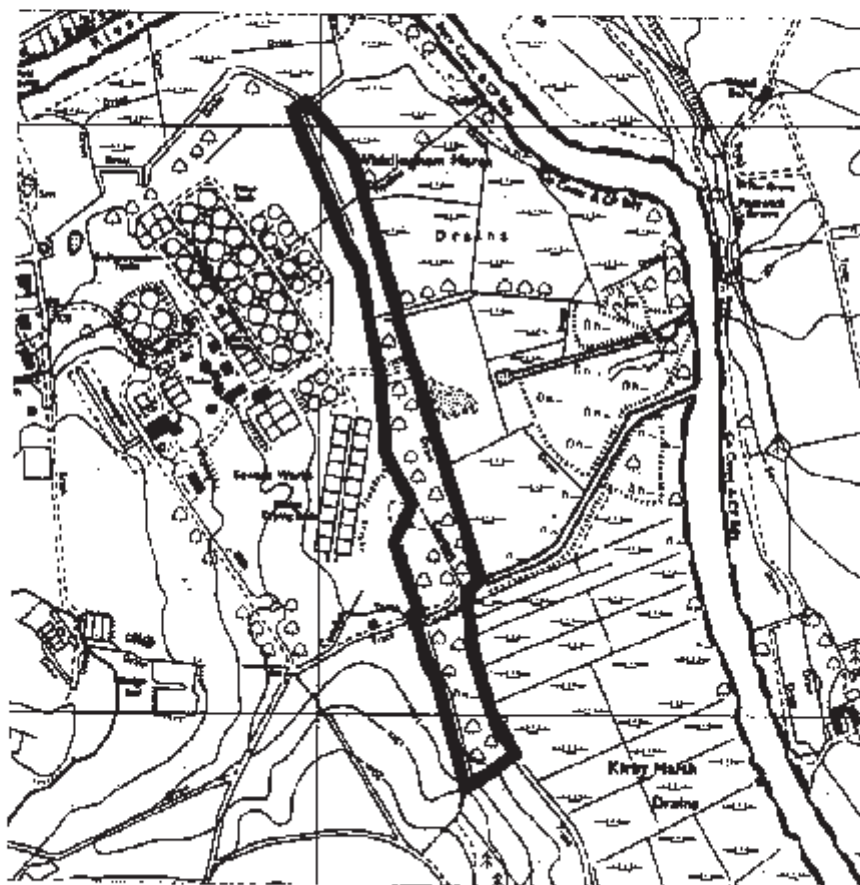
Site Description:

This is a linear site running along the eastern side of the Whitlingham sewerage treatment works. It consists largely of fen and wet scrub woodland but also includes a series of open ponds. The area is largely unmanaged.

The fen vegetation is dominated by reed sweet-grass (*Glyceria maxima*) or greater pond-sedge (*Carex riparia*). Bulrush (*Typha latifolia*) and reed (*Phragmites australis*) appear in dense stands along old ditchlines and in the wettest areas. Along the peripheries the vegetation becomes more diverse with purple loosestrife (*Lythrum salicaria*) and water mint (*Mentha aquatica*).

The wet woodland is dominated by mature willow (*Salix* spp.) scrub with occasional hawthorn (*Crataegus monogyna*) and elder (*Sambucus nigra*). In drier areas this grades into beech (*Fagus sylvatica*) and hornbeam (*Carpinus betulus*) woodland with a ground flora of nettle (*Urtica dioica*).

The ponds lie towards the centre of the site and have abundant growth of great yellow-cress (*Rorippa amphibia*), water-plantain (*Alisma plantago-aquatica*) and pink water-speedwell (*Veronica catenata*). Drier peripheral areas contain great willowherb (*Epilobium hirsutum*) and broad-leaved ragwort (*Senecio fluviatilis*) whilst willow (*Salix* spp.) scrub is a frequent invader of shallow muddy margins.



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Date

TREE PRESERVATION ORDER 1991 No.10
(MODIFIED)

Individual Trees T1. etc.

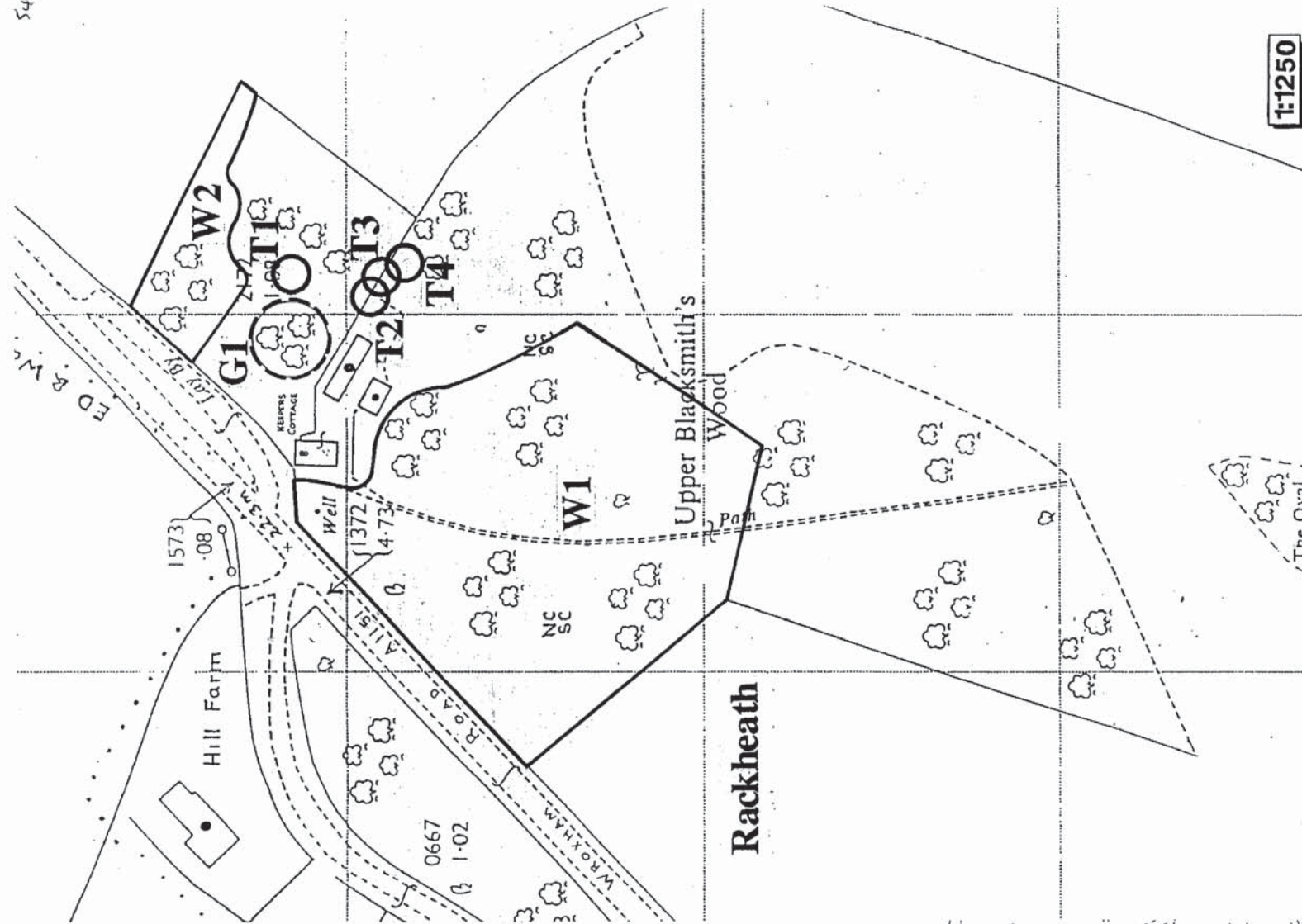
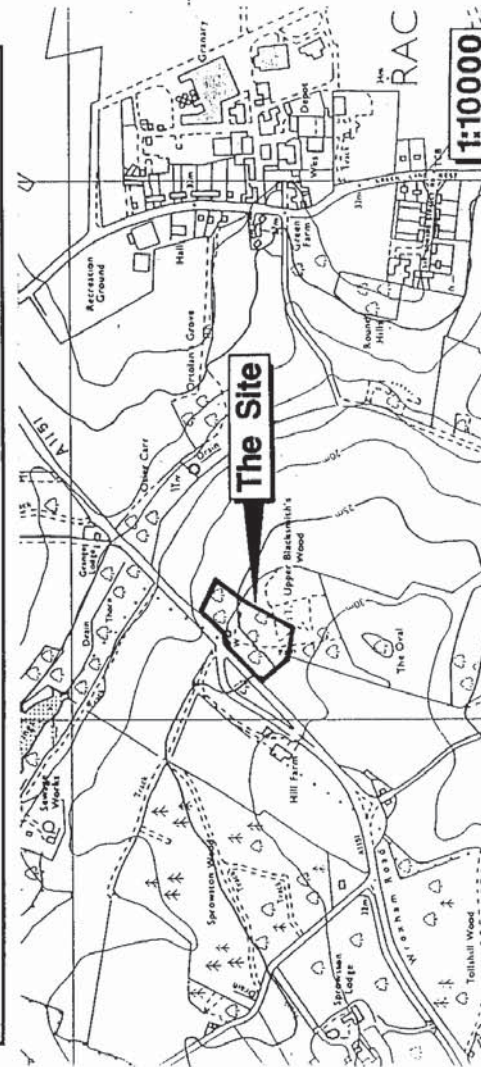
Areas A1. etc.

(Inner edge of dots denotes boundary).

Groups G1. etc.

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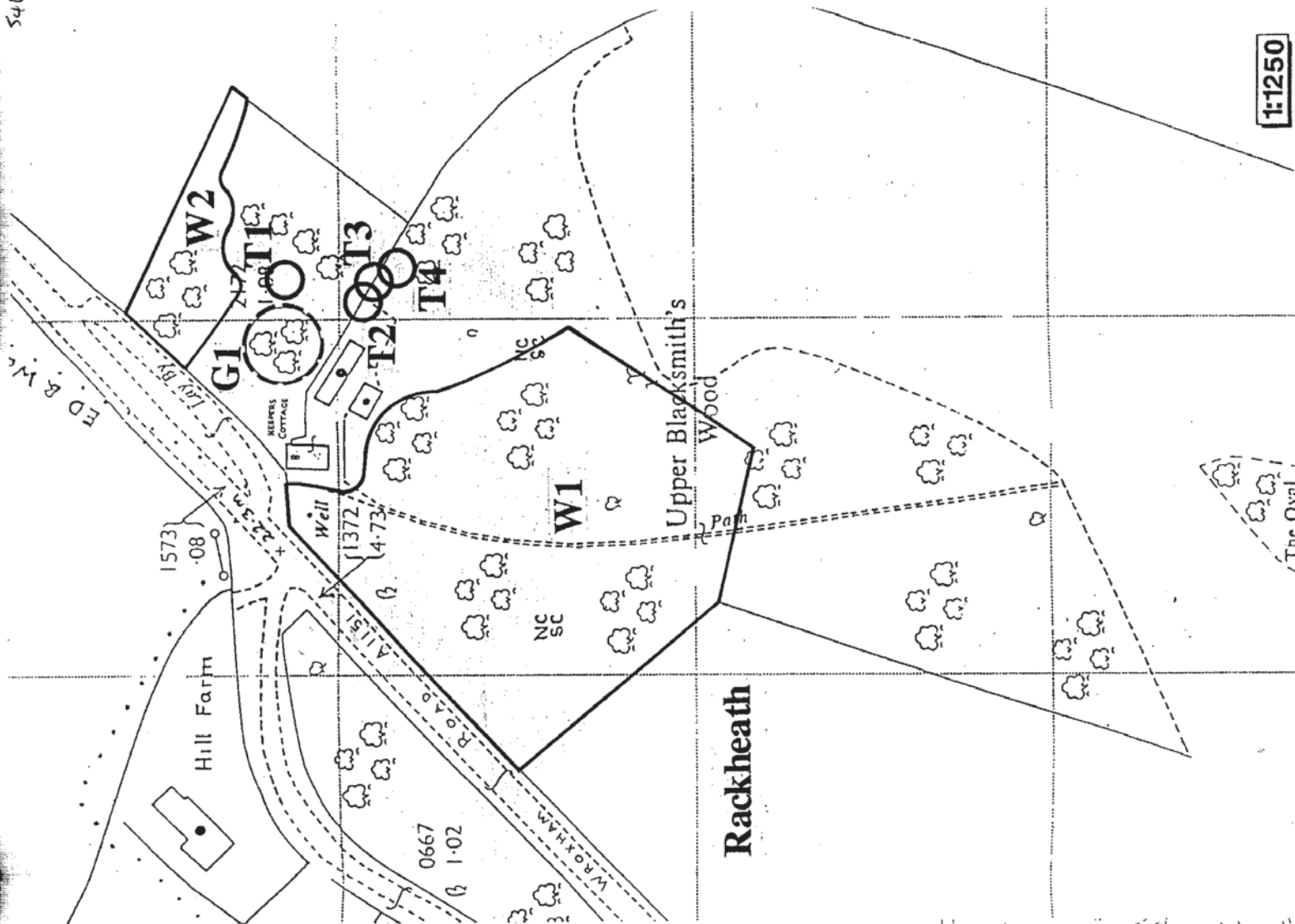
Woodlands W1. etc.

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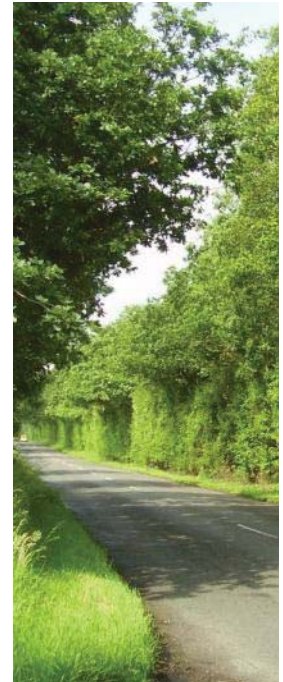
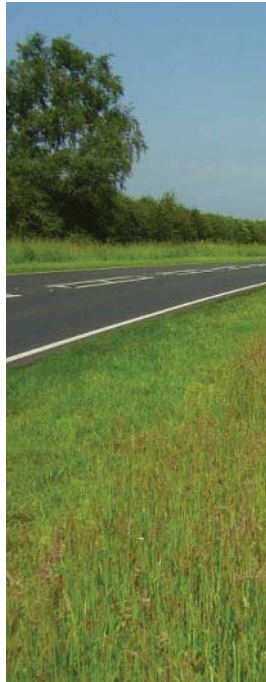
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B. Phase 1 Habitat Survey Report

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Norwich Northern Distributor Road

Phase 1 Habitat Assessment - Technical
Appendix

November 2013

Norfolk County Council

Norwich Northern Distributor Road

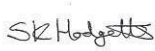
Phase 1 Habitat Assessment - Technical
Appendix

November 2013

Norfolk County Council

County Hall
Martineau Lane
Norwich
Norfolk
NR1 2SG.

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description	Standard
A	August 2013	Sarah Hodgetts	Mihai Coroi	Laura Henderson	2013 Update	
						
B	November 2013	Sarah Hodgetts	Mihai Coroi	Laura Henderson		
					Final version	

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1 Introduction

This document has been produced to report on the baseline Phase 1 Habitat surveys undertaken for the Norwich Northern Distributor Road (known as the “NDR”) scheme in Norfolk. Full details of the scheme, including a description of the need for the scheme and alternatives considered, can be found in Volume One of the Environmental Statement.

2 Methodology

2.1 Desk Study

The desk study included a review of the statutory designated sites within 2km and the non-statutory designated sites within 500m of the NDR Scheme. The habitats and protected/notable species within 1km of the NDR Scheme were reviewed by searching available publications, reports and online databases from Nature on the Map, Multi-Agency Geographic Information for the Countryside (MAGIC), Joint Nature Conservation Committee (JNCC), UK BAP website, Norfolk LBAP website (Norfolk Biodiversity Partnership, NBP, 2006), Norfolk County Council and Broadland District Council.

2.2 Field Survey

In line with standard practice, a field survey of a 75m wide corridor (either side of the proposed road giving a total corridor of 150m) was undertaken in June 2012 by a suitably experienced ecologist. In previous surveys, the exact route of the proposed road was not yet defined. As a result, a much wider corridor was included in earlier surveys to ensure all possible route variations were covered.

The habitat types were identified and mapped in compliance with the 'Handbook for Phase 1 Habitat Survey: a Technique for Environmental Audit' (JNCC, 2010). Dominant plant species were noted, as were any protected, uncommon, invasive species or species indicative of particular habitat types, but there was no attempt to compile exhaustive species lists.

Botanical nomenclature in this report follows Stace (2010) for both scientific and English names. Scientific names are only mentioned the first time the species occur in the report. It was not possible to survey some areas within the survey corridor due to the absence of land access (e.g. Norwich Airport) or because of health and safety reasons. Where access was not possible, efforts were made to survey these areas from adjacent fields (vantage points).

Species-rich hedgerows were also assessed using standard methods outlined in the Hedgerow Regulations (1997) to determine whether they should be classed as 'Important.' This is based on the age of the hedgerow (to be 'important' the hedgerow should be over 30 years old) and the number of native woody species, and other features including banks, ditches, trees and parallel hedgerows (see Appendix E for qualifying features).

3 Designated Sites

3.1 Overview

Four statutory designated sites for nature conservation are present within 2km of the proposed NDR: The Broads Special Area of Conservation (SAC), Broadland Special Protected Area (SPA) and Ramsar Site, River Wensum SAC and Site of Special Scientific Interest (SSSI) and Whitlingham Marsh Local Nature Reserve.

A Tree Preservation Order (TPO) designation surrounds Keepers Cottage, along Wroxham Road. Seven non-statutory designated sites are present within 500m of the NDR, including six County Wildlife Sites (CWS) and one Roadside Nature Reserve (RNR).

The designated sites are briefly presented in Table 3.1. (see Mott MacDonald, 2011, Figure A.2 in Appendix A for map). The full citations of the statutory designated sites are found on the Natural England and JNCC websites.

Table 3.1: Summary of Designated Sites

Name	Designation	Distance and direction from NDR
The Broads	SAC, National Park	2km north
Broadland	SPA, Ramsar	2km north
River Wensum	SAC, SSSI	230m, south-west
Keepers Cottage	TPO	80m, south
Attlebridge Hills	CWS	100m north, west end of NDR
Walsingham Plantation	CWS	100m, south-west (west end of NDR)
Ladies Wood, Church Carr and Springs	CWS	50m, north-east
Tollshaw Wood	CWS	650m, south
Paines Yard Wood, The Owlery and March Covert	CWS	400m, south-west
Marriott's Way	CWS	0m (crossed by NDR)
Fakenham Road Roadside Nature Reserve	RNR	0m, west end of NDR
Whitlingham Marsh Local Nature Reserve	LNR	600m southwest of south end of NDR

Source: Norfolk County Council, MAGIC

3.2 Statutory Designated Sites

3.2.1 International Designations

The Broads Special Area of Conservation (SAC), Broadland Special Protected Area (SPA) and Ramsar Site, and River Wensum SAC are all located within 2km of the scheme. However, Natural England has advised Norfolk County Council that:

“In our view it is likely that it [the proposed project] will have a significant effect on the River Wensum SAC and therefore will require assessment under the Habitats Regulations” (Natural England, 2013 in The Planning Inspectorate, 2013).

A Stage 1 and Stage 2 Habitats Regulations Assessment (HRA) has, therefore, been carried out to assess these potential effects on the designated site. The River Wensum has been designated a SAC for the following features:

- Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation (water crowfoot);
- *Austropotamobius pallipes* (white-clawed crayfish);
- *Vertigo moulinsiana* (Desmoulin's whorl snail);
- *Lampetra planeri* (brook lamprey), and;
- *Cottus gobio* (bullhead).

The River Wensum is a chalk river system fed by springs, rising near Whissonsett and flowing approximately 71km to its tidal limit at New Mills, Norwich. The river runs through a shallow valley and much of the adjacent habitats remain as grassland managed by cutting or grazing. The natural gradient of the river is interrupted by numerous mills and other water control structures, which give rise to the characteristic profile with relatively deep, slow flowing ponded sections upstream of the structures, and shallow riffles and runs downstream of the structures.

The route of the proposed NDR is approximately 230m from River Wensum at its closest point.

3.2.2 National Designations

The River Wensum Site of Special Scientific Interest (SSSI) is approximately 230m from the proposed NDR. This river has been selected as one of a national series of rivers of special interest as an example of an enriched, calcareous lowland river. With a total of over 100 species of plants, a rich invertebrate fauna and a relatively natural corridor, it is an extremely high quality example of a whole river of its type in nature conservation terms, although short stretches of other similar rivers may show a slightly greater diversity of species.

3.2.3 Tree Preservation Orders (TPO)

The only TPO within the survey corridor surrounds Keepers Cottage along the Wroxham Road, adjacent to the proposed new junction with the NDR (Figure A.1, Appendix A). The TPO covers:

- Four individual trees (pedunculate oak (*Quercus robur*) and sycamore (*Acer pseudoplatanus*));
- A group of four horse chestnut (*Aesculus hippocastanum*) trees; and
- Two stands of mixed woodland.

The woodland south-west of Keepers Cottage contains mainly sycamore, ash (*Fraxinus excelsior*), pedunculate oak, birch (*Betula* sp.) and sweet chestnut (*Castanea sativa*). The woodland area adjacent to

the NDR consists mainly of pedunculate oak, horse chestnut, sycamore and ash. None of these TPO features are likely to be affected by the NDR (construction and operation).

3.3 Non-statutory Designated Sites

3.3.1 County Wildlife Sites

There are five county designated sites within 500m of the proposed NDR, and a sixth within 650m. County Wildlife Sites (CWS) are defined in Structure Plans and Local Plans under the Town and Country planning system and are a material consideration in the determination of planning applications.

Attlebridge Hills CWS. This site is broad-leaved semi-natural woodland with a varied structure. The canopy is dominated by mature pedunculate oak, sycamore, sweet chestnut with extensive areas of mixed coppice of hazel (*Corylus avellana*), sycamore and sweet chestnut. The ground flora is typical of such woodlands, but also contains red campion (*Silene dioica*), viper's bugloss (*Echium vulgare*), nipplewort (*Lapsana communis*) and common centaury (*Centaureum erythraea*). Several ancient woodland indicator species were recorded during the woodland survey.

Walsingham Plantation CWS. The plantation is broad-leaved semi-natural woodland adjacent to the A1067. The canopy is predominantly pedunculate oak with silver birch (*Betula pendula*), beech (*Fagus sylvatica*), and sycamore. The canopy is high and broken in places; a coppice layer is present dominated by mainly elder (*Sambucus nigra*). The ground flora is mainly bracken (*Pteridium aquilinum*) and bramble (*Rubus fruticosus*).

Ladies Wood, Church Carr and Springs CWS. This site has various woodland, grassland and standing water habitats. The lakes are generally species poor and fringed by grey willow (*Salix cinerea*) dominated carr. There are two areas of marshy grassland and one of improved grassland. Apart from an area of lime (*Tilia x europaea*) coppice the woodlands are dominated by oak and sweet chestnut. There has been some planting of deciduous trees throughout, otherwise no other discernible management. Part of this wood is ancient woodland.

Tollshaw Wood CWS. The site is ancient broad-leaved semi-natural woodland. The canopy is varied in structure and density, and is dominated by sycamore and sweet chestnut, with frequent pedunculate oak and beech; a small proportion of exotic conifers are interspersed throughout. The ground flora includes areas of abundant bluebell (*Hyacinthoides non-scripta*), particularly along the rides, wood anemone (*Anemone nemorosa*), with bramble and bracken co-dominant in places.

Paines Yard Wood, The Owlery and March Covert CWS. In March Covert, oak dominates a tight canopy with chestnut sycamore also present. The shrub layer is mainly hazel occasionally blackthorn (*Prunus spinosa*) and holly (*Ilex aquilinum*). Bramble dominates the ground layer with patches of primrose (*Primula vulgaris*).

Marriott's Way CWS follows a disused railway line which is now used by walkers, cyclists and horse-riders. The central track is generally un-vegetated, and the vegetation between the track and the fenceline is varied. Cuttings and embankments often have a more diverse flora, possibly as relics of a woodland flora with plants such as sanicle (*Sanicula europaea*), yellow archangel (*Lamium galeobdolon*), bluebell and moschatel (*Adoxa moschatellina*), or wetland species such as grey willow, common reed (*Phragmites australis*) and great horsetail (*Equisetum telmateia*). Trees and scrub are the dominant vegetation along Marriott's Way, forming an almost continuous corridor as far as Reepham, with a more scattered coverage eastward to Aylsham. A plant species of conservation concern occurs along Marriott's Way, namely basil thyme (*Clinopodium acinos*) (see Section 5 below).

3.3.2 Roadside Nature Reserves

Norfolk Roadside Nature Reserve is a scheme that was set up in the mid-1990s by collaboration between the Norfolk County Council and the Norfolk Wildlife Trust. The aim of this scheme is to protect and promote the verges of Norfolk's roadside that contain rare and scarce plant and insect species. Many of Norfolk's roadside verges have survived modern road improvements and as such are remnants of the natural grassland habitats.

Fakenham Road RNR on the A1067 near Attlebridge (west end of the scheme) is likely to be directly affected by the scheme as the area for temporary diversion of traffic is located on at least 50% of the site. The site is important for hoary mullein (*Verbascum pulverulentum*).

4 Habitats

The habitats identified within the study area are shown on the Phase 1 habitat maps (Appendix A). A detailed description of the habitats, the dominant plant species and notes on the presence or potential presence of protected species are given in the Phase 1 Target Notes (TNs 1-95) in Appendix B. This section presents a brief description of the main habitats present on site and in the zone of influence, along with information on any notable or invasive plant species recorded.

The area subject to the Phase 1 Habitat Survey comprised a variety of habitat types, including broad-leaved woodland, mixed and coniferous woodland, scrub, hedgerows, improved and semi-improved grassland, swamp, water courses, tall ruderal herbs, arable fields (these are the majority), buildings and hard standing. The main habitat types are described below.

4.1 Woodland, Scattered Trees and Scrub

A relatively large number of woodland areas are present on the footprint of the NDR and within 75m. Most woodland is planted, but there are a few semi-natural broad-leaved woodland areas within the survey corridor. There is no semi-natural ancient woodland within the survey corridor, and there is one area of replanted ancient woodland in the location identified by TNs 26 and 29 (see the section below for more details). However, this woodland area will not be lost under the development although some indirect impacts may occur.

Some of the woodland plantations have valuable and diverse ground flora and understory, and there is high potential for restoration to semi-natural woodland through appropriate management. Long-term management plans would be necessary to ensure this is put in practice.

Brief descriptions of the main woodland types and areas are given below. A tree survey was undertaken in 2007 and the results are presented in Mott MacDonald, 2011 (Appendix D).

4.1.1 Semi-natural Broad-leaved Woodland

Areas of semi-natural broad-leaved woodland are present near Gazebo Covert, west of New Rackheath (TNs 17, 19 & 20). The canopies are composed of pedunculate oak, ash (*Fraxinus excelsior*) and sycamore, with hawthorn (*Crataegus monogyna*), ash saplings, elder and blackthorn frequent in the understoreys. Ground flora is composed of ivy (*Hedera helix*), ground ivy (*Glechoma hederacea*), common nettle (*Urtica dioica*), male fern (*Dryopteris filix-mas*) and wood avens (*Geum urbanum*).

Semi-natural woodland is present either side of the junction of the A1151 road with the NDR, west of Rackheath (TNs 20, 26 & 29). Wet woodland dominated by grey willow and with abundant lesser pond sedge (*Carex acutiformis*) in the ground flora is present to the west of the A1151 road (TN26). This is part of the Ladies Wood, Church Carr and the Springs CWS (see map in Mott MacDonald 2011, Appendix A). Part of this woodland is a designated site and within the survey corridor is an area of replanted ancient woodland (TN 29). Two ancient woodland indicator species are present here: bluebell and dog's-mercury (*Mercurialis perennis*). A large part of the wet woodland by the A1151 road has been replanted with Canadian poplar (*Populus x canadensis*) (TN 22). The replanted area has a diverse ground flora and both

the understory and the ground flora are typical of wet woodland; there is high potential for restoration to wet woodland. Wet woodland is listed under Section 41 of the NERC Act (2006) and is a Norfolk LBAP priority habitat.

Other small areas of semi-natural broad-leaved woodland occur in the locations identified by TNs 37 and 67.

4.1.2 Planted Woodland

Most of the woodland areas within the survey corridor are planted, including broad-leaved, mixed or coniferous woodland plantations.

Broad-leaved plantations occur in the locations identified by TNs 13, 18, 22, 30, 39, 44, 50, 55, 65 and 67. These areas have more than 30% planted trees in their canopies, which include sycamore, ash, horse chestnut (*Aesculus hippocastanum*), pedunculate oak, Canadian poplar and sweet chestnut. The understoreys are variable in terms of density and species composition, with hawthorn, ash saplings, elder and hazel. The most frequent and/or abundant ground flora species are: ground ivy, ivy, common nettle, bramble (*Rubus fruticosus* agg.), bluebell and *Kindbergia praelonga* moss.

Relatively large areas of mixed woodland plantations are found in the locations identified by TNs 11, 33, 35, 38 and 59. Broad-leaved and coniferous trees account for at least 10% each in mixed woodland. The main canopy trees are sweet chestnut, silver birch, pedunculate oak, ash, sycamore, Scott's pine (*Pinus sylvestris*), Leylandii cypress (*x Cupressocyparis leylandii*) and giant fir (*Abies grandis*). The understoreys are relatively sparse and include saplings of silver birch, sycamore, ash or sweet chestnut, elder, hawthorn and holly (*Ilex aquifolium*). Bluebell is dominant in some of these mixed woodland areas (TN 11) and other frequent or abundant species include broad buckler-fern (*Dryopteris dilatata*), scaly male-fern (*Dryopteris affinis*), ivy, bracken, bramble, climbing corydalis (*Ceratocarpus claviculata*) and *Kindbergia praelonga* moss.

Four areas of coniferous plantation woodland occur within the survey corridor (TNs 31, 41, 43 and 60). These areas have at least 90% coniferous trees in their canopies, and species include Scott's pine, Leylandii cypress and Sitka spruce (*Picea sitchensis*). The understorey is usually sparse or absent, and the ground flora is species-poor.

4.1.3 Scattered Trees

There are approximately 30 scattered trees along the NDR scheme (see Appendix A), of which some will be removed as part of the works.

4.1.4 Scrub and Landscape Planting

Native scrub appears very scarce along the survey corridor, but there were no attempts to accurately map small areas of scrub of limited intrinsic conservation importance (e.g. bramble scrub). The non-native and

ornamental scrub in residential areas was not mapped either. There are several areas of young landscape planting, especially on roadsides (TNs 3, 53, 54, 56 and 68).

4.2 Hedgerows

Seventy-two native and non-native hedgerows are crossed by the proposed NDR Scheme. Of these, 19 hedgerows are species-rich and the remaining are species-poor. Species-rich hedgerows support at least five woody species in any 30m section. All native hedgerows (including species-poor ones) are listed under Section 41 of the NERC Act (2006) and are a LBAP habitat.

Most of the hedgerows within the survey corridor are intact species-poor without trees, followed by intact species-poor with trees and defunct species-poor hedgerows without trees. The dominant woody species is hawthorn in most cases, with frequent or scattered pedunculate oak, dog-rose (*Rosa canina*), English elm (*Ulmus procera*), blackthorn and elder. The ground flora is generally poor in species and is dominated by bramble, ivy and common nettle, with few or no species indicators of ancient hedgerows/woodland.

A separate hedgerow survey was undertaken in 2007 and updated in 2012. Thirteen hedgerows that will be crossed by the proposed NDR Scheme are classed as 'Important' under the Hedgerow Regulations (1997); these are hedgerows marked Target Notes 75, 76, 78, 79, 80, 84, 85, 86, 87, 89, 90, 91, 93. The results are included in Appendix D.

The number of hedgerows recorded as 'Important' and likely to be removed by the proposed NDR scheme has changed over time. Ten hedgerows were identified as being both 'Important' and likely to be removed in the 2008 report (Mott MacDonald, 2008), whereas this report identifies 13. There are no inconsistencies regarding importance; anything that was classed as 'Important' in 2008 was still classed as 'Important' in 2013, but the footprint of the works has altered the final count of 'Important' hedgerows likely to be removed or otherwise affected by the works. The seven hedgerows at TN 79, 80, 85, 86, 87, 90 and 91 are directly comparable to H61, H65-1, H93-3, H102-1, H103, H114 and H115-1 and are included in the counts to be removed in 2008 and 2013.

The following hedges were included in the 2008 report but not in 2013:

- H152-1 was classed as 'Important' and being removed in 2008, but is not within the footprint of the works in 2013; and
- H204 was classed as 'Important' in 2008 but not included in the count in 2013 as this importance is based on archaeological/historical importance and not ecological importance.

The following hedges were included in the count of 'Important' hedgerows to be removed in 2013 but not in the 2008 report:

- Three hedges were not surveyed in 2008 (as they were not within the works footprint) but were included in the 2013 survey and subsequently classed as 'Important' (TN75, 76 and 78);
- H84 (TN84) was not within the footprint in the 2008 report but was classed as 'Important'. This was within the footprint in 2013;
- H105 was not within the footprint in 2008 but was included in 2013 (recorded as TN89); and

- H152-2 was classed as 'Important' in 2008 but not included in the count for that year as it was being crossed but not removed (according to the 2008 report). In 2013 it was included in the count.

4.3 Grassland

The survey corridor comprises many fields of improved grassland and a few areas of amenity grassland. A number of semi-improved neutral grassland areas are present within the survey corridor, but none of these are species-rich. The guidance in the Farm Environment Plan (FEP) Handbook (DEFRA, 2006) was used to distinguish between species-rich and species-poor grassland (www.defra.gov.uk). At least two of the following must apply for a grassland area to be classified as species-rich:

More than 15 different plant species (including grasses) per square metre;

- The cover of wild flowers (excluding white clover or injurious weeds) is usually more than 30% during the summer months;
- Cover of rye grass is generally less than 10% and there is a wide range of other grass species present.
- The term of 'species-poor grassland' used in this report does not coincide with 'poor semi-improved grassland' (B6) in the Phase 1 Handbook. The latter is a more degraded type of grassland, which is transitional between semi-improved and improved grassland.

The areas of semi-improved neutral grassland are dominated by one or a combination of the following species: Yorkshire-fog (*Holcus lanatus*), creeping bent (*Agrostis stolonifera*), common mouse-ear (*Cerastium fontanum*), creeping buttercup (*Ranunculus repens*), cock's-foot (*Dactylis glomerata*), white clover (*Trifolium repens*), ribwort plantain (*Plantago lanceolata*) and sweet meadow grass (*Anthoxanthum odoratum*) (TNs 2, 10, 12, 14, 47, 48, 57, 58 and 66). Some fields are overgrazed by sheep or rabbits, and ruderal herbs such as common nettle or creeping thistle (*Cirsium arvense*) are abundant in places.

A few grassland areas support a slightly higher number of species but they do not meet the above criteria to be classified as species-rich. However, some of these areas have potential for restoration to species-rich grassland provided the management is improved. A long-term management plan should be prepared to ensure this is implemented.

4.4 Ponds

Two ponds occur within the survey corridor (within 75m) (TNs 15 and 23), but only one (TN 15) will be directly affected by the development under the current proposal. Ponds are listed under Section 41 of the NERC Act (2006) and are a Norfolk LBAP habitat.

The pond that will be lost under the development supports abundant aquatic and emergent vegetation, including branched bur-reed (*Sparganium emersum*), bulrush (*Typha latifolia*) and broad-leaved pondweed (*Potamogeton natans*) (TN 15). During the 2012 survey season this pond was entirely dry, but in previous years held some water. This has been identified as a breeding pond for great crested newts in 2013 (see Mott MacDonald, 2013).

The pond identified by TN 23 is located within an area of wet woodland, which has been replanted with Canadian poplar (*Populus x canadensis*). The aquatic vegetation is sparse, but there is luxuriant and diverse vegetation on the banks. A small stream (TN 24) and large areas of swamp dominated by lesser pond-sedge (*Carex acutiformis*) (TN 25) are present in the same woodland (TN 22). The area nearest to the A1151 road, which includes all these wetland features, is not part of the Ladies Wood, Church Carr and the Springs CWS.

4.5 Other Habitats

Arable fields are the main land use within the survey corridor. These include cereal and non-cereal crops and fields recently seeded with grass. Set-aside field margins are found in a few locations, and they support vegetation resembling semi-improved neutral grassland, with a higher proportion of arable weeds (TNs 2, 27, 36, 42 and 61b). The most frequent and/or abundant species here are barren brome (*Anisantha sterilis*), dandelion (*Taraxacum officinale* agg.), soft brome (*Bromus hordeaceus*), mugwort (*Artemisia vulgaris*), field forget-me-not (*Myosotis arvensis*), creeping thistle and white clover. Cereal field margins are a priority habitat in the Norfolk LBAP and are listed under Section 41 of the NERC Act (2006).

Of 25 threatened arable species identified in Norfolk, 15 occur primarily or frequently in arable field margins (Walker et al, 2012); corn spurrey (*Spergula arvensis*) (a vulnerable species) was recorded in semi-improved grassland near to Marriot's Way, near TN 61b during the botanical survey (Mott MacDonald, 2010b). The Scheme runs through Important Arable Plant Areas of county conservation importance (areas are 2x2km tetrads), as based on methods for identifying arable land of importance by Plantlife International that includes threatened species and assemblages.

Small areas of tall ruderal herbs are present in many parts within the survey corridor, but there was no attempt to map these accurately, given their limited conservation importance. The exception to this were the patches of Japanese knotweed (*Fallopia japonica*), which were mapped and/or target noted.

The other habitats present within the survey corridor have negligible intrinsic nature conservation importance e.g. hard standing and buildings.

5 Protected and Notable Plant Species

No plant species protected under Schedule 8 of the Wildlife and Countryside Act 1981 (as amended) were observed during the survey or previously recorded. The following four notable species have previously been recorded within 1km from the NDR:

- There is an old record (1987) of Corn cleavers (*Galium tricornutum*) within 1km of the NDR (NBRC). This species was targeted during the 2009 botanical survey but it was not recorded (see Mott MacDonald, 2011, Appendix D). This species is critically endangered (Cheffings et al., 2005) and nationally rare in the UK (Preston et al., 2002). It is also listed under Section 41 of the NERC Act (2006). Corn cleavers is an archaeophyte, an annual of cereal fields and disturbed ground, chiefly on dry calcareous soils. The species has suffered a very substantial decline, due to the intensification of arable farming.
- Hoary mullein is a nationally scarce plant species, which has been recorded in Fakenham Road RNR on the A1067 near Attlebridge. The plant community where this species occurs was subject to a botanical survey in 2009 (see Mott MacDonald, 2011, Appendix D). The species is frequent in East Anglia, but rare and of introduced origin elsewhere in the UK. Apart from roadside verges, hoary mullein is found on railway banks, in old quarries and gravel-pits, in hedge banks, rough ground, and locally on coastal shingle (its only 'natural' habitat). Seed remains viable for many years and new populations can appear after soil disturbance.
- Basil thyme (*Clinopodium acinos*) is listed within the citation for Marriott's Way CWS. During this Phase 1 habitat survey and the botanical survey (see Mott MacDonald, 2011, Appendix D), a section of 150m of Marriott's Way CWS was surveyed each side of the NDR crossing. However, basil thyme was not found in this section. This species is scattered in the south of England and is classified as vulnerable on the red data list (Cheffings et al., 2005). It is also listed on Section 41 of the NERC Act (2006). Basil thyme is a species of conservation importance as it has substantially declined as a result of more efficient methods of weed control. In many areas it is no longer found in arable fields, surviving only in less intensively managed habitats. Basil thyme is an annual herb of calcareous soils (in Britain) and open habitats in dry grassland, rocky ground or arable fields. It is also a rare casual of waste ground, quarries and banks by roads and railways.
- Corn spurrey is a vulnerable species that has previously been recorded in semi-improved grassland near to Marriott's Way, near TN 61b. It is found in open, disturbed habitats on light, often sandy soils, most frequently in arable fields but also on roadsides and waste ground.

6 Invasive Plant Species

Two non-native and invasive species which are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) have been recorded on the footprint of NDR: Japanese knotweed and rhododendron (*Rhododendron ponticum*). It is an offence to plant or cause to grow in the wild any species listed on Schedule 9. Winter heliotrope (*Petasites fragrans*) is another non-native and invasive species recorded on NDR, but this species is not listed on Schedule 9. More details on these three species are provided below.

Small patches of Japanese knotweed were identified in two locations within the survey corridor (TNs 1&16), although the patch at TN 1 appears to have been subject to management recently. Japanese knotweed is a rhizomatous perennial native of East Asia, and forms dense thickets on waste ground, rubbish tips, roadsides, railway banks, along canal, stream and river banks and on sea-loch shores. Rhizome fragments are dispersed in garden and other rubbish, and by river floods. Japanese knotweed has been grown in British gardens since 1825. It was first recorded in the wild in 1886 and became well-established between 1920 and 1940.

Rhododendron shrubs are frequent in the understorey of an area of mixed woodland, in the location identified by TN 11. Rhododendron is native of two distinct areas: the Iberian peninsula and S.E. Europe, Lebanon, Turkey and the Caucasus. In Britain, it is naturalised on healthy and rocky hillsides, rocky stream banks and ravines and as an understory in woodland, especially on acid soils. It regenerates from seed freely and can form dense thickets. Rhododendron was introduced to cultivation in 1763, it was known in the wild by at least 1894, and spread widely in the 20th century.

Winter heliotrope is dominant on the roadside in the location identified by TN 9. In Britain, this rhizomatous perennial herb is also naturalised on streamsides, banks and rough ground. Winter heliotrope was introduced to Britain in 1806 as an ornamental plant, and was well established by the start of the 20th century. Only male plants are known in Britain.

7 Requirements and Recommendations for Mitigation and Compensation

Based on the current project design proposal, measures to mitigate or compensate against the potential impacts of the development are recommended in the following sections. In order for Norfolk County Council to fulfil their biodiversity duty under the NERC Act (2006) consideration should be given to the mitigations and enhancements suggested. Ideally developments should not lead to a loss of biodiversity but instead enhance it (NBP, 2004).

7.1 Designated sites

7.1.1 Mitigation During Construction

The works at the western end of the scheme would directly affect the habitat within Fakenham Road RNR, as it is likely to fall within the traffic diversion area. Consultation with the Council Ecologist will be required to agree a mitigation strategy for this site. Mitigation may include translocation of hoary mullein seeds, plants and soil surrounding existing plants, to unaffected areas.

To reduce any potential direct and indirect impacts or disturbance to the other nearby County Wildlife Sites, a boundary, if possible at a minimum distance of 10m, could be clearly marked between the scheme and the designated site. This would prevent any activities from being undertaken near the designated site. The importance of this marked boundary should be briefed to all site personnel. No soil or other material should be stored within 10m from the boundary of the designated site. Guidance in the Design Manual for Roads and Bridges (Highways Agency, 2012) should be followed, as well as the Environment Agency's guidance on Works and Maintenance in or Near Water (PPG 5, 2007).

Lost habitat at designated sites could be compensated for by incorporating wildlife planting and habitat creation in the NDR Scheme, for example along the new road embankments.

It is inevitable that there will be some loss of connectivity during the construction of the Marriotts Way bridge over the proposed road. However, every effort has been made to minimise this loss through the scheduling of the different stages of the work. The loss will only be temporary as the crossing will be a green bridge and will ultimately have two parallel hedgerows growing across it.

7.1.2 Mitigation During Operation

To mitigate against the increase in run-off and traffic-related pollution along Marriott's Way CWS and the Fakenham Road Roadside Nature Reserve, sufficient drainage and design should reduce this impact by following guidance in the Design Manual for Roads and Bridges, Chapter 4 on Drainage (Highways Agency, 2012). Additional roadside planting may also screen some habitats from this impact where appropriate.

7.1.3 Enhancement

Scrub could be managed to prevent it encroaching on Fakenham Road RNR and to increase and enhance the grassland habitat along the road verge. This could be done with consultation with the Wildlife Trust.

The additional planting along the NDR scheme will increase the available woodland habitat.

7.2 Trees and Sensitive Habitats

7.2.1 Mitigation During Construction

The removal of mature native trees and those designated under Tree Preservation Orders should be avoided where possible. Tree protection will be provided for the retained trees, using recognised methods in accordance with BS5837:2012 Trees in relationship to design, demolition and construction – recommendations and this should be carried out by suitably trained personnel (this guidance has superseded BS 5837 Guidance for trees in relation to construction).

The loss of any trees removed by the Scheme should be compensated for by replacing them after the works are complete. Three trees should be planted for every one removed. Mature hedgerow trees should be replaced at a ratio of 3:1. This is a standard recommendation based on the possibility of some trees dying and the time taken for trees to mature. Planted tree species should be native, of local provenance and be suitable for the local habitat and soil types (they should be monitored under a management plan and replaced if they fail to survive). There are plans as part of the works to plant trees along the road embankment at certain locations.

Access across sensitive habitats should be carefully planned to avoid excessive damage such as compaction. This could involve laying temporary access track ways over the ground to reduce vehicle damage. No topsoil or other materials should be stored in the woodland areas and hedgerows or within 10m from them; this should be avoided for example at Chainage 9050-9500 where a temporary topsoil storage area is proposed near to a species-poor hedgerow. In addition, soil and materials should not be stored directly on the semi-improved grassland to avoid contamination of the grassland. In particular, there are site compounds near the following sensitive features; species-rich hedgerow at Chainage 5000-5500. Sensitive habitats should be protected during any works to proposed footway/cycleway/equestrian links: at New Home Lane near Chainage 7000-8000, at St Faiths Road at Chainage 10,000 and at Quaker Lane. Where new grassland planting is proposed as part of the works, removal or damage to existing hedgerows should be avoided, for example at Chainage 8000.

For any works within 9m of a water body, the construction should follow The Environment Agency Pollution Prevention Guidelines PPG05 'Works in, near or liable to affect watercourses' (EA, 2007). The pond that will be removed as part of the works should be replaced nearby to avoid a permanent loss of aquatic habitat (see also Mott MacDonald, 2013b, for recommendations for great crested newts). This will need to be licenced by Natural England.

The removal of native hedgerows, especially those classified as species-rich and 'important' under the Hedgerows Regulations 1997 should be avoided where possible. Where the species-rich hedgerows are affected, the hedgebank topsoil should be translocated and reinstated where the new hedgerows will be planted. Species-poor hedgerows will be replaced with a species-rich assemblage after construction, which would increase the biodiversity of the area. The species-poor hedgerow at chainage 9500 and species-rich

hedgerow at chainage 10,050 are planned to be removed as part of compensation to the landowner to merge two small fields into one. The loss of this hedgerow will be mitigated with new planting along the proposed or existing fencelines. Permanent loss of connectivity by crossing hedgerows will be partly mitigated by other planting elsewhere.

7.2.2 Mitigation During Operation

Replaced saplings/trees and hedgerows should be monitored for five years after planting, and any dead saplings replaced with plants of the same species and specification.

To mitigate against the increase in run-off and traffic-related pollution, sufficient drainage and design should reduce this impact by following guidance in the Design Manual for Roads and Bridges, Chapter 4 on Drainage (Highways Agency, 2012). Additional roadside planting may also screen some habitats from this impact where appropriate. To mitigate these impacts where the road runs near to water, the Environment Agency Pollution Prevention Guidelines PPG05 'Works in, near or liable to affect watercourses' (EA, 2007) should be followed.

7.2.3 Enhancement

Although no grassland area to be affected by the works is species-rich, some of these areas have potential for restoration to species-rich grassland if the management is improved. This would increase the biodiversity of these areas. The area of semi-improved grassland at TN 12 could be managed in conjunction with the Wildlife Trust for reptiles, amphibians and invertebrates to maintain its biodiversity value.

Consideration to using the new road embankment for habitat creation should be given, as this would increase its biodiversity and conservation value. This would increase the available habitat for species, and a management plan should be produced to ensure the habitat is maintained. This could include grassland, scrub, hedgerow or woodland habitats. The habitat created should be of species appropriate to the local area and nearby habitats, and with aim of increasing the biodiversity of the area.

There are 32 new drainage lagoons (Sustainable Urban Drainage Schemes or SUDS ponds) to be created along the NDR route. These should be designed to increase the biodiversity of the area (NBP, 2004). This would enhance the available habitat for a number of species; including great crested newts (see Mott MacDonald (2013b) for recommendations regarding great crested newts). These SUDS areas typically involve a range of features, such as porous surfaces, swales (grassy ditches), buffer strips and filter beds. Suggestions for enhancing the conservation value of SUDS can be found in Scottish Environment Protection Agency SUDS manual (SEPA, 2000).

7.3 Invasive Species

7.3.1 Japanese Knotweed

7.3.1.1 Mitigation During Construction

Under the current proposal, there are two small patches of Japanese knotweed identified by TN 16 (Appendix A) that fall within the footprint of the NDR.

Soil disturbance which may lead to possible spread of Japanese knotweed should be avoided. It is an offence to plant or spread in the wild Japanese knotweed, which is listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). The Environment Agency has published a Knotweed Code of Practice on managing Japanese knotweed on development sites (EA, 2013). The knotweed management recommendations depend on the timeframe of the project, but excavation of the contaminated material is seen as a last resort, as this would increase the risk of spreading this invasive species. A Japanese Knotweed Management Plan should be produced for any site where works are likely to spread this species.

Chemical treatment is the preferred control method if a period of up to three years is available before the start of the works. If the Japanese knotweed patches and/or an area of 7m around them are to be disturbed, it is recommended that these areas are treated with an approved herbicide; as the two patches are near a pond, only glyphosate and 2,4- D amine can be used as they are approved to be used near water. The chemical treatment is usually undertaken twice a year (in June and late August or September), for a period of three years to ensure the eradication is completed; an assessment is necessary after each year.

Owing to the programme of the NDR construction, excavation and disposal of the knotweed material may be unavoidable if the Japanese knotweed areas cannot be fully avoided. All contaminated material within a 7m radius and 3m deep should be excavated, but this volume may vary depending on the type of soil/substrate – a qualified ecologist will oversee the operation and decide the extent of the excavation.

7.3.2 Rhododendron

7.3.2.1 Mitigation During Construction

Rhododendron is present in the understorey of an area of mixed woodland, in the location identified by TN 11 (Appendix A).

Soil disturbance which may lead to possible spread of rhododendron should be avoided where possible. It is an offence to plant or spread in the wild rhododendron, which is listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). If avoidance is not possible, the rhododendron should be excavated and disposed of as controlled waste.

8 References

BS5837:2012 Trees in relationship to design, demolition and construction – recommendations. BSI.

Cheffings, C.M., Farrell, L. (Eds), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D., Rumsey, F.J., Taylor, I. (2005). The Vascular Plant Red Data List for Great Britain. Species Status 7: 1-116. Joint Nature Conservation Committee, Peterborough.

Department for Communities and Local Government (DCLG, 2012). National Planning Policy Framework [Online]. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (Accessed on 18 December 2012).

DEFRA (2006). Farm Environment Plan Handbook. Available from www.defra.gov.uk [Accessed 18 July 2012].

Environment Agency (EA) (2007). Pollution Prevention Guidelines PPG05 'Works in, near or liable to affect watercourses.' Environment Agency, Rotherham.

Environment Agency (EA) (2013). The Knotweed Code of Practice – Managing Japanese Knotweed on Development Sites. Environment Agency. Rotherham.

Joint Nature Conservation Council (2010). Handbook for Phase 1 Habitat Survey – a Technique for Environmental Audit. JNCC Publications, Peterborough.

IEEM (2006). Guidelines for Ecological Impact Assessment. Institute of Ecology and Environmental Management. Available from www.ieem.net [Accessed 18 July 2012].

Mott MacDonald (2008). Norwich Northern Distribution Road: Hedgerow Survey. Mott MacDonald Ltd; Cambridge.

Mott MacDonald (2010a). Northern Distribution Road: Phase 1 Habitat Survey. Mott MacDonald Ltd; Cambridge. (Not Issued).

Mott MacDonald (2010b). Northern Distribution Road: Botanical Surveys. Mott MacDonald Ltd; Cambridge. (Not Issued).

Mott MacDonald (2011). Northern Distribution Road: Environmental Statement. Mott MacDonald Ltd, Cambridge.

Mott MacDonald (2013a). Norwich Northern Distributor Road: Aquatic Invertebrates Survey Report. Mott MacDonald; Cambridge.

Mott MacDonald (2013b). Norwich Northern Distributor Road: GCN Survey Report. Mott MacDonald Ltd, Cambridge.

Mott MacDonald (2013c). Norwich Northern Distributor Road: Stage 1 and Stage 2 Habitats Regulations Assessment. Mott MacDonald Ltd.

Norfolk Biodiversity Partnership (NBP) (2004). Biodiversity Supplementary Planning Guidance for Norfolk. Available from the Norfolk Biodiversity Partnership website at <http://www.norfolkbiodiversity.org/planningguidance/> [Accessed 18 July 2012].

Norfolk Biodiversity Partnership (NBP) (2006). Action Plans. Available from <http://www.norfolkbiodiversity.org/actionplans/> [Accessed 18 July 2012].

Preston, C.D., Pearman, D.A. and Dines, T.D. (Eds.) (2002). New Atlas of the British and Irish Flora. Oxford University Press, Oxford.

Scottish Environment Protection Agency (SEPA) (2000). Ponds, pools and Lochans [Online]. Available from <http://search.sepa.org.uk/sepa?action=search&q=ponds,%20pools%20and%20lochans> (Accessed: 19 December 2012).

Stace, C. (2010). New Flora of the British Isles. Cambridge University Press 3rd Edition; Cambridge.

Walker, H., Cunningham, S., Ellis, B., Neal, S. and Swan, E. (2012). Important Arable Plant Areas in Norfolk; A Preliminary Study. Norfolk Biodiversity Partnership.

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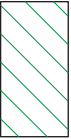
Appendix A. Maps



Broad-leaved semi-natural woodland



Broad-leaved plantation



Mixed Plantation



Coniferous plantation



Dense/continuous scrub



Scattered scrub



Broad-leaved trees



Scattered coniferous trees



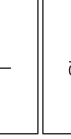
Neutral grassland unimproved



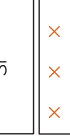
Neutral grassland semi-improved



Improved grassland



Poor semi-improved grassland



Bracken - scattered



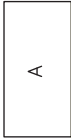
Target Note



Running water



Arable land



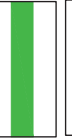
Amenity grassland



Ephemeral/short perennial vegetation



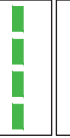
Intact hedge - Native species poor



Intact hedge - Native species rich



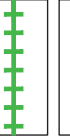
Defunct hedge - Native species poor



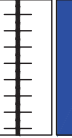
Hedge and tree - Native species rich



Hedge and tree - Native species poor



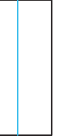
Fence



Standing water



Zone of Influence



Cm = Crataegus monogyna
Qr = Quercus robur
Ac = Acer campestre
Fe = Fraxinus excelsior
Psyl= Pinus sylvestris

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Sheet 1 of 7

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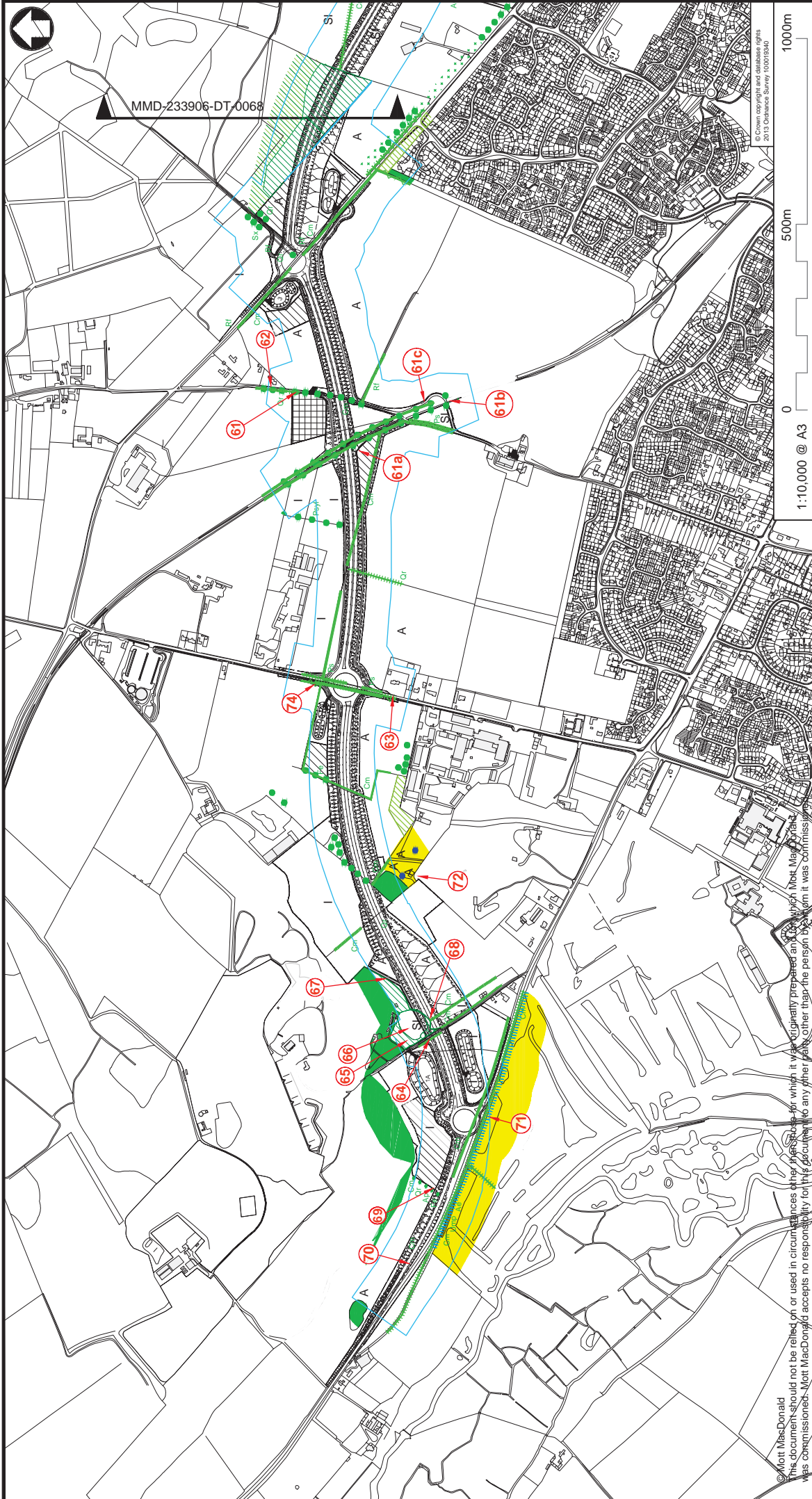
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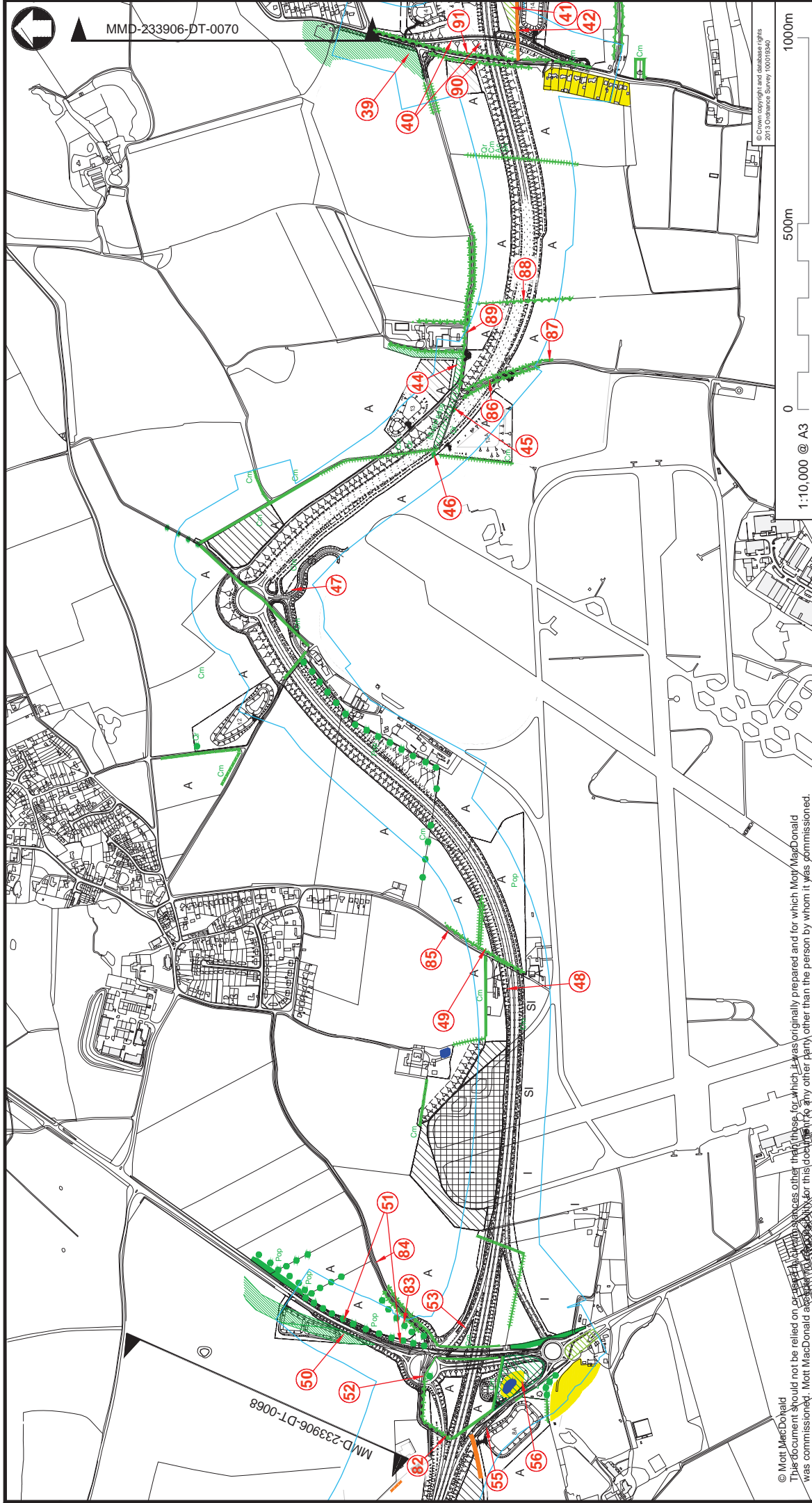


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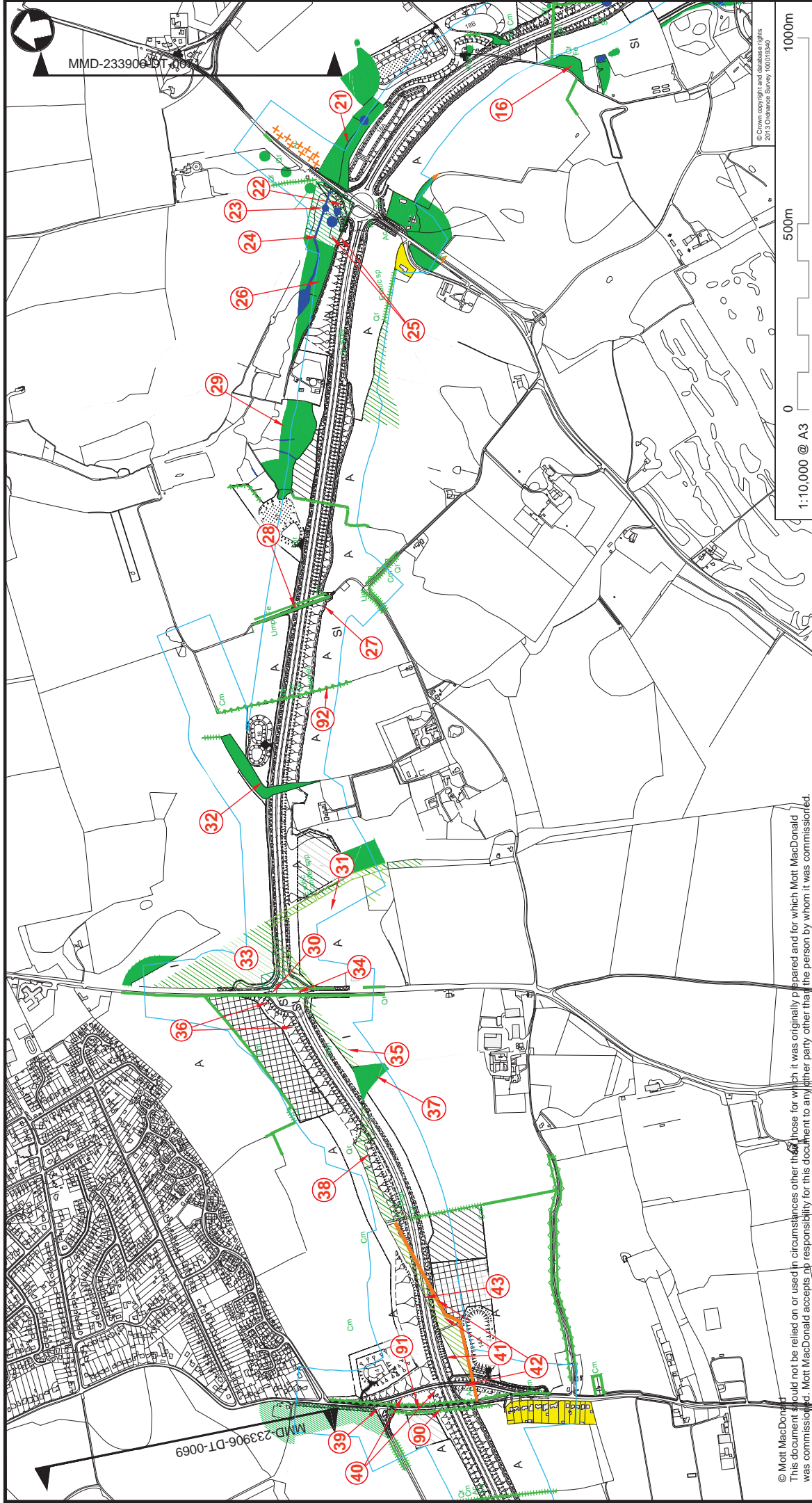
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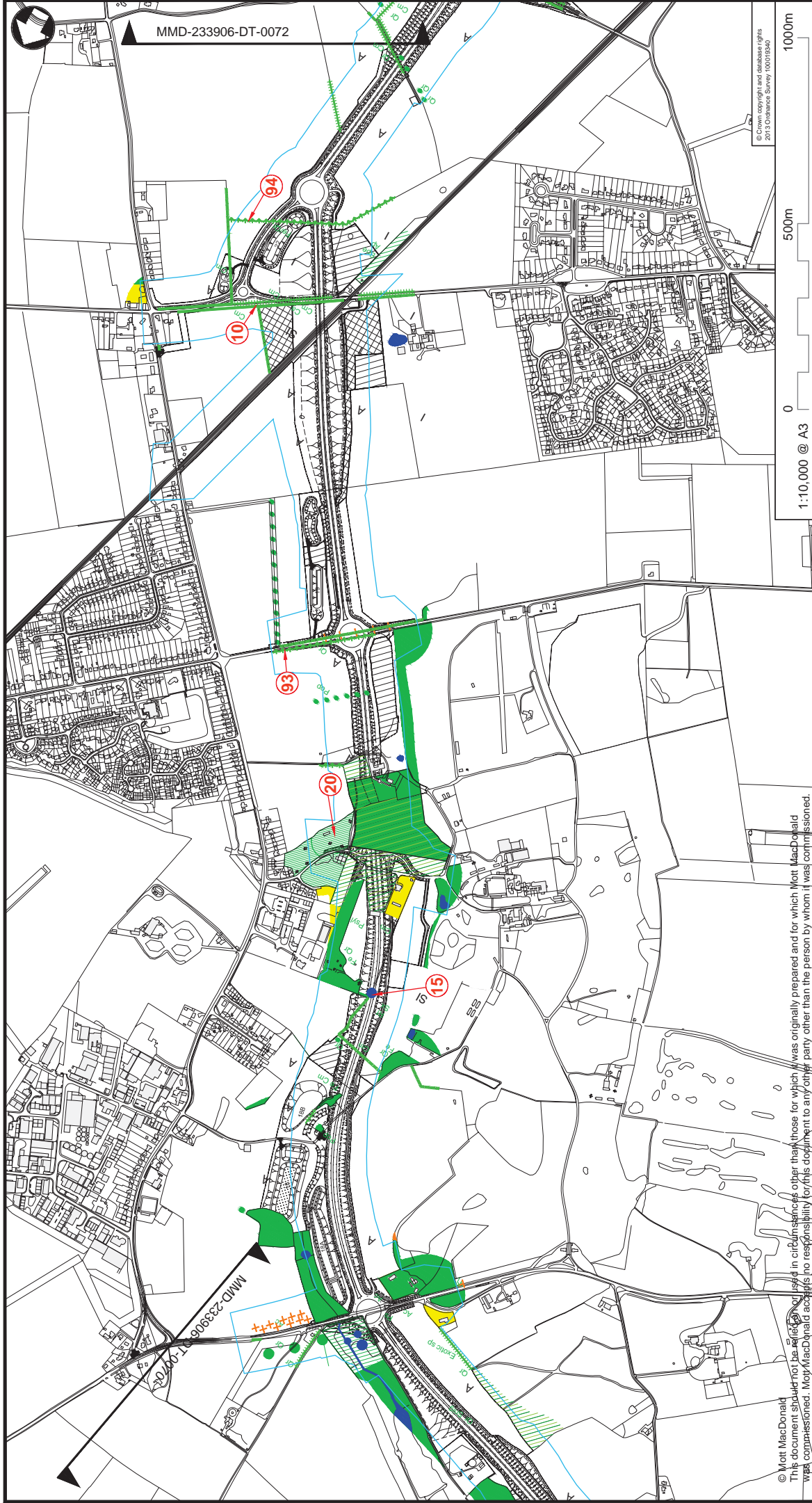


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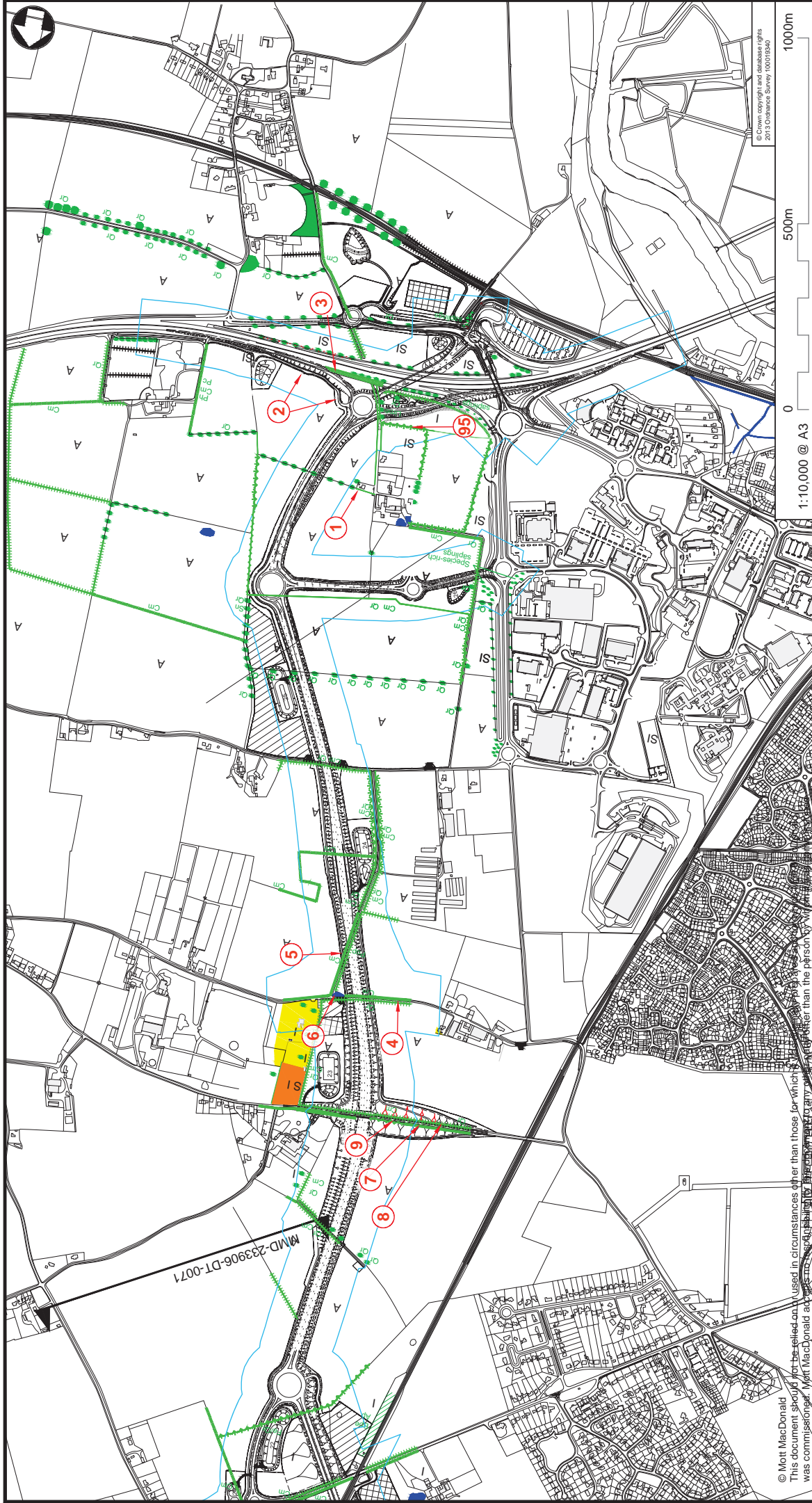


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Drawn				N.Irakiy				Checked			
Rev				R.Sandler				Approved			
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Appendix B. Target Notes

Table B1: Target notes (updated for 2012).

TN	Habitat Description	Photo (see Appendix C)
1	Small patch of Japanese knotweed alongside hedgerow that has been managed. Only the dead stems are now visible.	1
2	Strip (15m wide and corner of the field) of species-poor semi-improved neutral grassland on field margin. Supports the following species; cock's foot, dandelion, common ragwort, Yorkshire fog, scarlet pimpernel, American willowherb (which is locally dominant in the corner of the field), greater willowherb, soft brome, rough meadow-grass and common mouse ear. Scattered common poppy.	2, 3
3	Dense scrub (landscape planting) on roadside, comprising of hawthorn, hazel, field maple, ash and rough grassland beneath.	4
4	Species-poor intact hedgerow with mature pedunculate oak trees; hedgerow dominated by hawthorn, with some dog-rose, and abundant bramble and cleavers in the ground flora.	5
5	Species-poor intact hedge with trees, supporting Canadian poplar, hawthorn, dog-rose, bramble, English elm, ivy.	6
6	There used to be a pond at this location, but there is no longer.	n/a
7	Species-poor intact hedgerow, hawthorn dominated.	7
8	Species-poor intact hedge with trees. Hedge dominated by hawthorn, with pedunculate oak, dog-rose, and Midland hawthorn. Ground flora dominated by ivy, with bramble, honeysuckle, bracken, cleavers and common nettle. A few veteran trees (>1.3 m) present within the survey corridor.	7
9	Winter heliotrope dominant on roadside.	8
10	Species-poor semi-improved neutral grassland supporting common/creeping bent, common mouse-ear, Yorkshire-fog, common sorrel, meadow buttercup, and patches of common nettle, common ragwort, bugle, patch of dense scrub (bramble and elder) in the margins, scarlet pimpernel, forget-me-not, germander speedwell, and creeping thistle. Skylarks were heard singing overhead. The area is rabbit grazed and may be used for grazing livestock sometimes.	9
11	Mixed broad-leaved-coniferous woodland plantation (Heath Wood), with a canopy of sweet chestnut (F), silver birch, Scott's pine (F), sycamore (O), Douglas fir (R) and Leylandii cypress (O). The understorey is relatively sparse and comprises saplings of silver birch, pedunculate oak, sycamore, chestnut (O) and Dutch elm (R). Rhododendron is locally frequent near the track to the north of this woodland compartment. Ground flora supporting bluebell (A/LD), male-fern, scaly male-fern (F), broad buckler fern (F/LA), bracken (F), climbing corydalis (O), bramble, honeysuckle, rough meadow-grass, ground ivy, and <i>Kindbergia praelonga</i> and <i>Atrichum undulatum</i> mosses.	10, 11
12	Species-poor semi-improved neutral grassland. Species recorded include creeping bent (F/LA), Yorkshire-fog, white clover, germander speedwell, creeping thistle, ground ivy, creeping buttercup, common nettle, hard rush (O), scarlet pimpernel. The area is grazed by rabbits.	12
13	Planted broad-leaved woodland with a canopy of sycamore (A) and ash (O) trees, and an understorey of hawthorn, ash and pedunculate oak saplings, and elder. Ground flora comprises abundant common nettle, sycamore seedlings (F/LA), ground ivy (F), male fern (O), bluebell (O), wood avens, red campion, and <i>Kindbergia praelonga</i> moss.	13
14	Species-poor semi-improved neutral grassland with evidence of grazing. Species recorded: creeping bent (A), Yorkshire-fog (F), creeping buttercup, selfheal, ground ivy, creeping thistle, white clover (F), ribwort plantain.	14
15	Pond c. 10x18m, dry, but with aquatic/emergent vegetation covering approximately 65%. Species present include bulrush (A), gypsywort (O), broad-leaved pondweed (LA), branched bur-	15

TN	Habitat Description	Photo (see Appendix C)
	reed (F/LA). The banks are covered in bramble and teasel, with ¼ shaded by grey willow.	
16	Two patches of Japanese knotweed near pond (c. 5x5m).	16
17	Semi-natural broad-leaved woodland with a canopy of ash, pedunculate oak and sycamore, and understorey of hawthorn, ash saplings and blackthorn. Ground flora composed of common nettle, bramble, ground ivy, wood avens and herb-Robert.	n/a
18	Planted broad-leaved woodland with a canopy of sycamore and horse chestnut, with scattered silver birch. Understorey is very sparse and ground flora is dominated by common nettle.	n/a
19	Semi-natural broad-leaved woodland with a canopy of pedunculate oak and sycamore, and a dense understorey composed of blackthorn, small-leaved elm, goat willow, elder, crab apple, and frequent wild plum. Ground flora dominated by common nettle, ground ivy and <i>Kindbergia praelonga</i> moss, with occasional wood avens and scaly male-fern.	n/a
20	Semi-natural broad-leaved woodland with a canopy of semi-mature pedunculate oak, ash and silver birch trees. Understorey composed of field maple, ash/sycamore saplings, hawthorn and elder. Ground flora supporting male-fern, ivy, bluebell (O – D in spring), lesser celandine and common nettle (LA).	17
21	Semi-natural broad-leaved woodland with a canopy of ash and sycamore, and understorey of hawthorn, hazel, elder, and sycamore/ash saplings. Ground flora is dominated by dog's-mercury, with common nettle (LA), rough meadow-grass (F), bluebell (O/LF), ivy and red campion.	18
22	Plantation of semi-mature Canadian poplar either side of stream. Understorey of grey willow, silver birch and elder, resembling wet woodland in places. Ground flora composed of ground ivy (F), scaly male-fern (F), enchanter's nightshade (O/LF), common nettle (LA), red campion (F), marsh thistle (F), creeping buttercup (LA), bramble, wild angelica (O). High potential for restoration to wet woodland.	19, 20, 21
23	Pond (c. 15x5 m) in woodland, partially shaded by poplar and grey willow. Starwort covering c. 15% of the water body, with the following species recorded on/along banks: bulrush, meadowsweet, great willowherb, hemp agrimony, bittersweet, hemlock, and lesser pond-sedge.	22
24	Small stream approximately 1.5 m wide, with green algae and starwort in the water and abundant lesser pond-sedge on the banks. Other species recorded on banks include bittersweet, marsh thistle, red campion, cleavers, red campion and bramble.	23
25	Large areas of swamp dominated by lesser pond sedge, with marsh bedstraw (F), gypsywort (O), water mint (O) and marsh marigold (O).	24
26	Wet woodland dominated by grey willow, with abundant lesser pond-sedge in the ground flora and fern species, false oat-grass and Yorkshire fog.	25
27	Semi-improved, species-poor neutral grassland on field margin (c. 6 m wide). Supports abundant barren brome, field forget-me-not, spear thistle, bramble, dandelion, greater plantain, mugwort, wild parsnip, false-oat grass and brown bent.	26
28	Two species-poor intact hedgerows with no trees. Hawthorn is dominant and other species recorded include dog-rose, bramble, English elm, cleavers, and common nettle.	27
29	Semi-natural broad-leaved woodland (replanted ancient) with a canopy of silver birch, pedunculate oak, sycamore and sweet chestnut, and understorey of hazel (F) and elder. Ground flora composed of dog's-mercury, bluebell, bracken, cleavers, bramble, honeysuckle, enchanter's nightshade, ground ivy, broad-buckler fern, sycamore seedlings, male fern and <i>Mnium hornum</i> moss. Patches of wet woodland dominated by alder. A larger area dominated by pedunculate oak (semi-mature and mature) trees with saplings of sweet chestnut planted in lines. Ground flora supporting bluebell and bracken.	28, 29
30	Planted broadleaved woodland with a canopy dominated by sycamore and understorey	30

TN	Habitat Description	Photo (see Appendix C)
	composed of hazel (F), elder, sycamore saplings, field maple and blackcurrant. Ground flora supports bluebell (LA), ivy (A), bramble, climbing corydalis (LF).	
31	Belt of planted Leylandii cypress, with some sweet chestnut and elder in the understorey. Ground flora composed of ground ivy and red campion.	n/a
32	Broad-leaved woodland – not surveyed.	n/a
33	Mixed broad-leaved-coniferous plantation woodland with a canopy of European fir (F), sycamore, silver birch, pedunculate oak and Douglas fir. Understorey supporting hazel (F), elder and silver birch saplings. Ground flora is composed of climbing corydalis (LF), ground ivy, bramble, broad buckler-fern, bracken, sycamore seedlings, bluebell, <i>Kindbergia praelonga</i> and <i>Mniium hornum</i> mosses.	n/a
34	Young coniferous plantation (nursery) – no access	n/a
35	Mixed broad-leaved-coniferous plantation with a canopy of Scott's pine and some pedunculate oak. Understorey composed of elder (F), blackthorn, holly and hawthorn, and ground flora supporting ivy (A), bramble (A), black bryony, lords-and-ladies, cleavers and common nettle.	31
36	Cereal field margin. Species recorded include Yorkshire-fog, creeping thistle, broad-leaved dock, mugwort, barren brome, field forget-me-not, dandelion, common cat's-ear.	32
37	Semi-natural broad-leaved woodland with a canopy of pedunculate oak and sweet chestnut, and understorey of hawthorn, small-leaved elm (F), hazel and holly. Ground flora dominated by bramble, with red campion and ivy.	33, 34
38	Mixed broad-leaved-coniferous plantation with a canopy of Scott's pine (A), with sycamore (F), sweet chestnut (O) and pedunculate oak (R). Understorey composed of elder, sycamore saplings and garden privet. Ground flora dominated by ivy, with abundant bramble.	35
39	Planted broad-leaved woodland with a canopy of sycamore (A), sweet chestnut (O) and pedunculate oak (O). Understorey composed of elder, hawthorn (O), snowberry, sycamore saplings and yew (O). Ground flora dominated by bramble, with annual meadow-grass, ivy, common nettle, cleavers and bluebell (O).	36
40	Cereal field margin (c. 5 m wide) with a public footpath alongside hedgerow/road. Species recorded include soft brome, dandelion, hop trefoil, annual meadow-grass, common nettle, creeping bent, white clover, mugwort and barren brome.	37
41	Coniferous plantation dominated by Scott's pine and very sparse or absent understorey. Ground flora supports abundant common nettle and ivy, with frequent ground ivy and cleavers.	38
42	Cereal field margin supporting barren brome (F), soft brome (F), Yorkshire-fog, creeping bent (F), dandelion (F), creeping thistle (F), hop trefoil (LF), beaked hawk's-beard (F), cow parsley and mugwort.	39
43	Coniferous plantation with a canopy dominated by Scott's pine, with some silver birch (O) and Sitka spruce (LF). Understorey composed of elder, hawthorn and pedunculate oak saplings, and ground flora dominated by bramble and ivy.	40
44	Young plantation of broad-leaved trees/shrubs including pedunculate oak, ash, wild cherry and hawthorn. Ground flora dominated by cow parsley, with frequent hogweed and rough meadow-grass.	41, 42
45	Large pedunculate oak tree approximately 1 m in diameter.	43
46	Large pedunculate oak tree approximately 1.2-1.3 m in diameter – possibly a veteran tree	44
47	Species-poor semi-improved neutral grassland within the boundary of Norwich Airport (no access).	45

TN	Habitat Description	Photo (see Appendix C)
48	Species-poor semi-improved neutral grassland within the boundary of Norwich Airport (no access). Species recorded include sweet meadow-grass, common sorrel, ribwort plantain and creeping buttercup.	46
49	Intact and species-rich hedge with trees. Species recorded include hawthorn, dog-rose, pedunculate oak, blackthorn, common nettle, ivy and ground ivy.	47
50	Planted broad-leaved woodland with a canopy of silver birch, rowan, sycamore, Italian alder and Scott's pine. Understorey composed of hawthorn, elder and rowan, and ground flora dominated by common nettle.	48
51	Line of planted Canadian poplar	49
52	Mature pedunculate oak tree, and second mature oak outside of works footprint.	50
53	Young landscape planting on roadside, including hawthorn, field maple, dog-rose and guelder rose.	51
54	Dense scrub (landscape planting) on roadside.	n/a
55	Narrow strip of planted broad-leaved woodland on roadside. Canopy composed of pedunculate oak, sycamore, field maple, with an understorey of blackthorn and elder. Ground flora dominated by ivy, with some garlic mustard and cow parsley.	n/a
56	Young plantation woodland with oak, spruce, ash, field maple, hawthorn and guelder-rose. Semi-improved grassland and pond with ground-ivy, common cudweed, tare sp., creeping cinquefoil, common mouse-ear, black medick and southern marsh orchid.	52-55
57	Species-poor semi-improved neutral grassland, over-seeded with cock's-foot. Species recorded include cock's-foot (A/LD), ribwort plantain, dandelion, oxeye daisy, common knapweed, meadow foxtail, red fescue and white clover.	56
57b	Strip of semi-improved grassland with tormentil, ribwort plantain, timothy grass sp, common vetch, goat's-beard, dandelion, white clover, prickly sow-thistle, perennial rye-grass, smooth tare, cock's-foot, yarrow, ragwort, common vetch, common bird's-foot-trefoil, hedge bindweed and crested dog's tail.	57, 58
58	Species-poor semi-improved neutral grassland composed of Yorkshire-fog (A), white clover (A), creeping thistle (F), common nettle (LA), ribwort plantain, dandelion, common cat's-ear, common mouse-ear, common ragwort (F) and creeping buttercup.	59
59	Mixed broad-leaved-coniferous woodland plantation with a canopy of Scott's pine (A), pedunculate oak, silver birch and larch. Understorey composed of rowan (F), silver birch (F), holly (O). Ground flora supporting bracken (A), honeysuckle (F/LA), climbing corydalis (A), bramble (LF) and broad buckler fern (F).	60, 61
60	Coniferous plantation dominated by Scott's pine.	62
61	Line of semi-mature pedunculate oak trees on roadside.	63
61a	Marriot's Way. Very mixed flora, sunny and shaded rides, lined by hedgerows with trees and scrub.	64, 65
61b	Poor semi-improved grassland field margin with false-oat grass dominant, hogweed, cock's-foot, cat's-ear, guelder rose and Yorkshire fog.	66
61c	3m field margin with tussocky semi-improved grassland, with cock's-foot, Yorkshire fog, hogweed, ragwort, mugwort, cut-leaved crane's-bill, perennial rye-grass, dandelion, yarrow and goat's-beard.	67
62	Species-poor hedge with trees. Species recorded include pedunculate oak, hawthorn, dog-rose, bramble, cleavers and common nettle.	68

TN	Habitat Description	Photo (see Appendix C)
63	Intact species-rich hedge with no trees – recently planted. Species recorded: hawthorn (dominant), field maple, hazel, guelder rose, blackthorn, holly and dogwood.	n/a
64	Intact species-poor hedge without trees: blackthorn, hawthorn and elder, and an understory dominated by bracken.	69
65	Planted broad-leaved woodland with a canopy of sycamore (F), ash (O), larch (O) and oak (O). Understory of hazel, ash saplings and dog-rose, and ground flora dominated by ivy, with common nettle, lords-and-ladies and ground ivy.	70
66	Semi-improved neutral grassland (species-poor) heavily grazed by rabbits. Species recorded include Yorkshire-fog, bird's-foot-trefoil (A), field forget-me-not, germander speedwell, white clover, creeping buttercup, common nettle, bramble scrub and <i>Rhytidiadelphus squarrosus</i> moss.	71
67	Planted broadleaved woodland and areas of semi-natural broadleaved woodland. Canopy dominated by sycamore and pedunculate oak; understory of hawthorn and elder and ground flora with abundant common nettle.	72, 73
68	Landscape planting	n/a
69	Line of broad-leaved trees on field boundary.	74
70	Fakenham Road RNR consisting of semi-improved grassland. Hoary mullein is frequent with mullein moth caterpillar present, Yorkshire fog and cock's-foot abundant, bramble frequent, and also ragwort, germander speedwell, yarrow, red and white campion, common poppy, prickly sow thistle, dog-rose, smooth tare, cut-leaved cranesbill, St-John's wort, ground ivy, false-oat grass, scarlett pimpernel, common vetch, common mouse-ear and common nettle, also bugloss and Canadian fleabane. The verge is mown short in the first 2m next to the road, and the rest of the southern facing slope is managed probably by strimming. There are frequent rabbit holes. The habitat continues at least 200-300m before the verge becomes scrubby.	75
71	Coniferous plantation woodland along the edge of the golf course.	n/a
72	Small block of broadleaved semi-natural woodland with sycamore, ash and oak in the canopy, and hawthorn and elder in the sub-canopy. The ground flora includes common nettle, cleavers and deadwood. Two garden ponds.	76, 77
73	Semi-improved grassland near Broadland Gate roundabout, with fox-and-cubs,	78
74	Species-rich hedgerow, not classified as 'important.'	79, 80
75	Species-rich hedgerow with trees, classified as 'important.'	81
76	Species-rich hedgerow, classified as 'important.'	82
77	Species-rich hedgerow with trees, not classified as 'important.'	83
78	Species-rich hedgerow with trees, classified as 'important.'	84
79	Species-rich hedgerow with trees, classified as 'important.'	85
80	Species-rich hedgerow with trees, classified as 'important.'	86
81	Species-rich hedgerow with trees, not classified as 'important.'	87
82	Species-rich hedgerow with trees, not classified as 'important.'	102
83	Species-rich hedgerow with trees, not classified as 'important.'	103
84	Species-rich hedgerow, classified as 'important.'	103
85	Species-rich hedgerow with trees, classified as 'important.'	88
86	Species-rich hedgerow, classified as 'important.'	89, 90

TN	Habitat Description	Photo (see Appendix C)
87	Species-rich hedgerow with trees, classified as 'important.'	91, 92
88	Species-rich hedgerow with trees, not classified as 'important.'	93
89	Species-rich hedgerow with trees, classified as 'important.'	94
90	Species-rich hedgerow with trees, classified as 'important.'	95
91	Species-rich hedgerow with trees, classified as 'important.'	96, 97
92	Species-rich hedgerow with trees, not classified as 'important.'	98
93	Species-rich hedgerow with trees, classified as 'important.'	99
94	Species-rich hedgerow with trees, not classified as 'important.'	100
95	Species-rich hedgerow with trees, not classified as 'important.'	101

Appendix C. Photographs

Photo 1



Photo 2



Photo 3



Photo 4



Photo 5 (2009)



Photo 6 (2009)

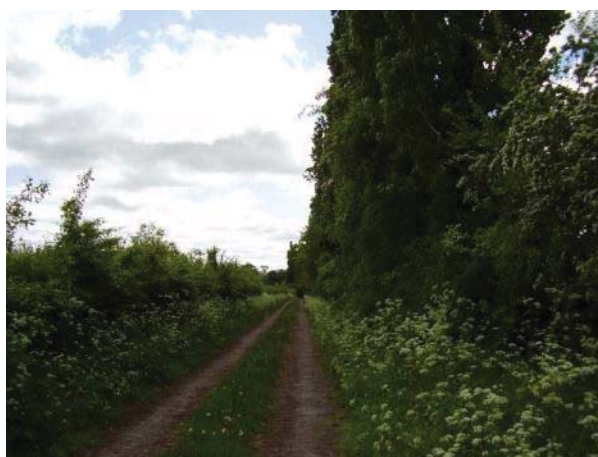


Photo 7



Photo 8 (2009)



Photo 9



Photo 10 (2009)



Photo 11 (2009)



Photo 12



Photo 13 (2009)



Photo 14 (2009)



Photo 15



Photo 16



Photo 17 (2009)



Photo 18 (2009)



Photo 19 (2009)



Photo 20 (2009)



Photo 21 (2009)



Photo 22



Photo 23



Photo 24 (2009)



Photo 25



Photo 26



Photo 27 (2009)



Photo 28 (2009)



Photo 29 (2009)



Photo 30 (2009)



Photo 31 (2009)



Photo 32



Photo 33 (2009)



Photo 34 (2009)



Photo 35 (2009)



Photo 36 (2009)



Photo 37 (2009)



Photo 38 (2009)



Photo 39



Photo 40 (2009)



Photo 41 (2009)



Photo 42 (2009)



Photo 43 (2009)



Photo 44 (2009)



Photo 45 (2009)



Photo 46 (2009)



Photo 47 (2009)



Photo 48



Photo 49



Photo 50 (2009)



Photo 51



Photo 52



Photo 53



Photo 54



Photo 55



Photo 56 (2009)



Photo 57

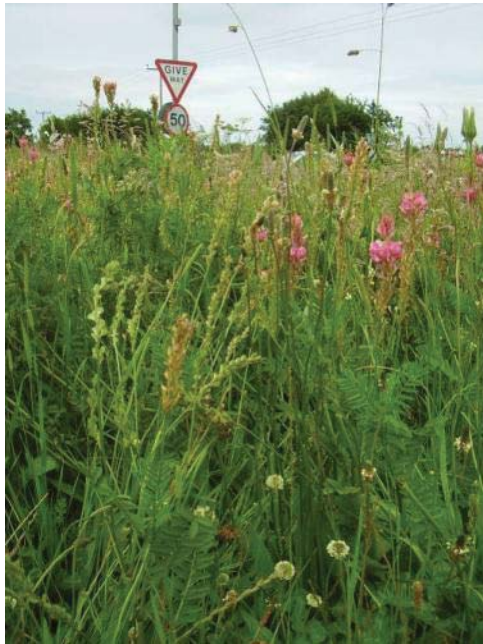


Photo 58



Photo 59 (2009)



Photo 60 (2009)



Photo 61 (2009)



Photo 62 (2009)



Photo 63 (2009)



Photo 64



Photo 65



Photo 66



Photo 67



Photo 68



Photo 69



Photo 70



Photo 71



Photo 72



Photo 73



Photo 74



Photo 75



Photo 76



Photo 77



Photo 78



Photo 79

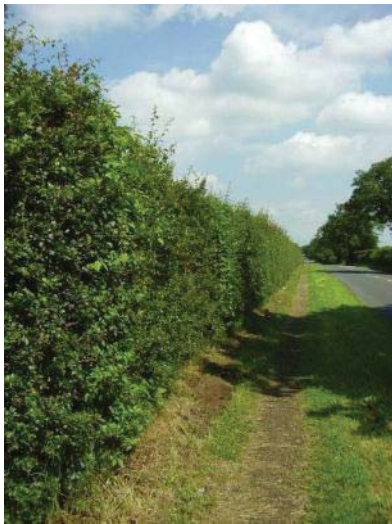


Photo 80

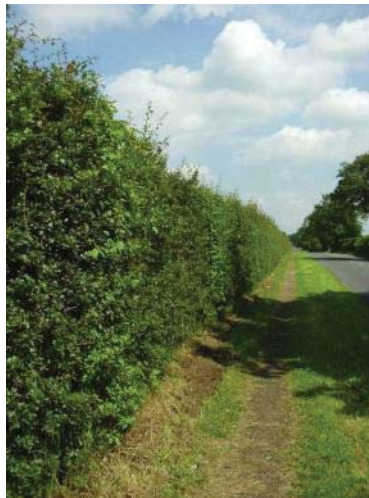


Photo 81



Photo 82



Photo 83



Photo 84



Photo 85



Photo 86



Photo 87



Photo 88



Photo 89



Photo 90



Photo 91



Photo 92



Photo 93



Photo 94



Photo 95



Photo 96



Photo 97



Photo 98



Photo 99



Photo 100



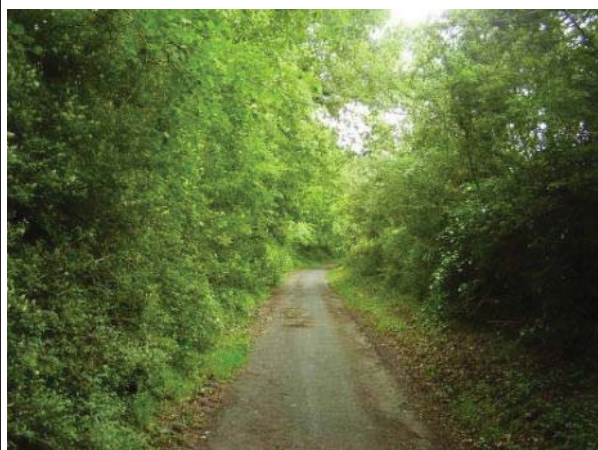
Photo 101



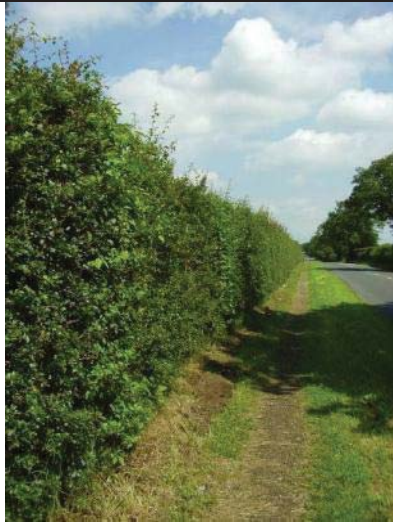
Photo 102



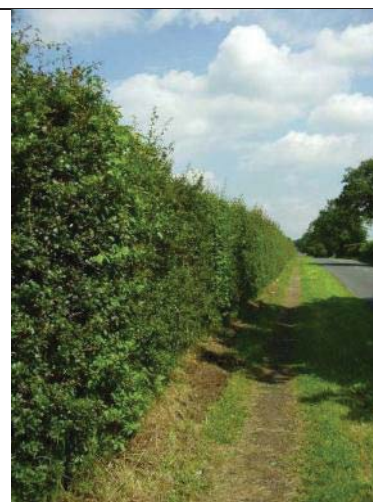
Photo 103




Appendix D. Hedgerow Regulations (1997) Record Sheets

Hedge No.	TN 74 (part a)	
Important	N	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	7	
Bank/wall	N	
Intact	Y	
Trees	N	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	3	
Parallel hedge	Y	
Notes	This hedge has been recently planted and is not 30 years old; it is closer to ten years old.	
Sample	a	b
Woody spp present		
Dogwood	Y	Y
Hawthorn	Y	Y
Hazel	Y	Y
Field Maple	Y	Y
Guelder-rose	Y	Y
Holly	N	Y
Blackthorn	Y	Y
Ash	N	Y
Ground flora (dominant)	Bramble	
Other ground flora inc notable spp	False oat-grass, cleavers, nipplewort, ribwort plantain, yarrow, smooth sow-thistle, ground-ivy, cat's-ear, Yorkshire fog, vetch sp., common nettle, black medick, cock's-foot.	


Hedge No.	TN 74 (part b)	
Important	N	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	7	
Bank/wall	N	
Intact	Y	
Trees	N	
3 flora spp.	N	
Ditch	N	
Connect \geq 4 points	3	
Parallel hedge	Y	
Notes	This hedge has been recently planted and is not 30 years old; it is closer to ten years old.	
Sample	a	b
Woody spp present		
Hazel	Y	Y
Hawthorn	Y	Y
Dogwood	Y	Y
Holly	Y	Y
Field maple	Y	Y
Blackthorn	Y	Y
Elder	N	N
Ash	N	Y
Guelder-rose	N	Y
Ground flora (dominant)	Bramble	
Other ground flora inc notable spp	False oat-grass, cleavers, nipplewort, ribwort plantain, yarrow, smooth sow-thistle, ground-ivy, cat's-ear, Yorkshire fog, vetch sp., common nettle, cock's-foot, mallow.	




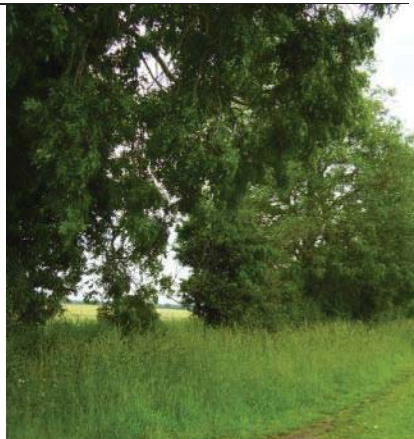
Hedge No.	TN 75	
Important	Y	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	4	
Bank/wall	N	
Intact	Y	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	Y	
Parallel hedge	N	
Notes		
Sample	a	b
Woody spp present		
Cherry plum	Y	N
Hawthorn	Y	Y
Guelder-rose	Y	N
Dog-rose	Y	Y
Hazel	Y	Y
Ground flora (dominant)	Common nettle	
Other ground flora inc notable spp	Cow parsley, cleavers, bracken, herb-Robert*, ivy, honeysuckle, black bryony, black medic, hedge woundwort.	

Hedge No.	TN 76	
Important	Y	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	6	
Bank/wall	Y	
Intact	Y	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	N	
Notes		
Sample	a	b
Woody spp present		
Dog-rose	Y	N
Oak	Y	Y
Field maple	Y	N
Hawthorn	Y	Y
Holly	Y	N
Cherry plum	Y	Y
Hornbeam	N	Y
Birch	N	Y
Elm	N	Y
Ground flora (dominant)	Ivy	
Other ground flora inc notable spp	Common nettle, cock's-foot, bramble, false-oat grass, wood brome, bracken, cleavers, herb-Robert*, black bryony.	


Hedge No.	TN 77	
Important	N	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	Y	
No. woody spp./30m	6	
Bank/wall	N	
Intact	N	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	Y	
Notes	Planted, hedge younger than 30 years old.	
Sample	a	b
Woody spp present		
Dog-rose	N	N
Hawthorn	N	Y
Wayfaring tree	N	N
Dogwood	Y	Y
Oak	Y	Y
Hazel	N	Y
Hornbeam	N	Y
Spindle	N	N
Cherry	N	Y
Goat willow	N	Y
Conifer sp.	N	N
Ash	Y	Y
Sweet chestnut	Y	Y
Ground flora (dominant)		
Other ground flora inc notable spp	Ragwort, false-oat grass, cock's-foot, common nettle, cut-leaved crane's-bill, hogweed, cow parsley.	

Hedge No.	TN 78	
Important	Y	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	6	
Bank/wall	N	
Intact	Y	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	Y	
Notes		
Sample	a	b
Woody spp present		
Field maple	Y	N
Conifer sp.	Y	N
Dogwood	Y	N
Hornbeam	Y	Y
Elder	Y	N
Hawthorn	Y	Y
Elm	Y	Y
Spindle	Y	Y
Sycamore	N	Y
Ground flora (dominant)	Common nettle	
Other ground flora inc notable spp	Cow parsley, hogweed, false-oat grass, mugwort, ivy, cleavers.	


Hedge No.	TN 79	
Important	Y	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	6	
Bank/wall	N	
Intact	N	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	N	
Notes	Looks older than 30 years. Southern half of this hedge appears to be species-rich, whereas further north it resembles a species-poor hedge.	
Sample	a	b
Woody spp present		
Hawthorn	Y	Y
Dog-rose	Y	N
Ash	Y	Y
Oak	Y	Y
Elder	Y	N
Spindle	Y	N
Apple	Y	N
Field maple	N	N
Cherry plum	N	N
Blackthorn	N	Y
Ground flora (dominant)	Ivy	
Other ground flora inc notable spp	Common nettle, Yorkshire fog, mugwort, bracken, false-oat grass, cow parsley, white campion, herb-Robert*, barren brome, cleavers, couch grass, prickly sow-thistle.	



Hedge No.	TN 80	
Important	Y	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	5	
Bank/wall	Y	
Intact	N	
Trees	Y	
3 flora spp.	Y	
Ditch	N	
Connect ≥ 4 points	Y	
Parallel hedge	N	
Notes		


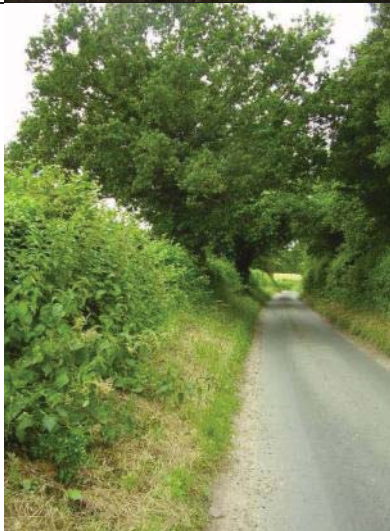
Sample	a
Woody spp present	
Hawthorn	Y
Oak	Y
Ash	Y
Blackthorn	Y
Hazel	Y
Ground flora (dominant)	
Other ground flora inc notable spp	Cock's-foot, white campion, mugwort, false-oat grass, common nettle, prickly sow-thistle, cut-leaved crane's-bill, mallow, bluebell*, heath bedstraw*, ferns*.


Hedge No.	TN 81	
Important	N	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	4	
Bank/wall	Y	
Intact	N	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	N	
Notes	Two gaps of 5m.	


Sample	a
Woody spp present	
Oak	N
Field maple	N
Blackthorn	N
Hawthorn	Y
Hornbeam	N
Elder	Y
Spindle	Y
Dogwood	Y
Elm	Y
Ground flora (dominant)	Common nettle, false-oat grass.
Other ground flora inc notable spp	Herb-Robert*, ivy, wood brome, white campion, cow parsley, cock's-foot, bracken, cleavers.


Hedge No.	TN 85	
Important	Y	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	5	
Bank/wall	Y	
Intact	Y	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	N	
Notes		
		
Sample	a	b
Woody spp present		
Blackthorn	Y	Y
Hawthorn	Y	Y
Oak	Y	Y
Dog-rose	Y	Y
Privet	Y	N
Elder	Y	Y
Ground flora (dominant)	Common nettle	
Other ground flora inc notable spp	Cleavers, wood brome, white bryony, cock's-foot, ivy, ground-ivy, herb-Robert*, cut-leaved crane's-bill, white dead-nettle, germander speedwell, greater stitchwort, barren brome.	


Hedge No.	TN 86			
Important	Y			
Bridleway/path	N			
Pn/Sot/Tic/Tip	N			
No. woody spp./30m	8			
Bank/wall	Y			
Intact	Y			
Trees	N			
3 flora spp.	N			
Ditch	Y			
Connect ≥ 4 points	N			
Parallel hedge	Y			
Notes				
Sample	a	b	c	
Woody spp present				
Dogwood	Y	N	N	
Cherry	Y	Y	Y	
Elder	Y	Y	N	
Oak	Y	Y	Y	
Dog-rose	Y	Y	N	
Holly	Y	Y	N	
Field maple	Y	N	N	
Hazel	Y	Y	Y	
Ash	Y	Y	N	
Hawthorn	Y	Y	Y	
Blackthorn	N	Y	Y	
Hornbeam	N	Y	N	
Ground flora (dominant)	Bindweed			
Other ground flora inc notable spp	Dock sp., greater stitchwort, ground-ivy, common nettle, false-oat grass, garlic mustard, honeysuckle, barren brome, cleavers, bramble, herb-Robert*, yarrow, hogweed, creeping soft grass, cut-leaved crane's-bill.			


Hedge No.	TN 87					
Important	Y					
Bridleway/path	N					
Pn/Sot/Tic/Tip	N					
No. woody spp./30m	5					
Bank/wall	Y					
Intact	Y					
Trees	Y					
3 flora spp.	N					
Ditch	N					
Connect ≥ 4 points	N					
Parallel hedge	Y					
Notes						
Sample	a	b	c	d	e	
Woody spp present						
Hawthorn	Y	Y	Y	Y	Y	
Oak	Y	Y	Y	Y	Y	
Elm	Y	N	N	N	N	
Dog-rose	Y	Y	Y	Y	Y	
Blackthorn	N	Y	N	Y	Y	
Hazel	N	Y	Y	Y	Y	
Field maple	N	Y	N	Y	N	
Elder	N	N	N	N	Y	
Ground flora (dominant)	Ivy					
Other ground flora inc notable spp	Cleavers, ground-ivy, herb-Robert*, false-oat grass, white dead-nettle, smooth sow-thistle.					


Hedge No.	TN 88			
Important	N			
Bridleway/path	N			
Pn/Sot/Tic/Tip	N			
No. woody spp./30m	5			
Bank/wall	Y			
Intact	Y			
Trees	Y			
3 flora spp.	N			
Ditch	N			
Connect ≥ 4 points	N			
Parallel hedge	N			
Notes				
Sample	a	b	c	
Woody spp present				
Field maple	N	N	Y	
Elm	Y	Y	N	
Hawthorn	Y	Y	Y	
Dog-rose	Y	Y	N	
Elder	Y	Y	Y	
Sycamore	N	Y	N	
Blackthorn	N	Y	Y	
Oak	N	N	Y	
Holly	N	N	Y	
Ground flora (dominant)	Ivy			
Other ground flora inc notable spp	Common nettle, mugwort, hogweed, cleavers, couch grass, false-oat grass, barren brome.			


Hedge No.	TN 89		
Important	Y		
Bridleway/path	N		
Pn/Sot/Tic/Tip	N		
No. woody spp./30m	5		
Bank/wall	Y		
Intact	Y		
Trees	Y		
3 flora spp.	N		
Ditch	N		
Connect ≥ 4 points	N		
Parallel hedge	Y		
Notes			
Sample	a	b	
Woody spp present			
Field maple	Y	Y	
Oak	Y	N	
Hazel	Y	N	
Hawthorn	Y	Y	
Dog-rose	Y	N	
Blackthorn	Y	N	
Elder	Y	N	
English elm	N	Y	
Ground flora (dominant)	Ivy		
Other ground flora inc notable spp	Bindweed, herb-Robert*, ivy, ground-ivy, false-oat grass, barren brome, bramble, cleavers, common nettle, cow parsley, creeping soft grass, cut-leaved crane's-bill.		


Hedge No.	TN 90		
Important	Y		
Bridleway/path	N		
Pn/Sot/Tic/Tip	N		
No. woody spp./30m	6		
Bank/wall	Y		
Intact	Y		
Trees	Y		
3 flora spp.	N		
Ditch	Y		
Connect ≥ 4 points	N		
Parallel hedge	Y		
Notes			
Sample	a	b	c
Woody spp present			
Hornbeam	N	Y	N
Beech	N	N	N
Hazel	Y	N	Y
Oak	N	Y	Y
Hawthorn	Y	Y	Y
Field maple	N	Y	N
English elm	Y	N	N
Elder	Y	N	N
Field maple	Y	N	Y
Blackthorn	Y	N	Y
Ash	N	Y	N
Spindle	N	Y	Y
Dog-rose	N	N	Y
Dogwood	N	N	N
Wayfaring tree	N	N	N
	N	N	N
Ground flora (dominant)	Ivy		
Other ground flora inc notable spp	Cow parsley, Yorkshire fog, cleavers, common nettle, bramble, hogweed, white dead-nettle, false-oat grass, ground-ivy, herb-Robert*, mugwort, barren brome, greater stitchwort.		


Hedge No.	TN 91			
Important	Y			
Bridleway/path	Y			
Pn/Sot/Tic/Tip	N			
No. woody spp./30m	6			
Bank/wall	Y			
Intact	Y			
Trees	Y			
3 flora spp.	N			
Ditch	N			
Connect ≥ 4 points	N			
Parallel hedge	Y			
Notes	The most part of this hedge is older than 30 years, but a younger section has been planted to replace a removed section, and this part is less than 30 years old.			
Sample	a	b	c	
Woody spp present				
Apple	Y	N	N	
Holly	Y	N	N	
Field maple	Y	Y	Y	
Dogwood	Y	N	N	
Blackthorn	Y	Y	N	
Hawthorn	Y	Y	Y	
Hazel	Y	Y	N	
Oak	Y	Y	N	
Guelder-rose	Y	N	N	
Goat willow	N	N	N	
Dog-rose	N	Y	N	
Spindle	N	Y	Y	
Elder	N	N	N	
Ground flora (dominant)	Ivy			
Other ground flora inc notable spp	Ground-ivy, false-oat grass, bent sp., Yorkshire fog, herb-Robert*, cleavers, mallow, bindweed, barren brome, soft brome, bracken, white campion, yarrow, cow parsley, mugwort, herb-Robert*, bramble, prickly sow-thistle, red dead-nettle, rough meadow-grass, brown bent, cut-leaved crane's-bill, nipplewort.			


Hedge No.	TN 92			
Important	N			
Bridleway/path	N			
Pn/Sot/Tic/Tip	N			
No. woody spp./30m	5			
Bank/wall	N			
Intact	Y			
Trees	Y			
3 flora spp.	N			
Ditch	N			
Connect ≥ 4 points	N			
Parallel hedge	N			
Notes	Includes veteran trees.			
Sample	a	b	c	
Woody spp present				
Field maple	Y	Y	Y	
Elm	Y	Y	Y	
Oak	N	N	Y	
Holly	Y	Y	Y	
Hawthorn	Y	Y	Y	
Hazel	Y	N	N	
Dog-rose	N	Y	N	
Blackthorn	N	Y	N	
Ash	N	N	N	
Ground flora (dominant)	Common nettle			
Other ground flora inc notable spp	Cleavers, ivy, dock sp., hogweed, red campion, mugwort, forget-me-not, barren brome, black bryony, bracken, wild parsnip, false-oat grass, brown bent, meadowsweet.			


Hedge No.	TN 93			
Important	Y			
Bridleway/path	N			
Pn/Sot/Tic/Tip	N			
No. woody spp./30m	5			
Bank/wall	Y			
Intact	Y			
Trees	Y			
3 flora spp.	Y			
Ditch	Y			
Connect ≥ 4 points	N			
Parallel hedge	Y			
Notes				
Sample	a	b	c	
Woody spp present				
Ash	Y	Y	Y	
Hawthorn	Y	Y	Y	
Blackthorn	N	Y	Y	
Oak	Y	Y	Y	
Dog-rose	Y	Y	Y	
Goat willow	N	N	N	
Privet	Y	N	N	
Apple	Y	N	N	
Ground flora (dominant)	Common nettle			
Other ground flora inc notable spp	Ivy, cleavers, herb-Robert*, spear-thistle, ground-ivy, bracken, cow parsley, false-oat grass, prickly sow-thistle, bugle*, white bryony, garlic mustard, white campion, cock's-foot, red campion, wood sage*.			

Hedge No.	TN 94			
Important	N			
Bridleway/path	Y			
Pn/Sot/Tic/Tip	N			
No. woody spp./30m	5			
Bank/wall	N			
Intact	Y			
Trees	Y			
3 flora spp.	N			
Ditch	N			
Connect ≥ 4 points	N			
Parallel hedge	N			
Notes				
Sample	a	b	c	
Woody spp present				
Blackthorn	Y	Y	N	
Oak	Y	Y	Y	
Elder	Y	Y	N	
Hawthorn	Y	Y	Y	
Ash	Y	Y	Y	
Holly	N	Y	N	
Ground flora (dominant)	Common nettle			
Other ground flora inc notable spp	Cleavers, cock's-foot, yellow pimpernel*.			

Hedge No.	TN 95	
Important	N	
Bridleway/path	N	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	5	
Bank/wall	N	
Intact	Y	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	N	
Notes		
Sample	a	
Woody spp present		
Oak	Y	
Hawthorn	Y	
Field maple	Y	
Elder	Y	
Blackthorn	Y	
Dogwood	N	
Ground flora (dominant)	Common nettle/ivy	
Other ground flora inc notable spp	Bramble, cleavers, prickly sow-thistle, Yorkshire fog, wood avens*.	

Hedge No.	TN 82	
Important	N	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	3	
Bank/wall	Y	
Intact	N	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	N	
Notes	2 veteran oaks.	
Sample	a	b
Woody spp present		
Hawthorn	Y	Y
Oak	Y	N
Cherry plum	N	Y
Dog-rose	N	N
Hazel	N	Y
Field maple	N	N
Ash	N	Y
Ground flora (dominant)	Bracken	
Other ground flora inc notable spp	Bramble, common poppy, cock's-foot, red campion, ground-ivy, cleavers, herb-Robert*, ivy, cow parsley, germander speedwell, false-oat grass, white campion, hogweed, common fumitory, creeping cinquefoil, white dead-nettle, mugwort, crested dog's-tail, smooth meadow-grass, cut-leaved crane's-bill, yellow pimpernel, meadow vetchling. .	

Hedge No.	TN 83	
Important	N	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	3	
Bank/wall	Y	
Intact	Y	
Trees	Y	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	Y	
Notes	At least 50m from the road.	
Sample	a	
Woody spp present		
Oak	N	
Poplar	N	
Aspen	Y	
Dog-rose	Y	
Privet	Y	
Dogwood	N	
Hazel	N	
Blackthorn	N	
Ground flora (dominant)	Ivy	
Other ground flora inc notable spp	Common nettle, cleavers, red campion, ground-ivy, ivy, smooth meadow-grass, cock's-foot, germander speedwell, herb-Robert*, cut-leaved crane's-bill, field bindweed, common vetch, garlic mustard, cut-leaved crane's-bill.	

Hedge No.	TN 84	
Important	Y	
Bridleway/path	Y	
Pn/Sot/Tic/Tip	N	
No. woody spp./30m	5	
Bank/wall	Y	
Intact	Y	
Trees	N	
3 flora spp.	N	
Ditch	N	
Connect ≥ 4 points	N	
Parallel hedge	Y	
Notes	Likely to be 30 years old or older.	Right hedge in this photo.
Sample	a	
Woody spp present		
Hawthorn	Y	
Dog-rose	Y	
Blackthorn	Y	
Aspen	Y	
Oak	Y	
Ground flora (dominant)	Cleavers	
Other ground flora inc notable spp	Common nettle, cow parsley, herb-Robert*, white dead-nettle, false-oat grass, cleavers, ivy, ground-ivy, garlic mustard, Lords-and-ladies*.	

Appendix E. Hedgerow Regulations (1997) Assessment Information

Accompanying Notes for Hedgerows Regulations (1997) Record Sheet

These Regulations only apply to hedgerows adjacent to land in agricultural/horticultural use. A hedgerow may be classified as 'important' for archaeological/historical reasons, or according to Wildlife and Landscape criteria. To be classified as 'important' under the Wildlife and Landscape criteria, the hedgerow must be over 30 years old and should comprise one of the following:

- *at least 7 woody species/30m;
- *at least 6 woody species/30m and at least 3 features;
- *at least 6 woody spp/30m including any one of Pn/Sot/Tic/Tip (see below);
- *at least 5 woody species and at least 4 features;
- or if adjacent to a bridleway/footpath, at least 4 woody species and at least 2 features.

*If the hedgerow is situated wholly or partly in one of the counties listed in Criteria 7 sub-paragraph (2) of the Regulations, the number of woody species should be reduced by one.

(N.B. A hedgerow may also be classified as 'important' due to the presence/recorded presence of particular animal and plant species (see Criteria 6 sub-paragraphs (1)-(4) of the Regulations for details).)

The woody species 'recognised' by the Hedgerows Regulations are listed below, along with the species codes to be used on the record sheet:-

Spp code	Scientific name	English name	Spp code	Scientific name	English code
Ac	<i>Acer campestre</i>	Field Maple	Pa	<i>Prunus avium</i>	Wild Cherry
Ag	<i>Alnus glutinosa</i>	Alder	Pp	<i>Prunus padus</i>	Bird Cherry
Bpe	<i>Betula pendula</i>	Silver Birch	Ps	<i>Prunus spinosa</i>	Blackthorn
Bpu	<i>Betula pubescens</i>	Downy Birch	Pyc	<i>Pyrus communis</i>	Pear
Bxs	<i>Buxus sempervirens</i>	Box	Qp	<i>Quercus petraea</i>	Sessile Oak
Cb	<i>Carpinus betulus</i>	Hornbeam	Qr	<i>Quercus robur</i>	Pedunculate Oak
Cos	<i>Cornus sanguinea</i>	Dogwood	Rc	<i>Rhamnus catharticus</i>	Buckthorn
Ca	<i>Corylus avellana</i>	Hazel	Ruv	<i>Ribes uva-crispa</i>	Gooseberry
Cla	<i>Crataegus laevigata</i>	Midland Hawthorn	Ros	<i>Rosa sp(p)</i>	Rose
Cm	<i>Crataegus monogyna</i>	Hawthorn	Rac	<i>Ruscus aculeatus</i>	Butcher's-broom
Cys	<i>Cytisus scoparius</i>	Broom	Sx	<i>Salix sp(p)</i>	Willow
DI	<i>Daphne laureola</i>	Spurge-laurel	Sxv	<i>Salix viminalis</i>	Osier
Ee	<i>Euonymus europaeus</i>	Spindle	Sn	<i>Sambucus nigra</i>	Elder
Fs	<i>Fagus sylvatica</i>	Beech	Sac	<i>Sorbus aucuparia</i>	Rowan
Fa	<i>Frangula alnus</i>	Alder Buckthorn	Sor	<i>Sorbus sp(p)</i>	Whitebeam
Fe	<i>Fraxinus excelsior</i>	Ash	Sot	<i>Sorbus torminalis</i>	Wild Service-tree
Hr	<i>Hippophae rhamnoides</i>	Sea-buckthorn	Tb	<i>Taxus baccata</i>	Yew
Ia	<i>Ilex aquifolium</i>	Holly	Tic	<i>Tilia cordata</i>	Small-leaved Lime
Jr	<i>Juglans regia</i>	Walnut	Tip	<i>Tilia platyphyllos</i>	Large-leaved Lime
Jc	<i>Juniperus communis</i>	Common Juniper	Ue	<i>Ulex europaeus</i>	Gorse
Liv	<i>Ligustrum vulgare</i>	Wild Privet	Ug	<i>Ulex gallii</i>	Western Gorse
Ms	<i>Malus sylvestris</i>	Crab Apple	Umi	<i>Ulex minor</i>	Dwarf Gorse
Pal	<i>Populus alba</i>	White Poplar	Um	<i>Ulmus sp(p)</i>	Elm
Pn	<i>Populus nigra sub-species betulifolia</i>	Black-poplar	VI	<i>Viburnum lantana</i>	Wayfaring-tree
Pot	<i>Populus tremula</i>	Aspen	Vop	<i>Viburnum opulus</i>	Gelder Rose
Pcan	<i>Populus x canescens</i>	Grey Poplar			

Woody species recorded in hedgerows but not recognised as such by Hedgerows Regulations.

Ah	<i>Aesculus hippocastanum</i>	Horse-chestnut
Ap	<i>Acer pseudoplatanus</i>	Sycamore
Cs	<i>Castanea sativa</i>	Sweet Chestnut
Pd	<i>Prunus domestica</i>	Wild Plum
Pd	<i>Prunus laurocerasus</i>	Cherry Laurel
Tie	<i>Tilia x europaea</i>	Lime

The presence of a number of features along a hedgerow influences the classification under the Regulations. The terms used on the record sheet are explained below, and their presence is indicated by a '✓':

Bank/wall	The hedgerow is supported along at least half of its length by a bank/wall.
Intact	The hedgerow contains less than 10% gaps along its length.
Trees	The hedgerow supports at least 1 standard tree per 50m length (standard trees are defined as those which when measured at 1.3m above ground level have a diameter of at least 20 cm, or 15 cm for multi-stemmed trees).
3 flora spp.	The hedgerow supports at least 3 of the valuable ground flora species defined by the Regulations. The hedgerow is considered to support a plant if it is rooted within 1m (in any direction) of the hedgerow.
Ditch	There is a ditch along at least half of the length of the hedgerow.
Connections ≥ 4 points	A hedgerow must score 4 or more 'connections points'. Connections with an adjoining hedgerow(s) score 1 point each and a connection with a pond or woodland (in which the majority of the trees are broad-leaved) scores 2 points each. A hedgerow is considered to be connected if it meets the feature or if it has a point within 10m of it and would meet it if the line of the hedgerow continued.
Parallel hedge	A parallel hedgerow is present within 15m.

An explanation of additional terms used on the Hedgerows Regulation Record Sheet follows:

Hedge No.	Hedgerow Number (within survey area/ site)
Important	Is the hedgerow classified as 'important' under the Hedgerows Regulations?
Bridleway/path	The hedgerow runs parallel to a designated bridleway/footpath.
Pn/Sot/Tic/Tip	The presence of these trees within the hedgerow influences the classification. An explanation of the species codes is shown above.

Woody species A list of the woody species found along the hedgerow (this is likely to list more species than are present along 30 m length(s)).

Ground flora spp. Any dominant and/or notable ground flora species recorded along the hedgerow.

Valuable ground flora species with regard to the Hedgerows Regulations (1997)

Amos	<i>Adoxa mochatellina</i>	Moschatel
Ajr*	<i>Ajuga reptans</i>	Bugle
Alu*	<i>Allium ursinum</i>	Ramsons
An*	<i>Anemone nemorosa</i>	Wood Anemone
Amac	<i>Arum maculatum</i>	Lord's-and-Ladies
Aff*	<i>Athyrium filix-femina</i>	Lady-fern
Bsp*	<i>Blechnum spicant</i>	Hard-fern
Bs*	<i>Brachypodium sylvaticum</i>	False Brome
Bram	<i>Bromopsis ramosa</i>	Hairy Brome
Clat	<i>Campanula latifolia</i>	Giant Bellflower
Ctra	<i>Campanula trachelium</i>	Nettle-leaved Bellflower
Cxsy	<i>Carex sylvatica</i>	Wood Sedge
Cl*	<i>Circaea lutetiana</i>	Enchanter's Nightshade
Cmaj	<i>Conopodium majus</i>	Pignut
Daff	<i>Dryopteris affinis</i>	Scaly Male-fern
Dcar	<i>Dryopteris carthusiana</i>	Narrow Buckler-fern
Dfm	<i>Dryopteris filix-mas</i>	Male-fern
Ehel	<i>Epipactis helleborine</i>	Broad-leaved Helleborine
Esyl	<i>Equisetum sylvaticum</i>	Wood Horsetail
Eamy	<i>Euphorbia amygdaloides</i>	Wood Spurge
Fgig	<i>Festuca gigantea</i>	Giant Fescue
Fv*	<i>Fragaria vesca</i>	Wild Strawberry
Godo	<i>Galium odoratum</i>	Woodruff
Gsx*	<i>Galium saxatile</i>	Heath Bedstraw
Gro*	<i>Geranium robertianum</i>	Herb-Robert
Gu*	<i>Geum urbanum</i>	Wood Avens
Hn*	<i>Hyacinthoides non-scripta</i>	Bluebell
Lgal	<i>Lamiastrum galeobdolon</i>	Yellow Archangel
Lsqu	<i>Lathraea squamaria</i>	Toothwort
Ls*	<i>Luzula sylvatica</i>	Greater Wood-rush
Lnem	<i>Lysimachia nemorum</i>	Yellow Pimpernel
Mpra	<i>Melampyrum pratense</i>	Common Cow-wheat
Msyl	<i>Melampyrum sylvaticum</i>	Small Cow-wheat
Muni	<i>Melica uniflora</i>	Wood Melick
Mp*	<i>Mercurialis perennis</i>	Dog's Mercury
Meff	<i>Milium effusum</i>	Wood Millet
Omas	<i>Orchis mascula</i>	Early -purple Orchid
Oxa*	<i>Oxalis acetosella</i>	Wood Sorrel
Pqua	<i>Paris quadrifolia</i>	Herb Paris
PSCO	<i>Phyllitis scolopendrium</i>	Hart's-tongue
Pnem	<i>Poa nemoralis</i>	Wood Meadow-grass
Pvul	<i>Polypodium vulgare</i>	Polypody
Pacu	<i>Polystichum aculeatum</i>	Hard Shield-fern
Pset	<i>Polystichum setiferum</i>	Soft Shield-fern
Pere	<i>Potentilla erecta</i>	Tormentil
Pste	<i>Potentilla sterilis</i>	Barren Strawberry
Pela	<i>Primula elatior</i>	Oxlip
Pvul	<i>Primula vulgaris</i>	Primrose

Raur	<i>Ranunculus auricomus</i>	Goldilocks Buttercup
Sne*	<i>Sanicula europaea</i>	Sanicle
Tsn*	<i>Teucrium scorodonia</i>	Wood Sage
Vmon	<i>Veronica montana</i>	Wood Speedwell
Vodo	<i>Viola odorata</i>	Sweet Violet
Vrei	<i>Viola reichenbachiana</i>	Early Dog-violet
Vriv	<i>Viola riviniana</i>	Common Dog-violet

* For the table above and below, denotes code taken from Phase 1 handbook.

The remaining species have not been given a code under Phase 1. To make up a code, use the first letter of the genus and first 3 letters of the specific epithet (for sedges use 'Cx')

Below are species codes for other species often found in hedgerows, with their codes as stated in Phase 1 handbook. The table suggests some of the possible dominant species for the recording table above, but is not exclusive. If any Ancient Woodland Indicators are encountered (some are included below and marked 'AWI') which are not dominant and not listed as valuable under the Hedgerow Regulations, they should be included in the 'notes' section, not in the 'notables' section.

	<i>Arrhenatherum elatius</i>	False Oat-grass
Apet	<i>Alliaria petiolata</i>	Garlic Mustard
Aste	<i>Anisantha sterilis</i>	Barren Brome
Asy*	<i>Anthriscus sylvestris</i>	Cow Parsley
Car*	<i>Cirsium arvense</i>	Creeping Thistle
Cxrm AWI	<i>Carex remota</i>	Remote Sedge
Ddl*	<i>Dryopteris dilatata</i>	Broad Buckler-fern
Dp*	<i>Digitalis purpurea</i>	Foxglove
Fu*	<i>Filipendula ulmaria</i>	Meadowsweet
Gap*	<i>Galium aparine</i>	Cleavers
Gh*	<i>Glechoma hederacea</i>	Ground-ivy
Gmol	<i>Galium mollugo</i>	Hedge Bedstraw
Hh*	<i>Hedera helix</i>	Ivy
HI*	<i>Holcus lanatus</i>	Yorkshire-fog
Hlup	<i>Humulus lupulus</i>	Hop
Ig*	<i>Impatiens glandulifera</i>	Indian Balsam
Lped	<i>Lotus pedunculatus</i>	Greater Bird's-foot-trefoil
Lpc*	<i>Lonicera periclymenum</i>	Honeysuckle
Ocro	<i>Oenanthe crocata</i>	Hemlock Water-dropwort
Cop* AWI	<i>Chrysosplenium oppositifolium</i>	Opposite-leaved Golden-saxifrage
Pt*	<i>Pteridium aquilinum</i>	Bracken
Pver	<i>Primula veris</i>	Cowslip
Rf*	<i>Rubus fruticosus agg.</i>	Bramble
Shol	<i>Stellaria holostea</i>	Greater Stitchwort
Ssyl	<i>Stachys sylvatica</i>	Hedge Woundwort
Hand AWI	<i>Hypericum androsaemum</i>	Tutsan
Ud*	<i>Urtica dioica</i>	Common Nettle
Vio	<i>Viola sp</i>	Violet species

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C. Phase 2 National Vegetation Classification Report

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Norwich Northern Distribution Road

Appendix D: Botanical Surveys

Norwich Northern Distribution Road

Ecology (Volume 2)

Appendix D: Botanical Surveys

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1 Introduction

1.1 Background

Mott MacDonald Ltd was appointed by Norfolk County Council to undertake botanical surveys of the woodland, grassland and arable field margins along the proposed Northern Distribution Road (NDR). The NDR is located to the north and east of Norwich, in Co Norfolk (see Figure A.1 in Appendix A). The NDR is approximately 21 km long.

1.2 Scope of works

The aim of the botanical surveys is to assess the composition, structure and conservation importance of the most important plant communities in the vicinity of the NDR. The objectives are to:

- Undertake a botanical survey of all woodland areas along the NDR;
- Undertake a botanical survey of all semi-improved grassland areas along the NDR; and
- Undertake a botanical survey of all field margins crossed by the NDR.

Botanical surveys were undertaken in 2005 in a number of grassland and woodland areas along several NDR route options (Harris, Jane. 2005). No botanical surveys of field margins have been previously undertaken. The botanical surveys in grassland and woodland areas were repeated in 2009 as a) the original surveys were too old to be used in the Environmental Statement and the planning application for NDR; b) there have been important changes to the NDR route since 2005; c) there have been changes in land use since 2005; and d) the 2005 surveys did not include vegetation quadrats, which are required by the National Vegetation Classification (NVC) methodology.

2 Methodology

The Phase 1 habitat survey identified several areas as being potentially valuable given the habitats they supported (Mott MacDonald, 2009). A detailed botanical survey of the woodland, grassland and arable field margins within 75 m of the NDR was undertaken in June 2009.

The habitats were sampled using vegetation quadrats, following the NVC methodology (Rodwell et al., 1991, 1992). At least two quadrats (where space permitted) were placed randomly within each stand of homogenous vegetation, and the abundance of the plant species within each quadrat was assessed using the Domin scale (Table 2.1).

Table 2.1: Assessment of Species Abundance Using the Domin Scale

Cover Value	Domin Score
91-100%	10
76-90%	9
51-75%	8
34-50%	7
26-33%	6
11-25%	5
4-10%	4
<4% - many individuals	3
<4% - several individuals	2
<4% - few individuals	1

Each stand of homogenous vegetation was assigned to a community and sub-community type using the National Vegetation Classification (Rodwell et al., 1991, 1992). For communities where at least five quadrats are taken, the frequency (constancy) class would be calculated for each species using the scale in Table 2.2. However, all communities had less than five quadrats taken so the frequency (constancy) class was not calculated.

Table 2.2: Frequency Classes and Species Cover Values

Cover Value	Frequency Class
1-20%	I
21-40%	II
41-60%	III

61-80%	IV
81-100%	V

Plant species lists were compiled for all habitats subject to Phase 2 botanical survey, including the areas which were too small to take quadrats. The relative abundances of the plant species in each plant community (both within and outside quadrats) were recorded using the DAFOR scale (Table 2.3).

Table 2.3: Assessment of Species Abundance using the DAFOR Scale

DAFOR Score	Meaning
D	Dominant
A	Abundant
F	Frequent
O	Occasional
R	Rare

The nomenclature for the vascular plants in this report follows Stace (1997) for both Latin and English names. The bryophyte nomenclature follows Blackstock *et al.* (2005) for Latin names and Edwards (2003) for English names. Latin names are only mentioned the first time each species is named in the report unless heading a table or figure.

3 Results

The results of the botanical surveys undertaken in 2009 are presented below. For each plant community, a description of the structure and species composition is given, along with the NVC classification. In addition, a vegetation table comprising the quadrat data and a species list are presented for each plant community. The plant communities and quadrat locations are illustrated in detail on Figures A.1 to A.3 in Appendix A. Appendix B includes photographs of all quadrats taken and other photographs of study area. Table 3.1 below includes a summary of the plant communities identified within the study site and presented in the sections below.

Habitats surveyed are described below and shown in quadrat type order: woodlands, grasslands and then arable field margins. Within each quadrat type habitats are listed in order of NVC community and then habitat type. A short habitat description and a floristic table which includes data from up to three quadrats are presented for each location.

Table 3.1: Summary of Plant Communities Subject to Phase 2 Botanical Surveys

NVC community	NVC sub-community	Habitat	Quadrat Type	Location	Photos	Quadrats taken
W6 <i>Alnus glutinosa-Urtica dioica</i> woodland	W6a typical sub-community)	Broad-leaved plantation woodland	Woodland	Strip Plantation, Rackheath.	68,69	Q8
W8 <i>Fraxinus excelsior-Acer campestre-Mercurialis perennis</i> woodland	W8d <i>Hedera helix</i>	Broad-leaved plantation woodland	Woodland	Heath Wood, Rackheath Hall, Rackheath.	64-65	Q6
W10 <i>Quercus robur-Pteridium aquilinum-Rubus fruticosus</i> woodland	W10a typical sub-community)	Semi-natural broad-leaved woodland	Woodland	Ladies Wood, Beaston St Andrews.	70,71	Q9
W10 <i>Quercus robur-Pteridium aquilinum-Rubus fruticosus</i> woodland	W10a Typical	Semi-natural broad-leaved woodland	Woodland	Spixworth Plantation, south of Spixworth.	78-79	Q15
W10 <i>Quercus robur-Pteridium aquilinum-Rubus fruticosus</i> woodland	W10c <i>Hedera helix</i>	Broad-leaved plantation	Woodland	Woodland south of Spixworth Park, Nr Spixworth.	82-83	Q17
W10 <i>Quercus robur-Pteridium aquilinum-Rubus fruticosus</i> woodland	W10a typical sub-community)	Mixed plantation woodland	Woodland	Heath Wood, Rackheath Hall, Rackheath.	60-63,-66,67	Q4, Q5, Q7
W10 <i>Quercus robur-Pteridium aquilinum-Rubus fruticosus</i> woodland	W10a Typical	Mixed plantation woodland	Woodland	Tithe Plantation, south of Spixworth.	74-75	Q12

NVC community	NVC sub-community	Habitat	Quadrat Type	Location	Photos	Quadrats taken
W10 <i>Quercus robur</i> - <i>Pteridium aquilinum</i> - <i>Rubus fruticosus</i> woodland	W10c <i>Hedera helix</i>	Coniferous plantation	Woodland	Spixworth Plantation, south of Spixworth.	80-81	Q16
W16 <i>Quercus</i> spp.- <i>Betula</i> spp.- <i>Deschampsia flexuosa</i> woodland	W16a <i>Quercus robur</i>	Mixed plantation woodland	Woodland	Dole Plantation (North Thorpe Marriot)	86-87, 88-89	Q20, Q21
MG1 <i>Arrhenatherum elatius</i> grassland	MG1a <i>Festuca rubra</i>	Semi-improved neutral grassland	Grassland	Adjacent to Brick Yard Farm, Reepham Road, East Drayton	84-85	Q18-19
MG1 <i>Arrhenatherum elatius</i> grassland	MG1b <i>Urtica dioica</i>	Semi-improved neutral grassland (species-poor)	Grassland	Roadside Nature Reserve (A1067 Crooked Oaks)	94-96	Q24-26
OV9 <i>Matricaria perforata</i> - <i>Stellaria media</i> community	OV9d <i>Bilderdykia convolvulus</i> - <i>Veronica persica</i>	Vegetation of open habitats	Arable Margin	Adjacent to Marriot's Way	90	Q22
OV22 <i>Poa annua</i> - <i>Taraxacum officinale</i> community	OV22c <i>Crepis vesicaria</i> - <i>Epilobium adenocaulon</i>	Vegetation of open habitats	Arable Margin	To east of Tithe Plantation, south of Spixworth.	76-77	Q13-14
OV25 <i>Urtica dioica</i> - <i>Cirsium arvense</i> community	N/A	Vegetation of open habitats	Arable Margin	North of Beeston Park and north of Beeston Lane, Beeston St Andrews.	72-73	Q10-11
MG1 <i>Arrhenatherum elatius</i> grassland	MG1a <i>Festuca rubra</i> sub-community	Semi-improved neutral grassland	Arable Margin	North of Postwick on north side of A47	57-59	Q1-Q3
MG1 <i>Arrhenatherum elatius</i> grassland	n/a	Semi-improved neutral grassland	Arable Margin	Adjacent to Marriott's Way	91	Q23

3.1 Woodlands

A relatively large number of woodland areas are present on the footprint and within 75 m of the NDR. Most of the woodland is planted, but there are a few semi-natural broad-leaved woodland areas. There are no areas of semi-natural ancient woodland within the survey corridor, but there is one area of replanted ancient woodland at Ladies Wood, (see the section below for more details). Although this woodland area will not be lost under the development some indirect impacts may occur.

Semi-natural Broad-leaved Woodland

Part of the Ladies Wood, Church Carr and the Springs County Wildlife Site and within the survey corridor is an area of replanted ancient woodland (Q9, Table 3.4). Two ancient woodland indicator species are present here: bluebell (*Hyacinthoides non-scripta*) and dog's-mercury (*Mercurialis perennis*).

Another small area of semi-natural broad-leaved woodland occurs at Spixworth Plantation (Q15, Table 3.5). Large mature pedunculate oaks dominate the canopy. The understorey is composed largely of sycamore (*Acer pseudoplatanus*) saplings and hazel (*Corylus avellana*), and bramble (*Rubus fruticosus* agg.) dominates the ground flora.

Planted Woodland

The woodland at Heath Wood (Q6, Table 3.3), has a canopy dominated by ash with hawthorn (*Crataegus monogyna*), and ash saplings frequent in the understorey. Ground flora is primarily composed of ivy (*Hedera helix*) and ground ivy (*Glechoma hederacea*), with common nettle (*Urtica dioica*), male fern (*Dryopteris filix-mas*) and wood avens (*Geum urbanum*).

A large part of the wet woodland known as Strip Plantation (Q8, Table 3.2) has been replanted with Canadian poplar (*Populus x canadensis*). The replanted area has a diverse ground flora and both the understorey and the ground flora are typical of wet woodland; there is high potential for restoration to wet woodland. Wet woodland is a priority habitat in the UK BAP and Norfolk LBAP.

Most of the woodland areas within the survey corridor are planted, including broad-leaved, mixed or coniferous woodland plantations.

Broad-leaved plantation occurs in Woodland south of Spixworth Park (Q17, Table 3.6). This area has more than 30% planted trees in its canopy, which includes sycamore, ash (*Fraxinus excelsior*), horse chestnut (*Aesculus hippocastanum*), pedunculate oak (*Quercus robur*), Canadian poplar and sweet chestnut (*Castanea sativa*). The understorey is variable in terms of density and species composition, with hawthorn, ash saplings, elder (*Sambucus nigra*) and hazel. The most frequent and/or abundant ground flora species are: ground ivy, ivy, common nettle, bramble, bluebell and common feather-moss (*Kindbergia praelonga*).

Relatively large areas of mixed woodland plantations are found in the following locations: Heath Wood (Q4, 5, 7, Table 3.7), Tithe Plantation (Q12, Table 3.8), and Dole Plantation (Q20, 21, Table 3.10). Broad-leaved and coniferous trees account for at least 10% each in mixed woodland. The main canopy trees are sweet chestnut, silver birch (*Betula pendula*), pedunculate oak, ash, sycamore, Scott's pine (*Pinus sylvestris*), Leylandii cypress (x *Cupressocyparis leylandii*) and giant fir (*Abies grandis*). The understoreys are relatively sparse and include saplings of silver birch, sycamore, ash or sweet chestnut, elder, hawthorn and holly (*Ilex aquifolium*). Bluebell is dominant in some of these mixed woodland areas and other frequent or abundant species include broad buckler-fern (*Dryopteris dilatata*), scaly male-fern (*Dryopteris affinis*), ivy, bracken (*Pteridium aquilinum*), bramble, climbing corydalis (*Ceratocarpus claviculata*) and common Feather-moss.

An area of coniferous plantation woodland occurs within the survey corridor at Spixworth Plantation (Q16, Table 3.9). This area has at least 90% coniferous trees in the canopy, and species include Scott's pine, Leylandii cypress and Sitka spruce (*Picea sitchensis*). The understorey is sparse or absent, and the ground flora is species-poor.

3.1.1 NVC Community W6: *Alnus glutinosa-Urtica dioica* woodland

Habitat Type: Broad-leaved plantation woodland

Site: Strip Plantation (Quadrat 8, Table 3.2)

Semi-mature Canadian poplar plantation planted in an area that was most likely previously wet woodland, as indicated by the frequency of species such as lesser pond-sedge (*Carex acutiformis*) and willow (*Salix*) species, and the presence of other wetland species such as water mint (*Mentha aquatica*), marsh horsetail (*Equisetum palustre*), marsh thistle and marsh-bedstraw (*Galium palustre*). The understorey consists of frequent grey willow () with goat willow also occurring. These species are typical of wet woodland. This woodland has a high potential for restoration to wet woodland.

Table 3.2: Floristic table for W6a *Alnus glutinosa-Urtica dioica* woodland, typical sub-community (Strip Plantation - Semi-natural broad-leaved woodland)

Quadrat number		Q8	Species list (DAFOR)
Quadrat size (m ²)		50x50 & 10 x 10	
Canopy height (m)		15	
Canopy cover (%)		55	
Understorey height (m)		8	
Understorey cover (%)		30	
Ground flora height (m)		1	
Ground flora cover (%)		70	
Litter/bare ground (%)		30	
Aspect		N/A	
Slope (degrees)		0	
Soil		Water logged gley	
Latin name	English name	Domin score	
Canopy			
<i>Populus canadensis</i>	Canadian poplar	8	A
Understorey			
<i>Quercus robur</i>	Pedunculate oak spl	1	R
<i>Sambucus nigra</i>	Elder	1	R
<i>Salix caprea</i>	Goat willow	1	R
<i>Salix cinerea</i>	Grey willow	5	F
<i>Crataegus monogyna</i>	Hawthorn	5	F
Ground flora			
<i>Brachythecium rutabulum</i>	Rough-stalked feather-moss	2	O
<i>Solanum dulcamara</i>	Bittersweet	3	F
<i>Rubus fruticosus</i> agg.	Bramble	1	O

Quadrat number		Q8	Species list (DAFOR)
<i>Sparganium erectum</i>	Branched bur-reed	2	O
<i>Typha latifolia</i>	Bulrush	1	O
<i>Galium aparine</i>	Cleavers	4	F
<i>Galeopsis tetrahit</i>	Common hemp-nettle	1	R
<i>Urtica dioica</i>	Common nettle	2	O/LA
<i>Dactylorhiza fuchsii</i>	Common spotted-orchid	1	R
<i>Cirsium arvense</i>	Creeping thistle	2	R/LF
<i>Circaea lutetiana</i>	Enchanter's-nightshade	2	Lf/o
<i>Myosotis arvensis</i>	Field forget-me-knot	2	O
<i>Lotus pedunculatus</i>	Greater bird's-foot-trefoil	1	R
<i>Epilobium hirsutum</i>	Greater willowherb	1	R
<i>Lycopus europaeus</i>	Gypsywort	3	F
<i>Eupatorium cannabinum</i>	Hemp-agrimony	1	O
<i>Carex acutiformis</i>	Lesser pond-sedge	7	A/ld
<i>Equisetum palustre</i>	Marsh horsetail	1	O
<i>Cirsium palustre</i>	Marsh thistle	2	F
<i>Galium palustre</i>	Marsh-bedstraw	1	O
<i>Filipendula ulmaria</i>	Meadowsweet	1	O
<i>Silene dioica</i>	Red campion	2	O
<i>poa trivialis</i>	rough meadow grass	2	O
<i>Juncus effusus</i>	Soft-rush	2	O
<i>Scrophularia auriculata</i>	Water figwort	2	O
<i>Equisetum fluviatile</i>	Water horsetail	1	O
<i>Mentha aquatica</i>	Water mint	2	O/LF
<i>Cardamine flexuosa</i>	Wavy bitter-cress	3	O
<i>Angelica sylvestris</i>	Wild angelica	1	R
<i>Rumex sanguineus</i>	Wood-dock	2	O
Additional species			
<i>Dryopteris dilatata</i>	Broad buckler-fern		R
<i>Plagiomnium undulatum</i>	Hart's-tongue thyme-moss		R
<i>Brachythecium rivulare</i>	River feather-moss		R
<i>Ribes nigrum</i>	Blackcurrant		O
<i>Stellaria uliginosa</i>	Bog stitchwort		R
<i>Rumex obtusifolius</i>	Broad-leaved dock		R
<i>Callitriche stagnalis</i>	Common water-starwort		R/LF
<i>Ranunculus repens</i>	Creeping buttercup		R
<i>Glechoma hederacea</i>	Ground ivy		O
<i>Stachys sylvatica</i>	Hedge woundwort		R
<i>Conium maculatum</i>	Hemlock		R
<i>Arum maculatum</i>	Lords-and-ladies		R
<i>Senecio aquaticus</i>	Marsh ragwort		R
<i>Epilobium palustre</i>	Marsh willowherb		R
<i>Caltha palustris</i>	Marsh-marigold		R
<i>Lychnis flos-cuculi</i>	Ragged-robin		R
<i>Dryopteris affinis</i>	Scaly male-fern		O/LF
<i>Geum rivale</i>	Water avens		R
<i>Geum urbanum</i>	Wood avens		O

3.1.2 NVC Community W8: *Fraxinus excelsior*-*Acer campestre*-*Mercurialis perennis* woodland

Habitat Type: Broad-leaved Plantation Woodland

Site: Heath Wood (Quadrat 6, Table 3.3)

Heath Wood is an ash dominated broad-leaved plantation woodland with a fairly dense understorey dominated by elder and sycamore saplings. The ground flora species are sparse except where nettle and ivy are locally frequent. Bluebell, an ancient woodland indicator, is present.

Table 3.3: Floristic table for W8d *Fraxinus excelsior*-*Acer campestre*-*Mercurialis perennis* woodland, *Hedera helix* sub-community (Heath Wood - Semi-natural broad-leaved woodland)

Quadrat Number		Q6	Species list (DAFOR)
Quadrat Size (m ²)		35x75m, 10x10m	
Canopy Height (m)		15	
Canopy Cover (%)		70	
Understorey Height (m)		5	
Understorey Cover (%)		25	
Ground Flora Height (m)		0.4	
Ground Flora Cover (%)		50	
Litter/Bare Ground (%)		50	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth	
Latin Name	English Name	Domin score	
Canopy			
<i>Fraxinus excelsior</i>	Ash	7	A
<i>Quercus robur</i>	Pedunculate oak	4	O
<i>Betula pendula</i>	Silver birch	1	R
<i>Acer pseudoplatanus</i>	Sycamore	5	O
Understorey			
<i>Prunus spinosa</i>	Blackthorn	1	O
<i>Malus sylvestris</i>	Crab apple	1	R
<i>Sambucus nigra</i>	Elder	4	F
<i>Crataegus monogyna</i>	Hawthorn	2	O/LF
<i>Acer pseudoplatanus</i>	Sycamore spl	4	O/F
<i>Prunus avium</i>	Wild cherry spl	1	R
<i>Ulmus glabra</i>	Wych elm spl	1	R
Ground flora			
<i>Fraxinus excelsior</i>	Ash sdl	1	O
<i>Kindbergia praelonga</i>	Common Feather-moss	3	F
<i>Thamnobryum alopecurum</i>	Fox-tail Feather-moss	1	R
<i>Urtica dioica</i>	Common nettle	7	F/LA
<i>Glechoma hederacea</i>	Ground ivy	2	O
<i>Hedera helix</i>	Ivy	2	O/LF
<i>Dryopteris filix-mas</i>	Male fern	1	O
<i>Brachythecium rutabulum</i>	Rough-stalked Feather-moss	3	O/LF
<i>Acer pseudoplatanus</i>	Sycamore sdl	1	O
Additional Species			
<i>Fraxinus excelsior</i>	Ash spl		O

Quadrat Number		Q6	Species list (DAFOR)
<i>Tamus communis</i>	Black bryony		R
<i>Hyacinthoides non-scripta</i>	Bluebell		R/LF
<i>Dryopteris dilatata</i>	Broad buckler-fern		R
<i>Atrichum undulatum</i>	Common Smoothcap		R
<i>Acer campestre</i>	Field maple		O
<i>Ranunculus ficaria</i>	Lesser celandine		O
<i>Silene dioica</i>	Red campion		R
<i>Geum urbanum</i>	Wood avens		R

3.1.3 NVC Community W10: *Quercus robur*-*Pteridium aquilinum*-*Rubus fruticosus* woodland

Habitat Type: Semi-natural Broad-leaved Woodland

Site: Ladies Wood (Quadrat 9, Table 3.4)

Ladies Wood is a plantation on an ancient woodland site. It is an oak dominated semi-natural woodland with rare to occasional silver birch and sycamore also present in the canopy. It is a woodland of relatively low diversity with an open understorey. The ground flora includes bluebell and Enchanter's-nightshade (*Circaea lutetiana*), both ancient woodland indicator species. This woodland has potential for restoration.

Table 3.4: Floristic table for W10a *Quercus robur*-*Pteridium aquilinum*-*Rubus fruticosus* woodland, typical sub-community (Ladies Wood - Semi-natural broad-leaved woodland)

Quadrat Number		Q9	Species list (DAFOR)
Quadrat Size (m ²)		50x50m, 10x10m	
Canopy Height (m)		21	
Canopy Cover (%)		78	
Understorey Height (m)		4	
Understorey Cover (%)		20	
Ground Flora Height (m)			
Ground Flora Cover (%)		45	
Litter/Bare Ground (%)		55	
Aspect		NW	
Slope (degrees)		6	
Soil		Brown earth	
Latin Name	English Name	Domin score	
Canopy			
<i>Quercus robur</i>	Pedunculate oak	8	A/LD
<i>Betula pendula</i>	Silver birch	1	R
<i>Acer pseudoplatanus</i>	Sycamore	5	O/LF
Understorey			
<i>Corylus avellana</i>	Hazel	1	R
<i>Ilex aquifolium</i>	Holly	1	R
<i>Castanea sativa</i>	Sweet chestnut spl	4	F
<i>Acer pseudoplatanus</i>	Sycamore spl	5	F
Ground flora			
<i>Hyacinthoides non-scripta</i>	Bluebell	5	F/LA
<i>Pteridium aquilinum</i>	Bracken	7	A

Quadrat Number		Q9	Species list (DAFOR)
<i>Rubus fruticosus</i> agg.	Bramble	2	O/LF
<i>Dryopteris dilatata</i>	Broad buckler-fern	1	R
<i>Circaea lutetiana</i>	Enchanter's-nightshade	1	R
<i>Hypnum resupinatum</i>	Fox-tail Feather-moss	1	R
<i>Acer pseudoplatanus</i>	Sycamore sdl	2	O
<i>Mnium hornum</i>	Swan's-neck Thyme-moss	1	R
Additional Species			
<i>Alnus glutinosa</i>	Alder		O
<i>Mercurialis perennis</i>	Dog's Mercury		R
<i>Glechoma hederacea</i>	Ground ivy		R
<i>Lonicera periclymenum</i>	Honeysuckle		R

Site: Spixworth Plantation (Quadrat 15, Table 3.5)

Spixworth Plantation is a small block of semi-natural woodland with large mature pedunculate oaks dominating the canopy. Sycamore, sweet chestnut, ash and English elm (*Ulmus procera*) also appear in the canopy. The understorey is composed largely of sycamore saplings and hazel, and bramble dominates the ground flora.

Table 3.5: Floristic table for W10a Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland, typical sub-community (Spixworth Plantation - Semi-natural broad-leaved woodland)

Quadrat Number		Q15	Species list (DAFOR)
Quadrat Size (m ²)		40x40 m	
Canopy Height (m)		22	
Canopy Cover (%)		70	
Understorey Height (m)		7	
Understorey Cover (%)		55	
Ground Flora Height (m)		0.6	
Ground Flora Cover (%)		45	
Litter/Bare Ground (%)		55	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth	
Latin Name	English Name	Domin score	
Canopy			
<i>Fraxinus excelsior</i>	Ash	1	R
<i>Quercus robur</i>	Pedunculate oak	8	A
<i>Ulmus procera</i>	English elm	1	R
<i>Castanea sativa</i>	Sweet chestnut	4	O/LF
<i>Acer pseudoplatanus</i>	Sycamore	5	O
Understorey			
<i>Quercus robur</i>	Pedunculate oak spl	1	R
<i>Sambucus nigra</i>	Elder	1	R
<i>Ulmus</i> sp.	Elm spl	4	O
<i>Corylus avellana</i>	Hazel	5	O
<i>Picea abies</i>	Norway spruce	1	R
<i>Sorbus aucuparia</i>	Rowan	1	R
<i>Acer pseudoplatanus</i>	Sycamore spl	6	F
Ground flora			

Quadrat Number		Q15	Species list (DAFOR)
<i>Fraxinus excelsior</i>	Ash sdl	1	R
<i>Rubus fruticosus</i> agg.	Bramble	7	A/LD
<i>Gallium aparine</i>	Cleavers	1	O
<i>Sambucus nigra</i>	Elder sdl	1	R
<i>Acer campestre</i>	Field maple sdl	1	R
<i>Digitalis purpurea</i>	Foxglove	1	R
<i>Ilex aquifolium</i>	Holly sdl	1	O
<i>Hedera helix</i>	Ivy	1	O
<i>Silene dioica</i>	Red campion	3	O
<i>Acer pseudoplatanus</i>	Sycamore sdl	4	F
Additional Species			
<i>Poa annua</i>	Annual meadow grass		R
<i>Urtica dioica</i>	Common nettle		R/LF
<i>Ulmus</i> sp.	Elm sp. Sdl		R

Habitat Type: Broad-leaved Plantation

Site: Woodland south of Spixworth Park (Quadrat 17, Table 3.6)

This woodland is primarily a sycamore plantation with other species such as oak, sweet chestnut and grand fir (*Abies grandis*) also reaching the canopy. The understorey is fairly diverse and includes several native species such as hazel, elder and hawthorn, but also a noticeable number of non-native species such as garden privet (*Ligustrum ovalifolium*), Mahonia (*Mahonia aquifolium*), Leyland cypress (*X Cupressocyparis leylandii*) and snowberry (*Symphoricarpos albus*). The ground flora is dominated by bramble and ivy, but also contains several tree species seedlings as well as other species such as bluebell and giant fescue (*Festuca gigantea*) which are ancient woodland indicator species in the east of England.

Table 3.6: Floristic table for W10c Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland, Hedera helix sub-community (Woodland south of Spixworth Park - Broad-leaved plantation)

Quadrat Number		Q17	Species list (DAFOR)
Quadrat Size (m ²)		30x80, 10x10 m	
Canopy Height (m)		17	
Canopy Cover (%)		82	
Understorey Height (m)		2.5	
Understorey Cover (%)		25	
Ground Flora Height (m)		0.6	
Ground Flora Cover (%)		75	
Litter/Bare Ground (%)		25	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth	
Latin Name	English Name	Domin score	
Canopy			
<i>Fraxinus excelsior</i>	Ash	1	R
<i>Quercus robur</i>	Pedunculate oak	4	O
<i>Abies grandis</i>	Grand fir	1	R
<i>Castanea sativa</i>	Sweet chestnut	1	R

Quadrat Number		Q17	Species list (DAFOR)
<i>Acer pseudoplatanus</i>	Sycamore	8	A
<i>Taxus baccata</i>	Yew	2	O
Understorey			
<i>Sambucus nigra</i>	Elder	2	O
<i>Ligustrum ovalifolium</i>	Garden privet	1	R
<i>Crataegus monogyna</i>	Hawthorn	1	R
<i>Corylus avellana</i>	Hazel	2	O
<i>Ilex aquifolium</i>	Holly	2	O
<i>X Cupressocyparis leylandii</i>	Leyland cypress	1	R
<i>Mahonia aquifolium</i>	Mahonia	1	R
<i>Symphoricarpos albus</i>	Snowberry	5	O/LA
<i>Acer pseudoplatanus</i>	Sycamore spl	2	O
<i>Taxus baccata</i>	Yew spl	2	O
Ground flora			
<i>Mnium hornum</i>	Swan's-neck Thyme-moss	1	R
<i>Brachythecium rutabulum</i>	Rough-stalked Feather-moss	1	R
<i>Hyacinthoides non-scripta</i>	Bluebell	2	R/LF
<i>Rubus fruticosus agg.</i>	Bramble	8	A/LD
<i>Gallium aparine</i>	Cleavers	2	O
<i>Urtica dioica</i>	Common nettle	2	O/LA
<i>Crataegus monogyna</i>	Hawthorn sdl	1	R
<i>Ilex aquifolium</i>	Holly sdl	1	O
<i>Hedera helix</i>	Ivy	5	F/LA
<i>Castanea sativa</i>	Sweet chestnut sdl	1	R
<i>Acer pseudoplatanus</i>	Sycamore sdl	4	R
<i>Taxus baccata</i>	Yew sdl	2	O
Additional Species			
<i>Kindbergia praelonga</i>	Common Feather-moss		O
<i>Polytrichastrum formosum</i>	Bank Haircap		R
<i>Dryopteris dilatata</i>	Broad buckler-fern		R
<i>Festuca gigantea</i>	Giant fescue		R
<i>Glechoma hederacea</i>	Ground-ivy		R
<i>Dryopteris filix-mas</i>	Male fern		R
<i>Silene dioica</i>	Red campion		R
<i>Symphoricarpos albus</i>	Snowberry sdl		R
<i>Castanea sativa</i>	Sweet chestnut sdl		O
<i>Geum urbanum</i>	Wood avens		R
<i>Ulmus glabra</i>	Wych elm		R

Habitat Type: Mixed Coniferous Broad-leaved Plantation

Site: Heath Wood (Quadrats 4, 5 and 7, Table 3.7)

Heath woodland has a varied canopy composed of both conifers and native and non-native broad-leaved species including beech (*Fagus sylvatica*), grand fir, leyland cypress, pedunculate oak, red oak (*Quercus borealis*), and Scots pine (*Pinus sylvestris*). The understorey is sparse but varied and includes a mix of mostly native young trees and saplings. The ground flora is composed largely of bracken, bramble and broad buckler fern (*Dryopteris dilatata*). Bluebell is abundant and climbing corydalis (*Ceratocarpus claviculata*) is present within the woodland but rare. Both species are ancient woodland indicators in the east of England.

Table 3.7: Floristic table for W10a *Quercus robur*-*Pteridium aquilinum*-*Rubus fruticosus* woodland – typical sub-community (Heath Wood – Mixed Plantation)

Quadrat number		Q4	Q5	Q7	Species list (dafor)
Quadrat size (m ²)		50x50 and 10x10 m	50x50 and 10x10 m	50x50 and 10x10 m	
Canopy height (m)		17	16	18	
Canopy cover (%)		70	65	78	
Understorey height (m)		3.5	4	4	
Understorey cover (%)		4	6	25	
Ground flora height (m)		1.0	0.7	0.4	
Ground flora cover (%)		67	65	40	
Litter/bare ground (%)		33	35	60	
Aspect		N/a	Se	N/a	
Slope (degrees)		0	2	0	
Soil		Brown earth	Brown earth	Brown earth	
Latin name	English name	Domin score	Domin score	Domin score	
Canopy			1		
<i>Fagus sylvatica</i>	Beech	4	4	1	O/LF
<i>Abies grandis</i>	Grand fir	5	4	5	F
<i>X cupressocyparis leylandii</i>	Leyland cypress	4	2	1	O/LF
<i>Quercus robur</i>	Pedunculate oak	1			R
<i>Quercus borealis</i>	Red oak	4	6	5	F
<i>Pinus sylvestris</i>	Scots pine	6	2	2	O/LF
<i>Betula pendula</i>	Silver birch	5	4	6	F
<i>Castanea sativa</i>	Sweet chestnut	6	4	5	F
<i>Acer pseudoplatanus</i>	Sycamore		1		R
Understorey					
<i>Sambucus nigra</i>	Elder			1	R
<i>Crataegus monogyna</i>	Hawthorn			1	R
<i>Ilex aquifolium</i>	Holly spl		1		R
<i>Acer platanoides</i>	Norway maple	1			R
<i>Quercus robur</i>	Pedunculate oak spl			1	R
<i>Sorbus aucuparia</i>	Rowan spl.			1	R
<i>Castanea sativa</i>	Sweet chestnut spl	2	2	5	O/LF
<i>Acer pseudoplatanus</i>	Sycamore spl		2	4	O
Ground flora					
<i>Hyacinthoides non-scripta</i>	Bluebell	5	5	6	A
<i>Pteridium aquilinum</i>	Bracken	7	7		F/LA
<i>Rubus fruticosus</i> agg.	Bramble	4		2	O
<i>Dryopteris dilatata</i>	Broad buckler-fern	4	2	5	O/LF
<i>Kindbergia praelonga</i>	Common feather-moss	3		2	O
<i>Urtica dioica</i>	Common nettle	1			R
<i>Atrichum undulatum</i>	Common smoothcap	2			O
<i>Hypnum cupressiforme</i>	Cypress-leaved plait-moss	1			R
<i>Sambucus nigra</i>	Elder sdl	1			R
<i>Ilex aquifolium</i>	Holly sdl	1			R
<i>Lonicera periclymenum</i>	Honeysuckle	1		1	R
<i>Plagiothecium succulentum</i>	Juicy silk-moss	1		1	R
<i>Dryopteris filix-mas</i>	Male fern	2		2	O

Quadrat number		Q4	Q5	Q7	Species list (dafor)
<i>Acer pseudoplatanus</i>	Sycamore sdl	2	1	2	O
Additional species					
<i>Ceratocarpus claviculata</i>	Climbing corydalis				R/LF
<i>Glechoma hederacea</i>	Ground ivy				R
<i>Corylus avellana</i>	Hazel				R
<i>Mnium hornum</i>	Swan's-neck thyme-moss				R/LF
<i>Hedera helix</i> (understorey and canopy)	Ivy				R
<i>Hedera helix</i> (ground flora)	Ivy				R
<i>Rhododendron ponticum</i>	Rhododendron				R/LF

Site: Tithe Plantation (Quadrat 12, Table 3.8)

The canopy of this plantation woodland is composed of just four species: douglas fir (*Pseudotsuga menziesii*), sycamore, pedunculate oak and silver birch. The understorey is dominated by hazel and elder. The ground flora is fairly diverse and includes species such as bluebell (an ancient woodland indicator species), lady fern (*Athyrium filix-femina*), male fern and several moss species.

Table 3.8: Floristic table for W10a *Quercus robur*-*Pteridium aquilinum*-*Rubus fruticosus* woodland, typical sub-community (Tithe Plantation - Mixed broad-leaved coniferous plantation)

Quadrat Number		Q12	Species list (DAFOR)
Quadrat Size (m ²)		50x50m, 10x10m	
Canopy Height (m)		17	
Canopy Cover (%)		80	
Understorey Height (m)		4	
Understorey Cover (%)		25	
Ground Flora Height (m)		0.4	
Ground Flora Cover (%)		40	
Litter/Bare Ground (%)		60	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth	
Latin Name	English Name	Domin score	
Canopy			
<i>Pseudotsuga menziesii</i>	Douglas fir	5	
<i>Quercus robur</i>	Pedunculate oak	4	
<i>Betula pendula</i>	Silver birch	1	
<i>Acer pseudoplatanus</i>	Sycamore	8	
Understorey			
<i>Ribes nigrum</i>	Blackcurrant	2	
<i>Sambucus nigra</i>	Elder	4	
<i>Acer campestre</i>	Field maple	2	
<i>Corylus avellana</i>	Hazel	5	
<i>Ilex aquifolium</i>	Holly	1	
<i>Hedera helix</i>	Ivy	2	
Ground flora			

Quadrat Number		Q12	Species list (DAFOR)
<i>Kindbergia praelonga</i>	Common Feather-moss	4	F/LA
<i>Brachythecium rutabalum</i>	Rough-stalked Feather-moss	1	O
<i>Mnium hornum</i>	Swan's-neck Thyme-moss	1	R
<i>Hyacinthoides non-scripta</i>	Bluebell	1	O
<i>Pteridium aquilinum</i>	Bracken	2	F/LA
<i>Rubus fruticosus</i> agg.	Bramble	4	F/LA
<i>Dryopteris dilatata</i>	Broad buckler-fern	4	F
<i>Galium aparine</i>	Cleavers	1	O
<i>Urtica dioica</i>	Common nettle	4	O/LA
<i>Glechoma hederacea</i>	Ground ivy	1	O
<i>Hedera helix</i>	Ivy	2	O
<i>Athyrium filix-femina</i>	Lady-fern	1	R
<i>Dryopteris filix-mas</i>	Male fern	1	O
<i>Quercus robur</i>	Pedunculate oak sdl	1	R
<i>Silene dioica</i>	Red campion	1	O
<i>Acer pseudoplatanus</i>	Sycamore sdl	5	F
Additional Species			
<i>Fraxinus excelsior</i>	Ash		R
<i>Prunus spinosa</i>	Blackthorn sdl		R
<i>Ceratocarpus claviculata</i>	Climbing corydalis		R
<i>Atrichum undulatum</i>	Common Smoothcap		R
<i>Scrophularia nodosa</i>	Common Figwort		R
<i>Sambucus nigra</i>	Elder sdl		R
<i>Crataegus monogyna</i>	Hawthorn		R
<i>Geranium robertianum</i>	Herb robert		R
<i>Poa trivialis</i>	Rough meadow grass		R
<i>Pinus sylvestris</i>	Scots pine		O
<i>Betula pendula</i>	Silver birch spl		R/LF
<i>Epilobium lanceolatum</i>	Spear-leaved Willowherb		R
<i>Castanea sativa</i>	Sweet chestnut sdl		R
<i>Geum urbanum</i>	Wood avens		R

Habitat Type: Coniferous Plantation

Site: Spixworth Plantation (Quadrat 16, Table 3.9)

This section of Spixworth Plantation has been planted out primarily with Scots Pine trees. Pedunculate oak and hornbeam (*Carpinus betulus*) also occur in the canopy but only rarely. The understorey is dominated by elder with oak saplings occurring occasionally and ivy present at the understorey level. The ground flora is species poor and is dominated by bramble and ivy.

Table 3.9: Floristic table for W10c Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland, Hedera helix sub-community (Spixworth Plantation - Coniferous plantation)

Quadrat Number		Q16	Species list (DAFOR)
Quadrat Size (m ²)		20x110, 10x10 m	
Canopy Height (m)		14	
Canopy Cover (%)		60	
Understorey Height (m)		3	
Understorey Cover (%)		55	
Ground Flora Height (m)		0.3	
Ground Flora Cover (%)		75	
Litter/Bare Ground (%)		25	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth	
Latin Name	English Name	Domin score	
Canopy			
<i>Quercus robur</i>	Pedunculate oak	1	R
<i>Carpinus betulus</i>	Hornbeam	1	R
<i>Pinus sylvestris</i>	Scots pine	8	A
Understorey			
<i>Prunus spinosa</i>	Blackthorn	2	O
<i>Quercus robur</i>	Pedunculate oak spl	4	O
<i>Rosa canina</i>	Dog rose	1	R
<i>Sambucus nigra</i>	Elder	7	A
<i>Crataegus monogyna</i>	Hawthorn	2	R
<i>Corylus avellana</i>	Hazel	1	R
<i>Ilex aquifolium</i>	Holly spl	2	O
<i>Hedera helix</i>	Ivy	3	F
Ground flora			
<i>Rubus fruticosus</i> agg.	Bramble	5	A/LD
<i>Dryopteris dilatata</i>	Broad buckler fern	1	R
<i>Tussilago farfara</i>	Colt's-foot	1	R
<i>Urtica dioica</i>	Common nettle	1	R
<i>Arrhenatherum elatius</i>	False oat-grass	1	R
<i>Crataegus monogyna</i>	Hawthorn sdl	1	R
<i>Hedera helix</i>	Ivy	8	A/LD
Additional Species			
<i>Gallium aparine</i>	Cleavers		R
<i>Acer campestre</i>	Field maple		R
<i>Crataegus laevigata</i>	Midland hawthorn		R
<i>Castanea sativa</i>	Sweet chestnut		R
<i>Picea sitchensis</i>	Sitka spruce		R/LA
<i>Bryonia dioica</i>	White bryony		R

3.1.4 NVC Community W16: *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland

Habitat Type: Mixed Coniferous Broad-leaved Plantation

Site: Dole Plantation (Quadrats 20 and 21, Table 3.10)

Although primarily a Scot's pine plantation, silver birch and pedunculate oak are not rare in the canopy. The understorey is composed largely of pedunculate oak and silver birch saplings, with other species such as honeysuckle (*Lonicera periclymenum*), rowan (*Sorbus aucuparia*) and holly (*Ilex aquifolium*) also present. The ground flora is fairly diverse, although it is dominated by bracken and climbing corydalis (*Ceratocarpus claviculata*) which is an ancient woodland indicator species, with honeysuckle again found frequently. Two invasive species are also present in the woodland: Indian balsam (*Impatiens glandulifera*) and rhododendron (*Rhododendron ponticum*). Both species occur rarely, although rhododendron is locally abundant. See section 3.5 for details on invasive species.

Table 3.10: Floristic table for W16a *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland, *Quercus robur* sub-community (Dole Plantation – mixed plantation)

Quadrat Number		Q20	Q21	Species list (DAFOR)
Quadrat Size (m ²)		50x50 and 10x10 m	50x50 and 10x10 m	
Canopy Height (m)		18	15	
Canopy Cover (%)		60	55	
Understorey Height (m)		5	5	
Understorey Cover (%)		10	30	
Ground Flora Height (m)		1	0.7	
Ground Flora Cover (%)		65	65	
Litter/Bare Ground (%)		35	35	
Aspect		N/A	N/A	
Slope (degrees)		0	0	
Soil		Brown earth	Brown earth	
Latin Name	English Name	Domin score	Domin score	
Canopy				
<i>Larix decidua</i>	European larch	1		
<i>Quercus robur</i>	Pedunculate oak	4	4	
<i>Pinus sylvestris</i>	Scots pine	7	4	
<i>Betula pendula</i>	Silver birch	4	7	
Understorey				
<i>Pseudotsuga menziesii</i>	Douglas fir spl		1	
<i>Ilex aquifolium</i>	Holly	2		
<i>Lonicera periclymenum</i>	Honeysuckle	2		
<i>Quercus robur</i>	Pedunculate oak spl		1	
<i>Sorbus aucuparia</i>	Rowan	2		
<i>Betula pendula</i>	Silver birch spl	2		
Ground flora				
<i>Fraxinus excelsior</i>	Ash sdl	1		
<i>Pteridium aquilinum</i>	Bracken	7	7	
<i>Dryopteris dilatata</i>	Broad buckler-fern	1		
<i>Kindbergia praelonga</i>	Common Feather-moss	2	3	
<i>Atrichum undulatum</i>	Common Smoothcap		1	

Quadrat Number		Q20	Q21	Species list (DAFOR)
<i>Ceratocapnos claviculata</i>	Climbing corydalis	6	7	A
<i>Hypnum cupressiforme</i>	Cypress-leaved Plait-moss	1		O
<i>Ilex aquifolium</i>	Holly sdl	1		R
<i>Lonicera periclymenum</i>	Honeysuckle	5		F
<i>Plagiothecium succulentum</i>	Juicy Silk-moss		1	R
<i>Quercus robur</i>	Pedunculate oak sdl		1	R
<i>Brachythecium rutabulum</i>	Rough-stalked Feather-moss	1		O
<i>Betula pendula</i>	Silver birch sdl	1		R
<i>Mnium hornum</i>	Swan's-neck Thyme-moss		1	R
<i>Holcus lanatus</i>	Yorkshire fog	1	1	O
Additional Species				
<i>Polytrichastrum formosum</i>	Bank Haircap			R
<i>Hyacinthoides non-scripta</i>	Bluebell			R
<i>Rubus fruticosus</i> agg.	Bramble			R
<i>Stellaria media</i>	Common chickweed			R
<i>Pseudotsuga menziesii</i>	Douglas fir			R/LF
<i>Galium saxatile</i>	Heath bedstraw			R
<i>Ilex aquifolium</i>	Holly			R
<i>Impatiens glandulifera</i>	Indian balsam			R
<i>X Cupressocyparis leylandii</i>	Leyland cypress			R
<i>Senecio aquaticus</i>	Marsh ragwort			R
<i>Urtica dioica</i>	Nettle			R
<i>Rhododendron ponticum</i>	Rhododendron			R/LA
<i>Acer pseudoplatanus</i>	Sycamore spl			R
<i>Persicaria hydropiper</i>	Water-pepper			R
<i>Teucrium scorodonia</i>	Wood sage			R

3.2 Grasslands

The survey corridor comprises many fields of improved grassland and a few areas of amenity grassland, which are both of negligible intrinsic conservation importance. A number of semi-improved neutral grassland areas are present within the survey corridor, but none of these is species-rich. The guidance in the Farm Environment Plan (FEP) Handbook (DEFRA, 2006) was used to distinguish between species-rich and species-poor grassland (www.defra.gov.uk). At least two of the following must apply for a grassland area to be classified as species-rich:

- More than 15 different plant species (including grasses) per square metre;
- The cover of wild flowers (excluding white clover or injurious weeds) is usually more than 30% during the summer months;
- Cover of rye grass (*Lolium perenne*) is generally less than 10% and there is a wide range of other grass species present.

The areas of semi-improved neutral grassland are dominated by one or a combination of the following species: Yorkshire-fog (*Holcus lanatus*), creeping bent (*Agrostis stolonifera*), common mouse-ear (*Cerastium fontanum*), creeping buttercup (*Ranunculus repens*), cock's-foot (*Dactylis glomerata*), white clover (*Trifolium repens*), ribwort plantain (*Plantago lanceolata*) and sweet meadow grass (*Anthoxanthum odoratum*). Some fields are overgrazed by sheep or rabbits, and ruderal herbs such as common nettle or creeping thistle (*Cirsium arvense*) are abundant in places.

A few grassland areas support a slightly higher number of species but they do not meet the above criteria to be classified as species-rich. Two areas of grassland with slightly higher species richness and occurring under the footprint of the scheme were surveyed. The area at Brick Yard Farm (Q18 and 19, Table 3.11) was dominated by non-native species and may have been sown at some stage. The Roadside Nature Reserve (Q24-26, Table 3.12) consists largely of coarse grass species and scattered scrub, but does include hoary mullein (*Verbascum pulverulentum*), a notable plant species described separately in section 3.5.

3.2.1 NVC Community MG1: *Arrhenatherum elatius* grassland

Habitat Type: Semi-improved Neutral Grassland

Site: Brick Yard Farm (Quadrats 18 and 19, Table 3.11)

This is a tall sward of grassland which is probably cut on a fairly regular basis (annually). The sward is dominated by coarse grasses, two of which are non-native varieties. The dominant species are a red fescue cultivar (*Festuca rubra* sub sp. *rubra*), a false oat grass cultivar (*Arrhenatherum* sp), cock's foot (*Dactylis glomerata*) and Yorkshire fog (*Holcus lanatus*). Forbs present are generally fast growing competitive species such as yarrow (*Achillea millefolium*), oxeye daisy (*Leucanthemum vulgare*) and ribwort plantain (*Plantago lanceolata*).

Table 3.11: Floristic table for MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community (Semi-improved neutral grassland - Brick Yard Farm, East Drayton)

Quadrat Number		Q18	Q19	Species list (DAFOR)
Quadrat Size (m ²)		2x2 m	2x2 m	
Vegetation Height (m)		0.7	1.1	
Vegetation Cover (%)		93	95	
Litter/Bare Soil (%)		7	5	
Aspect		N/A	N/A	
Slope (degrees)		0	0	
Soil		Brown earth / sandy	Brown earth / sandy	
GPS coordinates		TG19238/14297	TG19220/14312	
Latin Name	English Name	Domin score	Domin score	
<i>Lotus corniculatus</i>	Birds foot trefoil	2		O
<i>Rumex obtusifolius</i>	Broad-leaved dock		1	O
<i>Hypochaeris radicata</i>	Cat's ear	1		R
<i>Dactylis glomerata</i>	Cocks foot	5	5	A
<i>Centaurea nigra</i>	Common knapweed		2	O
<i>Agrostis stolonifera</i>	Creeping bent	3	4	F

Quadrat Number		Q18	Q19	Species list
<i>Cirsium arvense</i>	Creeping thistle		2	O
<i>Cynosurus cristatus</i>	Crested dogs tail	2		R
<i>Taraxacum agg.</i>	Dandelion	1	1	O
<i>Arrhenatherum elatius</i>	False oat grass	2	1	O
<i>Arrhenatherum sp.</i>	False oat grass cultivar	5	6	A
<i>Alopecurus pratensis</i>	Meadow foxtail	2	1	O
<i>Leucanthemum vulgare</i>	Oxeye daisy	2	1	O
<i>Festuca rubra sub sp. rubra</i>	Red fescue cultivar		4	F
<i>Plantago lanceolata</i>	Ribwort plantain	1	2	O
<i>Poa trivialis</i>	Rough meadow grass	4	3	F
<i>Anthoxanthum odoratum</i>	Sweet vernal grass	2		O
<i>Achillea millefolium</i>	Yarrow	1	2	O
<i>Holcus lanatus</i>	Yorkshire fog	6	5	F/LA
Additional Species				
<i>Crepis setosa</i>	Bristly Hawk's-beard			R
<i>Heracleum sphondylium</i>	Common hogweed			R
<i>Senecio jacobaea</i>	Common ragwort			O
<i>Vicia sativa</i>	Common vetch			R
<i>Artemisia vulgaris</i>	Mugwort			R
<i>Bromus hordeaceus</i>	Soft brome			R
<i>Trifolium repens</i>	White clover			R

Site: Roadside Nature Reserve (Quadrats 24-26, Table 3.12)

This habitat consists of a wide verge of semi-improved neutral grassland on the north side of the A1067. The verge is flat at the road edge and then slopes steeply upwards towards the adjacent land creating a south facing slope. Likely management of this road verge is annual cutting.

A relatively high proportion of bare ground and litter (approx. 30%) are present on the slope, which is otherwise dominated by tussocks of false oat grass and cock's foot. Scattered scrub species (hawthorn, dog-rose (*rosa canina*) and hazel) are present on the slope, as are patches of dense bramble.

Hoary mullein was found only on the slopes and only occasionally, although it was locally frequent. It was also present approximately 10 m outside the designated nature reserve to the west. Many of the leaves of this plant had been extensively eaten by the mullein moth caterpillar.

Table 3.12: Floristic table for MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community (Semi-improved neutral grassland - Roadside Nature Reserve)

Quadrat Number		Q24	Q25	Q26	Species list (DAFOR)
Quadrat Size (m ²)		2x2 m	2x2 m	2x2 m	
Vegetation Height (m)		0.2	0.3	0.2	
Vegetation Cover (%)		80	65	60	
Litter/Bare Soil (%)		20	35	40	
Aspect		South	South	South	
Slope (degrees)		45	30	35	
Soil		Brown earth / sandy	Brown earth / sandy	Brown earth / sandy	
GPS coordinates		TG14328/15568	TG14365/15539	TG14433/15493	
Latin Name	English Name	Domin score	Domin score	Domin score	
<i>Anisantha sterilis</i>	Barren brome	2		1	O
<i>Silene vulgaris</i>	Bladder campion			2	O
<i>Conyza canadensis</i>	Canadian fleabane			2	O
<i>Hypochaeris radicata</i>	Cat's ear			1	R
<i>Galium aparine</i>	Cleavers	1			R
<i>Dactylis glomerata</i>	Cock's-foot	3	3	7	F
<i>Agrostis capillaris</i>	Common bent	2			O
<i>Heracleum sphondylium</i>	Common hogweed	1	1		R
<i>Centaurea nigra</i>	Common knapweed			2	O
<i>Cerastium fontanum</i>	Common mouse-ear		1		O
<i>Urtica dioica</i>	Common nettle	2	1	1	O
<i>Senecio jacobaea</i>	Common ragwort	2	2	2	O
<i>Anthriscus sylvestris</i>	Cow parsley	2		2	O
<i>Taraxacum agg.</i>	Dandelion			1	O
<i>rosa canina</i>	Dog rose	2			O
<i>Arrhenatherum elatius</i>	False oat grass	5	7		F/LA
<i>convolvulus arvensis</i>	Field bindweed	2	1		O
<i>Myosotis arvensis</i>	Field forget me knot		1		R
<i>Veronica chamaedrys</i>	Germander speedwell		3		O
<i>Glechoma hederacea</i>	Ground ivy			2	O
<i>Verbascum pulverulentum</i>	Hoary mullein	2	1	4	O
<i>Sonchus asper</i>	Prickly sow thistle	1	1	1	O
<i>Silene dioica</i>	Red campion	4			R
<i>Plantago lanceolata</i>	Ribwort plantain	3	4	3	F/LA
<i>Cirsium vulgare</i>	Spear thistle	2	1		O
<i>Arenaria serpyllifolia</i>	Thyme leaved sandwort		1	1	R
<i>Achillea millefolium</i>	Yarrow	3	2	2	F

Quadrat Number		Q24	Q25	Q26	Species list
<i>Holcus lanatus</i>	Yorkshire fog	5	4		F/LA
<i>Geranium dissectum</i>	Cut-leaved Crane's-bill			1	O
Additional species					
<i>Papaver atlanticum</i>	Atlas poppy				R
<i>Rubus fruticosus</i> agg.	Bramble				O/LA
<i>Anchusa arvensis</i>	Bugloss				R
<i>Agrostis stolonifera</i>	Creeping bent				O/LF
<i>Ranunculus repens</i>	Creeping buttercup				O/LF
<i>Rumex crispus</i>	Curled dock				R
<i>Corylus avellana</i>	Hazel				R
<i>Crataegus monogyna</i>	Hawthorn				R
<i>Poa trivialis</i>	Rough meadow grass				O
<i>Acer pseudoplatanus</i>	Sycamore spl				R
<i>Silene latifolia</i>	White campion				R
<i>Trifolium repens</i>	White clover				LF

3.3 Arable Field Margins

Arable fields are the main land use within the survey corridor. These include cereal and non-cereal crops and fields recently seeded with grass. Set-aside field margins are found in a few locations, and they support vegetation resembling semi-improved neutral grassland, with a higher proportion of arable weeds.

The field margins Adjacent to Marriot's Way (Q22 Table 3.13) east of Tithe Plantation (Q13, 14, Table 3.14) and to the North of Beeston Park (Q10, 11, Table 3.15), are frequently disturbed and hence have an open habitat structure with an abundance of arable weeds. These are classified as vegetation of open habitats.

The field margins at the following sites: North of Postwick (Q1-3, Table 3.16) and Adjacent to Marriot's Way (Q23, Table 3.17) are less disturbed and more closely resemble semi-improved neutral grassland.

Arable field margins are a priority habitat in the Norfolk LBAP and the UK BAP habitat.

Vegetation of open habitats

NVC Community: OV9 *Matricaria perforata*-*Stellaria media* community

Site: Adjacent to Marriott's Way (Quadrat 22, Table 3.13)

This arable margin is frequently disturbed. It is relatively species rich and contains many arable weed species such as common poppy (*Papaver rhoeas*), corn spurrey (*Spergula arvensis*), black bindweed (*Fallopia convolvulus*), field pansy (*Viola arvensis*) and scentless mayweed (*Tripleurospermum inodorum*). It has a relatively high vegetation cover (of 85%) for disturbed land.

Table 3.13: Floristic table for OV9d *Matricaria perforata*-*Stellaria media* community, *Bilderdykia convolvulus*-*Veronica persica* sub-community (Semi-improved neutral grassland) (adjacent to Marriott's Way)

Quadrat Number		Q22	Species list (DAFOR)
Quadrat Size (m ²)		2x2 m	
Vegetation Height (m)		0.35	
Vegetation Cover (%)		85	
Litter/Bare Soil (%)		15	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth / sandy	
GPS coordinates		TG16600/15630	
Latin Name	English Name	Domin score	
<i>Anisantha sterilis</i>	Barren brome	5	F/LA
<i>Fallopia convolvulus</i>	Black bindweed	1	O
<i>Anchusa arvensis</i>	Bugloss	2	O
<i>Agrostis capillaris</i>	Common bent	5	F
<i>Stellaria media</i>	Common chickweed	1	R
<i>Elytrigia repens</i>	Common couch grass	2	F
<i>Urtica dioica</i>	Common nettle	1	R
<i>Papaver rhoeas</i>	Common poppy	2	O
<i>Spergula arvensis</i>	Corn spurrey	3	O/LF
<i>Rumex crispus</i>	Curled dock	1	O
<i>Geranium dissectum</i>	Cut-leaved Crane's-bill	1	O
<i>Taraxacum agg.</i>	Dandelion	1	R
<i>Arrhenatherum elatius</i>	False oat grass	2	F/LA
<i>Chenopodium album</i>	Fat hen	1	O
<i>Equisetum arvense</i>	Field horsetail	2	O
<i>Viola arvensis</i>	Field pansy	1	O
<i>Veronica persica</i>	Common Field speedwell	1	R
<i>Senecio vulgaris</i>	Groundsel	1	O
<i>Sisymbrium officinale</i>	Hedge mustard	1	O
<i>Polygonum aviculare</i>	Knotgrass	1	O
<i>Artemisia vulgaris</i>	Mugwort	4	O
<i>Sonchus asper</i>	Prickly sow thistle	1	O
<i>Tripleurospermum inodorum</i>	Scentless mayweed	4	F
<i>Brassica rapa</i>	Turnip	1	R
<i>Raphanus raphanistrum</i> subsp. <i>raphanistrum</i>	Wild radish	5	O/LF
<i>Holcus lanatus</i>	Yorkshire fog	3	F
Additional Species			

Quadrat Number		Q22	Species list (DAFOR)
<i>Poa annua</i>	Annual Meadow-grass		R
<i>Agrostis sp.</i>	Bent cultivar		R
<i>Silene vulgaris</i>	Bladder campion		R
<i>Pteridium aquilinum</i>	Bracken		O/LA
<i>Hypochaeris radicata</i>	Cat's ear		O
<i>Dactylis glomerata</i>	Cock's-foot		F
<i>Filago vulgaris</i>	Common cudweed		O
<i>Senecio jacobaea</i>	Common ragwort		O
<i>Rumex acetosa</i>	Common sorrel		O
<i>Vicia sativa</i>	Common vetch		R
<i>Agrostis stolonifera</i>	Creeping bent		F
<i>Cirsium arvense</i>	Creeping thistle		O
<i>Lotus pedunculatus</i>	Greater Bird's-foot-trefoil		R
<i>Vicia hirsuta</i>	Hairy tare		R
<i>Veronica hederifolia</i>	Ivy-leaved Speedwell		R
<i>Plantago lanceolata</i>	Ribwort plantain		O
<i>Poa trivialis</i>	Rough meadow grass		F
<i>Anagallis arvensis</i>	scarlet pimpernel		R
<i>Cirsium vulgare</i>	Spear thistle		R
<i>Beta vulgaris</i>	Sugar beet		R
<i>Anthoxanthum odoratum</i>	Sweet vernal-grass		R
<i>Veronica arvensis</i>	Wall Speedwell		R
<i>Persicaria hydropiper</i>	Water-pepper		R
<i>Silene latifolia</i>	White campion		R
<i>Trifolium repens</i>	White clover		R
<i>Achillea millefolium</i>	Yarrow		O/LF

NVC Community OV22: *Poa annua*-*Taraxacum officinale* community

Site: To east of Tithe Plantation, south of Spixworth (Quadrats 13 and 14, Table 3.14)

Although grass species are the most abundant species in this arable margin, it is also fairly rich with forbs. A few arable weeds are present such as scentless mayweed and common cudweed (*Filago vulgaris*). However, the large majority of the forb species are more coarse perennials such as broad-leaved dock (*Rumex obtusifolius*) and hoary willowherb (*Epilobium parviflorum*).

Table 3.14: Floristic table for OV22c *Poa annua*-*Taraxacum officinale* community, *Crepis vesicaria*-*Epilobium adenocaulon* sub-community (Semi-improved neutral grassland)

Quadrat Number		Q13	Q14	Species list (DAFOR)
Quadrat Size (m ²)		2x2 m	2x2 m	
Vegetation Height (m)		0.35	0.35	
Vegetation Cover (%)		75	75	
Litter/Bare Soil (%)		25	25	
Aspect		N/A	N/A	
Slope (degrees)		0	0	
Soil		Brown earth	Brown earth	
GPS coordinates		TG25158/ 14418	TG25192/ 14449	
Latin Name	English Name	Domin score	Domin score	
<i>Epilobium ciliatum</i>	American Willowherb	1	1	O
<i>Poa annua</i>	Annual Meadow-grass	2	4	O/LF
<i>Anisantha sterilis</i>	Barren brome	2	3	O/LF
<i>Crepis vesicaria</i>	Beaked Hawk's-beard	2	1	O
<i>Prunus spinosa</i>	Blackthorn sdl	1		R
<i>Erigeron acer</i>	Blue fleabane		1	R
<i>Rumex obtusifolius</i>	Broad-leaved dock		1	O
<i>Hypochaeris radicata</i>	Cat's ear		5	F/LA
<i>Galium aparine</i>	Cleavers	1		O
<i>Filago vulgaris</i>	Common cudweed	1		R
<i>Centaurea nigra</i>	Common knapweed		3	R
<i>Senecio jacobaea</i>	Common ragwort		1	O
<i>Juncus conglomeratus</i>	Compact Rush			R
<i>Agrostis stolonifera</i>	Creeping bent	4	4	F
<i>Taraxacum agg.</i>	Dandelion	1	1	O
<i>Plantago major</i>	Greater Plantain	4	3	F
<i>Salix cinerea</i>	Grey willow sdl	1	1	R
<i>Epilobium parviflorum</i>	Hoary Willowherb	2	1	
<i>Trifolium dubium</i>	Lesser trefoil			R
<i>Lolium perenne</i>	Perennial rye-grass			O
<i>Sonchus asper</i>	Prickly sow thistle	1	1	O
<i>Trifolium pratense</i>	Red clover			R
<i>Poa trivialis</i>	Rough meadow grass	7	3	F/LA
<i>Tripleurospermum inodorum</i>	Scentless mayweed	2	2	O
<i>Bromus hordeaceus</i>	Soft-brome	2	6	F/LA
<i>Cirsium vulgare</i>	Spear thistle	1	2	O
<i>Holcus lanatus</i>	Yorkshire fog	4	2	O
Additional species				

Quadrat Number		Q13	Q14	Species list (DAFOR)
<i>Rubus fruticosus</i> agg.	Bramble			R
<i>Dactylis glomerata</i>	Cock's-foot			O
<i>Heracleum sphondylium</i>	Common hogweed			R
<i>Cerastium fontanum</i>	Common mouse-ear			O
<i>Cirsium arvense</i>	Creeping thistle			O
<i>Arrhenatherum elatius</i>	False oat grass			O
<i>Myosotis arvensis</i>	Field forget me knot			R
<i>Hedera helix</i>	Ivy			R
<i>Artemisia vulgaris</i>	Mugwort			O
<i>Plantago lanceolata</i>	Ribwort plantain			O
<i>Trifolium repens</i>	White clover			R

NVC Community OV25: *Urtica dioica*-*Cirsium arvense* community

Site: North of Beeston Park and North of Beeston Lane, Beeston St Andrews. (Quadrats 10 and 11, Table 3.15)

A habitat of relatively open vegetation but dominated by coarse tall grasses and forbs, in particular barren brome (*Anisantha sterilis*) and mugwort (*Artemisia vulgaris*). Other frequent species include common couch grass (*Elytrigia repens*), creeping bent (*Agrostis stolonifera*), blue fleabane (*Erigeron acer*), ground ivy, red fescue (*Festuca rubra*) and rough meadow grass (*Poa trivialis*).

Table 3.15: Floristic table for OV25 *Urtica dioica*-*Cirsium arvense* community (Semi-improved neutral grassland)

Quadrat Number		Q10	Q11	Species list (DAFOR)
Quadrat Size (m ²)		2x2 m	2x2 m	
Vegetation Height (m)		0.2	0.2	
Vegetation Cover (%)		65	65	
Litter/Bare Soil (%)		35	35	
Aspect		South	South	
Slope (degrees)		2	2	
Soil		Brown earth / sandy	Brown earth / sandy	
GPS coordinates		TG26212/ 14164	TG26214/ 14184	
Latin Name	English Name	Domin score	Domin score	
<i>Epilobium ciliatum</i>	American Willowherb		1	
<i>Poa annua</i>	Annual Meadow-grass		1	
<i>Fraxinus excelsior</i>	Ash sdl		1	
<i>Papaver atlanticum</i>	Atlas poppy		1	
<i>Anisantha sterilis</i>	Barren brome	5	5	
<i>Crepis vesicaria</i>	Beaked Hawk's-beard		1	
<i>Erigeron acer</i>	Blue fleabane	3		
<i>Rubus fruticosus</i> agg.	Bramble	1		
<i>Hypochaeris radicata</i>	Cat's ear		1	
<i>Galium aparine</i>	Cleavers	1		
<i>Dactylis glomerata</i>	Cock's-foot	2		
<i>Elytrigia repens</i>	Common couch grass	1	4	

Quadrat Number		Q10	Q11	Species list (DAFOR)
<i>Cerastium fontanum</i>	Common mouse-ear	1	2	O
<i>Agrostis stolonifera</i>	Creeping bent		2	O/LF
<i>Cirsium arvense</i>	Creeping thistle	4		O
<i>Taraxacum agg.</i>	Dandelion	1	2	O
<i>Myosotis arvensis</i>	Field forget me knot	1	2	O
<i>Plantago major</i>	Greater Plantain	1	1	O
<i>Epilobium hirsutum</i>	Greater willowherb		1	R
<i>Veronica agrestis</i>	Green Field-speedwell		2	
<i>Glechoma hederacea</i>	Ground ivy	3	4	O/LF
<i>Hedera helix</i>	Ivy	1	1	R
<i>Artemisia vulgaris</i>	Mugwort	4	5	F
<i>Sonchus asper</i>	Prickly sow thistle	1	1	R
<i>Festuca rubra</i>	Red fescue	5	2	F/LA
<i>Poa trivialis</i>	Rough meadow grass		2	O/F
<i>Anagallis arvensis</i>	Scarlet pimpernel	1		R
<i>Tripleurospermum inodorum</i>	Scentless mayweed	1		O
<i>Arabidopsis thaliana</i>	Thale cress		1	R
Additional species				
<i>Filago vulgaris</i>	Common cudweed			R
<i>Urtica dioica</i>	Common nettle			R
<i>Ranunculus repens</i>	Creeping buttercup			R
<i>Arrhenatherum elatius</i>	False oat grass			R
<i>Convolvulus arvensis</i>	Field bindweed			R
<i>Salix cinerea</i>	Grey willow sdl			R
<i>Arctium minus</i>	Lesser Burdock			R
<i>Sagina maritima</i>	Procumbent pearlwort			R
<i>Plantago lanceolata</i>	Ribwort plantain			R
<i>Cirsium vulgare</i>	Spear thistle			R
<i>Veronica arvensis</i>	Wall speedwell			O
<i>Trifolium repens</i>	White clover			R

Grassland

NVC Community MG1: *Arrhenatherum elatius* grassland community

Mesotrophic (neutral) grassland

Site: North of Postwick on north side of A47 (Quadrats 1 to 3, Table 3.16)

The grassland vegetation in Quadrats 1 – 3 was dominated by grass species including creeping bent, smooth meadow-grass (*Poa pratensis*), cock's-foot, red fescue and Yorkshire fog. However, there was a reasonably diverse array of weedy forb species. The vegetation was relatively sparse and low growing, suggesting this is a recently established grassland.

Table 3.16: Floristic table for MG1a (*Arrhenatherum elatius* grassland, *Festuca rubra* sub-community) (Semi-improved neutral grassland)

Quadrat Number		Q1	Q2	Q3	Species list (DAFOR)
Quadrat Size (m ²)		2x2 m	2x2 m	2x2 m	
Vegetation Height (m)		0.3	0.25	0.25	
Vegetation Cover (%)		92	95	95	
Litter/Bare Soil (%)		8	5	5	
Aspect		South	South	South	
Slope (degrees)		4	4	2	
Soil		Brown earth / sandy	Brown earth / sandy	Brown earth / sandy	
GPS coordinates		TG29183/08580	TG29227/08586	TG29252/08581	
Latin Name	English Name	Domin score	Domin score	Domin score	
<i>Leontodon autumnalis</i>	Autumn hawkbit	1		1	R
<i>Crepis vesicaria</i>	Beaked hawk's-beard	1	1	1	O
<i>Hypochaeris radicata</i>	Cat's ear	3	2	2	O
<i>Dactylis glomerata</i>	Cock's-foot	5	2	4	F/LA
<i>Pulicaria dysenterica</i>	Common fleabane		1		R
<i>Heracleum sphondylium</i>	Common hogweed	2	1	2	O
<i>Cerastium fontanum</i>	Common mouse-ear	1	3		O
<i>Senecio jacobaea</i>	Common ragwort	1		1	R
<i>Vicia sativa</i>	Common vetch			2	O
<i>Agrostis stolonifera</i>	Creeping bent	4	4	5	F
<i>Cirsium arvense</i>	Creeping thistle		1	1	O
<i>Rumex crispus</i>	Curled dock			1	R
<i>Geranium dissectum</i>	Cut-leaved Crane's-bill			1	R
<i>Taraxacum agg.</i>	Dandelion	5	7	5	A
<i>Arrhenatherum elatius</i>	False oat grass		1	2	O
<i>Equisetum arvense</i>	Field horsetail	4	1	1	O
<i>Salix cinerea</i>	Grey willow sdl	1		1	R
<i>Trifolium dubium</i>	Lesser trefoil	1	3	2	O
<i>Artemisia vulgaris</i>	Mugwort		1	2	O
<i>Quercus robur</i>	Pedunculate oak	1			
<i>Festuca rubra</i>	Red fescue	3	5	2	F/LA
<i>Plantago lanceolata</i>	Ribwort plantain	1			R
<i>Poa pratensis</i>	Smooth meadow-grass	3	4	3	F
<i>Bromus hordeaceus</i>	Soft-brome	2	2		O
<i>Holcus lanatus</i>	Yorkshire fog	6	4	5	F/LA

Site: Adjacent to Marriott's Way (Quadrat 23, Table 3.17)

Quadrat 23 was placed in a section of the margin that was not frequently disturbed. The vegetation at Q23 was fairly species poor and was dominated by competitive species such as false oat grass and barren brome indicating higher nutrient levels in the soil at this site. A few coarse forb species were also present here, again suggesting higher nutrient levels.

Table 3.17: Floristic table for MG1 *Arrhenatherum elatius* Grassland (Semi-improved neutral grassland) (adjacent to Marriott's Way)

Quadrat number		Q23	Species list (DAFOR)
Quadrat size (m ²)		2x2 m	
Vegetation height (m)		0.5	
Vegetation cover (%)		85	
Litter/bare soil (%)		15	
Aspect		N/A	
Slope (degrees)		0	
Soil		Brown earth / sandy	
Gps coordinates		Tg16584/15653	
Latin name	English name	Domin score	
<i>Anisantha sterilis</i>	Barren brome	6	F/LA
<i>Hypochaeris radicata</i>	Cat's ear	2	O
<i>Dactylis glomerata</i>	Cock's-foot	2	F
<i>Elytrigia repens</i>	Common couch grass	2	F
<i>Filago vulgaris</i>	Common cudweed	2	O
<i>Senecio jacobaea</i>	Common ragwort	2	O
<i>Rumex acetosa</i>	Common sorrel	1	O
<i>Agrostis stolonifera</i>	Creeping bent	3	F
<i>Cirsium arvense</i>	Creeping thistle	1	O
<i>Rumex crispus</i>	Curled dock	2	O
<i>Taraxacum agg.</i>	Dandelion	1	R
<i>Arrhenatherum elatius</i>	False oat grass	5	F/LA
<i>Lotus pedunculatus</i>	Greater bird's-foot-trefoil	1	R
<i>Sonchus asper</i>	Prickly sow thistle	1	O
<i>Poa trivialis</i>	Rough meadow grass	3	F
<i>Achillea millefolium</i>	Yarrow	3	O/LF
<i>Holcus lanatus</i>	Yorkshire fog	3	F

3.4 Other Habitats

Scattered Scrub and Grassland Mosaic - Marriott's Way County Wildlife Site:

The citation for the Marriott's Way County Wildlife Site (disused railway) describes the vegetation of consisting of a diverse mixture of scrub and woodland habitats with areas of open grassland. Pedunculate oak and hawthorn occur all the way along the path, with other tree and scrub species occurring with varying frequency. Much of the grassland along Marriott's Way is on acidic ground, with light, sandy soil but plants also found in neutral and basic soils seem to occur alongside one another. Species such as greater knapweed (*Centaurea scabiosa*), field scabious (*Knautia arvensis*), mouse-ear hawkweed (*Pilosella officinarum*) and wild carrot (*Daucus carota*) are characteristic of basic grassland; these occur alongside neutral grassland species such as germander speedwell (*Veronica chamaedrys*), common sorrel (*Rumex acetosa*), common knapweed (*Centaurea nigra*) and false oat grass and acidic grassland plants including bracken and wood sage (*Teucrium scorodonia*)

The citation describes some less common plants that occur along Marriott's Way to include yellow archangel (*Lamiastrum galeobdolon*), wild marjoram (*Origanum vulgare*), hellebores (*hellebores spp*) along the track edge, moschatel (*Adoxa moschatellina*), maidenhair spleenwort (*Asplenium trichomanes ssp*) and locally abundant sanicle (*Sanicula europaea*).

The area likely to be affected by the NDR (approximately 150 m either side of the NDR) along Marriott's Way was surveyed. Quadrats were not taken at this site due to the heterogeneity of the vegetation and an NVC community has not been assigned due to the diverse nature of the habitats present making habitat identification impractical. A species list with DAFOR scores was compiled for the survey section (Table 3.18)

At the point affected by the scheme, the habitats are of fairly open scrub and grassland. The banks are dominated by scattered oak, hawthorn and blackthorn (*Prunus spinosa*) with small areas of bramble scrub, and the lower slopes are dominated by coarse grassland composed of tall grasses including false oat grass, cock's foot, Yorkshire fog and sweet vernal grass (*Anthoxanthum odoratum*). Forbs present include perforate St John's wort (*Hypericum perforatum*) Wild Mignonette (*Reseda lutea*) Cut-leaved Crane's-bill (*Geranium dissectum*) and Hairy tare (*Vicia hirsuta*). No notable plant species were found during the survey.

Table 3.18: Floristic table for Marriott's Way

Latin Name	English Name	Species list (DAFOR)
<i>Agrimonia eupatoria</i>	Agrimony	R
<i>Anisantha sterilis</i>	Barren brome	O
<i>Prunus spinosa</i>	Blackthorn sdl	F
<i>Silene vulgaris</i>	Bladder campion	R
<i>Pteridium aquilinum</i>	Bracken	O
<i>Rubus fruticosus agg.</i>	Bramble	O/LA
<i>Rumex obtusifolius</i>	Broad-leaved dock	O
<i>Cytisus scoparius</i>	Broom	R

Latin Name	English Name	Species list (DAFOR)
<i>Hypochaeris radicata</i>	Cat's ear	O
<i>Galium aparine</i>	Cleavers	F
<i>Dactylis glomerata</i>	Cock's-foot	O/LF
<i>Heracleum sphondylium</i>	Common hogweed	O
<i>Centaurea nigra</i>	Common knapweed	O
<i>Cerastium fontanum</i>	Common mouse-ear	O
<i>Urtica dioica</i>	Common nettle	F
<i>Senecio jacobaea</i>	Common ragwort	R
<i>Anthriscus sylvestris</i>	Cow parsley	O
<i>Geranium dissectum</i>	Cut-leaved Crane's-bill	O
<i>Taraxacum agg.</i>	Dandelion	O
<i>Rosa canina</i>	Dog rose	O
<i>Sambucus nigra</i>	Elder	R
<i>Equisetum arvense</i>	Field horsetail	O
<i>Knautia arvensis</i>	Field Scabious	O
<i>Ribes uva-crispa</i>	Gooseberry	R
<i>Plantago major</i>	Greater plantain	O
<i>Vicia hirsuta</i>	Hairy tare	R
<i>Crataegus monogyna</i>	Hawthorn sdl	O
<i>Sisymbrium officinale</i>	Hedge Mustard	R
<i>Stachys sylvatica</i>	Hedge Woundwort	R
<i>Conium maculatum</i>	Hemlock	R
<i>Agrostis castellana</i>	Highland Bent	R
<i>Hedera helix</i>	Ivy	O/LF
<i>Arctium minus</i>	Lesser burdock	R
<i>Festuca pratensis</i>	Meadow Fescue	R
<i>Artemisia vulgaris</i>	Mugwort	O
<i>Lapsana communis</i>	Nipplewort	R
<i>Quercus robur</i>	Pedunculate oak	F
<i>Quercus robur</i>	Pedunculate oak spl	O
<i>Quercus robur</i>	Pedunculate oak sdl	R
<i>Lolium perenne</i>	Perennial rye-grass	O
<i>Hypericum perforatum</i>	Perforate St John's-wort	O
<i>Sonchus asper</i>	Prickly sow thistle	R
<i>Festuca rubra</i>	Red fescue	O
<i>Sedum rupestre</i>	Reflexed Stonecrop	R/LF
<i>Plantago lanceolata</i>	Ribwort plantain	F
<i>Hypericum calycinum</i>	Rose-of sharon	R/LF
<i>Poa trivialis</i>	Rough meadow grass	F
<i>Bromus hordeaceus</i>	Soft-brome	O
<i>Hyacinthoides hispanica</i>	Spanish bluebell	R
<i>Castanea sativa</i>	Sweet chestnut sdl	R
<i>Anthoxanthum odoratum</i>	Sweet vernal-grass	O
<i>Viola odorata</i>	Sweet Violet	R
<i>Trifolium repens</i>	White clover	O
<i>Prunus avium</i>	Wild cherry spl	R
<i>Prunus avium</i>	Wild cherry tree	R
<i>Reseda lutea</i>	Wild Mignonette	R
<i>Geum urbanum</i>	Wood avens	R
<i>Achillea millefolium</i>	Yarrow	O
<i>Holcus lanatus</i>	Yorkshire fog	F/LA

3.5 Protected, Notable and Invasive Plant Species

No plant species protected under Schedule 8 of the WCA 1981 were observed during the survey or previously recorded. Three notable species have previously been recorded within 1 km of the NDR, one of which was found during this botanical survey. Two invasive non-native plant species included on the amended Schedule 9 of the WCA 1981 were encountered during the NVC survey.

Notable Plant Species

There is an old record (1987) of corn cleavers (*Galium tricornutum*) within 1 km of the NDR (NBRC). This species is critically endangered (Cheffings *et al.*, 2005) and nationally rare in the UK (Preston *et al.*, 2002). This is also an UK BAP species. Corn cleavers is an archaeophyte, annual of cereal fields and disturbed ground, chiefly on dry calcareous soils. The species has suffered a very substantial decline, due to the intensification of arable farming. During the NVC survey this species was searched for but not found.

Hoary mullein (*Verbascum pulverulentum*) is a nationally scarce plant species, which has been recorded in the Roadside Nature Reserve on the A1067 near Attlebridge (Chainage 300). The species is frequent in East Anglia, but rare and of introduced origin elsewhere in the UK. Apart from roadside verges, hoary mullein is found on railway banks, in old quarries and gravel-pits, in hedge banks, rough ground, and locally on coastal shingle (its only 'natural' habitat). Seed remains viable for many years and new populations can appear after soil disturbance. This species was present in Q24, 25 and 26 (Table 3.12) on the Roadside Nature Reserve.

Basil thyme (*Clinopodium acinos*) has been previously recorded in the Marriott's Way CWS. During the Phase 1 habitat survey and this botanical survey, a section of 150 m of Marriott's Way CWS was surveyed each side of the NDR crossing; however, basil thyme was not found in this section. This species is scattered in the south of England and is classified as vulnerable on the red data list (Cheffings *et al.*, 2005). It is also a priority species in the UK BAP. Basil thyme is a species of conservation importance as it has substantially declined as a result of more efficient methods of weed control. In many areas it is no longer found in arable fields, surviving only in less intensively managed habitats. Basil thyme is an annual herb of calcareous soils (in Britain) and open habitats in dry grassland, rocky ground or arable fields. It is also a rare casual of waste ground, quarries and banks by roads and railways.

Invasive non-native plant species

During the NVC surveys, the invasive non-native species rhododendron (*Rhododendron ponticum*) was recorded in two of the woodland locations; Heath Wood (near to Q4, 5 and 7, Table 3.7) and Dole Plantation (near to Q20 and 21). Rhododendron is a medium to large sized evergreen shrub which is commonly found in the woodland understorey as well as in other more open habitats. It is an aggressive fast growing species which out competes other scrub species and reduces the biodiversity of the habitat in which it is growing.

The invasive non-native Indian balsam (*Impatiens glandulifera*) was recorded as occurring rarely in Dole Plantation (near to Q20 and 21, Table 3.10). This is an annual species that can grow to 3 m in height and usually spreads rapidly by projecting thousands of seeds per plant. It is common on open ground especially in wet areas but is also found in woodland. Once established, Indian balsam can out compete most other ground flora species including seedlings, thereby significantly reducing the biodiversity of the habitat in which it is present.

From 6th April 2010, both rhododendron and Indian balsam are to be included in the amended Part II of Schedule 9 of the Wildlife and Countryside Act 1981. This will make it an offence to cause these species to grow in the wild, including allowing them to spread by natural or other means onto adjacent land.

4 References

Blackstock, T.H., Rothero, G.P., Hill, M.O. (2005). Census Catalogue of British and Irish Bryophytes. British Bryological Society.

Cheffings, C.M., Farrell, L. (Eds), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D., Rumsey, F.J., Taylor, I. (2005). *The Vascular Plant Red Data List for Great Britain*. Species Status 7: 1-116. Joint Nature Conservation Committee, Peterborough.

Edwards, S.R. (2003). English Names for British Bryophytes. 3rd Edition. British Bryological Society Special Volumes No 5.

DEFRA (2006). *Farm Environment Plan Handbook*. www.defra.gov.uk.

Harris, Jane. NORTHERN DISTRIBUTOR ROAD GRASSLAND SURVEYS 2005 Report to Mott MacDonald August 2005

Harris, Jane. NORTHERN DISTRIBUTOR ROAD WOODLAND SURVEYS 2005 Report to Mott MacDonald August 2005

Joint Nature Conservation Council Website <http://www.jncc.gov.uk>.

Mott MacDonald (2009). Norwich Northern Distribution Road. Phase 1 Habitat Survey. Norfolk County Council.

Norfolk Biodiversity Action Plan. www.norfolkbiobiodiversity.org.

Preston, C.D., Pearman, D.A. and Dines, T.D. (Eds.) (2002). *New Atlas of the British and Irish Flora*. Oxford University Press, Oxford.

Rodwell, J.S. (Ed.), Pigott, C.D., Ratcliffe, D.A., Malloch, A.J.C., Birks, H.J.B., Proctor, M.C.F., Shimwell, D.W., Huntley, J.P., Radford, E., Wigginton, M.J., Wilkins, P. (1991). *British Plant Communities*. Vol. 1: Woodlands and Scrub. Cambridge University Press, Cambridge.

Rodwell, J.S. (Ed.), Pigott, C.D., Ratcliffe, D.A., Malloch, A.J.C., Birks, H.J.B., Proctor, M.C.F., Shimwell, D.W., Huntley, J.P., Radford, E., Wigginton, M.J., Wilkins, P. (1992). *British Plant Communities*. Vol. 3: Grassland and Montane Communities. Cambridge University Press, Cambridge.

Rose, F. (2006). *The Wild Flower Key*. 2nd Edition. Frederick Warne, Penguin Group, London.

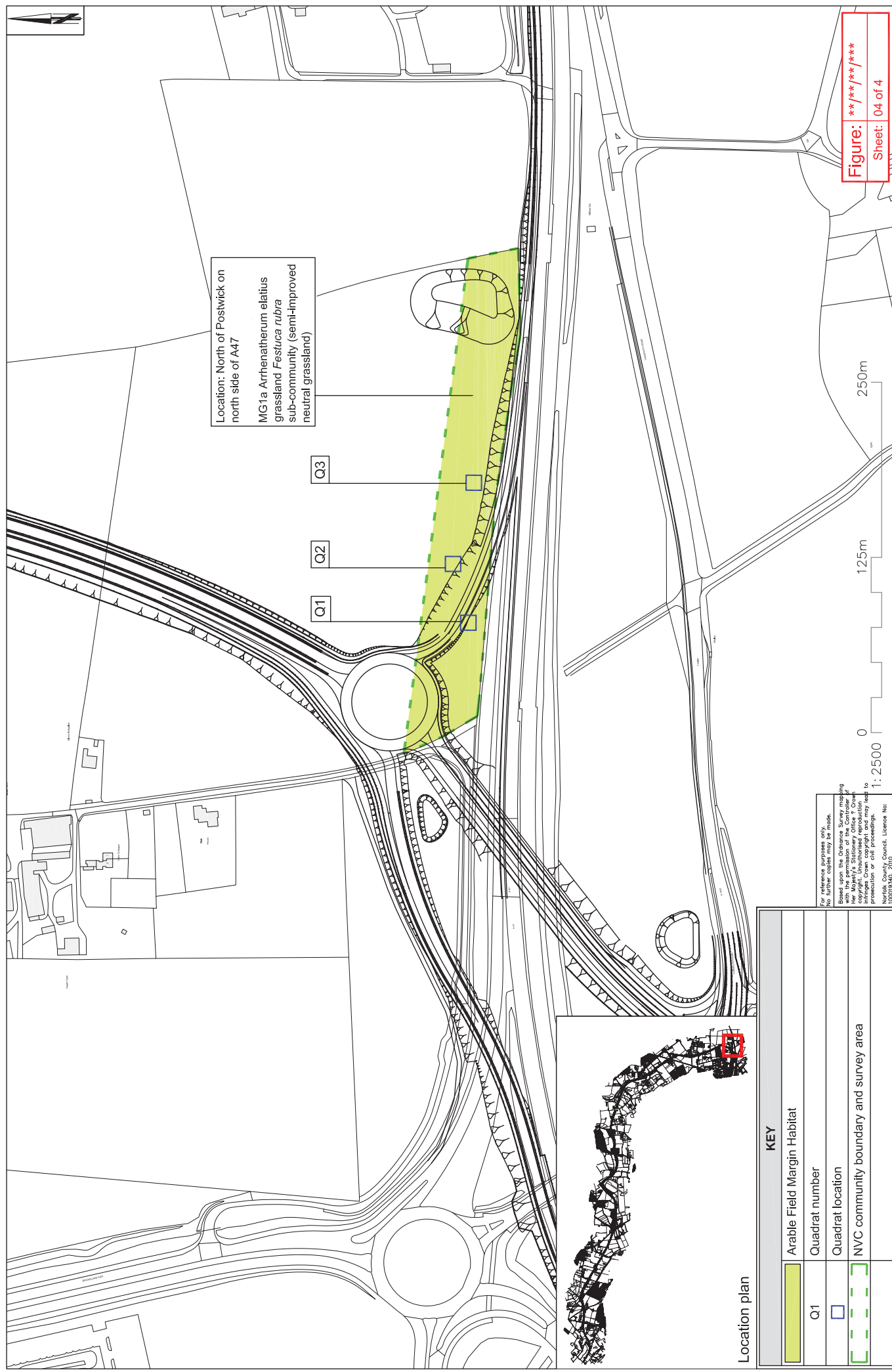
Stace, C.S. (1997). *New Flora of the British Isles*. 2nd Edition. Cambridge University Press, Cambridge.

Appendix A Maps and Drawings

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Figure A.2 – Grassland NVC Survey Maps

Figure A.3 – Arable Field Margins NVC Survey Maps

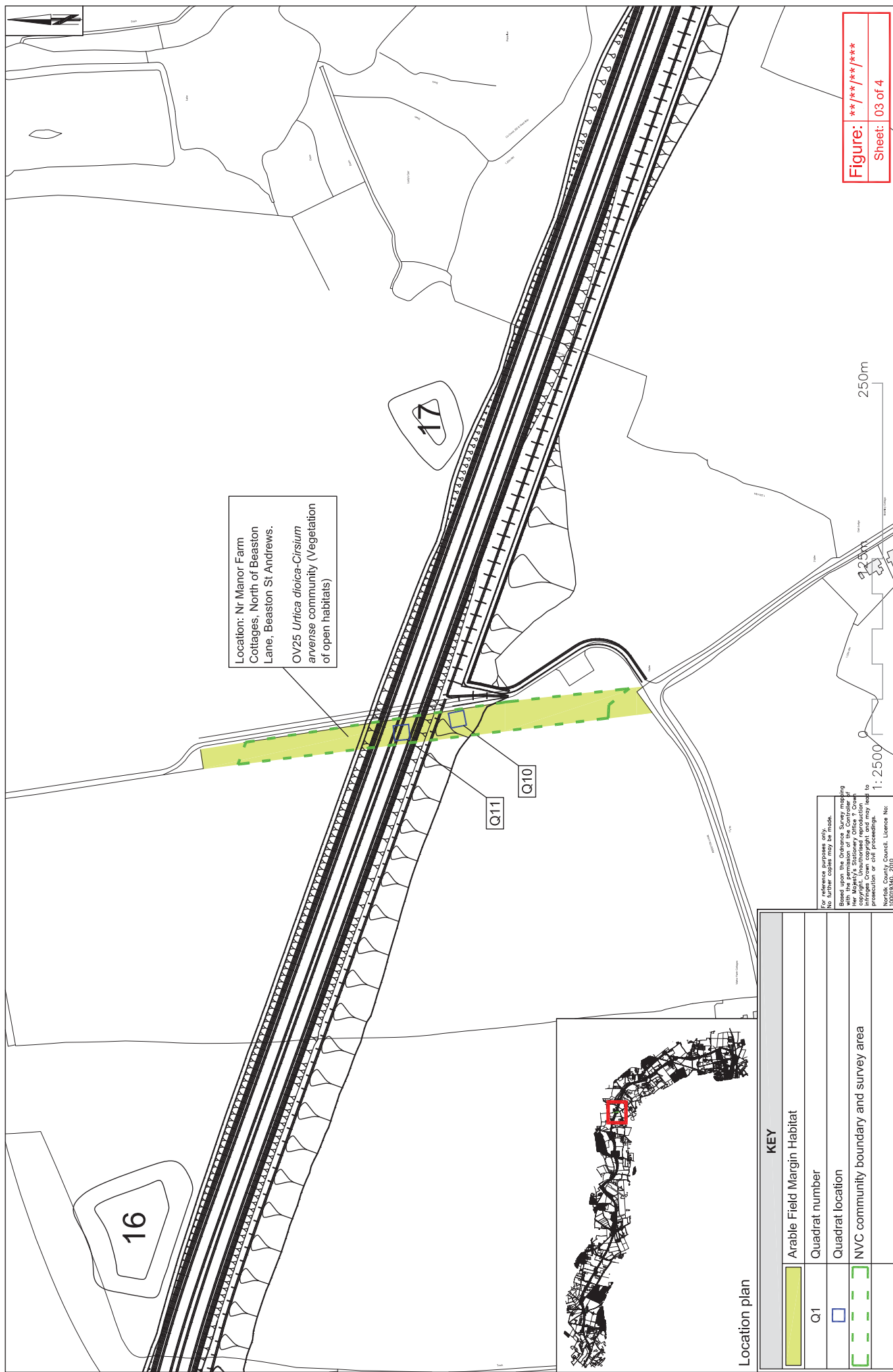


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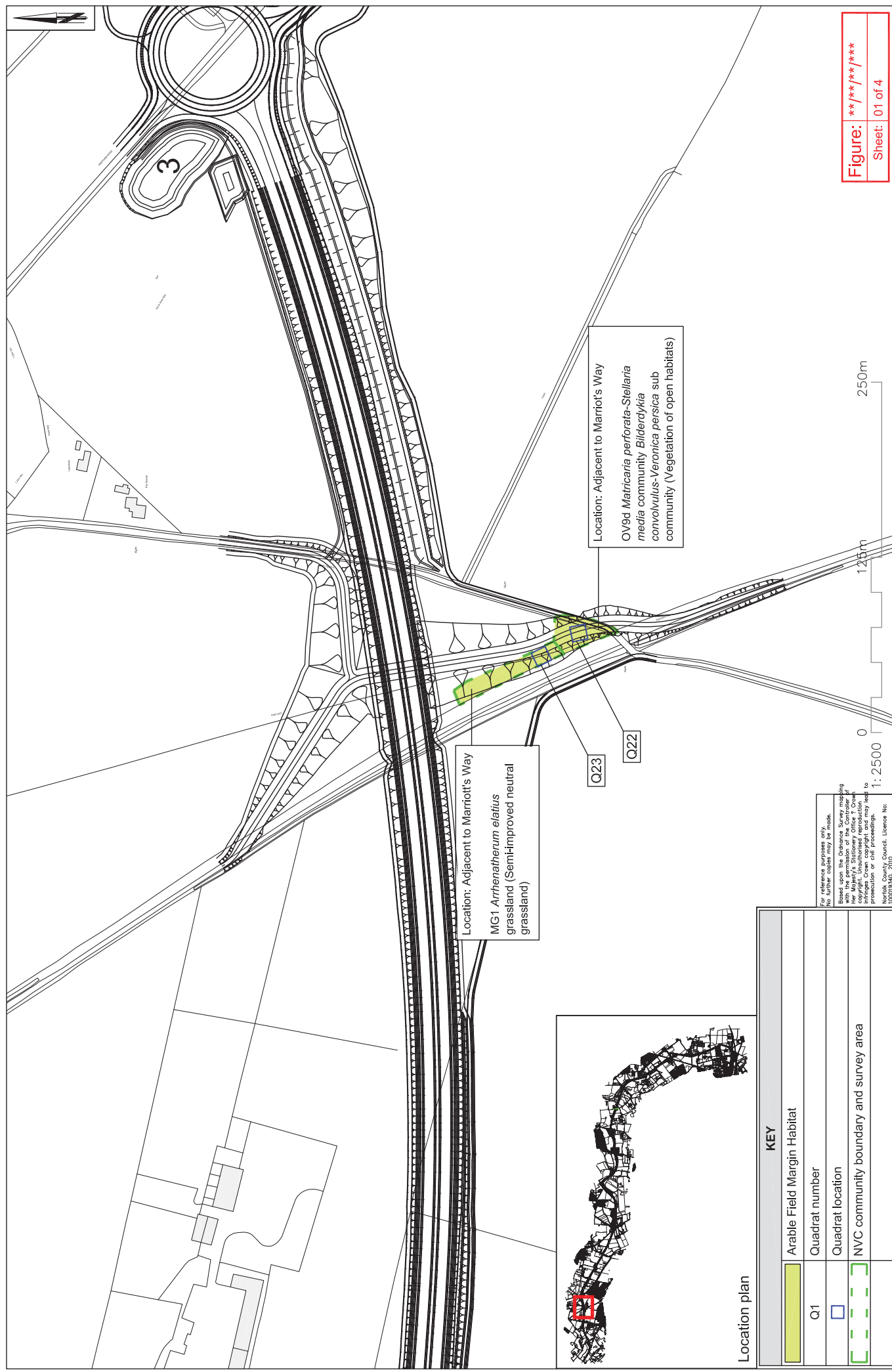
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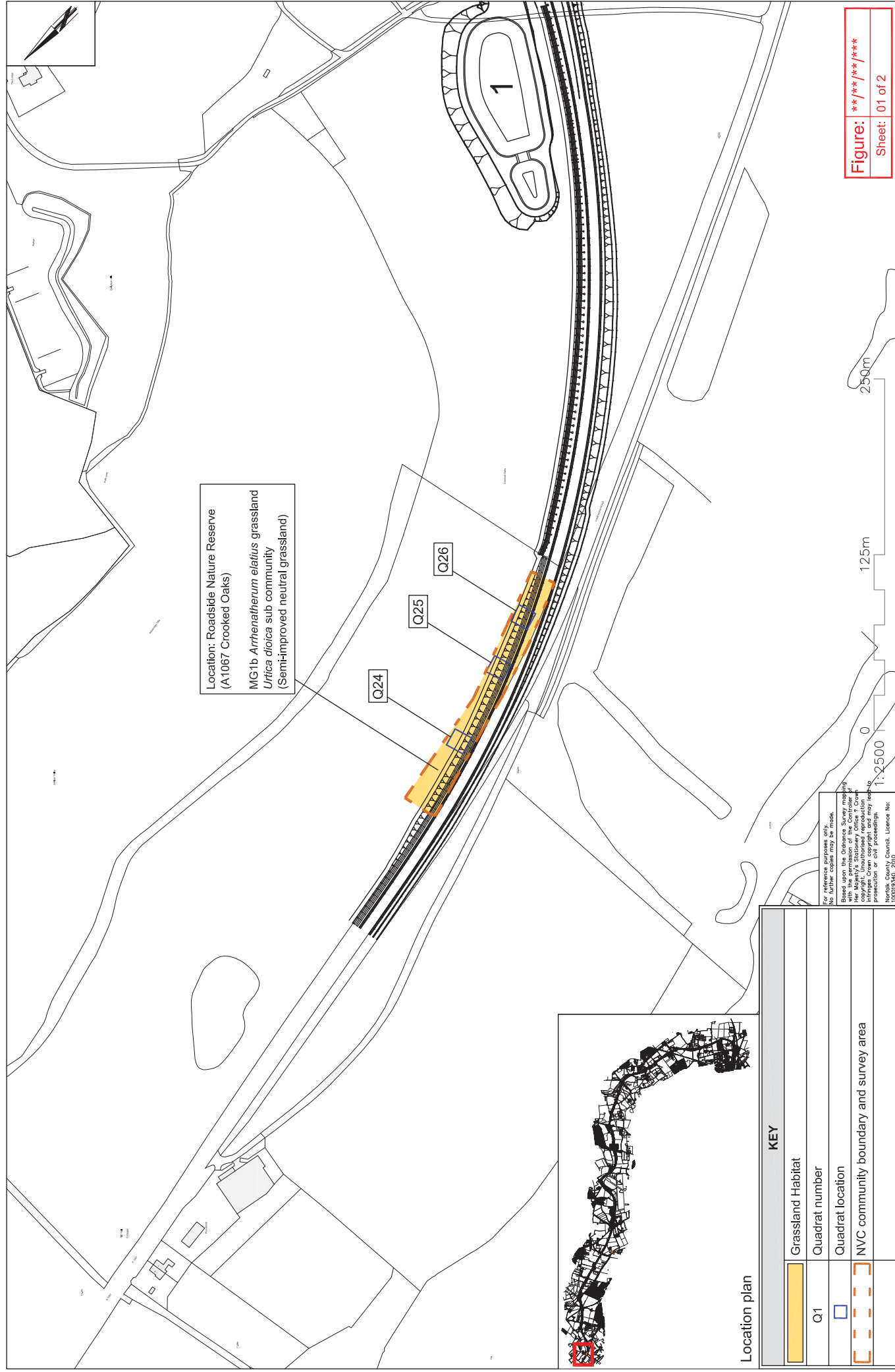
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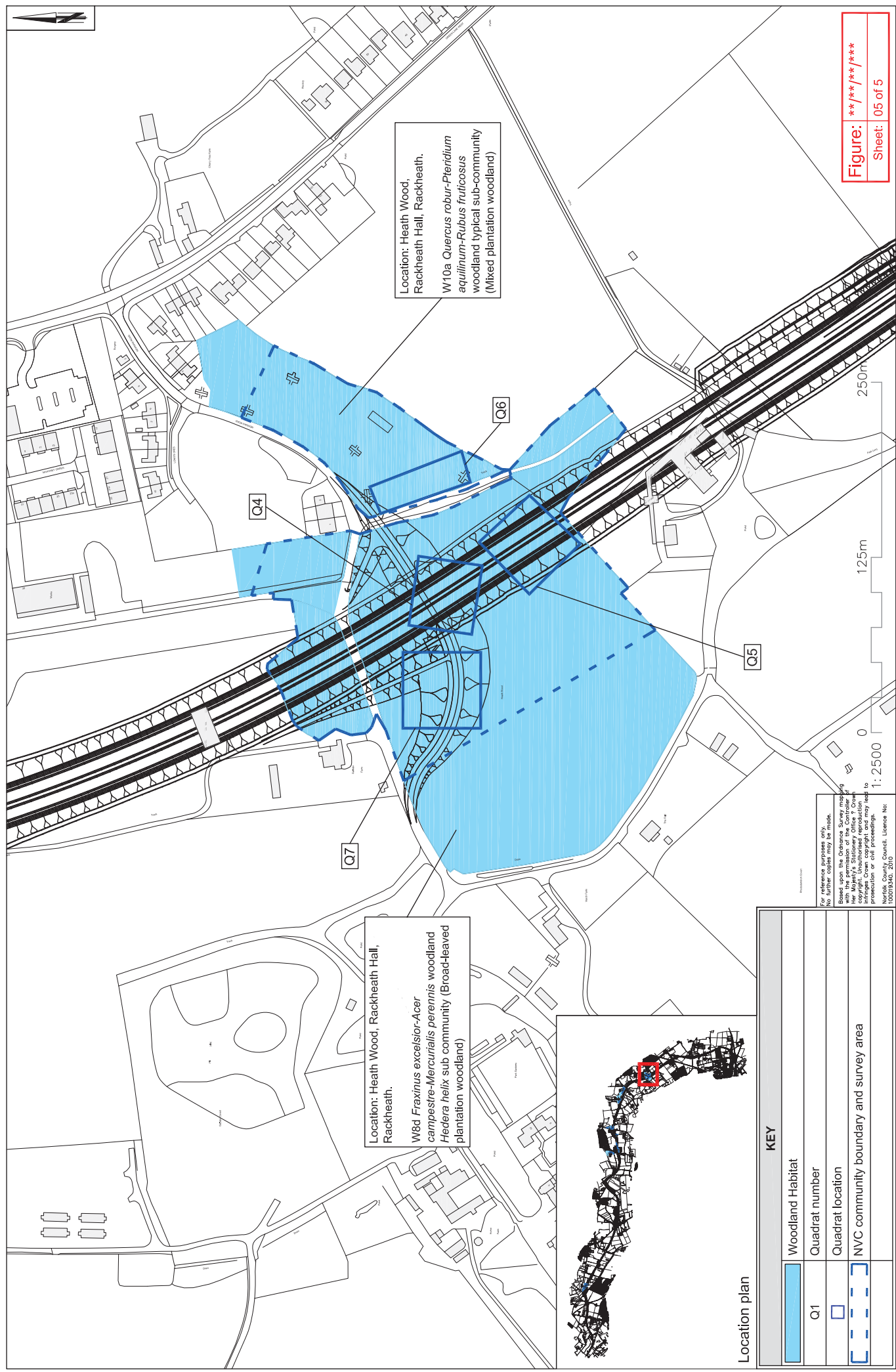
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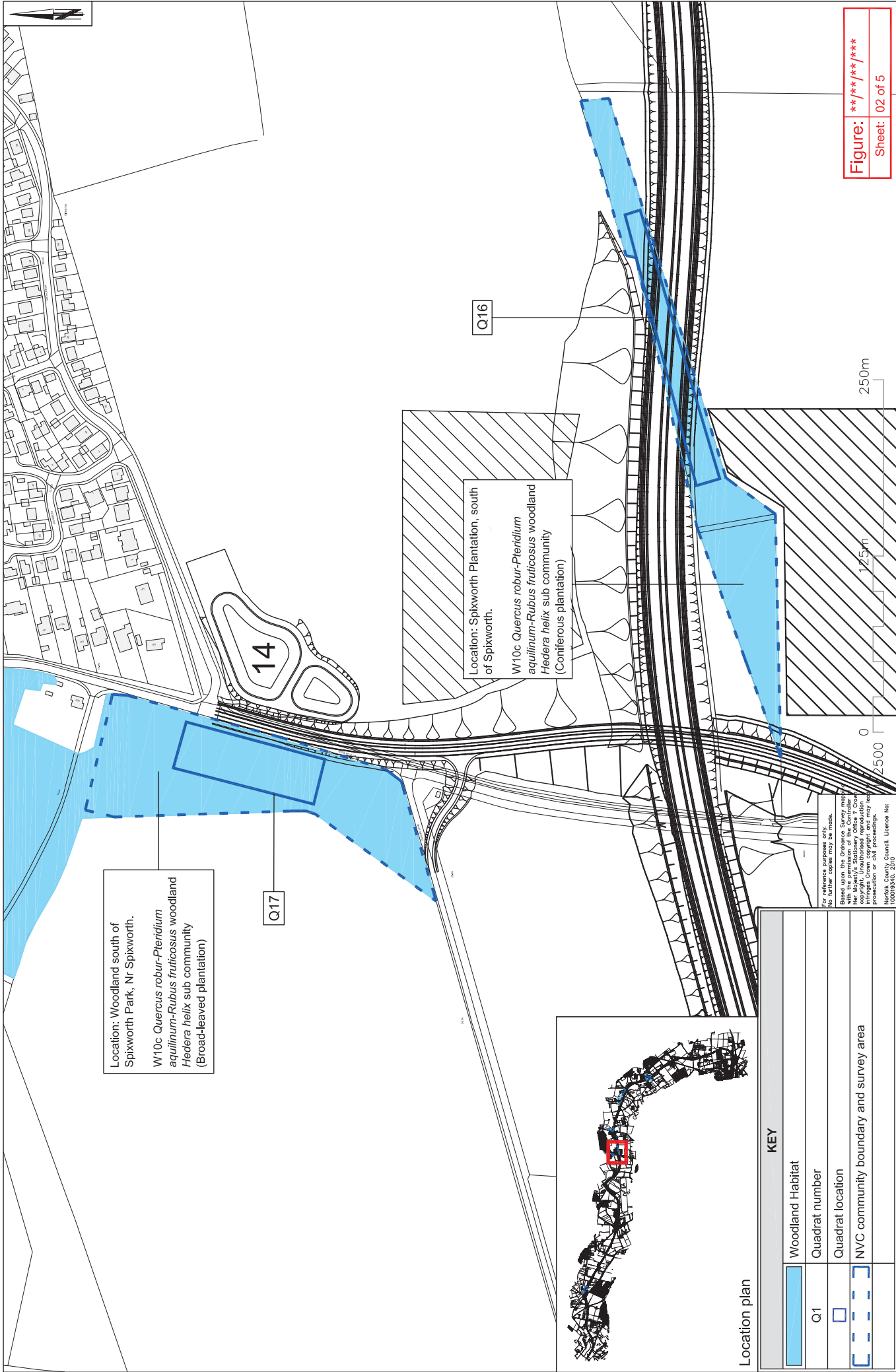


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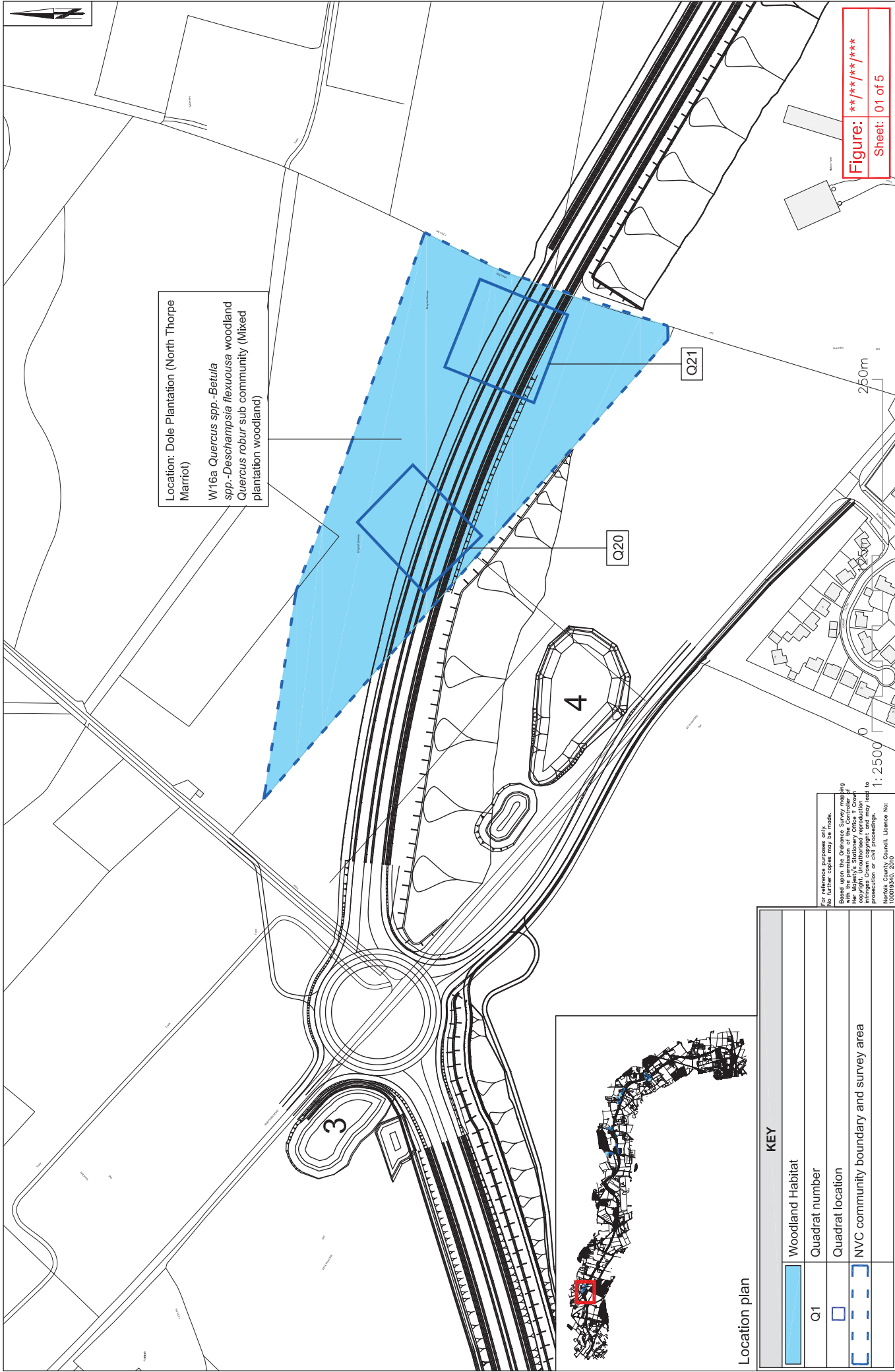


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Appendix B Photographs



Photo 57



Photo 58

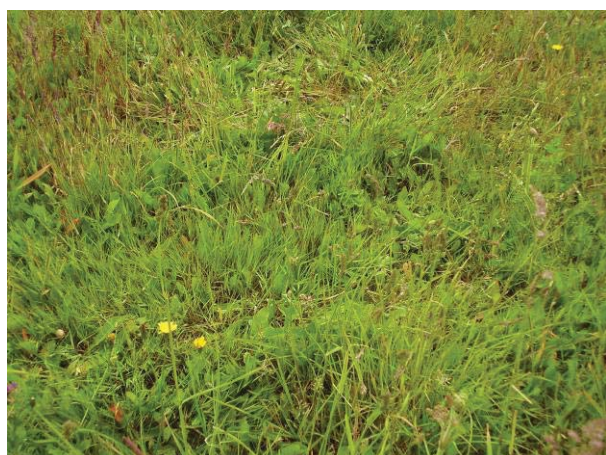


Photo 59



Photo 60



Photo 61



Photo 62



Photo 63



Photo 64



Photo 65



Photo 66



Photo 67



Photo 68



Photo 69



Photo 70



Photo 71



Photo 72



Photo 73

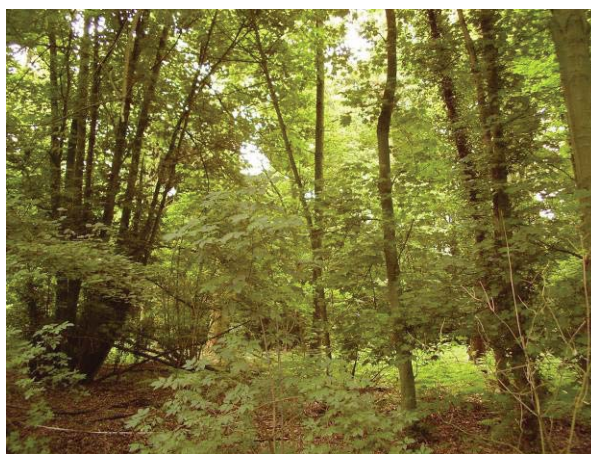


Photo 74



Photo 75



Photo 76



Photo 77



Photo 78



Photo 79



Photo 80



Photo 81



Photo 82



Photo 83



Photo 84



Photo 85



Photo 86



Photo 87



Photo 88



Photo 89

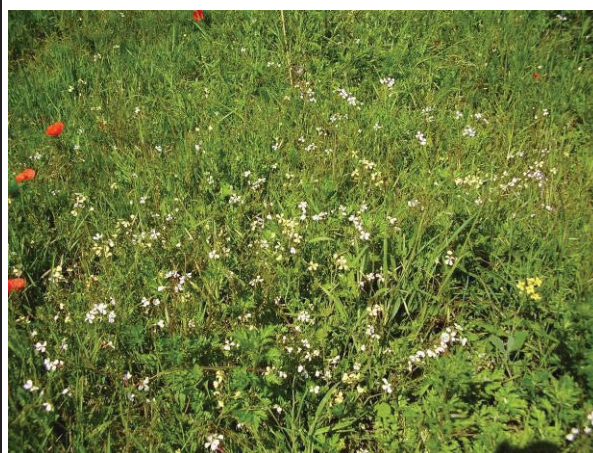


Photo 90



Photo 91



Photo 94



Photo 95



Photo 96

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D. Bat Report

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Technical Appendix for Bats.

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Executive Summary

Extensive bat surveys have been undertaken over a 5 year period (between 2008 and 2013), to assess the potential impacts of the proposed NDR scheme on local bat populations. Survey methodologies used include; hibernation surveys, building and tree assessments, tree climbing inspections, emergence and re-entry surveys of tree and buildings with bat potential, transect surveys, unmanned static monitoring, manned static monitoring and radio tracking surveys.

In total 10 species of bat were identified across the site, including barbastelle, common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle, brown long-eared, noctule, Leisler's, serotine and Myotis species (including Daubenton's and Natterer's). Some species were recorded more often and in higher numbers than others, but overall the number of all species of bats recorded and identified through the various survey methodologies was high. Therefore, the area intersected by the proposed road scheme, as a whole, is considered of importance for local bat populations.

A summary of the survey results are as follows:

- 53 barbastelle roosts;
- 35 Myotis and brown long-eared roosts;
- 23 pipistrelle roosts;
- Two noctule roosts; and,
- Two serotine roosts.

Significant flight routes and foraging grounds were also identified and along the route.

Combined results of all surveys can be found in Appendix L.

A European protected species licence is required prior to any site clearance work on site and will need to cover direct and indirect impacts on identified roosts, flight routes and known foraging grounds.

Appropriate mitigation measures will include the installation of wire bat gantries at identified crossing points, along with two green bridges (on Marriot's Way and Middle Road) and alterations to accommodation bridges to make them more 'bat friendly'. A single bat tunnel will be installed along a known flight path in Rackheath Estate.

A planting scheme will be developed to compliment the bat bridges; encouraging bats to cross the road at the designated crossing points. In addition, an off-site planting scheme will also be developed, to enhance the habitat and improve connectivity and enhance the wider landscape.

Two bat houses will be constructed at Gazebo Farm and Hall Farm, to mitigate the loss of building roosts to be demolished as part of the construction works.

A number of bat boxes will also be installed within woodlands near the route, to mitigate the loss of known tree roosts and trees with high potential features, under the road footprint.

A long term monitoring programme will be put in place to assess the effectiveness of the mitigation.

1. Introduction

This document has been produced to report on the baseline surveys undertaken for bats for the Northern Distributor Road (NDR) scheme in Norwich. Full details of the scheme, including a description of the need for the scheme and alternatives considered, can be found in Volume One of the Environmental Statement.

1.1 Project description

Mott MacDonald Ltd was appointed by Norfolk County Council to undertake detailed bat surveys as part of the Norwich Northern Distributor Route (NDR) Scheme in Norfolk, which runs between Fakenham Road (A1067) to the west of the city (near Attlebridge), and passes eastwards around the north of the city to join with the A47 at Postwick. The route is approximately 22km in length. A map of the route is provided in Figure 1 below.

Figure 1: NDR route.



1.1.1 Previous survey work

Extensive bat surveys have been undertaken over a six year period (between 2008 and 2013), by a team of experienced surveyors comprised of ecologists from Mott MacDonald and various sub-consultancies; 2008 (EcoGraphics, Mott MacDonald and Kepwick Ecological Surveys), 2009 and 2010 (Mott MacDonald and BSG, with Greena Ecological Consultancy, Geckoella and Corylus Ecology) and 2012 (Mott MacDonald and Greena Ecological Consultancy) in order to assess the potential impacts of the proposed NDR scheme on local bat populations.

As baseline data suggested the potential presence of barbastelles (*Barbastella barbastellus*) within close proximity to the scheme, in 2008 ECOGraphics and Mott MacDonald utilised multiple survey methodologies (including transects, remote monitoring (using Anabat detectors), tree assessments and emergence/re-entry surveys) to assess levels of bat activity within habitats of interest to be severed by the scheme. The results of these surveys indicated that the study area supports at least 10 species of bat, including four United Kingdom Biodiversity Action Plan (UK BAP) species: noctule (*Nyctalus noctula*), common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), serotine (*Eptesicus serotinus*), brown long-eared (*Plecotus auritus*), barbastelle, Daubenton's (*Myotis daubentonii*), Natterer's (*Myotis nattereri*), Brandt's (*Myotis brandtii*) and whiskered (*Myotis mystacinus*) (Mott MacDonald, 2008). Significant

movements of barbastelle bats were also noted along specific hedgerows due to be severed by the scheme (Mott MacDonald, 2008).

The level of activity recorded, along with route changes and delays to the scheme, resulted in more detailed surveys being carried out in 2009 and 2010, by Mott MacDonald in collaboration with ECOGraphics, Baker Shepherd Gillespie (BSG) and Greena Ecological Consultancy, in order to provide a robust and defensible baseline for the scheme in relation to bats. The scope of the survey work was expanded to include more in depth consideration of all bat species. However, the focus of the survey work remained with barbastelles as, whilst they are generally considered a widespread species in the UK, they are rare in Europe (Altringham, 2003).

During 2012 Mott MacDonald was tasked with updating previous surveys, due to additional alterations to the scheme and further delays to the programme for the scheme. The following report encompasses results of surveys undertaken up until August 2013.

1.2 Scope of works

The aim of the survey work to date has been:

- To determine the presence/absence of breeding barbastelle bats and describe the habitats and roosts used by this species;
- To identify areas used for foraging and flight paths of barbastelle bats and seasonal variations in activity; and,
- To locate roosts, key foraging sites and flight corridors used by other species of bat.

The aim of the report is to provide an up to date assessment of the distribution and abundance of various bat species along the proposed road scheme, to estimate the likelihood of any potential impacts on specific species and populations and prepare an indicative mitigation plan.

The objectives of this report are as follows:

- To collate all survey data and reports for the scheme, to date;
- To assess the potential impacts of the road scheme on local bat populations overall;
- To present an outline plan for mitigation and enhancements; and,
- To provide recommendations for future survey and/or monitoring.

1.3 Zone of influence and survey site

A zone of influence (Zoi) is defined by the Institute of Ecology and Environmental Management (IEEM) as the areas/resources that may be affected by the biophysical changes caused by activities associated with a project. Biophysical changes are physical changes to a place that alter the biology of the site (for example, by removing roosts and/or severing bat flight routes through the removal of trees, building and hedgerows).

The zone of influence for bats on a major infra-structure project, such as this, is 500 m either side of the proposed linear route (BCT, 2012). However, the survey requirements within this area will vary depending on quality of the habitat, species of bat likely to use the habitats available and the likely impact of the scheme on the habitats and species present in the area.

The ranges for the various survey methodologies for bats, used on this project, are as follows:

- 2 km for hibernation and church surveys;

- 2+ km for radio tracking surveys;
- 100 m building and tree assessments;
- 50 m building and tree surveys; and,
- Within 25 m for static monitoring surveys of hedgerows.

1.4 Legislative and policy framework

The construction and operational activities for the proposed works must comply with the International, European and UK nature conservation legislation and with national and local biodiversity policies. The main pieces of UK legislation on nature conservation are the Wildlife and Countryside Act (WCA), 1981 (as amended), the Conservation of Habitats and Species Regulations, 2010 and the Natural Environment and Rural Communities (NERC) Act, 2006. The biodiversity policies which are most relevant are NPPF (DCLG, 2012), the UK Biodiversity Action Plan (BAP) and the Norfolk Biodiversity Action Plan (LBAP).

All bat species are protected through UK Legislation, being listed on Schedule 5 of the WCA 1981 (as amended). Specific species, including barbastelle, Bechstein's (*Myotis bechsteinii*), lesser horseshoe (*Rhinolophus hipposideros*) and greater horseshoe (*Rhinolophus ferrumequinum*) are offered additional protection through European Legislation, being included on Annex II of the EC Habitats Directive, the Bern Convention and the Conservation (Habitats etc.) Regulations 1994.

As a result of the UK and European Legislation listed above, it is an offence to:

- Intentionally or recklessly disturb a bat while it is occupying a structure, place of shelter or protection, including in particular any disturbance which is likely:
 - To impair bats' ability to survive, breed or reproduce, or to rear or nurture their young; or,
 - To impair their ability to hibernate or migrate; or,
 - To significantly affect the local distribution or abundance of the species to which they belong.
- Intentionally or recklessly obstruct access to a structure or place used by a bat for protection or shelter (Damage or destroy a breeding site or resting place of a bat);
- Deliberately capture, injure or kill a bat; and,
- Possess, control, transport, exchange or sell a bat or parts of a bat, alive or dead.

Four bat species (barbastelle, soprano pipistrelle, noctule and brown long-eared) are listed in the Norfolk Biodiversity Action Plans (LBAP) and seven species of bat (soprano pipistrelle, lesser horseshoe, greater horseshoe, barbastelle, Bechstein's, noctule and brown long-eared) are listed on the UK BAP and Section 41 of the NERC Act (2006). Under the Natural Environment and Rural Communities (NERC) Act 2006, all public bodies are required to have regard to biodiversity conservation when carrying out their function. The species noted in the UK Biodiversity Action Plan (BAP) have been recognised as being threatened, rare or having an important population within the UK, and the government has committed to targets for maintaining

populations and aiding their recovery through increasing the numbers of breeding populations. Local BAP are similar but focus on those species which are important to a particular region of the country.

2. Methodology

2.1 Desk Study

An initial desk study included a search using aerial photography and historical/archaeological records to identify buildings and other structures which may be suitable for use by bats.

Bat records were requested from local bat groups. However, the Norwich Bat Group is relatively recent and has limited records available for the scheme area in question. No records were provided by the Norfolk Bat Group.

Due to the limited bat records available, for the proposed route and surrounding habitat, previous survey results and reports for the NDR scheme were reviewed prior to commencement of the survey work each season. In addition, a wide ranging review of books and research papers was undertaken. Some unpublished data has also been provided by the project's expert witness, for bats, Geoff Billington (of Greena Ecological Consultancy). The literature review focused specifically on studies looking at the effects of roads on bats and the efficacy of bat mitigation/compensation measures implemented for road schemes, in order to provide support for the recommendations given in this report.

The data set collected during the 2008 season, will be used as the baseline data, which all subsequent surveys were to build upon (Mott MacDonald, 2008 and ECOGraphics, 2008).

The selected methodology for the bat surveys, carried out from 2009 onwards, were discussed and agreed with the project expert witness, Geoff Billington, and the local Natural England officer.

2.2 Equipment

General equipment used for data collection varied with survey type and methodology utilised.

- Long term monitoring of hedgerows and buildings – Anabats were used, with 1.5 m microphone extension cables. Each unit was housed in a secure case, with a separate specialised housing unit for the microphones.
- Transect surveys
 - Anabat detector – used as a handheld detector;
 - Pettersson D240x and Batbox Duet combination detector connected to an Edirol R-09HR recorder; and,
 - GPS.
- Emergence/re-entry surveys (buildings and dense ivy trees)
 - Frequency division detector (Ciel or Batbox Duet) connected to Edirol R-09HR or Zoom recorder;
 - Pettersson D240x time expansion detector connected to Edirol R-09HR recorder;

- Night vision equipment; and,
 - Sony Night shot video camera and external infra-red light boost.
- Hibernation surveys and building inspections (internal and external):
 - Ladders;
 - Torches:
 - low power or red light for hibernation surveys;
 - High power for general building inspections;
- Climbing inspections – full set of specialised LOLER checked kit for each qualified climber.

Detailed descriptions of specific equipment are provided in Appendix A. Details of specific equipment set up for surveys are provided below.

2.2.1 Anabat detector

Anabat detectors were used as hand held detectors on transect surveys, alongside the time expansion and frequency division units. Anabats were also used in pairs for long-term monitoring of flight paths and single units were used to monitoring built structures for use as roosting sites.

Prior to use, all Anabats were calibrated to ensure that the sensitivity of the units to bat calls was equal (following a methodology similar to that given in Larson and Hayes, 2000). As a general standard the Anabats were only re-calibrated twice through the season, unless a unit was found to be malfunctioning or required an additional re-calibration.

2.2.2 Pettersson and Duet linked detector

Both types of detector (Pettersson D24x time expansion and BatBox Duet, frequency division) were used, independently, during emergence and re-entry surveys of buildings and trees on site.

The system used for the transect surveys on this scheme varied from that used for standard dusk/dawn surveys, by essentially turning them into one detector which could be used by a single surveyor. A specially designed connector cable linked the Duet and Pettersson D240x together allowing the surveyor to listen to the frequency division from the Duet constantly in their left ear, and to manually trigger and listen to the time expansion of the Pettersson in their right ear. The recorder was set to constantly record so that it captured all data from the Duet (frequency division) to the left channel, while the Pettersson (time expansion) data, when manually triggered, was recorded to the right channel. The advantage of this system is that it allows constant frequency division recording and listening, at the same time as allowing time expansion recordings, of key bat species identified by ear, for later analysis.

2.3 Church and Hibernation surveys

Hibernation surveys were carried out on all structures considered suitable, within a 2 km radius of the scheme footprint (identified during the desk study and through various site walkovers). These surveys were

originally conducted between January and March 2009 and updated during February/March 2012. Structures of interest included:

- Churches;
- Ice houses;
- Old military buildings; and,
- Large outbuildings and barns (where accessible).

The survey methodology comprised a slow methodical search of crevices and holes in all accessible areas within each structure (within buildings this also included searching behind stored material, equipment, paintings/tapestries etc). Areas not surveyed were considered unsafe for surveyors to access.

Each structure was initially inspected with a handheld spotlight (0.25M candle power), for evidence of bats, including droppings, urine staining and feeding remains. Holes and crevices were searched for bats or evidence of use by bats (droppings, wear and grease marks, feeding remains, fur and any distinctive odour), using a micro halogen pencil torch and a Seesnake video endoscope.

Data recorded during each survey included:

- Location, type and amount of evidence identified,
 - droppings identified to species and aged, if possible;
- Location, species and number of bats found;
- The depths of crevices or holes of note; and,
- Any areas not accessed or fully inspected during the survey.

All surveys were carried out by Mott MacDonald Ecologists, led by Sarah-Jayne Collins (Natural England licence no. 20123428).

The location of all churches and structures surveyed is shown in Appendix B.

2.4 Building surveys

An initial assessment of buildings within 100 metres of the scheme boundary was carried out in June 2009, during a general walkover of the route undertaken by Sarah-Jayne Collins (Mott MacDonald) and Geoff Billington (Greena Ecological Consultancy). General assessments were made based on features of interest and building suitability as per BCT guidance (BCT, 2007). A basic list for assessing highest and lowest potential for bats is listed in Table 1 below.

Table 1: Features of buildings suitable for use by bats (BCT,2007, 2012).

Potential for bats	Feature of building/structure and location
Highest	Pre-20th century or early 20th century construction Agricultural buildings of traditional brick, stone or timber construction

Potential for bats	Feature of building/structure and location
	<p>Large and complicated roof void with unobstructed flying spaces</p> <p>Large (>20 cm) roof timbers with mortice joints, cracks and holes</p> <p>Entrances for bats to fly through</p> <p>Poorly maintained fabric providing access into roof voids, walls</p> <p>Damaged brick work and cavity wall spaces</p> <p>South facing roof, warmed by sun</p> <p>Weatherboarding and/or hanging tiles with gaps</p> <p>Low disturbance by humans</p> <p>Low levels of external lighting</p> <p>Bridge structures, follies, aqueducts and viaducts over water or wet ground.</p> <p>Buildings with potential features, within core distribution areas of rare bat species</p> <p>Buildings with potential within close proximity to each other (providing a variety of roosting opportunities throughout the year)</p> <p>Buildings and structures close to good foraging habitat (mature parkland, woodland and wetland in a rural setting).</p>
Lowest	<p>Modern, well maintained buildings or structures that provide few opportunities for access by bats.</p> <p>Small, cluttered roof spaces.</p> <p>Buildings and structures comprised primarily of prefabricated steel and sheet materials.</p> <p>Cool, shaded, light or draughty roof voids.</p> <p>Roof voids with a dense cover of cobwebs and no sections of clean ridge board.</p> <p>High disturbance by humans</p> <p>High levels of external lighting</p> <p>Highly urbanised location with few or no mature trees, parkland, woodland or wetland/water bodies</p>

All buildings considered as having potential for bats was subject to a more detailed external assessment/inspection prior to emergence surveys being carried out. This information was fed into the design of subsequent emergence/re-entry surveys of each structure, to ensure that potential or known access points are covered and that methodologies are adapted to increase the efficiency of each survey and usefulness of data gathered.

Internal inspections of buildings were also carried out of buildings with potential, where possible. All rooms (accessible areas/voids), crevices and holes within the building were inspected thoroughly, for evidence of use by bats, using a torch and ladders where needed. Evidence of use by bats includes:

- Bat droppings;
- Urine staining (especially noted on varnished wood, glass and brass);
- Feeding remains (for example, butterfly wings);
- Live bats;
- Dead bats; and,
- Chattering/squeaking of resident bats.

Particular attention was paid to the floor and furniture surfaces, behind wall hangings (curtains, paintings etc.), behind wooden paneling and gaps in lintels above doors and windows.

Only a small percentage of buildings within the survey area were subject to internal inspections, due to restricted access (the majority of buildings along the route are private residence). Some structures which were considered to have potential for bats all year round, were inspected during the winter as part of the hibernation surveys. Buildings in which internal inspection was possible include:

- Quaker Farm Ancient Barn;
- Hall Farm;
- Gazebo Farm bungalow and out buildings; and,
- Military buildings on the boundary between Gazebo Farm and Rackheath Estate.

The location of buildings within 100 m, assessed for potential, and results of the surveys are provided in Appendix C.

2.4.1 Emergence and re-entry surveys

All buildings, within 50 m of the proposed scheme boundary, assessed as having potential for use by bats were subject to two dusk or dawn surveys, between 2009 and 2013.

During 2010 all buildings with potential up to 25 m from the scheme boundary were subject to at least 2 visits. However, changes to the scheme and delays to the programme resulted in these surveys being updated during the 2012 season. In addition, all buildings with potential between 25 and 50 m from the scheme boundary were also surveyed in 2012.

A single building at Quaker Farm (B55) was subject to three survey visits during the summer of 2013. This building is considered of particular importance due to its construction (being an ancient barn of similar construction to Paston Great Barn) and proximity to the scheme footprint.

All surveys were carried out in suitable weather conditions. Where possible, each building was surveyed once at dusk and once at dawn, however occasional buildings may have had two of one type of survey. Details of surveys are provided in Table 2, Table 3 and Table 4.

2.4.1.1 Dusk emergence survey methodology

Each survey commenced approximately 15 minutes prior to sunset and continued for up to 1.5 hours after sunset.

The number of surveyors required varied (between two and eight) depending on the size of the building. Each team was led by an experienced bat ecologist, with the rest of the team made up of trained ecologists of varying experience levels. Each surveyor was strategically placed to allow a high percentage cover of the building or specific features of interest; positions for individual surveyors were pre-determined following the previous assessment and inspection of each structure. All surveyors were made aware of features of specific interest, as having the greatest potential for roosting bats, along with any findings from the previous emergence/re-entry surveys, prior to surveys commencing.

Information recorded during surveys included emerging bats, specific access points identified, general bat activity (e.g. bats commuting, foraging etc.), timing of bat events, and the species involved.

2.4.1.2 Dawn re-entry survey methodology

Each dawn survey commenced 1.5 – 2 hours, prior to sunrise and continued until 5 – 10 minutes after sunrise.

The number of surveyors required varied (between two and eight) depending on the size of the building. Each team was led by an experienced bat ecologist, with the rest of the team made up of trained ecologists of varying experience levels. Each surveyor was strategically placed to allow a high percentage cover of the building or specific features of interest; positions for individual surveyors were pre-determined following the previous assessment and inspection of each structure. All surveyors were made aware of those features, identified during the building inspection as having the greatest potential for roosting bats, along with any findings from the previous emergence/re-entry surveys, prior to each survey commencing.

Information recorded during surveys included emerging bats, specific access points identified, general bat activity (e.g. bats commuting, foraging etc.), timing of bat events, and the species involved.

The dates each survey visit was undertaken are provided in Table 2 and Table 3 below.

Table 2: Dates for building survey visits during 2010

Building number	Visit 1	Visit 2
B10	-	22/07/2010
B24	21/05/2010	28/05/2010
B67	19/05/2010	22/07/2010
B69	02/06/2010	-
B76	20/05/2010	-
B77	25/05/2010	-
B78	01/06/2010	-
B81	18/05/2010	-
B82	19/05/2010	11/10/2010
B83	-	17/08/2010
B90	-	07/08/2010
B95	27/05/2010	-
GB2	20/05/2010	-
GB3	26/05/2010	-
GB5	28/05/2010	-

Table 3: Dates of building surveys during 2012

Building number	Visit 1	Visit 2
7 (b)	18/07/12 (dawn)	08/08/12 (dusk)
10	31/05/12 (dusk)	31/07/12 (dusk)
20	20/06/12 (dusk)	22/08/12 (dusk)
24	18/06/12 (dusk)	No access
58	21/06/12 (dusk)	08/08/12 (dawn)
67	25/05/12 (dawn)	09/07/12 (dusk)
68	26/07/12 (dawn)	06/09/12 (dusk)

Building number	Visit 1	Visit 2
69	19/07/2012 (dawn)	17/08/12 (dawn)
77	23/05/12 (dusk)	10/07/12 (dawn)
80	24/05/12 (dusk)	02/08/12 (dawn)
81	26/06/12 (dusk)	No Access
82	26/06/12 (dusk)	10/08/12 (dawn)
83	27/06/12 (dusk)	21/08/12 (dusk)
84	13/06/12 (dusk)	08/08/12 (dawn)
85	21/06/12 (dawn)	01/08/12 (dusk)
90	03/07/12 (dusk)	09/08/12 (dawn)
91	03/07/12 (dusk)	05/09/12 (dusk)
Building Y	14/06/12 (dusk)	01/08/12 (dawn)
Building Z	20/06/12 (dawn)	16/08/12 (dusk)
GB3	12/06/12 (dawn)	11/07/12 (dusk)
GB4	24/05/12 (dawn)	12/07/12 (dawn)
GB5	29/05/2012 (dusk)	27/07/12 (dawn)
GB8	01/06/12 (dawn)	17/07/12 (dawn)
R1	19/07/2012 (dusk)	07/08/12 (dusk)

Table 4: Building surveys 2013.

Building number	Visit 1	Visit 2	Visit 3
B55	30/07/2013	19/08/2013	11/09/2013

2.4.2 Long-term remote monitoring

The Ancient Barn at Quaker Farm (B55) (to the east of the airport) was identified, during the walkover in June 2009, as a building of specific interest. As such, long term monitoring of bat activity within the building was carried out using the Anabat system. A single detector was installed, at height, in a secure case, on a beam at the eastern and western end of the barn (alternated on a month by month basis) and left for at least 7 days a month between April and July 2010 (details listed in Table 5 below).

Table 5: Quaker farm (B55) monitoring dates

Location	Session 1	Session 2	Session 3	Session 4
Beam at eastern end of barn	14th to 21st April 2010		3rd to 9th June 2010	
Against western wall of barn		4th to 10th May 2010		12th to 22nd July 2010

2.4.2.1 Analysis

Sound analysis of the 2010 and 2012 remote/static monitoring data was carried out by Mott MacDonald. Data recorded by during the 2010 emergence and re-entry surveys was analysed by ECOGraphics and Mott MacDonald on completion of the survey work.

Analysis of data recorded during 2012 emergence and re-entry surveys of buildings was carried out by Mott MacDonald Ecologists and audited by Geoff Billington, of Greena Ecological Consultancy.

2.5 Tree and woodland surveys

2.5.1 Initial assessments

All hedgerow and parkland trees within 100 m of the proposed scheme boundary were initially assessed for bat potential during the site walkover carried out in June 2009. Additional trees were assessed in 2010 and 2012, where needed to accommodate for changes to the scheme boundary. Within woodland areas, only trees directly under the scheme footprint were individually assessed for potential.

The preliminary assessments were conducted using high powered torches and binoculars to enable inspection of the tree from ground to canopy. Features of interest include:

- Natural holes, rot holes;
- Woodpecker holes;
- Cracks and splits in major limbs;
- Loose bark;
- Hollow cavities;
- Dense ivy (specifically thick stemmed ivy); and,
- Bird and bat boxes.

Individual trees were categorised in accordance with BCT guidelines (BCT 2007, BCT 2010):

- Confirmed roost;
- Category 1* trees – high potential trees with multiple suitable features capable of supporting larger roosts;
- Category 1 – moderate to high potential – trees with fewer high quality features than category 1* trees or with multiple smaller features suitable for use by single bats;
- Category 2 – Trees with no obvious potential (from ground level), although tree is of an age and size that at height surveys may result in cracks or crevices being found; or the tree has a small number of features suitable of supporting a limited number of bats; and,
- Category 3 – Tree with no potential.

The locations of all individual trees, in relation to the scheme footprint (within 25 m, 50 m or 100 m), are provided in Appendix D.

The locations of woodland blocks are provided in Appendix C.

2.5.2 Dusk emergence and dawn re-entry surveys

All high potential trees, within 25 m of the scheme boundary, which were not considered suitable for at height inspections; for example trees close to or over hanging a major road, trees with high amounts of dead wood (considered unsafe to climb) and trees covered in dense ivy, were subject to two dusk and/or dawn survey visits.

Surveys of entire trees were carried out by at least 2 experienced ecologists. Where possible, trees were grouped tighter for surveys. Specialist night vision equipment was used (especially for surveys of woodland trees) to aid observation of features and identification of bat species.

Dusk emergence surveys began at least 15 minutes before sunset and continued for approximately 2 hours after sunset.

Dawn re-entry surveys commenced 1.5 to 2 hours before sunrise, continuing until 5 to 10 minutes after sunrise.

Survey details are provided in Table 6 and Table 7 below.

Table 6: Tree surveys 2012 (dense ivy trees and those unsuitable for climbing)

Tree/Group number	Visit 1	Visit 2
T1	28/05/12 (dusk)	10/07/12 (dusk)
T21	21/06/12 (dusk)	09/08/12 (dawn)
T157	18/06/12 (dusk)	25/07/12 (dawn)
T211	20/06/12 (dawn)	24/07/12 (dusk)
T252	29/06/12 (dawn)	03/08/12 (dawn)
T280	Tree removed	
T380	28/08/12 (dusk)	04/09/12 (dusk)
T451	29/08/12 (dawn)	11/09/12 (dusk)
T475B	31/08/12 (dusk)	07/09/12 (dusk)
T118-126	16/05/12 (dusk)	12/07/12 (dawn)
T160-166	17/05/12 (dusk)	05/07/12 (dusk)
T216-226	19/06/12 (dawn)	30/07/12 (dusk)
T351-357	19/06/12 (dawn)	19/07/12 (dusk)
T375-379	11/06/12 (dusk)	16/07/12 (dusk)
T454-462, 465, 466	11/06/12 (dusk)	12/07/12 (dusk)
TW11B	30/08/12 (dusk)	10/09/12 (dusk)
TW11N	04/07/12 (dusk)	31/07/12 (dawn)
R7	05/07/12 (dawn)	14/08/12 (dusk)
R10	05/07/12 (dawn)	14/08/12 (dusk)
R13	16/07/12 (dusk)	15/08/12 (dawn)
R18	15/07/12 (dusk)	15/08/12 (dawn)
R25	28/06/12 (dusk)	07/08/12 (dawn)
R26	14/07/12 (dusk)	-
R27	04/07/12 (dusk)	21/08/12 (dawn)

Tree/Group number	Visit 1	Visit 2
R29	14/07/12 (dusk)	16/08/12 (dawn)
R31	15/08/12 (dusk)	21/08/12 (dusk)
R34	18/07/12 (dusk)	27/08/12 (dusk)
R37	07/08/12 (dawn)	23/08/12 (dusk)
R38	06/08/12 (dusk)	22/08/12 (dawn)
R39	07/08/12 (dusk)	23/08/12 (dusk)
R40	06/08/12 (dusk)	22/08/12 (dawn)
R41	18/07/12 (dusk)	20/08/12 (dusk)
R42	16/07/12 (dusk)	03/09/12 (dusk)
R43	17/07/12 (dawn)	16/08/12 (dawn)
R46	17/07/12 (dusk)	03/09/12 (dusk)

Table 7: Tree surveys 2013

Tree/Group number	Visit 1	Visit 2
252	19/06/2013 (Dusk)	07/08/2013 (Dawn)
253	09/07/2013 (Dawn)	01/08/2013 (Dusk)
263	09/07/2013 (Dusk)	07/08/2013 (Dusk)
271	11/07/2013 (Dusk)	09/08/2013 (Dawn)
282	10/07/2013 (Dawn)	29/07/2013 (dusk)
285	05/06/2013 (Dusk)	29/07/2013 (dusk)
286	20/06/2013 (Dawn)	29/07/2013 (dusk)
289	10/07/2013 (Dusk)	15/08/2013 (Dawn)
291	10/07/2013 (Dusk)	30/08/2013 (Dawn)
323	19/06/2013 (Dawn)	30/07/2013 (Dusk)
380	17/06/2013 (Dusk)	01/08/2013 (Dawn)
416	18/06/2013 (Dawn)	31/07/2013 (Dusk)
451	18/06/2013 (Dusk)	23/07/2013 (Dawn)
459	21/06/2013 (Dawn)	25/07/2013 (Dawn)
457b	22/07/2013 (Dusk)	12/08/2013 (Dawn)
468	24/04/2013 (Dusk)	26/07/2013 (Dawn)
490	20/06/2013 (Dusk)	02/08/2013 (Dawn)
511	04/06/2013 (Dusk)	24/07/2013 (Dawn)
613	08/07/2013 (Dusk)	13/08/2013(Dawn)
615	03/07/2013 (Dusk)	08/08/2013 (Dawn)
616	04/07/2013 (Dawn)	06/08/2013 (Dusk)
W11B	06/06/2013 (Dusk)	20/08/2013(Dawn)
W11F	06/06/2013 (Dusk)	20/08/2013(Dawn)
W11N	06/06/2013 (Dusk)	20/08/2013(Dawn)
P30 - 35	11/07/2013 (Dawn)	14/08/2013(Dusk)
P39	10/06/2013 (Dusk)	31/07/2013 (Dawn)
P40	10/06/2013 (Dusk)	25/07/2013 (Dusk)

Tree/Group number	Visit 1	Visit 2
P41	12/06/2013 (Dawn)	23/07/2013 (Dusk)
P42	11/06/2013 (Dusk)	30/07/2013 (Dawn)
P43	11/06/2013 (Dusk)	30/07/2013 (Dawn)
P44	11/06/2013 (Dusk)	30/07/2013 (Dawn)
P65	12/06/2013 (Dawn)	24/07/2013 (Dusk)
P66	18/07/2013 (Dusk)	14/08/2013(Dawn)
P67	19/07/2013 (Dawn)	13/08/2013(Dusk)
P119	15/07/2013 (Dusk)	21/08/2013(Dawn)
P120	12/07/2013 (Dawn)	08/08/2013 (Dusk)
P123	16/07/2013 (Dawn)	20/08/2013(Dusk)
P124	17/07/2013 (Dusk)	28/08/2013(Dawn)
P125	18/07/2013 (Dawn)	27/08/2013(Dusk)

2.5.3 Woodland activity surveys

All woodlands under the scheme footprint were assessed during the 2009 site walkover. Each woodland area was subject to dusk or dawn survey visits during 2010 and subsequently updated in 2012, by teams of between 2 and 6 experienced ecologists. General activity in and around the woodland was noted, including any movement of individual bats or mass movements out of or in to the areas, at specific times in the surveys.

- Dusk emergence surveys began at least 15 minutes before sunset and continued for approximately 2 hours after sunset; and,
- Dawn re-entry surveys commenced 1.5 to 2 hours before sunrise, continuing until 5 to 10 minutes after sunrise.

Surveys dates and type during 2010 and 2012 are provided in Table 8 and Table 9 below.

Table 8: Woodland Surveys 2010

Woodland number	Visit 1
G17	13/08/2010
W4	23/08/2010
W11	11/08/2010
W12a	12/08/2010
W12b	24/08/2010
W12c	18/08/2010
W22 / 23	19/09/2010
W33	12/08/2010

Table 9: Woodland Surveys 2012

Woodland number	Visit 1		Visit 2	
	Date	Dusk or dawn		Date
W4	28/06/12	dawn	26/07/12	dusk
W12a	23/07/12	dusk	23/08/12	dawn
W12b	25/07/12	dusk	24/08/12	dawn
W12c	24/07/12	dawn	29/08/12	dusk
W22 / 23	19/06/12	dusk	20/07/12	dawn
W33	27/06/12	dawn	09/08/12	dusk

2.5.4 Analysis of emergence and re-entry survey data

Sound analysis of data recorded during 2012 emergence and re-entry surveys of trees and woodlands was carried out by Mott MacDonald Ecologists and audited by Geoff Billington, of Greena Ecological Consultancy.

2.5.5 Tree climbing inspections

During the assessment of trees in June 2009 (and subsequent assessments in 2010 and 2012), those deemed suitable for climbing, within 25 m of the scheme boundary, were subject to more detailed at-height surveys in 2010 (with updates of the survey in 2012), to assess presence/absence and rate individual features for potential.

Specific features (noted in Section 2.5.1) were inspected using a video endoscope, for signs of use by bats. Signs include:

- Staining and/or scratches around entrance;
- Smoothing of bark around cavity entrance;
- Bat droppings inside feature or on bark surrounding the entrance;
- Flies around entrance point;
- Distinctive smell of bats;
- Audible squeaking/chattering; and,
- Bats (live or dead) within the feature.

2.5.5.1 General methodology

All at-height inspections were conducted by a minimum of two ecologists, fully trained in tree climbing and aerial rescue techniques. All equipment used was checked on a daily basis by each individual climber. Weekly checks were also conducted, in compliance with the LOLER Regs. 1998. All climbing equipment used was also subject to official LOLER inspections every six months, after which any damaged items were disposed of and replaced immediately.

Prior to climbing activities commencing, each tree was subject to an individual risk assessment, on a day by day basis, to ensure it was in good health and suitable for climbing. Features and conditions checked included:

- Ground conditions;
- Health of the root system; and,
- General condition of the tree trunk, branches and canopy.

Any trees immediately adjacent to a busy road were not climbed unless road closure or traffic control measures could be put in place. In areas where climbers were working over a public footpath the 'drop zone' was cordoned off using cones and tape. During all work one climber remained on the ground to act as 'grounds person' and 'safety person' for other climbers. This team member was also responsible for warning members of the public of overhead work in progress and ensured they kept clear of the exclusion area.

A Tree Climbing Site Risk Assessment and Emergency Plan, was filled in by climbers for each site prior to climbing. This plan included general information such as site location, details of the nearest hospital, ambulance/air ambulance access, emergency contact details etc.

All climbers wore full PPE relating to their activity; including harness, helmet, gloves and boots. In order to reduce the risk of suspension trauma, all climbers minimised the length of time spent hanging/sitting in the harness during a climb, by using the available branches to stand on, where possible. Branches were also used as working platforms for endoscope work, where possible, to reduce the time spent suspended in the harness.

A throw-line was used to obtain a safe anchor point in the tree canopy. This was then used to pull the main climbing line up, on which climbing commenced. If necessary, once in the canopy, the climber was able to move the main line higher up the tree to another secure anchor point, to allow free movement throughout the canopy.

Once a working anchor was achieved, all areas of the tree canopy were assessed for potential features, including cracks, crevices, splits, snag ends, woodpecker holes etc. Such features, where accessible, were closely inspected with an endoscope to identify signs of bat use and assess potential for use as a roost. Evidence of use by bats included:

- Staining;
- Fur rubbing;
- Droppings; and,
- Dead or live bats.

2.6 Transect surveys

The design of the approach to the transect activity surveys was to ensure that they would meet with survey standards (BCT, 2007 and 2012) and to ensure that the survey would provide a spatially and temporally

robust data set, allowing comparative analysis of relative levels of bat activity across the scheme and the surrounding area. The systematic way this information has been collected also allows it to be used as a baseline for comparative studies of the effects of the NDR, both during and post-construction, on local bat populations, along with the success of the scheme's proposed mitigation measures.

The Bat Survey Guidelines (original and updated BCT 2007 and 2012) provide guidance on the level of survey effort that should be employed for activity surveys. For those species listed on Annex II of the Habitats Directive (including barbastelle bats) the guidelines recommend that up to two survey visits per month during the active season are required for each area, particularly where a proposed development covers a wide area (larger than 1ha) and is within 4km of a known roost.

Nine transect routes were selected; each approximately 3.5 to 4.5 miles long and designed to cover a variety of habitat types, supporting roosting, foraging and commuting bats, within close proximity to the road (including urban areas, farmland, hedgerows, woodlands and water bodies). Routes 1 to 7 were surveyed during the 2009 and 2010 monitoring. Route 8 was added in 2012 and Route 9 was added in 2013.

The transect route areas were also used to identify survey areas across the scheme and used to divide the route into more manageable sections, as follows:

1. Attlebridge;
2. Drayton Drewray;
3. Horsford;
4. Spixworth;
5. Beeston St Andrew;
6. Rackheath;
7. Plumstead;
8. Great Plumstead to Broadland Gate; and,
9. Postwick Junction.

Transect 1 to 6 were surveyed once a month April to September inclusive, during 2009. Transect 7 was surveyed from July to September 2009 and April to June 2010. Transect 8 was added in 2012, with surveys between April and September, to cover a possible gap in data between the end of area 7 and the start of the proposed Broadland Gate development. An additional transect survey route (Transect 9) has been added for the 2013 season, due to changes to the scheme design and footprint.

Each transect commenced with an observation period, starting 15 minutes before sunset and continuing for approximately 40 to 60 minutes after sunset, to allow observations of any emergence activity in the area. The focus of the 'emergence' period was alternated between suitable trees/buildings/areas of the transect route on each survey. Following the emergence period the transect survey commenced and continued for approximately 3 hours. A number of 3 minute stopping points (10-15 for each transect route) were used

during the transect, at strategic points (hedgerow crossings, ditches, buildings, roads etc.) along the route, to allow monitoring of activity at these locations.

Two ecologists carried out each individual transect survey. One surveyor used the Duet/Pettersson combination set up (in section 2.2.2) and the second team member used an Anabat detector, in the hand, and mapped the route on GPS. Notes were made during the survey on the bat species heard and seen, including time, location and, where possible, direction of flight.

Dates of the 2013 transect surveys carried out, to date, are provided in Table 10 below.

Table 10: Transect survey dates 2013

Area	April	May	June	July	August
1	-	30/05/2013	27/06/2013	01/07/2013	23/07/2013
2	24/04/2013	29/05/2013	26/06/2013	18/07/2013	21/08/2013
3	-	21/05/2013	25/06/2013	22/07/2013	28/08/2013
4	23/04/2013	20/05/2013	19/06/2013	15/07/2013	13/08/2013
5	-	-	18/06/2013	11/07/2013	27/08/2013
6	-		03/06/2013	08/07/2013	08/08/2013
7	-	28/05/2013	20/06/2013	16/07/2013	20/08/2013
8	22/04/2013	-	17/06/2013	04/07/2013	12/08/2013
9	-	04/06/2013	03/07/2013	17/07/2013	29/08/2013

Transect survey routes are provided in Appendix G.

2.7 Static monitoring

A combination of manned and un-manned static monitoring surveys was used to survey specific linear features, which would be severed by the proposed scheme. The locations for these surveys are provided in Appendix H.

Survey locations are numbered by the Survey Area.

2.7.1 Unmanned monitoring

In each of the eight key areas noted in the previous section, Anabat detectors were used to assess general bat activity, over pro-longed periods each month. Paired fixed points were identified along key potential bat commuting routes, crossed by the NDR, in each area. These potential commuting routes were identified from the baseline data (gathered in 2008) and on-site assessment of potential commuting features.

The linear features monitored (un-manned) included the following locations:

- Location 1: Access lane to the Shooting School at Deighton Hills;
- Location 2: Marriot's Way;
- Location 3: Treeline near Horsford;

- Location 4: Treeline at Beeston Park Estate;
- Location 5: Hedgerow between The Springs and Beeston Park;
- Location 6: Track at Rackheath Estate;
- Location 7: Treeline south of Norwich Road;
- Location 7a: Double tree line off Toad Lane;
- Location 7b: Low Road; and,
- Location 8: Smee Lane.

20 fixed points on 10 linear features were monitored using Anabats, during the 2009, 2010, 2012 and 2013 seasons. Not all fixed points were surveyed throughout each season, survey details are listed on Table 11, Table 12 and Table 13, respectively. The Anabats were programmed to begin recording from at least 30 minutes before sunset until 30 minutes after sunrise on each evening of the survey period, taking into account the change in sunrise and sunset time over the monitoring period. Survey hours varied throughout the survey season according to daylight hours.

Anabats were secured in water-proof housings with the microphone set at approximately the same height (on a 2m cable) at each fixed point monitoring location. Microphones were also housed in waterproof casings.

Table 11: Survey dates for hedgerow monitoring 2009

Survey Area	April	May	June	July	August	September
1	16th-29th April 2009	15th – 28th May 2009	4th - 17th June 2009	8th- 21st July 2009	12th- 23rd August 2009	9th- 22nd September 2009
2	16th-29th April 2009	15th – 28th May 2009	4th - 17th June 2009	8th- 21st July 2009	12th- 23rd August 2009	9th- 22nd September 2009
3	16th-29th April 2009	15th – 28th May 2009	4th - 17th June 2009	8th- 21st July 2009	12th- 23rd August 2009	9th- 22nd September 2009
4	16th-29th April 2009	15th – 28th May 2009	4th - 17th June 2009	8th- 21st July 2009	12th- 23rd August 2009	9th- 22nd September 2009
5	16th-29th April 2009	15th – 28th May 2009	4th - 17th June 2009	8th- 21st July 2009	12th- 23rd August 2009	9th -22nd September 2009
6	16th-29th April 2009	15th – 28th May 2009	4th - 17th June 2009	8th- 21st July 2009	12th- 23rd August 2009	9th -22nd September 2009
7	-	-	-	8th- 21st July 2009	12th- 23rd August 2009	9th -22nd September 2009
7a	-	-	-	-	-	8th – 16th September 2009
7b	-	-	-	-	-	16th – 27th

Survey Area	April	May	June	July	August	September
						September 2009
8	-	-	-	-	-	-

Table 12: Survey dates for hedgerow monitoring 2010

Survey Area	April	May	June	July	August	September
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	22nd April – 2nd May 2010	17th May – 4th June 2010	10th -25th June 2010	-	-	-
7a	22nd April – 2nd May 2010	17th May – 4th June 2010	10th -25th June 2010	-	-	-
7b	22nd April – 2nd May 2010	17th May – 4th June 2010	10th -25th June 2010	-	-	-
8	-	-	-	-	-	-

Table 13: Survey dates for hedgerow monitoring 2012

Survey Area	April	May	June	July	August	September
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
7a	-	-	-	-	-	-
7b	-	-	-	-	-	-
8	- 30th April – 1st June 2012	19th – 30th June 2012	26th July – 5th August 2012	6th – 17th August 2012	-	-

Surveys of the linear features listed above, with notable bat activity, are currently being repeated and updated during the 2013 season (excluding the unmanned locations 4, 5, 7 and 7b). Additional linear features have also been included in the 2013 monitoring programme, following the results of other survey carried out to date and additions/changes to the scheme design. These include the following:

- Location 4a: Quaker Lane;
- Location 6a: Woodland edge between Rackheath Estate and The Springs;
- Location 7c: Middle Road;
- Location 8a: Track between Low Road and Smee Lane;

- Location 9: hedgerow south of Smee Lane; and,
- Location 9a: hedgerow east of Broadland Way.

Dates of the 2013 monitoring carried out, up to submission of this report, are provided in Table 14.

Table 14: 2013 unmanned static surveys

Survey Area	April/May	June	July	August
1	16 th April – 7 th May	9 th – 21 st June	18 th – 28 th July	20 th August-2 nd September
2	16 th April – 7 th May	9 th – 21 st June	18 th – 28 th July	20 th August-2 nd September
3	7 th – 20 th May	21 st June – 3 rd July	28 th July – 7 th August	9 th August-19 th August
4a	7 th – 20 th May	21 st June – 3 rd July	28 th July – 7 th August	9 th August-19 th August
6	7 th – 20 th May	21 st June – 4 th July	28 th July – 7 th August	20 th August-2 nd September
6a	20 th – 30 th May	30 th May – 9 th June	4 th – 16 th July	2 nd September-12 th September
7a	20 th – 30 th May	30 th May – 9 th June	3 rd – 16 th July	20 th August-2 nd September
7c	16 th April – 7 th May	8 th – 21 st June	18 th – 28 th July	20 th August-2 nd September
8	16 th April – 7 th May	8 th – 21 st June	18 th – 28 th July	20 th August-2 nd September
8a	20 th – 30 th May	30 th May – 8 th June	3 rd – 16 th July	20 th August-1 st September
9	7 th – 20 th May	21 st June – 4 th July	28 th July – 7 th August	29 th August-1 st September
9a	20 th – 30 th May	30 th May – 8 th June	4 th – 16 th July	20 th August-1 st September

The locations of all of the linear features surveyed in 2009, 2010, 2012 and 2013 are displayed in Appendix H.

2.7.2 Manned static monitoring

During 2009 three static manned surveys were carried out in three of the original seven Survey Areas (Areas, 1, 3 and 6), involving paired surveyors at fixed points recording and observing bat activity from at least 15 minutes before sunset until 2-3 hours after sunset. One survey was carried out in each area concurrently in May, July and September. An additional survey point was added in Area 4 from July 2009 onwards, following results observed during the June 2009 radio-tracking session. Survey dates and environmental conditions are provided in Table 15 below.

Table 15: Dates of 2009 manned static monitoring surveys

Area	May		July		September	
	Date	Start/Finish temp	Date	Start/Finish temp	Date	Start/Finish temp
1	14/05/09	17/11.5°C	08/07/09	16.7/13.4°C	09/09/09	18.2/11.8°C
3	14/05/09	13/11°C	08/07/09	16.5/13.1°C	09/09/09	17.5/11.5°C
4	N/A	N/A	08/07/09	12.5/12.2°C	09/09/09	16.8/11.6°C

Area	May		July		September	
6	14/05/09	15/11°C	08/07/09	12/12°C	09/09/09	13/9°C

Surveyors used Duet/Pettersson combination detector (section 2.2.2) and an Anabat detector to listen to and record calls during the survey. Notes were made on the time of observations, species heard and, where possible, direction of flight/note of activity (e.g. feeding/commuting).

Manned static surveys of the four features listed in Table 15 are currently being updated, during the 2013 season, using the same methodology as in 2009. Additional features have also been added to the list, for 2013, following previous survey results. This includes:

- Two linear features in Area 5 (Locations 5 and 5a);
- One linear feature in Area 7 (Location 7b); and,
- One linear feature in Area 9.

Due to poor weather conditions at the start of the 2013 season, the manned static surveys did not commence until June. The dates of these surveys are provided in Table 16 below.

Table 16: Dates of 2013 manned static monitoring surveys.

Area	Visit 1	Visit 2	Visit 3
	Date	Date	Date
1	13/06/2013	24/07/2013	28/08/2013
3	25/06/2013	15/08/2013	11/09/2013
4	26/06/2013	21/08/2013	16/09/2013
5	01/07/2013	01/08/2013	24/09/2013
5a	27/06/2013	31/07/2013	09/10/2013
6	04/07/2013	25/07/2013	18/09/2013
7b	16/07/2013	07/08/2013	12/09/2013
9	09/07/2013	06/08/2013	28/08/2013

The locations of all the manned static survey monitoring positions are displayed in Appendix H.

2.8 Analysis

All data collected using Anabats was analysed using Analook W software. Data collected using Time expansion (Pettersson 240x) and Frequency division (Duet and Ciel) detectors was analysed using BatSound and BatScan.

Where possible the bat was identified to species level. For species of long-eared bats (*Plecotus* sp.) records were not identified to species level due to the overlapping call parameters of each species but were assumed to refer to brown long-eared bats *Plecotus auritus*. It is unlikely that grey long-eared bat *Plecotus austriacus* occur in the survey area, given the species' known distribution and rarity (Swift & Entwistle, 2008; Altringham, 2003; Dietz *et al.*, 2009). In addition, species of the genus *Myotis* were generally grouped together due to many of the species having overlapping call parameters making positive species identification difficult (BCT, 2007).

In addition, the following categories were used for calls which could not be identified with confidence due to the overlap in call characteristics between species or species groups:

- *Pipistrellus* sp. - calls which are clearly pipistrelle but which could not be assigned to soprano pipistrelle, common pipistrelle or Nathusius' pipistrelle *Pipistrellus nathusii*;
- *Myotis/Plecotus* sp. – calls which could not clearly be assigned to either *Myotis* sp. or *Plecotus* sp.;
- *Nyctalus* sp. – calls which could not be clearly distinguished between either Leisler's bat *Nyctalus leisleri* or noctule bat *Nyctalus noctula*;
- Big bat – calls which could not be clearly distinguished between either Leisler's, serotine or noctule;
- *Barbastellus/Eptesicus* - calls which could not be clearly distinguished between either serotine bat or barbastelle bat;
- *Eptesicus/Plecotus* – calls which could not be clearly distinguished between either serotine bat or long-eared bat; and,
- Indeterminate – bat calls which do not have enough information in them to be able to be assigned to a species or species group.

2.8.1.1 Interpretation of analysed data

The Analook software enables analysis of the relative activity of different species of bats by counting the minimum number of bats recorded within discreet sound files. Once triggered by ultrasound, the Anabat records sound files with a duration of less than 15 seconds, which may contain a number of individual bat passes, or discreet groups of ultrasound 'pulses'. For the purposes of this analysis, the recording of one or more passes by a single species within a sound file was counted as a single bat pass. More than one pass of the same species was counted within a sound file if multiple bats were recorded calling simultaneously.

During analysis of sound files from the unmanned static monitoring, it was possible to estimate the minimum number of bats recorded on individual sound files but not whether consecutive sound files had recorded, for example, a number of individual bats passing as they commute to a feeding habitat or one bat calling repeatedly as it flies up and down a hedgerow. Although relative abundance cannot be estimated from this analysis, the number of bat passes does reflect the relative importance of a feature/habitat to bats by assigning a level of bat activity that is associated with that feature, regardless of the type of activity. In this analysis, bat passes per hour has been used as a measure of relative activity. Comparing bat passes per hour between months also controls for the different night-lengths seen in different months through the season.

BatSound was used to analyse time-expansion calls recorded during the static-manned and transect surveys in the same way. Each time-expansion call (1.7 seconds real-time, 17 seconds time-expanded) was counted as a single bat pass and more than one pass if multiple bats were recorded calling simultaneously.

Both the BatSound files and Analook files were time-stamped with the time (hour:minute:second) that the call was recorded. For analysis of bat passes recorded during the static manned or transect surveys, the

BatSound file was only counted as an additional bat pass if there was no Analook file with that species recorded at that time, to avoid double-counting of bat passes. The Anabats and recorders were time-synced prior to the start of the surveys.

As the impacts of the proposed road will depend on the bat species affected by it, relative to their foraging ecology, the analysed calls are assigned to one of the following groups:

- Barbastelles – in a separate group due to their conservation status;
- Big bats – noctules, serotines, Leisler's and all indeterminate big bat calls – all these bats are generally fliers;
- *Plecotus* sp./*Myotis* sp. – all *Myotis* sp. and *Plecotus* sp. which tend to fly and forage close to features (generally gleaning species);
- Pipistrelles – all pipistrelle species (edge foraging species); and,
- Indeterminate – bat calls which do not have enough information in them to be able to assign to a species or species group.

2.9 Radio-tracking

Four separate radio-tracking sessions have been undertaken as part of the on-going survey effort to assess the potential impacts of the scheme on local bat populations; with a particular focus on barbastelle populations. These surveys were carried out in:

- June 2009;
- August 2009;
- August 2012; and,
- May 2013.

Trapping locations selected during these surveys are provided in Appendix K.

2.9.1 2009 survey

The 2009 radio-tracking work was a combined effort, led by Corylus Ecology with surveyors from Mott MacDonald, BSG, Geckoella and Greena Ecological Consultancy.

Two radio-tracking sessions were undertaken in and around the proposed NDR footprint in the 2009 season in May/June (June session) and August (August session). Harp-trapping and mist-netting were carried out for both the June and August radio-tracking sessions. Ten trapping nights were undertaken between 29th May 2009 and 7th June 2009 (June Session). Eight full trapping nights were undertaken between 1st August 2009 and 11th August 2009 (August Session). In addition, during the August session, one trapping night was abandoned after one hour due to heavy rain, and two nights were spent catching direct from tree roosts, rather than using harp-traps and mist-nets. An acoustic lure (Sussex Autobat) was

used near to a harp trap on each evening when trapping was undertaken specifically to attract barbastelle bats.

Due to the limited information on barbastelle activity around the north of Norwich, the June 2009 session trapping effort concentrated on catching barbastelles in areas where barbastelle activity had been identified through the 2008 activity surveys. Prior to commencing the first radio-tracking session suitable trapping locations were determined by a site walkover to assess habitats. Trapping locations for the second 2009 trapping session (in August 2009) was informed by the June data as well as results from the transect surveys, static and manned fixed point surveys, between April and July 2009. Trapping of bats was undertaken at the following locations (detailed in Appendix K):

- Location 1: Deighton Hills 1;
- Location 2: Deighton Hills 2;
- Location 3: Marriots Way 1;
- Location 4: The Springs;
- Location 5: Rackheath;
- Location 6: Beeston Park;
- Location 7: Marriots Way 2 (Railway bridge);
- Location 8: The Wilderness;
- Location 9: Hall Lane;
- Location 10: Beeston Park;
- Location 11: The Springs, North Pond;
- Location 12: Spixworth;
- Location 13: Hall Lane;
- Location 14: Millhill Plantation;
- Location 15: Larter Farm Path;
- Location 16: Cushion Common Plantation;
- Location 17: Felthorpe Common;
- Location 18: Swannington/Swifflers Lane;
- Location 19: Marriots Way 3 – Near Felthorpe Road;

- Location 20: Marriots Way 4 – Attlebridge Car Park and River crossing;
- Location 21: Footpath between Smee Lane and Low Road;
- Location 22: Whitlingham Country Park;
- Location 23: Gazebo Covert;
- Location 24: Double tree line off Toad Lane;
- Location 25: Pig's Park; and,
- Location 26: Rackheath Golf Course.

A licence for the trapping and radio-tracking project was granted to Helen Lucking of Corylus Ecology by Natural England (Licence number 20092774). Two key accredited agents were used: Geoff Billington of Greena Ecology and Alastair Wrigley of Corylus Ecology. A number of other surveyors employed by Corylus Ecology and Greena Ecology were used as accredited agents during the trapping and for radio-tracking. All radio-trackers were experienced in such work.

Biometric data was recorded from all bats caught; including gender, forearm length and weight. Every bat was examined to ascertain its breeding status. Only bats which were in healthy condition and of suitable weight were considered for tracking. All females were checked and if found to be at an advanced stage of pregnancy they were released immediately and not used for tracking. Bats were tagged with radio-transmitters provided by Biotrack; all transmitters were less than 7% of the body weight of the bat in question with two weights of tags used: 0.35g and 0.47g. The bats being tracked were fur-clipped and the transmitters glued between the shoulder blades using SkinBond adhesive. The transmitters used were designed with at least an eight day battery life. The bats and transmitters were given time to settle prior to tuning receivers to the optimum frequency of each transmitter and releasing the bats close to where they had been caught. Each tracked bat was assigned a number, in the order that the bats were tagged, to allow ease of distinction of bats during tracking. The August radio-tracking session continued the numbering of tagged bats from where the June session stopped. Nineteen bats were tracked during the first session; to avoid confusion between the numbers of bats tracked during the two sessions the number 20 was omitted, thus bats from the second session were numbered 21 and following.

Bats were radio-tracked using Australis and Sika radio-tracking scanning receivers with Yagi rigid directional aerials to track bats. Whip omni-directional antennas were employed when searching for bats by vehicle. Hand-held sighting compasses were used to take bearings and both detailed maps and handheld GPS units were used to provide locations for both surveyors and bats. Between two and five surveyors were used to radio-track the bats with both close tracking techniques and synchronised triangulation techniques used to produce joint bearings. Surveyors used radio-sets and mobile phones to allow contact to be maintained while synchronised "joint" bearings were taken. A series of safe observation points for the radio-tracking surveyors were pre-planned to allow for safe working and to provide the best locations for the receivers for joint bearings to be taken. Care was taken to ensure that the surveyors were not positioned in the vicinity of overhead cables and away from cars to avoid disturbance to the compasses and radio-signals and care was taken to ensure that tag frequencies would not overlap. The surveyors concentrated the tracking effort in the first instance on the line of the proposed route, scanning for tagged bats flying in the areas of the proposed NDR. If a bat was recorded then attempts were made to take

synchronised, also referred to as “joint”, bearings with another surveyor. This meant that surveyors frequently had to change locations in order to get joint bearings.

As a requirement under the Natural England licence for both periods of radio-tracking, the local bat group representatives were contacted, in this case Natural England Norwich Office, to inform them of the work and to check whether any other radio-tracking was being undertaken by other surveyors who should also have contacted the same bat group representatives. No such other concurrent studies were reported during this period.

2.9.2 2012 survey

The 2012 radio-tracking work was carried out by Greena Ecological Consultancy, led by Geoff Billington. A natural England license to trap and tag bats was obtained prior to fieldwork commencing.

A similar methodology, as used during the 2009 session, was used during 2012. This method was aimed at tracking larger numbers of bats to determine the overall home range of the local populations. Tracking higher numbers of animals increases potential data gathering on roosting sites, use and importance of feeding areas, flight corridors, interactions and overlapping foraging areas. The 2012 session specifically targeted the eastern end of the scheme, not covered in the previous tracking session in 2009, following evidence of barbastelles being recorded in the area during other bats surveys (2009 and 2010).

Trapping sites were selected from where previous bat detector surveys, during 2009 and 2010, and radio-tracking, in 2009, had recorded barbastelle bats. Bat catching was carried out nightly between 18th and 24th August 2012 and on 26th and 28th of August 2012, using a setup of up to 6 mist nets, one triple high net and four harp traps, which were installed shortly after dusk, remaining in place throughout the night until dawn at each of the following locations:

- Location 21: TG 288099 Footpath between Smee Lane and Low Road (trapping occurred here on multiple occasions);
 - Four single mist nets, four harp traps and an acoustic lure;
- Location 22: TG 271079 Whitlingham Country Park;
 - Five single mist nets, four harp traps and an acoustic lure;
- Location 23: TG 257127 Gazebo Covert;
 - Three single mist nets, one triple high mist net, four harp traps and an acoustic lure;
- Location 24: TG 288107 Double hedgerow/treeline off Toad Lane;
 - Four single mist nets, four harp traps and an acoustic lure;
- Location 25: TG 276124 Pig's Park;
 - Three single mist nets, four harp traps and an acoustic lure;
- Location 10: TG 260134 Beeston Park; and,

- Location 26: TG 265129 Rackheath Golf course;
 - Four single mist nets, four harp traps and an acoustic lure.

The location numbers given follow on from the previous radio tracking survey work. The location of all of the trapping sites are shown on the drawings in Appendix K.

An acoustic lure *AutoBat* playing synthetic ultrasonic calls of barbastelle bats was used at one of the harp traps, at each trapping location.

All ecologists involved in the radio tracking surveys were licensed to handle and survey bats.

Radio-tracking of tagged bats was carried out between 24th August 2012 and 31st August 2012. At the start of each night of tracking static monitoring points were used at vantage points, in good radio signal reception zones and or on bat commuting routes. Static monitoring points were also used during periods of continuous bat activity. The most significant vantage points are shown in Table 17 below. Radio tagged bats were tracked to their roosting sites at night and during the daytime. A minimum of three fieldworkers (four between 24th and 28th August) used *Australis 26K* and *Sika UHF* radio receivers with *Yaggi* rigid aerials to track bats. Omni directional antennas were used to search for bats by vehicle.

Table 17: Tracking observation points

Location	Grid reference
Pig's Park	TG 27640 12357
Salhouse Road	TG 28101 12204
Hall Farm	TG 28247 12687
Heath Wood	TG 27985 12886
Rackheath Industrial Park	TG 28019 13143
Rackheath Hall	TG 27327 12580
Rackheath roundabout	TG 28429 12463
Toad Lane	TG 29014 10524
Great Plumstead Hall	TG 29444 10480
Smee Lane	TG 29273 09610
Water Lane	TG 30439 10597
Broad Lane	TG 30224 11025
Salhouse Lane	TG 31334 11794
Norwich Road	TG 30597 12481
Sandhole Lane	TG 31077 12121
Salhouse	TG 30116 13735

Source: Greena Ecological Consultancy (2012)

Two *DataSika* logging static receivers were used to record when radio tagged bats visited two selected locations in order to extend the manual tracking, between 27th and 31st August 2012. One logger was positioned at Smee Lane footpath, the other one at March Covert (east side of Pig's Park).

Tailor made recording sheets were used to record data and a combination of radio sets and mobile phones were used for two-way communication. Accurate bearings of bat locations were taken from hand held

sighting Silva Expedition 54 compasses. Global Positioning Systems were used to increase the speed and accuracy of the surveyors to continuously supply their location.

For all tagged bats the following data was recorded:

- Observer location;
- Bat ID number;
- Triangulation bearings with other surveyor(s);
- Apparent location, route and behaviour; and,
- Roost location and details when located.

Whenever bats were commuting or at their first foraging sites, they were often observed from fixed (often elevated) points chosen where good radio reception was available, such as at high or other suitable vantage points. Where possible surveyors made close approaches to bats, to ascertain the exact foraging area and behaviour or to attempt pursuit if the bat was moving away.

Over the radio-tracking nights surveyors gradually built up a picture of routes bats travel and foraging areas. Surveyors positioned themselves strategically in the area of roosting sites to determine routes bats head and spreading further afield in the due course of the radio-tracking session. Areas and possible corridors checked for bats using them included: Pig's Park, Rackheath, New Rackheath, Salhouse, Little Plumstead, Blofield Heath, Blofield Corner, Blofield, Witton, Little Plumstead Hospital, Great Plumstead, Great Plumstead Hall, Smee Lane, Green Lane, Thorpe End and Racecourse Plantation, to name the most important and regularly visited ones.

Tracking ended either when the fieldwork period ended (generally half an hour before dawn), or when all bats had returned to the roost and were static or poor weather prevented bats from flying or made them return early to their roosts.

At the start of each survey night, estimations of environmental conditions were noted: wind strength and direction, rainfall, cloud cover and air temperature measured. Any significant changes in weather throughout the survey period were also noted.

Daytime work included locating and verifying roost occupation, recording and plotting out results and investigation of any night roosting sites discovered during the tracking sessions.

2.9.3 2013 survey

The 2013 radio-tracking survey work was carried out by Greena Ecological Consultancy, led by Geoff Billington. A natural England licence to trap and tag bats was obtained from Natural England prior to fieldwork commencing.

A similar methodology, as used during the 2009 and 2012 sessions, was used during the 2013 radio-tracking work (Greena Ecological Consultancy, 2013). This method was aimed at tracking larger numbers of bats to determine the overall home range of the local populations. Tracking higher numbers of animals increases potential data gathering on roosting sites, use and importance of feeding areas, flight corridors,

interactions and overlapping foraging areas. The 2013 session targeted areas at both the western and eastern ends of the scheme, previously covered by radio-tracking surveys during 2009 and 2010 (BSG, 2009 and Greena Ecological Consultancy, 2010).

All ecologists involved in the radio tracking surveys were licensed to handle and survey bats.

Trapping sites were selected from where previous bat detector surveys, during 2009 and 2010, and radio-tracking, in 2009 and 2012, had recorded barbastelle bats. Selected sites included:

- Location 21: TG 2887 0986 Footpath between Smee Lane and Low Road (selected as a trapping site on multiple occasions);
 - Four single mist nets;
- Location 27: TG 1520 1680, Marriot's Way;
 - Five single mist nets, 4 harp traps and an acoustic lure on one harp trap;
- Location 13: TG 1626 1864, Hall Lane;
 - Three single mist nets and two harp traps;
- Location 28: TG 1532 1755, Sandy Lane;
- Location 19: TG 1448 1704, Marriot's Way;
 - Five single mist nets, one triple high mist net and four harp traps;
- Location 12: TG 2406 1465, The Lodge, Spixworth Hall cottages;
 - Seven single mist nets and two harp traps;
- Location 29: TG 23294 14383, Quaker Farm;
 - Two harp traps;
- Location 30: TG 3136 1057, Little Plumstead Hospital;
 - Five single mist nets; and,
- Location 31: TG 3051 1311, Eighteen Acre Plantation;
 - Four harp traps.

Two bats were also caught directly out of a tree roost in Weston Park:

- Location : TG 11659 17241, Maternity roost in Weston Park;
 - Rope access.

The location numbers given above follow on from the previous radio tracking survey work. The location of all of the trapping sites are shown on the drawings in Appendix K.

Bat catching was carried out nightly between 3rd and 8th May 2013 and on 12th and 16th of May 2013, starting shortly after dusk and continuing throughout the night.

An *AutoBat* acoustic lure, playing synthetic ultrasonic calls of barbastelle bats, was used at harp traps, during several trapping nights.

Bats were tagged with Biotrack and Titley 0.47g radio transmitters, with batteries lasting between 11 and 13 days, at 52 to 61 beats per minute. A single tag was glued to the back of each bat caught, between the fur clipped shoulder blades, using a latex adhesive.

Radio-tracking of tagged bats was carried out between 4th May 2013 and 17th May 2013. At the start of each night of tracking static monitoring points were used at vantage points, in good radio signal reception zones and or on bat commuting routes. Static monitoring points were also used during periods of continuous bat activity. The most significant vantage points are shown in Table 18 below. Radio tagged bats were tracked to their roosting sites at night and during the daytime. A minimum of three fieldworkers used *Australis 26K* and *Sika UHF* radio receivers with *Yaggi* rigid aerials to track bats. Omni directional antennas were used to search for bats by vehicle.

Table 18: Tracking observation points

Location	Grid reference
Marl Hill Road	TG 12285 16931
Felthorpe Road	TG 14008 16976
Station Road	TG 12790 17605
King William's Drive	TG 15402 16737
Broad Lane	TG 13132 18132
Hall Lane	TG 16159 18447
Church Farm	TG 13166 16650
Ringland Road	TG 14924 14096
Weston Park Lodge	TG 11958 17387
Attlebridge	TG 12859 17654
Morton Bridge	TG 12495 16971
Synergy House	TG 11832 17493
Salhouse Lane	TG 31334 11794
Norwich Road	TG 30597 12481
Eighteen Acre Plantation	TG 30552 13169
Mousehold Farm	TG 29236 13117

Source: Greena Ecological Consultancy (2013)

Tracking surveys continued up until the end of the survey period each night (approximately 30 minutes before dawn), or until all of the bats returned to roost and remained static, or during extended periods of poor weather which resulted in markedly reduced bat activity. On occasions when the tagged bats remained in the roosts for two hours (during periods of poor weather) or when no emergence occurred within 2.5 hours after sunset, radio-tracking work ended early.

The following data was recorded for all tagged bats:

- Observer location;
- Bat identification number;
- Triangulation bearings with other surveyors;
- Location, flight direction/route and behaviour; and,
- Roost location and description (tag number etc.).

Additional roost monitoring continued for six days, following the radio-tracking period, between 17th May 2013 and 23rd May 2013.

Environmental conditions were checked prior to the start of the survey each night; including predicted wind speed, wind direction, temperature, rainfall and cloud cover.

Two *DataSika* static receivers were placed in two locations, considered of importance in the local habitat, were also used during these surveys, between 9th and 17th May 2013. The locations selected were both on Marriot's Way:

- Near the crossing of Furze Lane – grid reference TG 16637 15529; and,
- North-east of the quarry at grid reference TG 15148 16816.

The logging equipment recorded passes of tagged bats at each location and was a way of acquiring additional data to support the manual tracking results.

2.9.4 Analysis

Detailed statistical analysis relating to the differing sizes of home ranges or core areas has not been undertaken as the same level of survey effort was not carried out for each bat. However, the fixes that have been secured have allowed a description of the areas of use for each tagged bat with reference primarily to proximity to the proposed NDR and wherever sufficient information has been gathered, analysis of home ranges has been undertaken.

The data in this report uses all available triangulation points which were determined from intersecting bearings taken simultaneously. In addition, where a bat was known to be present in a given location at a given time a data point was also generated. Where a bat was close radio-tracked, for example a bat foraging for a sustained period within a specific area, a triangulation point was generated for the approximate centre of the foraging area with a separate triangulation point generated for every ten minute intervals. Bat fixes were transferred to digital geo-referenced maps using AutoCAD and coordinates for triangulation points were determined; the extent of bat activity for each bat was plotted independently and the data was carefully scrutinised and any obviously false bearings were discarded. The coordinates of the plotted triangulation points were then transferred into the Ranges 7 software (Anatrack) and analysed to produce Minimum Convex Polygons (MCPs), Neighbour Linkage (or Clusters) and Kernel Contours.

An animal's home range size, shape, and position are traditionally represented by joining the outermost fixes for that animal to form a minimum convex polygon (Mohr 1947). Outlying fixes (representing rare excursions) may unduly influence the polygon's shape and size to produce a misrepresentation of the space actually used by the animal (McNay et al. 1994). Minimum convex polygons (convex hulls) are an internationally accepted, standard method for estimating species' ranges, particularly in circumstances in which presence-only data are the only kind of spatially explicit data available. One of their main strengths is their simplicity. They are used to make area statements and to assess trends in occupied habitat, and are an important part of the assessment of the conservation status of species.

For all bats where roosts were found, the roost sites were included within the home ranges. The analysis was carried out using 95% of the locations closest to the home range centre (for polygons produced by MCP analysis) or the densest 95% for the contour analysis (the cluster and kernel contours). Additional coordinates for areas where no joint bearings had been achieved, but where close tracking had been undertaken, were also calculated. Such additional data were combined with the triangulation data to create a separate data set for re-analysis within Ranges 7.

Within each data set, the trapping locations were specified as the focal sites and all coordinates from the night time tracking and roost locations were inputted as Location Qualifying Variables (LQV's) within Ranges. Typically a focal site might consist of a den, nest or roost of a tracked animal. In the case of the bats tracked during this study, since animals regularly switched day roost, that location could not be used as focal site within Ranges; instead the location where the animal was caught was used for this purpose.

2.10 Survey constraints

General constraints on all bat surveys conducted between 2008 and 2013 include access restrictions and limitations (access was denied to land parcels, by the landowners, in specific locations at certain times during the surveys) and environmental constraints, such as poor weather conditions.

Specific constraints for each survey method or survey year are provided below.

2.10.1 Static monitoring constraints

Equipment failure was found to be the main limitation of these surveys. On average one Anabat detector was found to fail to record some or all of data at a specific monitoring location. Such failures resulted from a variety of reasons:

- Tampering;
- Reduced battery capacity;
- Limited or reduced data storage space;
- Water damage (some microphones were affected by ingress of rain water); and
- Unknown cause. Some units failed on one occasion but worked perfectly during following surveys.

One Anabat unit was lost during the 2010 survey period, along with all of the data from that one specific location.

On occasion, data storage space has been reduced by the detector picking up electrical interference, rain or birdsong, which causes the memory card to fill up before the survey period is complete. Increased triggering of the unit can also result in an increased drain on the battery.

The main limitation with these surveys is that when an error or problem occurs it is not detected until the end of the individual monitoring period and, therefore, may result in a loss of data from an entire survey period (in this case, as survey period occurs at each location once a month).

Pairing up the Anabat units reduces the risk of losing all information from each location, as it is considered highly unlikely that both detectors in a pair would fail at the same time.

2.10.2 Radio-tracking constraints

The general accuracy of radio-tracking surveys can be affected by local habitat structure and may result in biased estimates of the observed habitat use. The most common cause of error in recordings is signal bounce, which occurs most frequently in undulated terrain where a signal may be deflected by a hill/slope. Surveyors can attempt to troubleshoot and avoid this error by taking multiple bearings from a number of different observation points (White and Garrott, 1990).

Radio-tracking in urban and suburban areas introduces limitations caused by the density and size of structures, which shield and interfere with signals. Electrical interference can also cause problems with equipment receiving signals and access for surveyors can be more limited.

During the 2013 radio tracking survey limitations occurred due to the extreme weather conditions, which affected most of the UK between March and May 2013. During this period night time temperatures in Norfolk were recorded dropping as low as 1°C, which is below that required for bat activity. During the survey it was found that bats stayed in the roosts for longer periods. Those that did emerge on colder nights quickly returned to the roost (due to a combination of low temperatures and a reduction in available food supply).

2.11 Survey areas

For the purpose of this report, the proposed route of the NDR scheme has been divided into the nine areas used for transect surveys during 2009, 2010, 2012 and 2013. To enable interpretation of results and the development of suitable mitigation and enhancement plans, the following sections of this report, and related maps and drawings, will split the data into the sections previously mentioned.

3. Results

3.1 Desk study and baseline data

Bat surveys were carried out over two sessions in 2008, by ECOGraphics. These surveys focused on specific areas along the route, with habitat considered most suitable for use by bats:

1. Deighton Hills – Mixed plantations and arable fields, bordered by hawthorn hedgerows;
2. Drayton Drewray – an area dominated by extensive mixed plantation woodlands to the north of the proposed scheme, with intensively managed arable fields with boundaries of hawthorn (*Crataegus monogyna*) hedgerows and scattered Oak trees (*Quercus robur*);
3. Horsford – Intensively managed arable fields bordered by ditches and hedgerows (dominated by hawthorn and scattered oak trees);
4. Spixworth – Immediately to the east of Norwich Airport land. The habitat around the village consists predominately of intensively managed arable fields bordered by hawthorn hedgerows and scattered oak trees. A strip of plantation woodland is located south of the village (called Spixworth plantation). This is made up of a mixture of oak and conifer woodland;
5. Beeston Park and Rackheath – Predominately parkland with pasture, hays fields and large mature trees, along with areas of broadleaf and mixed woodland. A wetland area “The Springs”, including lakes and mixed woodland, is also located in this area, to the north of the proposed scheme footprint; and,
6. Great Plumstead and Little Plumstead – Intensively managed arable fields bordered by hedgerows, domestic dwellings, farm yards and an area of parkland to the east.

The survey methodology used was made up of a combination of walked transects, static monitoring (unmanned) and tree assessments.

The results highlighted the presence of good foraging and commuting habitat under and adjacent to the proposed road scheme. Species recorded included whiskered, Brandt’s, Natterer’s, Daubenton’s, serotine, noctule, common pipistrelle, soprano pipistrelle, brown long-eared and barbastelle.

Records of barbastelle bats were noted through the survey period on all transect routes and all passive monitoring stations. An exceptional number of passes by this species were recorded on one tree line near Horsford, suggesting specific importance of the linear feature for both foraging and commuting.

The results of these surveys and the large number of barbastelle recordings, in particular, highlighted the need for further investigation. As such the records from 2008 formed the baseline data from which all subsequent surveys originate. The baseline also influenced the development of subsequent survey methodologies.

The following sections present results of all surveys conducted, to date, by methodology. The most recent data is provided first, within each section.

3.2 Church and hibernation surveys

Inspections of churches and hibernation surveys of suitable structures were conducted in the winter (Jan – March) of 2009 and 2012, of all suitable buildings and structures within 2 km of the proposed scheme footprint (**Error! Reference source not found.**).

A total of 31 sites, consisting of churches, farm buildings, abandoned and derelict structures and ice houses, were surveyed for use by bats. The results are summarised in Table 19 below.

3.2.1 Church visits

A total of 17 churches were visited and subject to a thorough inspection, for evidence of use by bats (Table 19). The results of the visits are as follows:

- Evidence of use by bats was found in 11 of the churches;
- Hibernating bats were located in one of the churches;
- Seven of the churches were noted as having high potential for hibernating bats;
- Two of the churches contain known maternity roosts;
- Six of the churches were noted as having high potential for use as maternity roosts (due to significant amounts of droppings identified); and,
- Low levels of evidence were recorded in five of the churches, indicating either bats roosting in small numbers, transient use of the building or use of the building for foraging activity.

3.2.2 Hibernation surveys

14 additional sites were identified, during the desk study, as having potential for use as a hibernation roost. Some 'sites' consisted of multiple buildings or structures, which were surveyed for hibernation potential. All of the sites are also provided in Table 19.

The results of the hibernation surveys are as follows:

- Hibernating bats were located at four of the 14 sites;
- One site contained a known maternity roosts as well as a hibernation roost;
- One site contained a known maternity roost, which was closed under a Natural England license in 2009/2010. This building could not be accessed for a hibernation assessment;
- Three sites contain structures with high potential for use as both maternity and hibernation roosts;
- Access was not possible to five of the structures; and,
- Four bridges were identified as having potential but could not be accessed to inspect fully.

Details of the structures subject to hibernation surveys and results are provided in Table 19, below.

Table 19: Results of Church visits and hibernation surveys

Site	Church	Other buildings/structures	Droppings	Staining	feeding signs	Evidence (Y/N)	Roost location	Species	Roost type	Known?	Notes
Spixworth			Y	Y			Pipistrelle		maternity	Yes (500+ bats counted out by local bat enthusiasts)	Potential for hibernation. Church is cleaned thoroughly (including walls) - not much evidence for the number of bats known to be using the church.
Drayton		Y (approx., 20 or more in tower)					BLE (in tower), Pip and BLE in porch. None in main body of church		Not determined on visit		Potential for hibernation
Sprockston		Y	Y	Y	Y		Pip, BLE, Myotis sp.		Maternity		Potential for hibernation
Little Plumstead		Y (low numbers - less than 10)	Y - small amount				Pip		Not determined on visit		Church roof was replaced in 2007.
Great Plumstead		Y (low numbers)					BLE		Not determined on visit		Potential for hibernation
Horford		Y (BLE in tower)			Y (in tower)		BLE		Not determined on visit		Potential for hibernation
Horsham		Y (High number of droppings throughout church)	Y (large amount of staining on organ pipes)				Pip and BLE droppings.		Maternity		Potential for hibernation. Potential access points noted - high conc. Of droppings at these locations.
Attlebridge		Y					Pip and BLE droppings.		Maternity	Yes - known pip roost (VBW carried out assessment for repair works) - NE advise note provided.	
Ringland		Y	Y	Y	Y	Y	A single serotine was found roosting behind a board on the chancel wall and five pipistrelles behind a wooden panel at the west end of the church. Pip, BLE, myotis sp. and serotine droppings recorded.		Hibernation and maternity		A flint church in a rural setting. The church wardens have only recently moved here so did not know its 'bat history'.
Rackheath											Potential for bats but no evidence found in the church (recently painted, well-sealed inside). Church has good connectivity to woodland areas.
Crosthewick		Y	Y	Y	Y				Potential for a maternity roost.		Potential for hibernation. High concentration of droppings noted at potential access points and roost locations.
Felthorpe											No Access for survey.
Taverham		Y	Y	Y	Y		Pipistrelle, BLE and Natterer's		Maternity roost		
Old Catton											No evidence found.
Wilton											No evidence found.
Postwick											No evidence found

Site	Evidence (Y/N)			Roost location	Species	Roost type	Known?	Notes
Morton Hall chapel	Y	Y	Y	Maternity roost in hall roof. Hibernation in old coach house (plus evidence that building is used as maternity roost). Highly likely that bats are in all the buildings - several features suitable for bats on all buildings.	Natterer's, BLE and Pipistrelle	maternity and hibernation	Known maternity roost in hall (pips and BLE). Hibernation roost in coach house not previously known	Potential for more bats to be hibernating in the coach house (and other buildings) - plenty of roosting opportunities that could not be closely explored during the survey. Unable to access the owery for close inspection.
Little Plumstead hospital	Y	Y		Bungalows, Pavilion (BLE feeding perch), Leicester, Beech, Newton and the old hall.		Potential maternity roost sites and feeding perches.		Evidence of bat use found in several buildings on the site (belonging to the NHS). Not all buildings on site have potential (or could be accessed). H&S issues with some of the buildings (asbestos, syringes, rotten floors, holes in floors, flooding etc).
Development at Little Plumstead Hospital (bat houses, stables and gate house).								Unable to gain access to these structures for hibernation surveys.
Ice House, Spixworth Hall		Y		Gaps in the brick work in the tunnel to the ice house. Between bricks and wooden lintel.	Natterer's and Daubenton's	Hibernation	Yes (previous record form John Goldsmith, 1997).	
Attlebridge Bridges (x3)								There are a series of bridges over the river and parallel watercourses all of which were looked at and a fuller report on these will follow however there was little in the way of suitable niches so a low possibility as a bat roost.
Rackheath Bridge								Potential hibernation site - difficult to explore fully.
Brick Kiln, Spring Farm								Structure is buried - no access
Lime Kiln Hole								No structure found on this site
Old military buildings at Gazebo farm/culvert	Y	Y	Y	On walls and in gaps in ceiling joints	BLE and Barbastelle	Hibernation	Not previously known (Barbastelle was recorded in this woodland during 2008 transect survey).	
Hall Farm	Y	Y	Y			Roost status unknown.		Potential for use as maternity and hibernation roost.
House – Walsingham plantation								Not surveyed.
Whittingham Country Park Lime Kiln		Y			Myotis	Hibernation	Known soprano pipistrelle roost in 2007 – NE licence obtained to exclude bats from the building.	
Underground structure - Newman's farm								Padlock to the gate was jammed so access wasn't possible. Bats noted were seen from the entrance.
St Andrew's Hospital						Potential		No evidence or bats found.
								Derelict building with potential for roosting bats. No access during the survey period due to construction works.

The locations of roosts, which were identified during these surveys, are displayed in the drawings in Appendix L.

3.3 Building surveys

3.3.1 Initial assessment

The initial assessment of all buildings within 100 m of the proposed footprint was carried out in June 2009 and updated on numerous occasions since the initial walkover to incorporate changes to the scheme footprint. Potential has also be re-evaluated following findings of dusk and dawn surveys carried out on the previous categorised high potential buildings. The results of the walkover (including amendments) are as follows:

- 62 high potential buildings (including groups of buildings) within 100 m of the proposed scheme footprint; and,
- 29 low to moderate potential buildings.

Details of the buildings assessed are provided in Table 20 below and the locations of the buildings are shown in Appendix C.

Table 20: Assessment of buildings within 100 m of the proposed scheme footprint.

Building Number	Building Type	Description	Potential	Confirmed roost (Y/N)
3	Stables	Small, single storey stables with an entrance at either end of the southern facing wall. Exposed timbers. Pan tile roof.	High	Y
5	Shed	Large Shed, roof covered in moss, gaps between asbestos ridge tiles (not much light shining through). Solid concrete walls. Brown Long Eared droppings (low no.). Possible emergence	High	Y
7	bungalow	New built chalet bungalow.	High	
9	Shed	Farm store shed (large)	Low/moderate	
10	Bungalow	Fox culvert Rd (High Breck Farm Bungalow) Potential, pantiles, loft space	High	
11	Annex	Looks well sealed	Low/moderate	
13	Bungalow	Could potentially be cut off from Marriot's Way. Tiles, loft space and soffits	High	
14	Building	Steel clad building. No doors. Unlikely to be used	Low/moderate	
15	Farm Building	Looks like it has been renovated, single storey. Possible potential, tiles and wall tops	High	
16	Building	Block wall (potential gaps and access) and asbestos roof, 2 storey	High	
17	House	Barn conversion	High	
18	Farm Building	2 storey steel frame, asbestos clad and block wall, potential gaps	High	
19	Building	Low potential building	Low/	

Building Number	Building Type	Description	Potential	Confirmed roost (Y/N)
			moderate	
20	Farm Building	Asbestos	High	
21	Farm Building	Concrete block and asbestos, unable to photograph.	High	
22	Farm buildings-chicken sheds	Facia boards	Low/ Moderate	
23	Farm buildings-chicken sheds	Unlikely to be used	Low/ moderate	
24	Bungalow		High	
25	Garage		Low	
26	Shed	Unlikely to be used	Low	
27	Shed	Unlikely to be used	Low	
28	Sheds	Unlikely to be used	Low	
29	Kennels	Unlikely to be used	Low	
30	Shed	Unlikely to be used	Low	
31	Stable	Unlikely to be used	Low	
32	Sheds	Unlikely to be used	Low	
33	House		High	
37	Shed		Low	
38	House		High	
39	Shed/ garage	Single storey. Unlikely to be used	Low	
40	House		High	
44	Double house		High	
45	Sports club		High	
46	Low garage	Unlikely to be used. Single storey flat roof.	Low	
48	Portacabin		Low	
50	Dartshill/ Hartshill cottage		High	
51	Shed		Low	
52	Airport tower	Radar deters bats?	Low	
53	Aviation museum		Low	
54	House		High	
55	Ancient barn	Similar to Paston Great barn	High	Y
56	House		High	Y
57	House	extensive works (re roofing)	Low	
58	Bungalow		High	Y
59	Garage	Unlikely to be used	Low	
60	Annex		High	Y
61	Shed	Unlikely to be used	Low	
62	Bungalow		High	
63	House	In woodland	High	
64	House	Keepers cottage	High	
65	Shed		Low	
66	Hill Farm lodge		High	
67	Gazebo Farm		High	Y

Building Number	Building Type	Description	Potential	Confirmed roost (Y/N)
	House			
68	Sheds	gaps under roof sheets	High	Y
69	Chicken building		High	Y
70	Derelict building	Pre-demolition scope inspection of render	High	
71	Derelict building	Pre-demolition scope inspection of render	High	
72	Derelict building	Pre-demolition scope inspection of render	High	
73	Industrial building	limited use	Low	
74a	Derelict building	scope inspection of render	High	
74b	stable	To be removed. Investigation with torch	High	
75	open barn	pre demolition watching brief	High	
76	barn	potential features (covered wall tops)	High	
77	cottage		High	
78	barn	Wall tops etc.	High	
79	barn	Roof, wall tops etc.	High	
80	Railway house		High	
81	House		High	Y
82	House		High	Y
83	House		High	
84	House		High	
85	House		High	Y
86	House		High	
87	House		High	
88	House		High	
89	Large shed	Unlikely to be used	Low	
90	Stables	The Red House stables	High	Y
91	House	The Red House- mature trees in garden	High	
92	derelict farmhouse	Newmans farm	High	
93	cottage	The Lodge, Spixworth hall cottages. Small old cottage, pantile roof.	High	
94	Farmhouse	Farmhouse. Red brick, pantile roof.	High	
95	bungalow	pantile roof, loft space	High	
96	Bungalow	pantile roof, loft space	High	
97	house	pantile roof, loft space	High	
98	Indian restaurant	pantile roof - well lit walls and roof.	moderate	
GB1	10 houses on estate		High	
GB2	Helicopter buildings	steel framed and steel clad buildings, portacabins, concrete wall structure (blast wall)	High	
GB3	12 houses	all have potential, blocked exit survey to start with, may lead to individual surveys.	High	
GB4	7 buildings		High	
GB5	House and out buildings	Sheds and stables (house at least has potential)	High	Y
GB6	Farm shop building	Unlikely to be used	Low/moderate	

Building Number	Building Type	Description	Potential	Confirmed roost (Y/N)
GB7	group of bungalows	pantile roof, loft space, near church	High	
GB8	group of chalet houses	pantile roof, loft space, near church	High	

3.3.2 Dusk and Dawn surveys

Results from dusk and dawn surveys carried out on buildings, between May and September 2012, is provided in Table 21 below.

Results of the dusk and dawn surveys carried out for Building B55 in August 2013 is shown in Table 22.

In summary:

- 11 confirmed roosts within 50 m of the proposed scheme footprint:
 - Eight brown long-eared (BLE) roosts;
 - Four common pipistrelle roosts; and,
 - Two soprano pipistrelle roosts.

Buildings which have been identified as containing bat roosts are shown in Appendix L.

Other bat species were recorded close to the buildings during the dusk and dawn surveys, displaying either foraging or commuting behaviour. These include:

- Noctule;
- Leisler's;
- *Myotis* sp.; and,
- Barbastelle.

Table 21: Results of 2012 dusk and dawn surveys

Location	Species Identified	Confirmed Roost	Notes
B7	Noctule, Common and soprano pipistrelle	No	New building at site. Previous B7 has been demolished. Low levels of foraging and commuting activity recorded.
B10	common pipistrelle and noctule	No	Foraging and commuting activity - common pipistrelles and noctules.
B20	Common pipistrelle	No	Common pipistrelles noted emerging from B21 (south west of B20). Common pipistrelles also recorded foraging around a tree on the property boundary to the north of the building.
B24			Only surveyed once due to limited access.
B50	Not surveyed due to lack of access		
B58	Brown long-eared and common pipistrelle	Yes	BLE roost/access under wooden barge board/panelling. Common pipistrelle foraging and roosting under tiles. Bat roost also in outbuilding roof.
B60	BLE	Yes	
B67	BLE	Yes	Previously known BLE roost.
B68	BLE, Barbastelle, Noctule	Yes (BLE only)	Known BLE roost.
B69	BLE, Noctule, Common pipistrelle	No	
B69b	Not surveyed due to lack of access		
B77	Common pipistrelle and BLE	Yes	
B80	BLE (roost). common pipistrelle and noctule (foraging)	Yes (BLE only)	Single BLE returned to roost under a tile. General activity recorded included in the most foraging and commuting behaviour along the road and railway line.
B81	Soprano pipistrelle	Yes	
B82	Soprano pipistrelle	Yes	Small roost (only low number of bats recorded).
B83		No	Possible pip roost in large beech tree in back garden
B84	Myotis and common pip	No	Commuting and foraging activity.
B85	BLE, common pipistrelle and noctule	Yes (BLE only)	Small roost (only low number of bats recorded). Common pipistrelles noted

			foraging along the road.
B90	common pipistrelle	yes	Droppings found inside building and on wall by potential access point. Foraging activity over road. Single pip returned to roost behind alarm box on garden wall (at entrance gate).
B91	Soprano and common pipistrelle, BLE	No	Significant foraging activity in garden.
B95	common pipistrelle	No	Low levels of foraging activity.
B96	possible Leisler's and common pipistrelle	Possible (common pipistrelle only)	
GB3	Common pipistrelle	No	Foraging activity over road.
GB4	Common pipistrelle	No	
GB5	Noctule and BLE	Yes (BLE only)	Possible emergence from the east side of the house during dusk survey. Single bat returned to the stable building during the dawn survey. Significant foraging around the house and garden.
GB8	common pipistrelle	No	General foraging activity. Confirmed roost in building east of the Indian restaurant (B98).
R1	BLE	Yes	Known BLE roost. Other species recorded in the vicinity of the building include serotine, common and soprano pipistrelle and <i>Myotis</i> species (likely Daubenton's).

Table 22: 2013 building survey results

Location	Species Identified	Confirmed Roost	Notes
B55	Barbastelle, Brown long-eared, common pipistrelle, soprano pipistrelle, <i>Myotis</i> spp.	Yes	Significant activity. Within and around the building.

3.3.3 Remote monitoring – Quaker Farm

Additional surveys were carried out using remote bat detectors (Anabats), which can be left out on site for extended periods of time to monitor bat activity. A single Anabat was used to monitor the inside of an ancient barn at Quaker Farm (Building Number 55, approximately 125 m from the proposed scheme footprint) for a period of seven to 10 days every month between April and July 2010. The results of the monitoring are displayed in Table 23 below. The location of the Ancient Barn is shown on the building location plans in Appendix C and Appendix L.

Additional monitoring of the building is currently being carried out (during 2013). The data from this survey is not currently available for inclusion in this report.

Table 23: 2010 monitoring results

Month	Species					Total bat passes recorded
	Common pipistrelle	Soprano pipistrelle	Barbastelle	Myotis sp.	Brown long-eared	
April	77	2	0	5	0	84
May	15	1	0	6	0	22
June	445	34	7	270	91	847
July	1218	17	22	68	17	1342
Total	1755	54	29	349	108	

3.4 Trees and Woodlands

3.4.1 Initial assessment

Individual trees were identified and assessed for potential during an initial walkover in 2008. This list has been updated and modified through subsequent walkovers to allow for changes to the scheme design. From these assessments a total of 637 trees were identified as having medium to high potential for bats within 100 m of the proposed scheme footprint. Of this total, 452 were classed as high potential and 173 have been classed as medium potential.

Two woodlands were included in the initial assessments; W4 at Dreyton Drewray and W11 at Spixworth (Appendix C). However, only trees within these woodlands, which were directly under the scheme footprint, were assessed for potential. The location of each tree and assessment results, including features of interest, are provided in Appendix D, Appendix E and Appendix F.

Roosts identified through the combined survey effort are displayed in the drawings in Appendix L.

3.4.2 Tree climbing inspections

The climbing and inspect survey methodology allowed ecologists to get up close to potential features to assess potential and check for the presence of bats/roosts.

A total of 192 trees, within 25 m of the proposed footprint, were subject to at-height inspections in 2010 by fully trained tree climbers. Details of the trees climbed are included in Table 57 in Appendix E and shown on the drawings in Appendix F.

Within Woodland 4 and Woodland 11, only trees directly under the scheme footprint were inspected using this survey method.

Following these surveys the classification of 65 trees was reviewed, with many of the trees being downgraded to low/moderate or low potential. Details and locations of specific trees can be found in Appendix E and Appendix F.

An additional 15 trees were climbed, during 2012, to cover new survey areas arising through changes to the scheme design and areas where previous access was denied. As part of the 2012 surveys each tree was issued a tag number to enable surveyors to clearly identify each individual tree for future surveys.

The details of the additional trees are provided in Table 24 below, along with general information in Appendix E.

Table 24: Trees climbed in 2012.

Tree number	Tag number	Description/Feature of interest	Potential
264	23	Tree snapped off at 6m. Several woodpecker holes 4-5m AGL. Examined, no potential. Vertical splits extending over 40 cm. 6 m AGL	Medium
285	21	Snag ends and dense ivy. Dense Ivy 3-10 m AGL	Medium
289	19	Dense Ivy 3 – 10 m AGL	Medium
327	-	Woodpecker holes – examined (no potential)	Low
416	1	Flaking bark and splits	High
451	2	Flaking bark plates extending over 2 m	Confirmed roost
459	7	Hole and Flaking bark	High
467	6	Cavity	Medium
468	5	Flaking bark 5-7 m AGL	High
469		Feature 15 m AGL examined – no potential	Low
613		No features	Low
614	36	Flaking bark and crevice	Medium
615		No features	Low
616	33	Dense Ivy 4 – 8 m AGL	Medium
617		No features	Low

A total of ten trees were confirmed as roost sites during the combined survey effort in 2010 and 2012. Details of these trees are provided in Table 25 below.

Table 25: Confirmed roosts through the tree climbing surveys

Tree number	Species	Roost type
1 (R11)	Brown long-eared	Maternity/annex
21	Pipistrelle species	Individual bat
211	Myotis spp (Natterer's)	Individual bat.
252	Pipistrelle	Low number of droppings
280	pipistrelle	Small roosts, low number of bats
380	Possible Barbastelle	Possible maternity (20+ droppings in split).
451	Pipistrelle	Unknown
475b	Barbastelle	Low number of droppings under lifted bark – identified during tree climbing surveys.
W11b	Brown long-eared	Maternity
W11d	Pipistrelle	Unknown
W11n	Brown long-eared	Maternity

Further trees required assessment during 2013, due to the Postwick Junction scheme joining with the NDR scheme. The same methodology was adopted for the assessment of all trees within 100 m of the footprint, as used in the original tree assessments in 2009. The results of the assessment are included in the Table in Appendix E and displayed in the drawings in Appendix F.

Further surveys of all trees with high potential within 25 m of the scheme footprint, during the 2013 season, are currently underway; by at-height assessment and/or dusk and dawn surveys, where appropriate.

3.4.3 Dusk/dawn surveys

3.4.3.1 Trees

All trees identified as having high potential from the initial assessment, but were considered unsuitable for climbing inspections, were subject to two emergence or re-entry surveys (or one visit of each type of survey). This included:

- Trees with dense Ivy, within 25 m of the scheme footprint; and,
- Trees with dead wood, considered unsafe for climbing, within 25 m of the scheme footprint.

In addition, all trees identified as roosts through other survey methods (radio tracking or tree climbing) were subject to two dusk or dawn visits.

The results of the dusk and/or dawn surveys of individual trees are provided in Table 26 below. The location of each individual tree surveyed is shown in Appendix D and Appendix F.

Table 26: Results of tree dusk and dawn surveys (2010, 2012 and 2013)

Location	Species Identified during the survey	Confirmed Roost	Notes
T1/R11	Brown long-eared	Yes	BLE maternity roost
T21	Common pipistrelle	No	
T157	Common and soprano pipistrelle	Possible	Foraging activity up and down hedgerow.
T211	Natterer's	Yes	
T252	Pipistrelle species	Possible	One bat possibly returned to a hole in the tree. Foraging and commuting activity also recorded.
T253	Pipistrelle species, BLE	No	
T263	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	
T271	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	
T282	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	
T285	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	
T286	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	
T289	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	Surveys on-going
T291	Pipistrelle species, BLE, <i>Myotis</i> spp.	No	Possible roost at T290. Surveys on-going
T323	Pipistrelle spp.	No	
T380	Noctule, BLE and pipistrelle	Yes	Early noctule and BLE call. Pipistrelles recorded emerging from tree.
T415	Pipistrelle, Noctule, BLE	Yes	Noctule roost recorded in T415.
T451	common pipistrelle, noctule	No	foraging activity
T459	Common pipistrelle, barbastelle	No	
T475B	Barbastelle	Yes	Confirmed roost from radio tracking and dusk/dawn surveys. Approx. 5 - 8 bats emerged.
T468	Common pipistrelle, barbastelle	No	
T490			
T511	Common pipistrelle	Yes	Common pipistrelles noted emerging from tree.
T613	Pipistrelle spp. <i>Myotis</i> spp.	No	Surveys on-going

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T615	Pipistrelle spp., BLE, barbastelle	No	
T616	Pipistrelle spp., BLE, barbastelle	No	
T118-126	Common pipistrelle	No	foraging activity
T160-166	common pipistrelle	No	Commuting and foraging activity
T216-226	Pipistrelle species (soprano and pipistrelle)	No	Soprano pipistrelle roost at a nearby church. Tree line used as commuting route for bats.
T351-357	Noctule, BLE and common pipistrelle	No	Foraging up and down treeline.
T375-379	common pipistrelle, soprano pipistrelle, noctule and BLE	Yes	Common pip emergence. Noctule and common pip foraging (significant activity)
T454-462, 465, 466	common pipistrelle	No	foraging activity along treeline
TW11B	BLE	Yes	Surveys on-going
TW11F	BLE, Pipistrelle spp., barbastelle	No	Surveys on-going
TW11N	BLE, Noctule, common and soprano pipistrelle	Yes	BLE roost. Other bat activity in woodland.
R7	Soprano pipistrelle, common pipistrelle, noctule	Yes	Roost identified in 2009. Noctule roost identified in 2012. Possible noctule roost to the east of R7.
R10	common pipistrelle, soprano pipistrelle, noctule	Yes	Natterer's roost identified in 2009 radio-tracking. No bats emerged in 2012 surveys. Foraging around tree and along hedgerow to water body.
R13	common pipistrelles	Yes	Roost identified in 2009 radio-tracking. No bats emerged in 2012 surveys. Foraging activity.
R18	Common and soprano pipistrelle	Yes	Daubenton's roost identified in 2009 radio-tracking. Possible re-entry on dawn survey in 2012 (or to nearby tree).
R25	pipistrelle sp.	Yes	Natterer's roost identified in 2009. Pipistrelle roost identified in 2012.
R26		Yes	Barbastelle roost identified in 2009.
R27	Barbastelle, pipistrelle, serotine	Yes	Natterer's roost identified in 2009. Barbastelle, pipistrelle and serotine roost identified in 2012.
R29		Yes	BLE roost identified in 2009.
R31	pipistrelle and BLE	Yes	Barbastelle roost identified in 2009.
R34	Barbastelles, Pipistrelle, BLE and Myotis.	Yes	Barbastelle roost identified in 2009. No emergence recorded in 2012. Significant bat activity within the woodland.
R37	pipistrelle sp. BLE and Myotis.	Yes	Barbastelle roost identified in 2009. Pipistrelle roost

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			identified in 2012.
R38	Barbastelle, Myotis and pipistrelle species.	Yes	Barbastelle roost identified in 2009. Barbastelle roost confirmed in 2012. Significant activity (including social calling) recorded in the woodland.
R39	Barbastelle, Noctule, common pipistrelle	Yes	Barbastelle roost identified in 2009 and 2012.
R40	Barbastelle, Possible BLE, Noctule	Yes	Barbastelle roost identified in 2009. Little activity recorded in the area during 2012 surveys.
R41	Mostly Noctule	Yes	Barbastelle roost identified in 2009. Noctule activity recorded in 2012.
R42	Soprano pipistrelle.	Yes	Barbastelle roost identified in 2009. Possible roost close by, as bats out early in the woodland, chatter also heard by surveyors.
R43	Myotis, pipistrelle, barbastelle	Yes	Barbastelle roost identified in 2009. No emergence recorded in 2012. Foraging activity recorded in 2012
R46	Pipistrelle	Yes	Barbastelle roost identified in 2009. Pipistrelle activity recorded 2012.
Postwick T30-35	Common and soprano pipistrelles	No	Surveys on-going
Postwick T39	Common and soprano pipistrelles, noctule, barbastelle	No	
Postwick T40	Common and soprano pipistrelles	No	
Postwick T41	Common and soprano pipistrelles	No	
Postwick T42	Common and soprano pipistrelles	No	
Postwick T43	Common and soprano pipistrelles	No	
Postwick T44	Common and soprano pipistrelles	No	
Postwick T65	Common and soprano pipistrelles, noctule, barbastelle	No	
Postwick T66	Common and soprano pipistrelles, noctule, barbastelle	No	Surveys on-going
Postwick T67	Common and soprano pipistrelles, noctule, barbastelle	Yes	Identified noctule roost. Surveys on-going
Postwick T119	Common and soprano pipistrelles	No	Surveys on-going
Postwick T120	Common and soprano pipistrelles	No	
Postwick T123	Common and soprano pipistrelles	No	Surveys on-going
Postwick T124	Common and soprano pipistrelles	No	Surveys on-going
Postwick 125	Common and soprano pipistrelles	No	Surveys on-going

3.4.3.2 Woodlands

All woodlands within 25 m of the proposed scheme footprint were subject to two dusk or dawn activity or 'exit' surveys, to assess levels of activity and determine potential roosting within the woodland.

The results of the woodland activity surveys are provided in Table 27 below. Location of each woodland block is provided in Appendix C.

Table 27: Results of woodland dusk and dawn surveys

Location	Species Identified	Confirmed Roost	Other Notes
W1	Common pipistrelle	Yes	Pipistrelle roost in tree to northernmost corner.
W4	Common and soprano pipistrelle, BLE, Myotis	No	Many high potential trees within the woodland. Foraging and commuting behaviour from common and soprano pipistrelles, BLE and Myotis species.
W10	Common pipistrelle, Soprano pipistrelle, Nathusius pipistrelle, BLE, Noctule and Barbastelles in low numbers	No	Many high potential trees within the woodland. Foraging and commuting behaviour from common and soprano pipistrelles, BLE and Myotis species. Barbastelles noted in small numbers in this woodland.
W11	BLE	Yes	BLE roost identified in at least 2 trees (TW11B and TW11N). One tree (TW11B) was found to have been felled in 2012. Other species, including barbastelles noted in this woodland in 2009, 2010 and 2012.
Woodland 12a	Common and soprano pipistrelle, BLE and Barbastelles	No	Foraging and commuting behaviour observed. Likely that some bats emerged from trees within the woodland as a whole (W12a, W12b and W12c)
Woodland 12b	common pipistrelle, noctule, Nathusius pipistrelle, Barbastelle	No	Foraging and commuting behaviour observed. Likely that some bats emerged from trees within the woodland as a whole (W12a, W12b and W12c)
Woodland 12c	Noctule, common pipistrelle, Soprano pipistrelle, Myotis sp and Barbastelle	Yes	At least one barbastelle roost identified in W12c (T475B).
Woodland 22 & 23	common and soprano pipistrelle and BLE	No	Relatively low levels of bat activity during surveys. Activity recorded mainly foraging behaviour.
Woodland 33	Barbastelle, common pipistrelle, soprano pipistrelle, BLE, Myotis	No	No confirmed roost in woodland trees, however nearby roosts have been identified in buildings at Gazebo farm, Hall farm and within buildings in Rackheath estate. Barbastelle activity recorded along Newman Road, especially in very dark, sheltered areas.

3.5 Transect Surveys

The number of bat passes recorded during a single transect survey provides an indication of the habitat richness of the site for bats.

The drawings in Appendix G show the transect routes surveyed in 2009/2010 and 2013. Routes one to seven surveyed in 2009 and 2010 were repeated in 2013 (with some minor adjustments in places due to restricted access or changes to the scheme). Transect eight was part surveyed during the 2012 season, but due to be repeated again in 2013 due to poor weather. An additional transect (number nine) has been added to the survey package for the 2013 season, due to changes to the scheme footprint in 2012 to include the Postwick Junction.

The locations of monitoring stations (stopping points) and recorded bat passes, along with species identified on each route are also detailed on the drawings in Appendix G.

3.5.1 2009/2010 survey results

Detailed results of the 2009/2010 surveys are provided in Appendix T. The results shown exclude all recordings of all pipistrelle species and group all other bat species into the following three distinct groups:

- Barbastelle;
- Big bat; and,
- Plecotus/Myotis species.

During the 2009 surveys barbastelles were recorded on all transect routes, except for the route in Area 7 (BSG, 2009). A summary of the 2009 transect results, in the form of early bat passes, is provided in Table 28 below.

Table 28: Identification of early bat passes during transects

Area	Species' group	Location of early calls.
1	Big bats (noctules)	Along the River Wensum corridor and in Attlebridge hills (south and north of the proposed road route respectively)
	Myotis/Plecotus (Myotis sp.)	In the woodland just north of Crooked oaks (north of the proposed road route).
2	Barbastelle	Along Marriott's Way and in Drayton Drewray woodland (south and north of the proposed road route respectively)
	Big bats (noctules)	Along Marriott's Way
	Myotis/Plecotus (Myotis sp.)	Drayton Drewray woodland
3	None	N/A
4	Barbastelle	Just south of Spixworth.
	Big bats (noctules)	Along Beeston Lane near to Red Hall
5	Barbastelle	Near to Church Wood
	Big bats (noctules)	The Springs and Sprowston Wood
	Myotis/Plecotus (Myotis sp.)	The Springs
6	Barbastelle	Tollshill Wood
	Big bats (noctules and serotine)	Newman's strip, Tollshill Wood and recorded in a field in Rackheath Park
7	Big bat (noctule)	Near to the Laurels on Low Road.

Source: BSG (2009).

3.5.2 2012 survey results

A total of six species of bat were recorded on Transect 8, during the 2012 surveys. These included:

- Common pipistrelle;
- Soprano pipistrelle;
- Nathusius' pipistrelle;
- Myotis species;
- Noctule; and,
- Serotine.

A summary of species numbers recorded each month is provided in

Table 29 below. No barbastelles were identified on Transect 8 during 2012 surveys.

The results of these surveys are considered limited due to poor weather conditions experienced during the 2012 Spring/Summer seasons.

Table 29: 2012 Area 8 Survey Results

Month								Species	Total bat passes recorded
	Common pipistrelle	Soprano pipistrelle	Nathusius pipistrelle	Barbastelle	Myotis sp.	Noctule	Serotine	Brown long-eared	
May	81	11	0	0	2	1	0	0	95
June	49	4	0	0	0	42	1	0	96
July	90	21	3	0	1	22	0	0	137
Total	220	36	3	0	3	65	1	0	

3.5.3 2013 survey results

The 2013 transect surveys are on-going. Species recorded to date include:

- Barbastelle;
- Common pipistrelle;
- Soprano pipistrelle;
- Nathusius' pipistrelle;
- Brown long-eared (BLE);
- Noctule;
- Serotine;
- Leisler's;
- Myotis species;
- Daubenton's; and,
- Natterer's.

Data collected to date is provided in Table 30, separated out by area.

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Table 30: Summary of results from the transect surveys. Anabat data only.

Area	Visit number	Date	Area Total	Species							Myotis species				Query	Total
				Barbastelle	Common pipistrelle	Soprano pipistrelle	Nathusius' pipistrelle	Pipistrelle species	BLE	Noctule	Serotine	Leisler's	Unidentified to species level	Possible Natterer's	Possible Daubenton's	
1	1	30/05/2013			14	22				2					1	39
	2															0
	3	23/07/2013			12	7				13		2	1			35
	4															0
			Total	0	26	29	0	0	0	15	0	2	1	0	1	74
2	1	29/05/2013		1	34	18							1			54
	2	26/06/2013		1	112	26							6			145
	3	18/07/2013		1	40	18							1			60
	4															0
			Total	3	186	62	0	0	0	0	0	0	8	0	0	259
3	1	21/05/2013			28											28
	2	25/06/2013			48	1							1			50
	3	22/07/2013			21	1	3				1		1			27
	4															0
			Total	0	97	2	3	0	0	0	1	0	2	0	0	0
4	1	20/05/2013			62	136										0
	2	19/06/2013			38	6										198
	3	15/07/2013		1	22	8										44
	4															31
			Total	1	122	150	0	0	0	0	0	0	0	0	0	273
5	1	07/05/2013			36	31		4					3			75
	2	18/06/2013			13	34				1					2	50
	3															0
	4															0
			Total	0	49	65	0	4	0	1	0	0	3	0	2	125
6	1															0
	2	08/07/2013			19	13										32
	3															0
	4															0
			Total	0	19	13	0	0	0	0	0	0	0	0	0	32
7	1	28/05/2013		1	101	15				2		1				120
	2	20/06/2013			117	14				1		1				133
	3	16/07/2013			77	15				1						93
	4															0
			Total	1	295	44	0	0	0	4	0	2	0	0	0	346
8	1	08/05/2013		5	28	8			1			1				43
	2	17/06/2013			45	5	16			1						67
	3	04/07/2013			41	11	3			4						59
	4															0
			Total	5	114	24	19	0	1	5	0	1	0	0	0	169

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[illegible]

A summary of notable passes, recorded early in each transect survey, is provided in Table 31 below. The timing of bat passes can give an indication of proximity of roosts within or close to the survey area.

Table 31: Identification of early bat passes

Area	Species' group	Location of early calls.
1	Big bats (noctules)	Along the River Wensum corridor and in Attlebridge hills (south and north of the proposed road route respectively)
	Myotis/Plecotus (Myotis sp.)	In the woodland just north of Crooked oaks (north of the proposed road route).
2	Barbastelle	Along Marriott's Way and in Drayton Drewray woodland (south and north of the proposed road route respectively)
	Big bats (noctules)	Along Marriott's Way
	Myotis/Plecotus (Myotis sp.)	Drayton Drewray woodland
3	None	N/A
4	Barbastelle	Just south of Spixworth.
	Pipistrelle	Spixworth Plantation and W11.
	Myotis/Plecotus (Plecotus sp.)	W11.
	Big bats (noctules)	Along Beeston Lane near to Red Hall
5	Barbastelle	Near to Church Wood
	Big bats (noctules)	The Springs and Sprowston Wood
	Myotis/Plecotus (Myotis sp.)	The Springs
6	Barbastelle	Tollshill Wood
	Big bats (noctules and serotine)	Newman's strip, Tollshill Wood and recorded in a field in Rackheath Park
7	Big bat (noctule)	Near to the Laurels on Low Road.
8	Big bat (noctule)	Low Road
	Pipistrelle spp.	Near B90 on Low Road and T451 on Smea Lane
9	Big Bat (noctule)	Near unmanned static 9a

An emergence period was carried out at the start of each transect survey. This provided an opportunity to survey features of interest, such as trees and buildings, which are situated outside of the survey areas that target potential roost sites and features of interest. A list of additional roost sites, which have been identified through the transect surveys is provided in Table 32, below.

Table 32: Roosts identified during the transect surveys

Area	Feature/Roost number	Species	Comments
2	M1	Pipistrelle spp.	Tree on Marriot's Way
3			
4	W12c (tree at eastern edge of woodland)	Possible BLE	New tree not previously noted. Second Oak tree from the road on the southern edge of the woodland.
5	T290	Possible BLE emergence	Low number of bats seen emerging during transect emergence period
6	R50	BLE	Brown long-eared night roost in water tower.
8	T451	Noctule	Previously identified noctule roost.
9	Postwick T1	Possible pipistrelle roost	

3.6 Static surveys – unmanned

A summary of results of the unmanned surveys is provided in the following sections. The areas numbers for the static monitoring relate to the transect areas.

Areas 1 – 6 were surveyed between April and September 2009. Area 7 was added to the survey package part way through the season, resulting in a shorter monitoring period (July to September). As such it was determined that Area 7 was to surveyed again during the earlier part of the 2010 season to complete the survey package.

Area 8 was added to the survey package in 2012, to ensure that no gaps were left in the survey data within the habitat where the NDR scheme would join the proposed Postwick Junction scheme.

An additional area (Area 9) was added at the start of the 2013 survey season, due to changes to the proposed NDR scheme to include Postwick Junction between the A47 in the east and the NDR.

Locations of all paired Anabats for the unmanned static monitoring are shown on the drawings in Appendix H.

3.6.1 2009 surveys

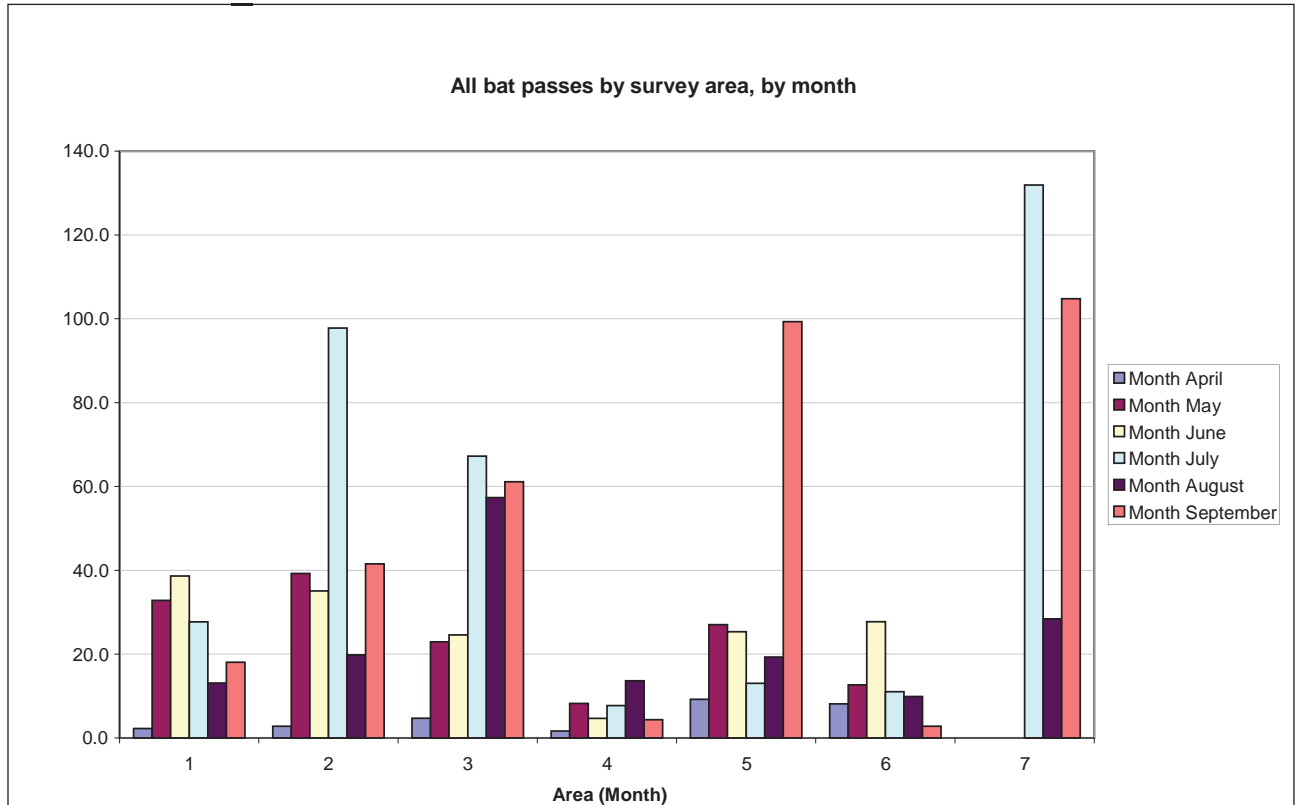
All results from the 2009 unmanned static monitoring surveys is sourced from the BSG report (BSG, 2009), Appendix T.

During the 2009 unmanned static surveys all 14 of the Anabats deployed across the survey area recorded over 300,000 bat passes, combined. Species recorded included: common pipistrelle, soprano pipistrelle, Nathusius pipistrelle, barbastelle, noctule, serotine Myotis spp. and brown long-eared bats.

Patterns of general bat activity across the transect areas surveyed throughout the 2009 season are shown in Figure 2 below. The graph displays the passes of all bat species, combined, and therefore shows patterns of activity as a whole across the scheme.

B

Figure 2: Total number of bat passes per hour, in each area, per month

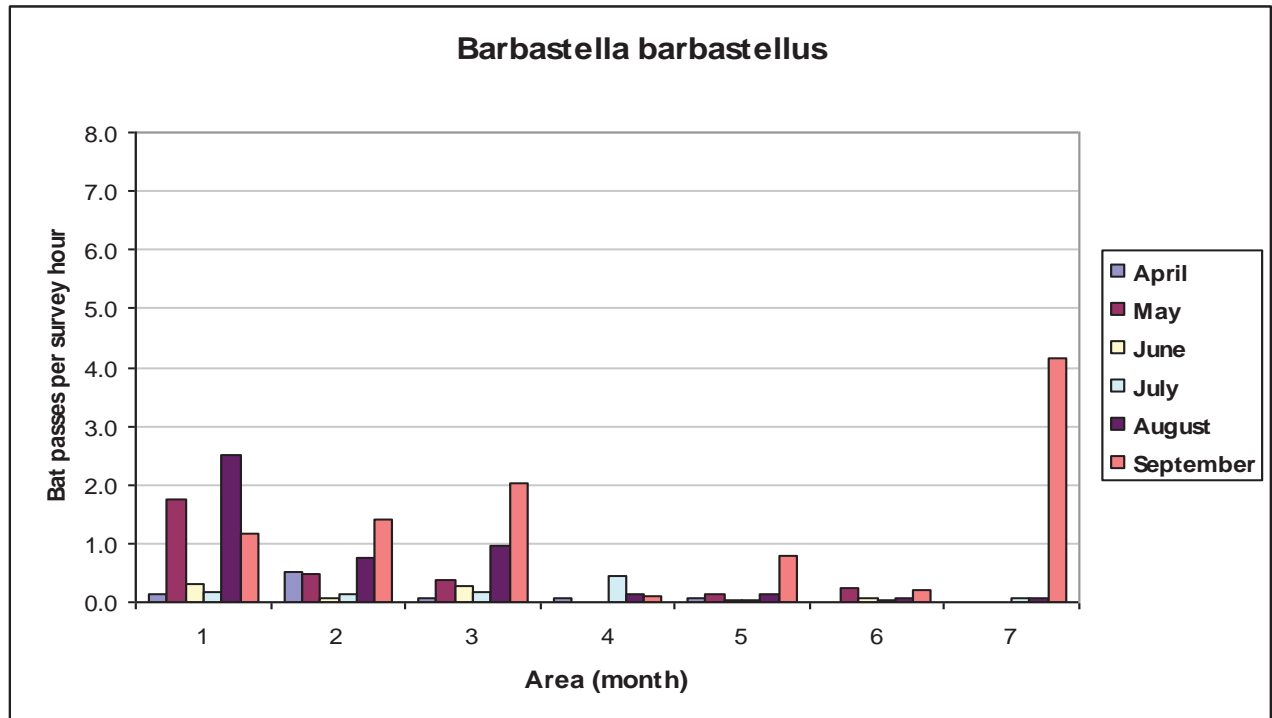


On average each Anabat recorded more than 20 bat passes per survey hour, each month. This equates to more than one bat pass every three minutes at the majority of monitoring stations.

3.6.1.1 Analysis of bat passes (by species) per hour, per area, per month

The number of bat passes per hour for each species group, throughout the 2009 survey season, are shown in Figure 2 to Figure 6, below.

Figure 3: Number of barbastelle passes per hour



The highest levels of barbastelle activity, within a particular month, were recorded in areas 1, 2, 3 and 7. Areas 2, 3 and 7 showed the highest levels of activity during the September monitoring with between 1.5 and 4 passes per hour. Area 1 showed highest levels during August, with 2.5 barbastelle passes per hour. Area 2 was found to have the highest proportion of early or late passes; with bats recorded in the hour after sunset or the hour before sunrise.

Figure 4, below, displays the number of big bat species (Noctule, Leisler's and Serotine) passes recorded per hour in each monitoring area, throughout the entire survey period.

Areas 1, 5 and 7 were found to have the highest number of passes by big bat species; Area 1 had just under 7 passes per hour in June, Area 5 had 5.5 passes per hour in September and Area 7 had 2.5 passes per hour in August.

All areas showed a higher proportion of big bat passes early or late in the survey each night; with bats recorded in the hour after sunset or the hour before sunrise.

Figure 4: Number of Big bat species recorded per hour.

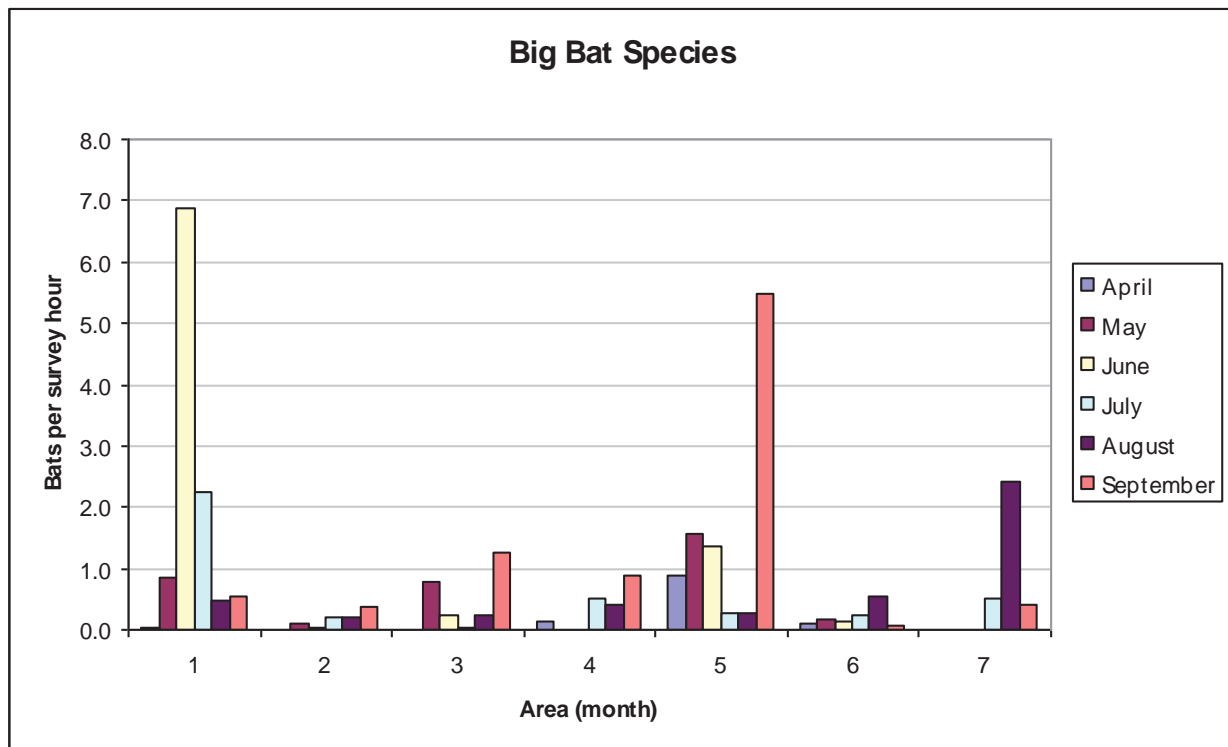
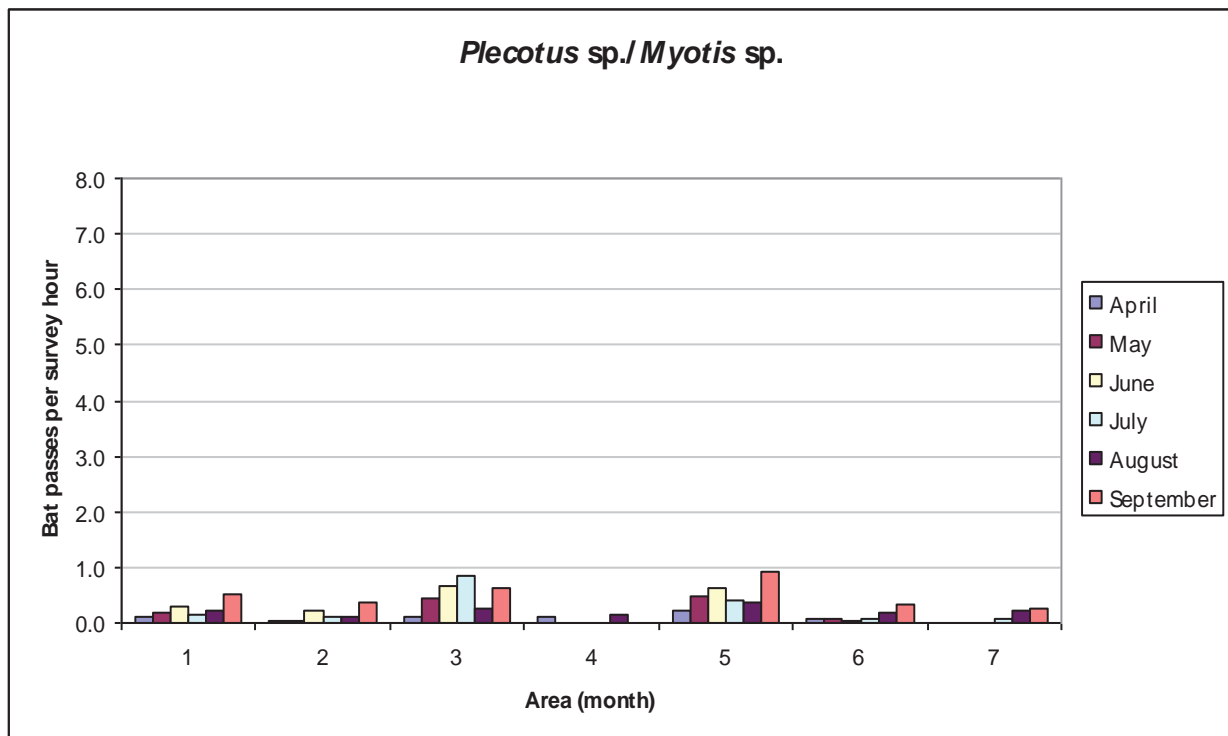


Figure 5, below, displays the number of brown long-eared and *Myotis* species passes per hour, in each area throughout the survey period. Echolocation calls in these species quiet by nature, coupled with the directional microphone of the Anabats, makes recording these calls during monitoring surveys less likely. However, it can be seen that passes by this species' group were recorded in all areas, throughout the 2009 monitoring period. Area 5 was found to have a slightly higher proportion of early and late passes which may indicate close proximity to roosting locations.

Figure 5: *Plecotus* and *Myotis* species recorded per hour.



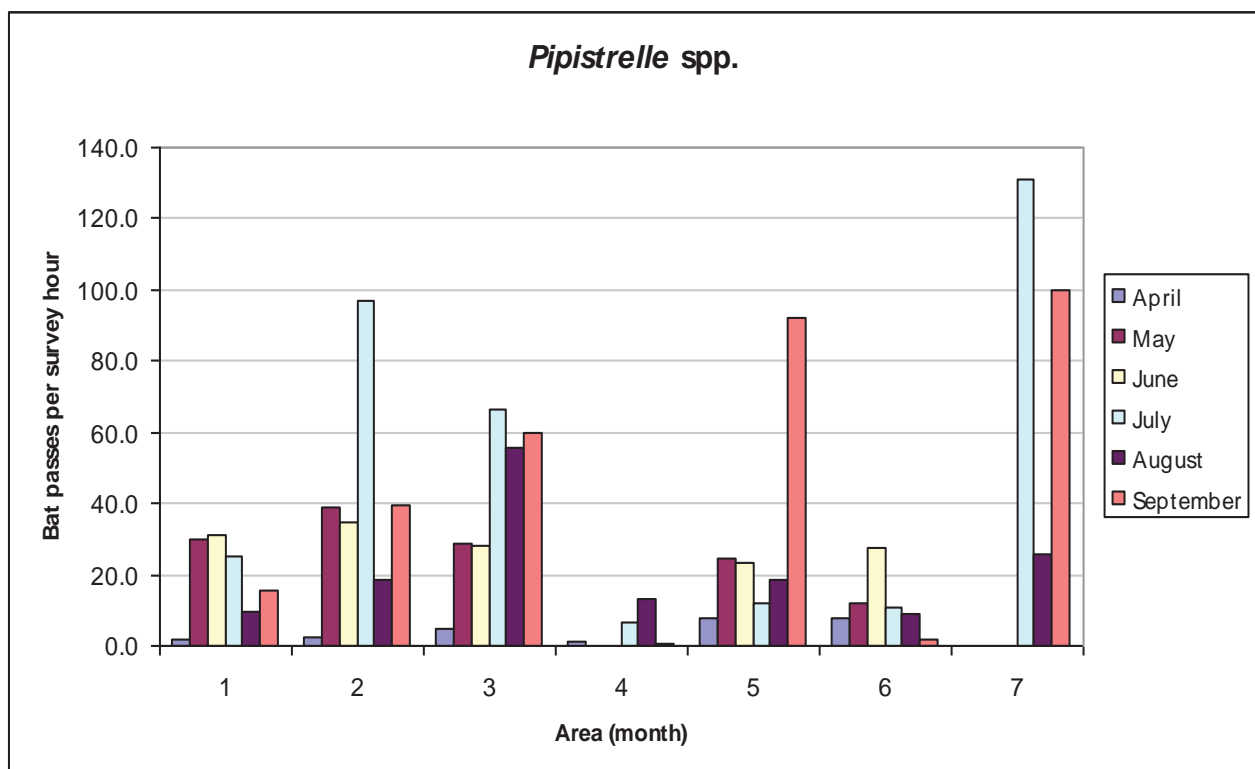
The highest number of bat recordings, in all survey areas, were of pipistrelle bat species (the total equated to more than 90% of the total number of bat passes recorded). Figure 6, below, shows the number of passes by pipistrelle species throughout the 2009 survey season.

- Areas 1 and 6 saw the highest number of passes in June, with approximately 30 and between 25 - 30 passes per hour, respectively;
- Areas 2, 3 and 7 had the highest number of passes in July, with just under 100, approximately 65 and 130 passes per hour, respectively;
- Area 4 saw the highest number of passes per hour in August, with between 15 – 20. This area saw the lowest number of pipistrelle recordings throughout the entire monitoring period; and,
- Area 5 saw the highest number of pipistrelle passes during September, with approximately 90 passes per hour.

A low percentage were identified as belonging to Nathusius' pipistrelle bats, however, these were so few it was not considered useful to separate them from the other pipistrelle species. Such low numbers suggest that the bats were just passing through the site and not roosting nearby.

The numbers of both soprano and common pipistrelle passes recorded were significant, with the proportions of early or late passes indicating that a number of roosts of these two species are likely to be in close proximity to the NDR route.

Figure 6: Pipistrelle recordings per hour.



Similar patterns of activity, in terms of numbers or patterns associated with bat passes/hour on both the paired static detectors in each area through the months of survey, is one indicator that the feature is likely to be used for commuting by that species group, as the paired detectors are placed along the same linear feature. Table 33, below, provides details on patterns of bat activity (similarities between species groups) at each of the monitoring locations.

Table 33: Similar patterns of bat activity on paired static detectors

Area	Species group
1	Barbastelle, big bats, Plecotus/Myotis
2	Barbastelle, Plecotus/Myotis
3	Barbastelle*, big bats, Plecotus/Myotis
4	Plecotus/Myotis, pipistrelles
5	Barbastelle, Plecotus/Myotis, pipistrelles
6	Plecotus/Myotis

Area	Species group
7	Barbastelle, big bats, Plecotus/Myotis, pipistrelles

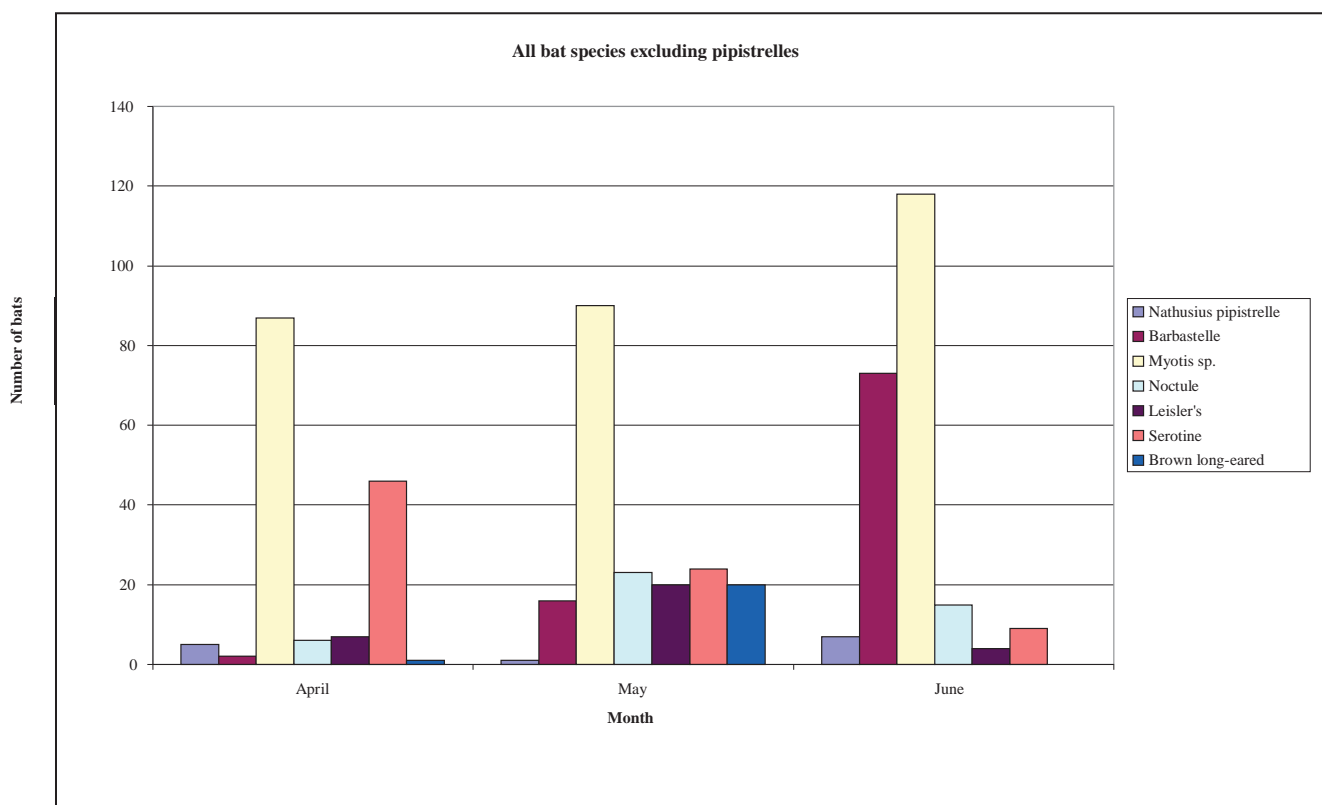
Source: BSG (2009)

3.6.2 2010 surveys – Area 7

Unmanned static surveys in 2010 were conducted in Area 7 only. As the 2009 surveys within this area started later in the season than in areas 1 – 6 (July – September), the monitoring period was completed during the first part of the 2010 season (April – June, inclusive).

Three potential commuting routes were selected within Area 7, for monitoring. The location of each monitoring station is provided on the drawings in Appendix H. A summary of results of the monitoring are displayed in Figure 7, below, showing total number of each species (excluding common and soprano pipistrelles) recorded each month. Tables with the raw data along with a graph of total numbers of bats recorded each month, including pipistrelles, are provided in Appendix I.

Figure 7: Total number of bats per species/per month (excluding common and soprano pipistrelles).



3.6.3 Area 8 – 2012 results

Unmanned static monitoring points for Area 8 were added to the survey package in 2012 to cover any potential bat habitat in the gap between the end of Area 7 and the Postwick Junction scheme. The selected monitoring location monitoring location was along the hedgerow to the north of Smee Lane (Appendix H).

At least nine species of bat were recorded during the Area 8 monitoring survey. These included:

- Barbastelle;
- *Myotis* spp.;
- Noctule;
- Leisler's;
- Serotine;
- Brown long-eared;
- Common pipistrelle;
- Soprano pipistrelle; and,
- Nathusius' pipistrelle.

A summary of the number of each bat species recorded during the 2012 survey season is provided in Figure 8 and Figure 9 below.

Figure 8: Total number of bats per species/per month (excluding common, soprano and Nathusius' pipistrelles)

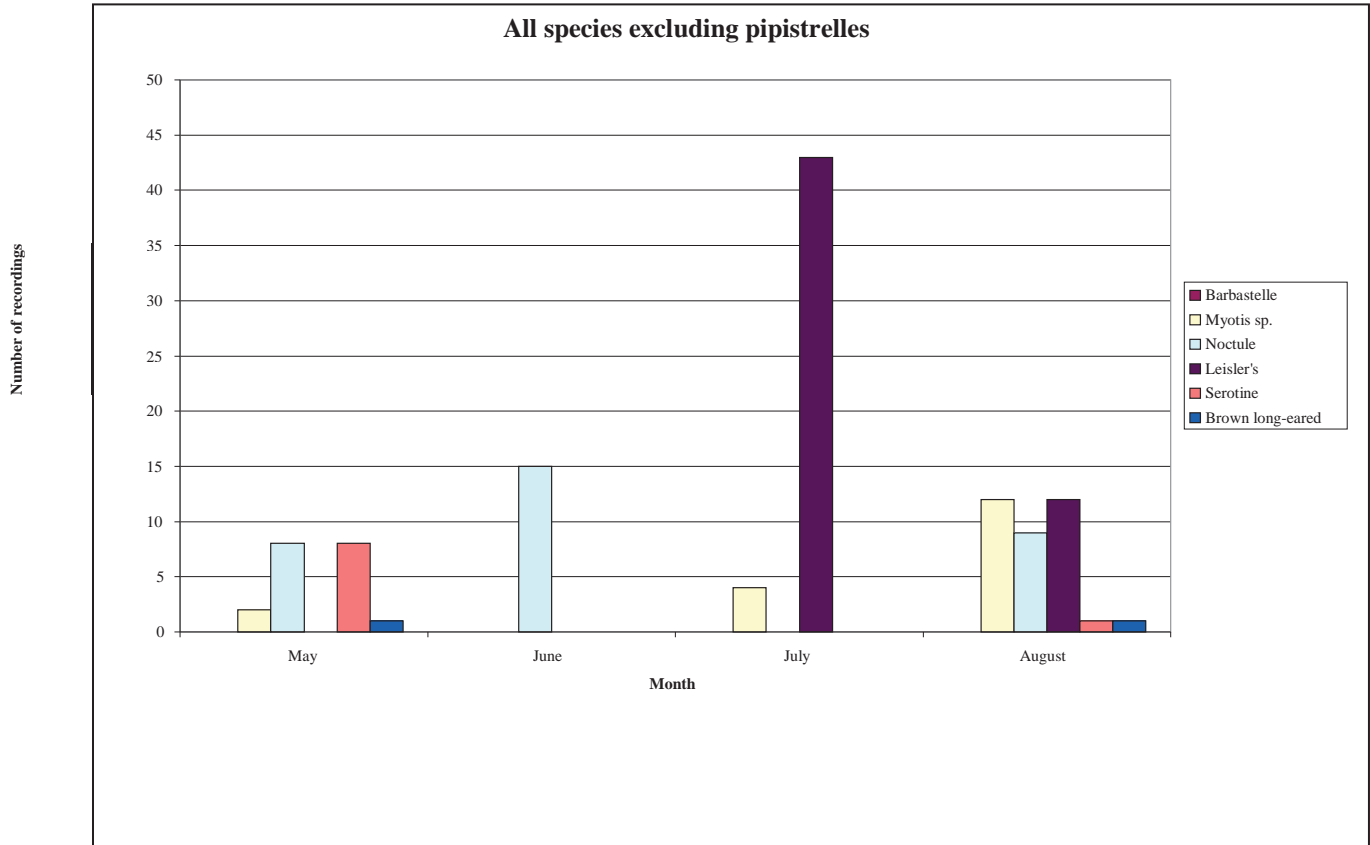
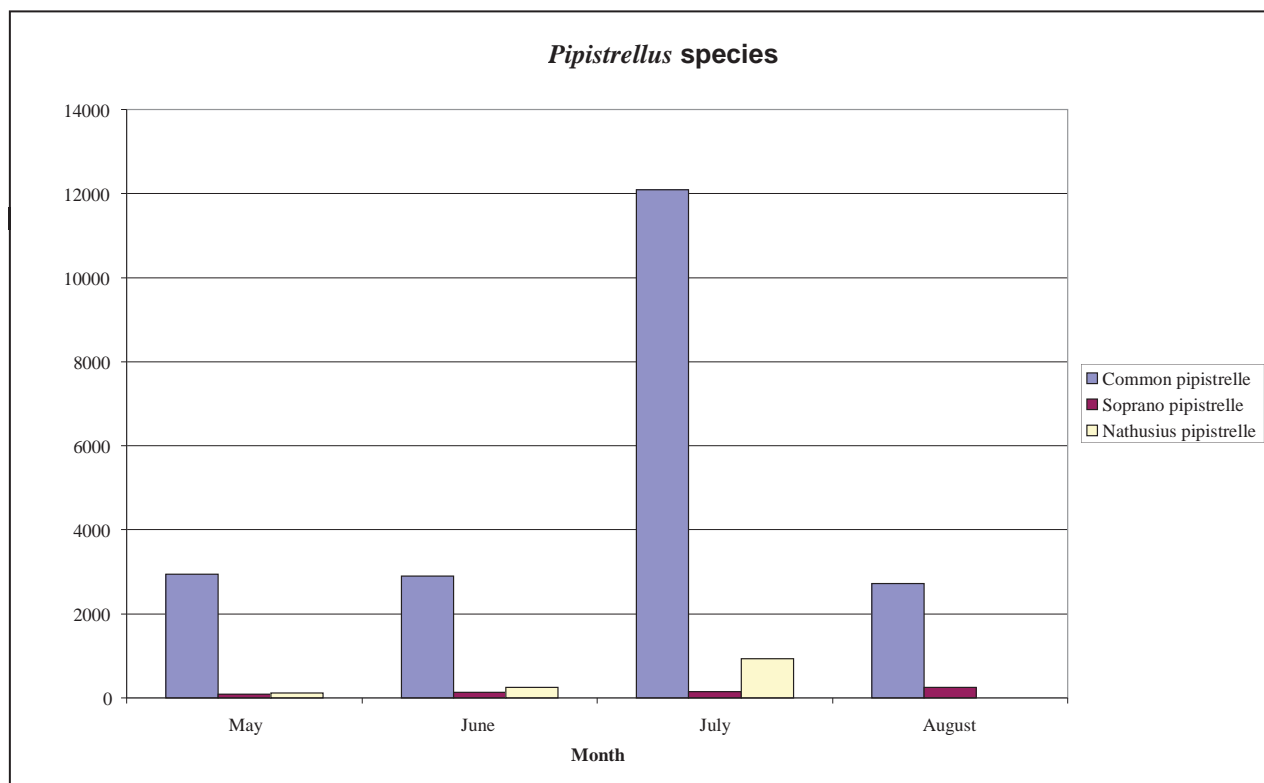


Figure 9: Total number of pipistrelle passes recorded per month



Data tables showing the monitoring results for each species at both of the Anabat stations in Area 8 are provided in Appendix J.

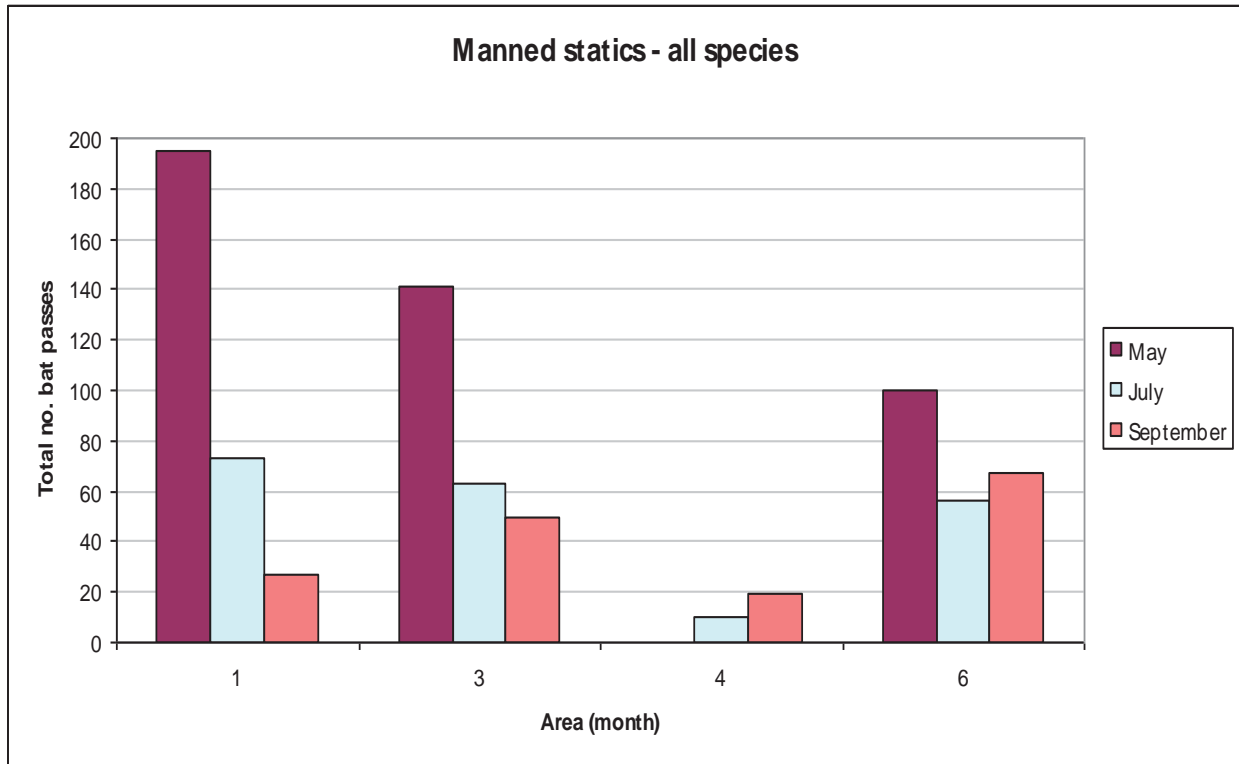
3.7 Static monitoring – manned

Manned static surveys were carried out at four selected locations between April and September 2009 and seven locations between May and September 2013. The locations for these surveys are provided in Appendix H. Each location was subject to three survey visits.

3.7.1 2009 surveys

The surveys in 2009 highlighted patterns of bat activity across the four survey areas, throughout the whole survey season, looking at total number of bat passes (of all species) are shown in Figure 10, below. Highest levels of activity were recorded in May at the manned static locations in Area 1, 3 and 6, with approximately 195, 140 and 100 bat passes respectively. No survey was carried out at the monitoring station in Area 4 during May 2009.

Figure 10: Total number of bat passes each survey (all species) by area, by month



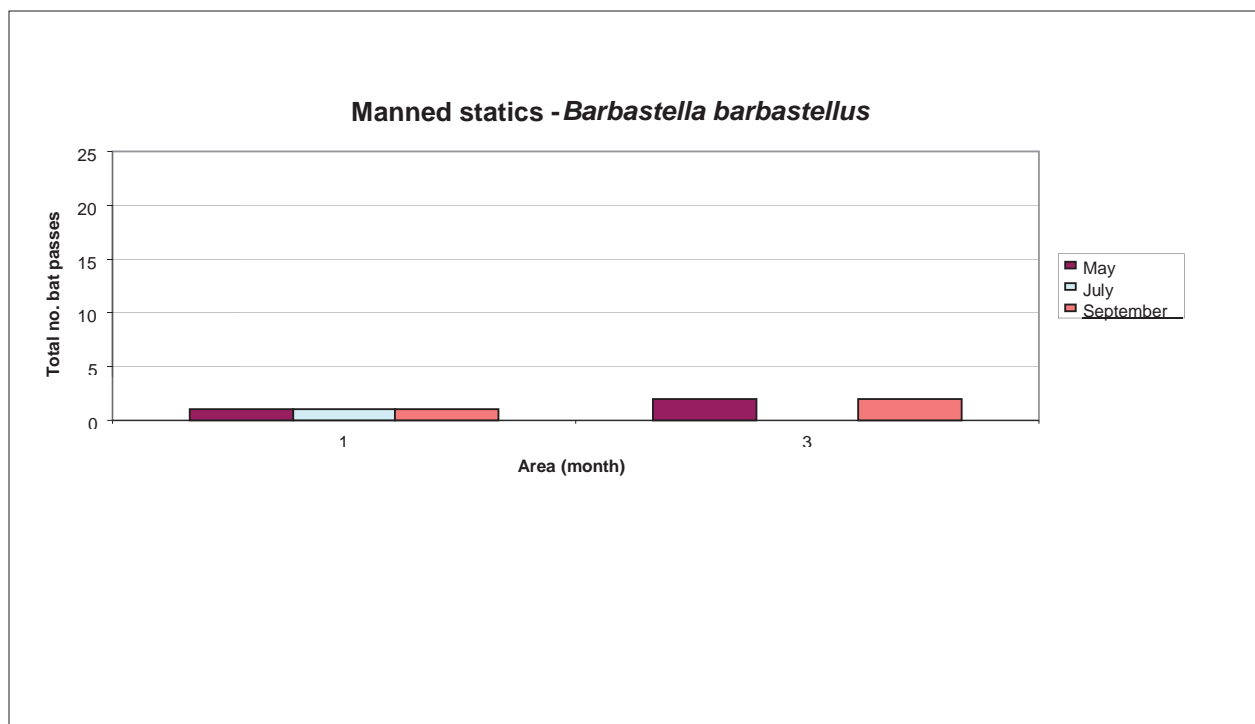
The total number of passes of each species group recorded during each survey in each area across the season is presented in the following series of graphs shown in Figure 11.

Barbastelles were only recorded in Areas 1 and 3 during the static manned surveys (Figure 11):

- Area 1: One barbastelle recorded during each survey in May, June and September; and,
- Area 3: Two barbastelles recorded during each survey in May and September.

Early passes were only recorded in Area 1.

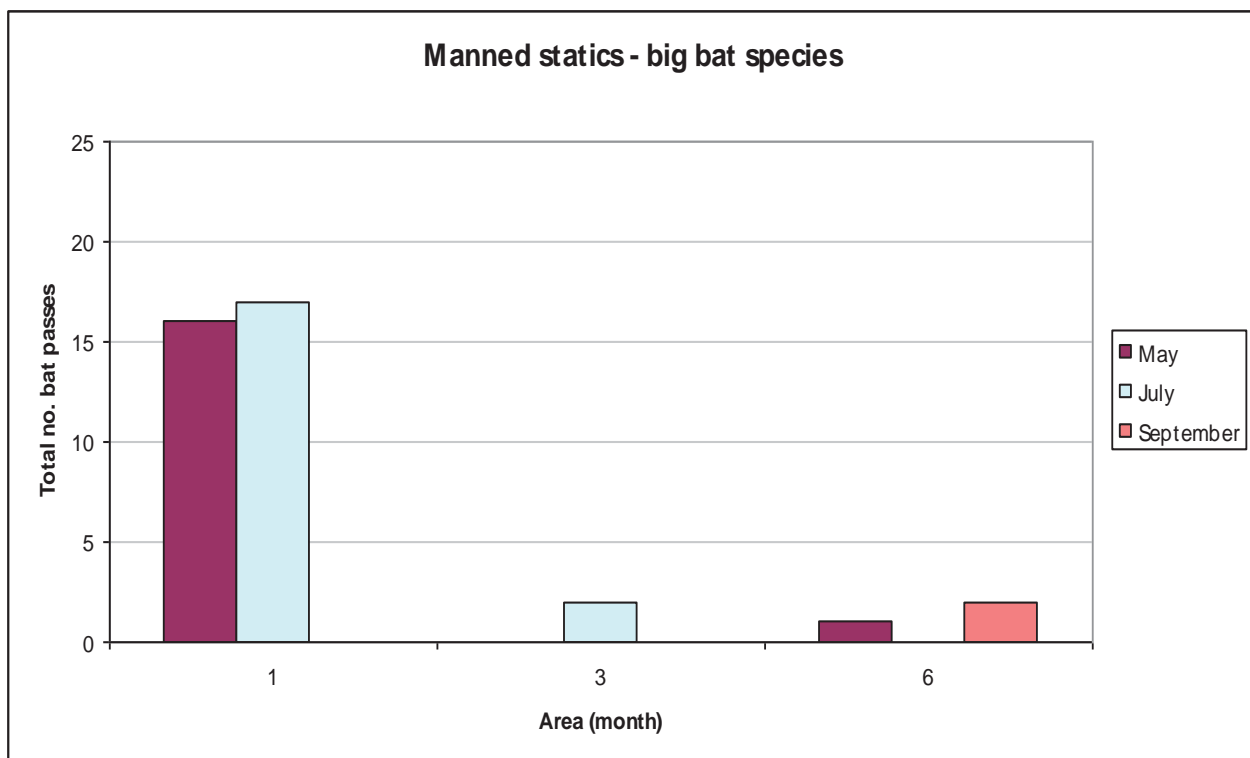
Figure 11: Total number of barbastelle passes in each survey area/per month



Most big bat passes recorded on the static manned surveys were noted earlier in the season in Area 1, with 16 passes recorded in May and 17 recorded in July. No big bat passes were recorded in Area 1 in September. More than a third of the recordings in Area 1 were recorded within the first hour of survey.

Lower numbers of big bat passes were recorded in Area 3 (two passes in July) and Area 6 (one pass in May and 2 passes in September) (Figure 12).

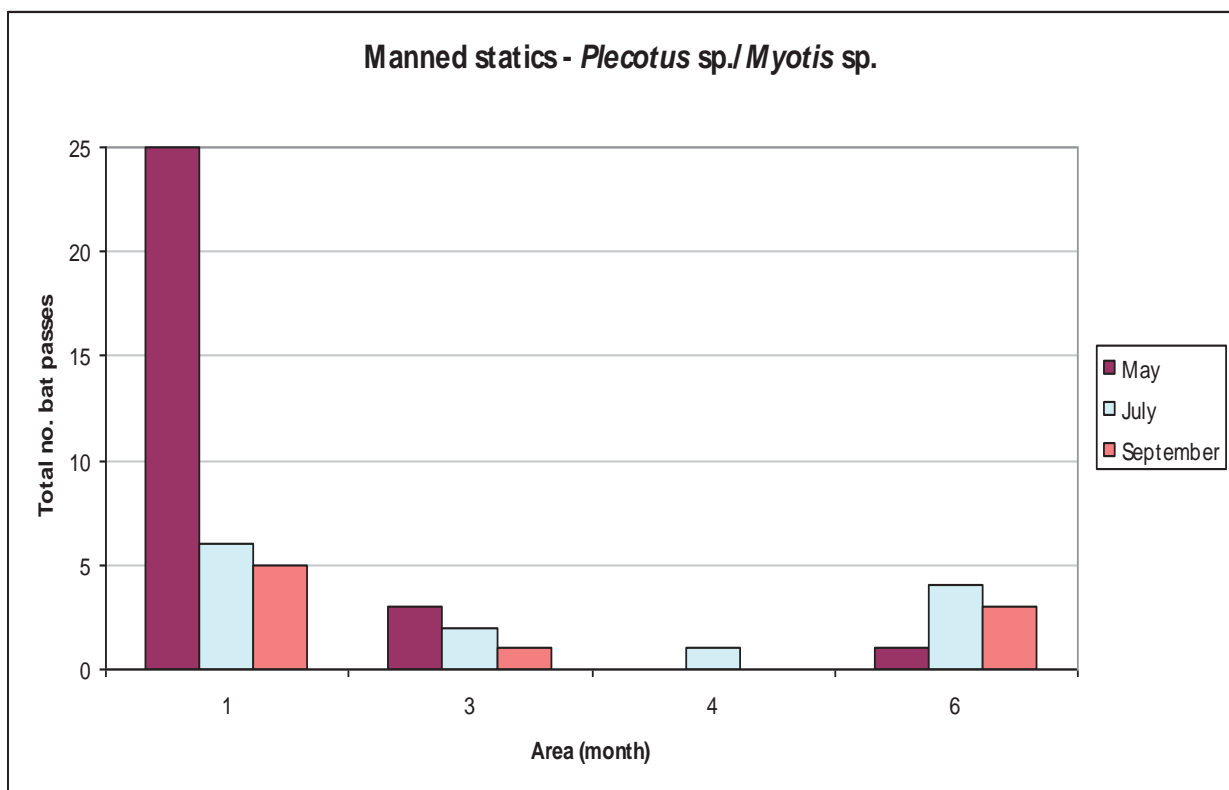
Figure 12: Total number of Big Bat passes in each survey area per month.



The majority of *Myotis* spp. and brown long-eared passes were recorded in Area 1, with 25 passes recorded in May, six in July and five in September. Of the passes noted in Area 1, 20% or more were recorded within the first hour of survey.

Lower numbers of *Myotis* spp. and brown long-eared passes were recorded at the other three manned static survey locations, with fewer than five passes recorded each month (Figure 13).

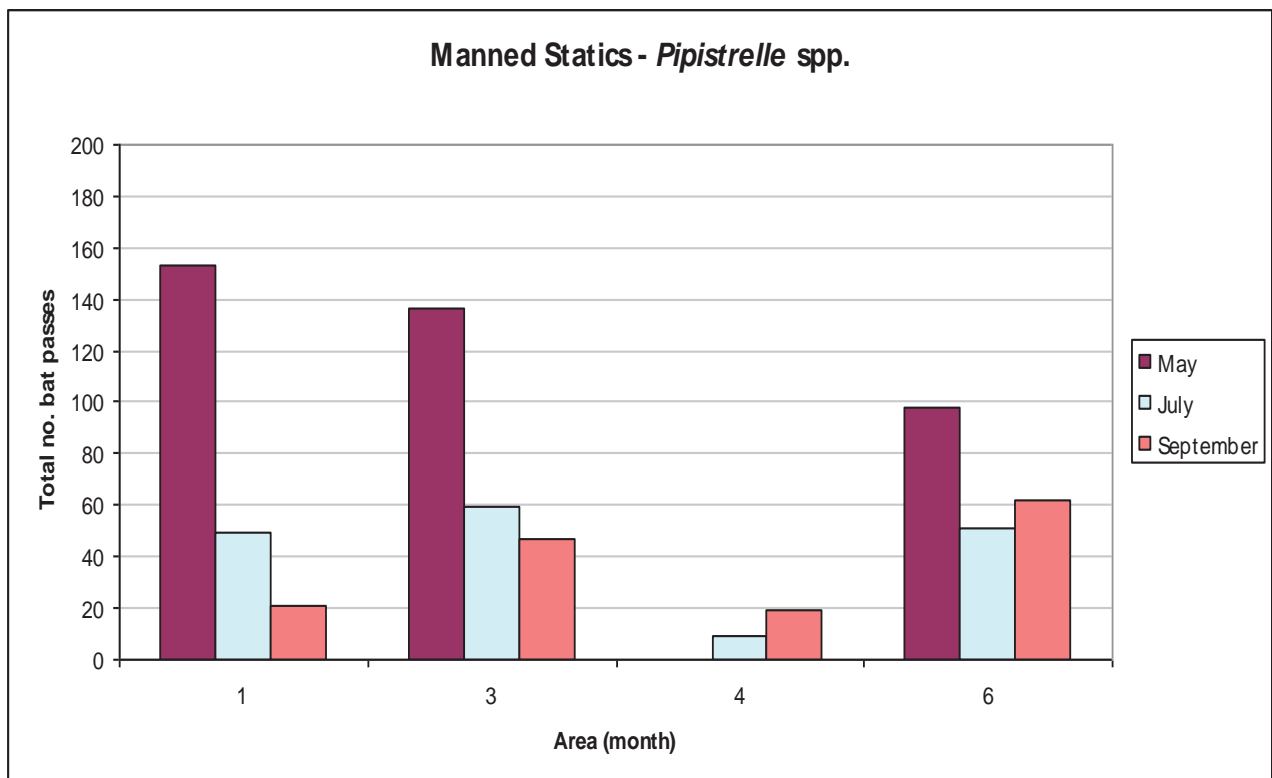
Figure 13: Total number of *Plecotus* and *Myotis* species in each survey area per month.



The most commonly recorded species at all of the manned static survey locations were that of the *Pipistrelle* species group (Figure 14). The highest number of pipistrelle passes was recorded in Areas 1, 3 and 6, during the May surveys, with approximately 155, 138 and 98 passes respectively. Areas 1, 3 and 6 also recorded more than 25% of the passes within the first hour of survey.

During July and September all survey locations recorded fewer than 65 passes.

Figure 14: Total number of passes by pipistrelle species in each survey area per month.



3.8 Radio-tracking

Four radio tracking sessions were carried out as part of the detailed survey package for the NDR scheme. Two sessions were undertaken during the 2009 survey season; June and August. One session was carried out in August 2012, focusing on the eastern end of the scheme. An additional session was undertaken in May 2013, as an update to the 2009 data and to collect additional information for the eastern end of the scheme.

Trapping of bats was undertaken at the locations detailed in sections 2.9.1 to 2.9.3 and Appendix K.

For the purpose of this report, catching locations, bat numbers and roost locations have been renumbered, to follow consecutively between radio-tracking sessions.

Drawings showing the identified roost locations, flight routes and home ranges (MCP 95%) of the bats tagged, during all of the radio tracking survey sessions, are provided in Appendix L and Appendix M.

A summary of findings of each session is provided below. Detailed survey data is provided in the relevant reports in Appendix R, Appendix S and Appendix T (Greena Ecological Consultancy, 2013 (a and b) and BSG, 2009).

3.8.1 2013 results

The following results are summarised from the report provided by Greena Ecological Consultancy (Billington, 2013b). The full report and detailed survey data is provided in Appendix T.

Catching sessions were undertaken between 3rd and 8th May 2013 and again on 12th and 16th May 2013. A variety of sites along the entire NDR route were selected as trapping locations (listed in 2.9.3), to update the 2009 survey data and also to add to and support the results of the 2012 radio-tracking survey work. During the May 2013 catching sessions a total of 100 bats were captured. The most abundant species were soprano pipistrelles, common pipistrelles and brown long-eared bats (Billington, 2013b). Details of the number of bats caught at each location, on each night, are provided in Table 34 below.

Table 34: Results of 2013 trapping sessions.

Date	Location		Species (sex)						
		Common pipistrelle	Soprano pipistrelle	Nathusius pipistrelle	Barbastelle	BLE	Noctule	Natterer's	Daubenton's
03/05/2013	21	4(M)							
04/05/2013	27	3(F)	1(M)		1(M), 1(F)				
05/05/2013	13	1(M), 1(F)	2(M), 6(F)			1(M), 1(F)			
05/05/2013	28					1(F)			
06/05/2013	19	2(M), 3(F)	8(M), 23(F)		2(F)		1(M)	1(F)	1(F)
07/05/2013	12	1(F)				1(F)			
07/05/2013	29		2(M)			5(F)		2(M)	
08/05/2013	30	4(M), 1(F)	4(M), 5(F)					1(M)	2(M)
08/05/2013	31		1(M), 1(F)		1(M)	1(F)			

12/05/2013	21	1(M)
16/05/2013	21	2(M)

In addition to the catching sessions, using harp traps and mist nets, two female barbastelles (bats 49 and 50) were caught directly out of an identified tree roost (no. 58), on 8th May 2013, using roped access techniques.

Environmental conditions during the 2013 radio-tracking survey period were not considered suitable for bat activity. On multiple nights bat activity levels were significantly reduced, with bats either remaining in their roosts or limiting distances travelled, returning to roost after brief foraging periods. Conditions recorded on each night during the radio-tracking survey are provided in Table 35: Weather conditions during the 2013 radio-tracking survey period below.

Table 35: Weather conditions during the 2013 radio-tracking survey period.

Date	Max. Temp. (°C)	Min. Temp. (°C)	Precipitation (mm)	Sunrise time	Sunset time
03/05/2013	18	2	0	05.19	20.25
04/05/2013	16	7	0	05.17	20.27
05/05/2013	18	5	0	05.15	20.29
06/05/2013	19	9	0	05.14	20.30
07/05/2013	20	7	0	05.12	20.32
08/05/2013	17	8	5	05.10	20.34
09/05/2013	15	4	3	05.08	20.35
10/05/2013	16	9	3	05.06	20.37
11/05/2013	13	4	9	05.05	20.39
12/05/2013	13	1	4	05.03	20.40
13/05/2013	13	3	3	05.01	20.42
14/05/2013	12	2	10	05.00	20.44
15/05/2013	12	4	6	04.58	20.45
16/05/2013	14	6	3	04.57	20.47
17/05/2013	11	6	2	04.55	20.48
18/05/2013	14	8	3	04.54	20.50
19/05/2013	18	6	0	04.52	20.51
20/05/2013	15	9	4	04.51	20.53
21/05/2013	13	7	1	04.49	20.54
22/05/2013	14	7	3	04.48	20.46
23/05/2013	9	3	7	04.47	20.57
24/05/2013	9	4	15	04.45	20.59

In total, seven barbastelles (five females and two males) were caught during the 2013 radio-tracking session. Four female barbastelles caught, along with the two males, were fitted with tags and radio-tracked between 4th and 17th May 2013, inclusive. Each tagged bat was provided with a number so that it could be tracked to roosts and foraging (for reference; numbers provided in brackets below are the original bat numbers shown in the report in Appendix R):

- Bat 46 (1): Male barbastelle caught at location 27 on 4th May 2013;

- Bat 47 (2): Female barbastelle caught at location 27 on 4th May 2013;
- Bat 48 (3): Female barbastelle caught at location 19 on 6th May 2013;
- Bat 49 (4): Female barbastelle caught at roost 58 on 8th May 2013;
- Bat 50 (5): Female barbastelle caught at roost 58 on 8th May 2013; and,
- Bat 51 (6): Male barbastelle caught at location 31 on 8th May 2013.

A total of 10 barbastelle roosts were identified as a result of the May 2013 radio-tracking survey. Information on roost location, description and bat(s) identified using each one, is provided in Table 36 below. All but one bat (no. 51) were found to change roost location during the study period.

Table 36: Radio-tracking results: Identified roosts.

Roost number	Bat number	Species (sex)	Roost location	Grid reference	Roost description
56	47	Barbastelle (F)	Morton Plantation	TG 12023 17315	Oak tree. Roost is under flaking bark on the north west aspect. (Tag no. 993).
57	46	Barbastelle (M)	Millhill Plantation	TG16156 18368	Oak tree. Roost is under flaking bark on the north east aspect (Tag no. 949).
58	48, 49, 50	Barbastelle (F x3)	Weston Park	TG 11659 17241	Oak tree. Roost is in a rot cavity on the north east aspect (Tag no. 945).
59	47	Barbastelle (F)	Snake Wood	TG 14952 14113	Oak tree. Roost is in a cavity or under flaking bark on the north east aspect.
60	49	Barbastelle (F)	Weston Park	TG 11743 17397	Oak tree. Roost is under flaking bark on the east aspect. (Tag no. 992).
61	48	Barbastelle (F)	Weston Park	TG 11455 17166	Hornbeam. Roost is under a scar on the north aspect. (Tag no. 48).
62	51	Barbastelle (M)	Hospital Plantation	TG 29899 13429	Dead Oak tree. Roost is under flaking bark on the south west aspect. (Tag no. 951).
63	46	Barbastelle (M)	Millhill Plantation	TG 16213 18455	Oak tree. Roost is in pockets in the bark on the northern aspect. (Tag no. 952).
64	46	Barbastelle (M)	Millhill Plantation	TG 16216 18448	Oak tree. Roost is in a central vertical callous in the tree. (Tag no. 985).
65	49	Barbastelle (F)	Weston Park	TG 11790 17413	Oak tree. Roost is in a dead limb on the north east aspect. (Tag no. 907).

After being caught out of tree Roost 58, on 8th May 2013, the roosting site of bat 50 was not identified.

Two data loggers were placed along Marriot's Way between 9th and 17th May 2013. This equipment was utilised in order to gain additional information to support the findings of the manual radio-tracking. During the monitoring period none of the tagged bats were recorded on either of the data loggers, due to reduced bat activity as a result of extreme weather conditions for the time of year.

The most significant foraging area identified through the radio-tracking survey in 2013 was located north of Attlebridge, west along Marriot's Way and covering Morton Plantation. Two bats (47 and 48) were regularly

identified using this area; with an overlap in their individual foraging areas (used by both bats) of 125 ha (152Appendix M).

Calculated foraging areas of bats tagged during this period ranged up to 4.57 km from the roost sites. The average distance travelled from the roost, for foraging, was calculated as:

- 1.52 km for tagged males – bat 46 and 51; and,
- 2.55 km for tagged females – bat 47, 48 and 49.

The overall foraging area of all bats tracked at the western end of the scheme totaled 814 ha.

Bat 51 was the only bat caught and tracked at the eastern end of the NDR scheme. The calculated foraging area of this bat, following the results of the radio-tracking survey, was found to extend over 60 ha, with the maximum distance travelled from the roosting site calculated at 1.12 km. These results are limited, as activity of this bat was reduced by the extreme weather conditions experienced during the survey period. As such, it is not possible to compare the data recorded from this bat, with the other bats tracked, at the western end of the scheme during 2013, nor can it be compared with the previous results from radio-tracking carried out at the eastern end in 2012.

The calculated home ranges of each tracked bat are provided in Table 37 below and shown on the drawings in Appendix M.

Table 37: Summary of results of 2013 radio tracking survey

Bat number	Area covered	MCP area 95% - ha	Percentage of combined foraging area.
46	Felthorpe Hall to Marriot's Way.	16	2%
47	Morton Plantation, Marriot's Way, south east to Taverham.	562	69%
48	Weston Park to Swannington, Marriot's Way and Morton Hall.	361	44.3%
49	No radio-tracking data recorded. The bat remained within Weston Park during the study.		
50	Bat was not recorded during the radio-tracking session. The bat either travelled to a roost outside of the survey area or the tagged failed shortly after activation.		
51	Area between Hospital Plantation and Eighteen Acre Plantation.	60	N/A

Due to adverse weather conditions, bat behaviour recorded during the radio-tracking, in 2013, cannot be considered representative.

3.8.2 2012 results

The following results are summarised from the Greena Ecological Consultancy Report (2013a). The full report and detailed survey data is provided in Appendix S.

In total 75 bats were captured during the 2012 session. This included 31 juveniles, eight lactating/post lactating females and two females in breeding condition. The most abundant species were soprano pipistrelles, common pipistrelles and brown long-eared (BLE) bats (Billington, 2013a). Details of the numbers of bats trapped on each date at each location are provided in Table 38 below.

Table 38: Total number of bats caught in each location.

Date	Location		Species (sex)						
		Common pipistrelle	Soprano pipistrelle	Nathusius pipistrelle	Barbastelle	BLE	Serotine	Natterer's	Daubenton's
18/08/2012	21	3(M) / 5(F)	7(M) / 1(F)	1(M)		3(M)	1(M)		
19/08/2012	22	2(M) / 2(F)	4(M) / 1(F)						
20/08/2012	23		4(M) / 1(F)			3(M) / 4(F)		1(M)	
21/08/2012	24		1(M)						
22/08/2012	25	1(M)	4(M)					1(F)	
23/08/2012	21	3(M) / 1(F)		1(F)	1(M) / 1(F)	1(M) / 1(F)			
24/08/2012	10								
26/08/2012	21				1(M)	1(M) / 3(F)			
28/08/2012	26	3(M)	2(M) / 4(F)						1(M)

Source: Greena Ecological Consultancy (2012).

Three Barbastelle bats, two adult males and one adult (non-breeding) female, were caught at location 21 (between Smee Lane and Low Road, Appendix K), during three trapping sessions at this location. All three of these bats were tagged and tracked back to roosts at various locations (Table 39), which are shown in the maps in Appendix L. Each tagged bat was provided with a number, for reference (numbers provided in brackets below are the original bat numbers shown in the report in Appendix S):

- Bat 43 (1): Male barbastelle caught at Location 21;
- Bat 44 (2): Female barbastelle caught at Location 21; and,
- Bat 45 (3): Male barbastelle caught at Location 21.

Table 39: Radio tracking results 2012: Barbastelle roost details.

Roost number	Bat number	Species (sex)	Roost location		Roost description
51	43	Barbatselle (male)	Rackheath Estate		Veteran Sweet Chestnut Tree
52	44	Barbastelle (Female)	Heath Wood		Tree roost – single female
53	44		Paine's Yard Wood		Tree roost – single female
54	45	Barbastelle (Male)	Great Plumstead Hall	Tree roost – 3 bats recorded emerging during roost count	
55	45		Little Plumstead Hospital		Tree roost

All three radio tracked bats roosted individually. No evidence suggesting the presence of barbastelle colonies or nursery roosts was recorded in the area, with the nearest known colony at Felthorpe Hall,

approximately 15 km to the west. However, due to the activity recorded in the area and across the scheme as a whole, it is considered possible that a colony exists at Blofield Heath, east of Little Plumstead.

Several important foraging areas were identified through tracking the three tagged barbastelles. The main area of activity for all three bats covered an area bordered by Bulmer's Coppice, Paine's Yard Wood, Fir Covert, Rackheath Hall, Heath Wood and Pig's Park in the north. They were connected to Great Plumstead Hall and Postwick, to the south, by a flight route identified through Thorpe End and Triangle Wood (Appendix L). Foraging grounds of each individual bat can be found in Appendix M.

The records from the data loggers also showed that all three tagged bats were regular visitors to both the March Covert/Pigs Park and Smee Lane/Postwick areas, showing regular movement between the two areas, although the female was recorded between them more often than the two tagged males. This monitoring highlighted the use of the area between Low Road and Smee Lane for foraging and commuting bats. Table 40 shows the results of the monitoring in the two areas between 27th August and 1st September 2012.

Table 40: Results from data loggers recording passes by tagged bats, between 27/08/12 to 01/09/2012

Location	Bat number	Number of passess
Smee Lane	43	513
	44	495
	45	624
March Covert/Pig's Park	43	7
	44	1035
	45	18

Source: Greena Ecological Consultancy, 2012

The overall foraging area of all three bats, combined, covered approximately 1537 ha. The calculated home ranges of each tracked bat are provided in Table 41 below and shown on drawings in Appendix M.

- The foraging area of bat 44 was the largest of the three bats tracked, extending north to Salhouse and east towards Little Plumstead Hospital; and,
- The foraging area of bat 45 covered a triangular area between Rackheath Estate, Heath Farm and Little Plumstead Hospital.

Table 41: Summary of results of 2012 radio tracking survey

Bat number	Average Distance travelled (km)	Area covered	MCP area 95% - ha	% of combined foraging area.
43	4	Rackheath Hall to Great Plumstead Hall	532	34.6
44	4	Heath Wood to Great Plumstead Hall	1165	75.8
45	4	Little Plumstead Hospital to Pig's Park	955	62.1

All three bats shared a percentage of their foraging areas, with 29.6% overlapping, suggesting that this sample is representative of local barbastelle behaviour. This area of foraging activity is due to be intersected by the proposed scheme.

None of the tagged bats were recorded crossing the A47.

3.8.3 2009 results

Results detailed below are taken from the report produced by BSG (2009), provided in Appendix T.

A total of 532 bats of eight species were caught over the 2 periods in 2009. Results of each session are provided below.

3.8.3.1 June Session

During the first tracking session in 2009 a total of 302 bats were caught between 29th May and 7th June. Seven species were captured during this trapping period, including barbastelle's, Daubenton's, Natterer's, brown long-eared, common pipistrelle, soprano pipistrelle and Nathusius' pipistrelle bats.

A summary of the number and sex of bats caught at each trapping location is provided in Table 42.

Table 42: June 2009 bat captures.

Date	Location	Species (sex)							Total
		Common pipistrelle	Soprano pipistrelle	Nathusius pipistrelle	Barbastelle	BLE	Natterer's	Daubenton's	
29/05/2009	1	1(F)	7(M) / 6(F)				2(F) / 2(M)		18
	2	2(M)	1(M) / 1(F)			2(F)			6
30/05/2009	3	13(F) / 7(M)	7(M) / 2(F)		2(M) / 1(F)	6 (F) / 3(M)	1(M)		42
31/05/2009	4	1(M) / 1(F)	6(M) / 11(F)		1 (M)	2(M)	2(M) / 2(F)	1(F)	27
01/06/2009	5	3(F) / 1(M)	2(M)			6(M) / 16(F)	1(M)		29
02/06/2009	6	1(M) / 1(F)	2(M)			1(M) / 1(F)			6
03/06/2009	7	2(M) / 1(F)	4(M)		1(M)				8
	8	5(F) / 1(M)	1(M)						7
04/06/2009	9	14(F) / 11(M)	89(F) / 5(M)	1(M)	1(M) / 1(F)	1(M) / 1(F)	1(F) / 2(M)	2(M)	129
05/06/2009	10				1(M)	1(F)			2
06/06/2009	11	4(M) / 2(F)	1(M) / 1(F)			2(F) / 1(M)	1(F)	1(M) / 1(F)	14
07/06/2009	12	1(M) / 2(F)	4(M) / 2(F)		1(F)		1(M) / 1(F)	2(M)	14
Total		74	152	1	9	43	16	7	

A total of 19 of the bats caught during this period were tagged and radio tracked, nine of which were barbastelles. Of the nine barbastelles tagged six were male and three female, two of which were thought to be pregnant. Details of the bats radio tracked are provided in Table 43 below.

Table 43: Bats tagged and tracked in June 2009.

Bat number	Species	Trapping location	Sex	Breeding condition	Roosts tracked to
1	Brown long-eared	2	Female	Pregnant	1, 11
2	Barbastelle	3	Male		2
3	Barbastelle	3	Female	Pregnant	3, 5, 9
4	Barbastelle	3	Male		4, 6, 19
5	Barbastelle	4	Male		8
6	Natterer's	4	Female	Pregnant	10, 25
7	Daubenton's	4	Female	Pregnant	7, 18, 20
8	Brown long-eared	5	Female	Pregnant	12, 50
9	Barbastelle	7	Male		14
10	Nathusius' pipistrelle	9	Male		15
11	Daubenton's	9	Male		17
12	Barbastelle	9	Female		3
13	Natterer's	9	Male		3
14	Barbastelle	9	Male		16, 22, 23, 28
15	Barbastelle	10	Male		21, 24, 30
16	Brown long-eared	11	Female	Lactating	29
17	Daubenton's	11	Female	Pregnant	7
18	Natterer's	12	Female	Pregnant	27
19	Barbastelle	12	Female	Pregnant	26

All of the female barbastelle bats caught and tracked during this session were found to be roosting in the woodlands immediately surrounding Felthorpe Hall. This included bat 19, which was trapped at Spixworth, approximately 8.2 Km away from the roost location.

Roost locations are shown on the maps in Appendix L.

Significant flight routes and foraging grounds identified during the radio tracking surveys are shown on the maps in Appendix L and Appendix M.

3.8.3.2 August session

A total of 230 bats were caught between 1st and 11th August 2009, of which 12 were trapped directly from tree roosts on 10th and 11th August.

Species caught during this period included barbastelle, Daubenton's, Natterer's, brown long-eared, noctule, common pipistrelle, soprano pipistrelle and Nathusius' pipistrelle bats. Details on species, number and sex of bats trapped at each location are provided in Table 44 below.

Table 44: August 2009 bat captures

Date	Location	Species (sex)								Total
		Common pipistrelle	Soprano pipistrelle	Nathusius pipistrelle	Barbastelle	BLE	Noctule	Natterer's	Daubenton's	
01/08/09	13									0
02/08/09	13		3(F) / 2(M)			1(M) / 1(F)			1(M) / 1(F)	9
	14		1(M) / 1(F)			1(F)				3
03/08/09	3	2(F) / 1(M)	5(F) / 4(M)		1(M)	1(F)				14
	7	6(M) / 3(F)	3(M) / 3(F)					1(M)		16
04/08/09	15	3(M)	2(F)			1(M)		1(F)	1(F)	8
	16		1(M)							1
05/08/09	17	1(F)	1(M) / 1(F)			4(M) / 7(F)		1(F)		15
	18	7(M) /	1(M)	1(F)		7(F) / 1(M)		2(M)	1(F)	23
06/08/09	12	3(F) / 1(M)	2(M) / 5(F)	1(M) / 4(F)	1(M)	1(F) / 3(M)	1(F)	1(F)		23
07/08/09	8			1(M) / 1(F)		1(F)		2(M) / 2(F)		7
08/08/09	19	2(F)	7(F) / 3(M)	1(F) / 1(M)	2(M) / 1(F)	1(M) / 1(F)		2(M)	5(F)	26
	3		2(M)		2(M)	1(F) / 1(M)	1(M)			7
09/08/09	20	2(F)	26(F) / 17(M)	1(F)	2(M) / 2(F)	2(F) / 3(M)		1(M) / 1(F)	1(F) / 3(M)	61
Total		34	90	11	11	38	2	14	13	

Of the 230 bats trapped in August 2009, 22 barbastelles were tagged and radio tracked. Details including the trapping and roost locations are provided below in Table 45.

Table 45: Bats tagged and tracked during August 2009

Bat number	Species	Trapping location	Sex	Breeding condition	Roosts tracked to
21	Barbastelle	3	Male	Juvenile	47, 48
22	Barbastelle	12	Male		N/A
23	Barbastelle	19	Male		44
24	Barbastelle	19	Female	Lactating	39
25	Barbastelle	19	Male		43, 45
26	Barbastelle	3	Male		42, 46
27	Barbastelle	3	Male	Juvenile	N/A

Bat number	Species	Trapping location	Sex	Breeding condition	Roosts tracked to
28	Barbastelle	20	Female	Lactating	31
29	Barbastelle	20	Male		32, 36
30	Barbastelle	20	Female		31, 34, 37
31	Barbastelle	20	Male		N/A
32	Barbastelle	Tree roost 31	Female	Juvenile	40
33	Barbastelle	Tree roost 31	Female		35, 40, 33, 49
34	Barbastelle	Tree roost 31	Female	Juvenile	40
35	Barbastelle	Tree roost 31	Male	Juvenile	40
36	Barbastelle	Tree roost 31	Female	Juvenile	40
37	Barbastelle	Tree roost 31	Female		40
38	Barbastelle	Tree roost 31	Male	Juvenile	40, 41
39	Barbastelle	Tree roost 31	Female		33, 40
40	Barbastelle	Tree roost 34	Female	Lactating	34, 35, 37
41	Barbastelle	Tree roost 34	Male	Juvenile	34, 35, 37
42	Barbastelle	Tree roost 33	Female	Lactating	33

During the August radio tracking session Weston Park Golf Course and surrounding woodlands were identified as a significant area for barbastelle activity. The majority of the roosts identified were with Morton Plantation, as well as roosts within Scotchwood Hills, Hardingham Hills (Appendix L).

Tree roosts identified as a result of the tracking surveys were subject to emergence counts, which noted the presence of a number of large roosts. The largest of these was roost 38 (Appendix L), with a count of between 55 and 59 bats recorded emerging on 12th August and 24 bats recorded emerging on 13th August. In addition to this, 24 bats (seven of which were tagged) and 10 bats were recorded emerging from roost 40 and 39, respectively. Three and four bats were also counted from roosts 37 and 35.

The bats tracked during this session were found to travel significant distances between the roost sites and feeding grounds. For example, a single female barbastelle (bat 24), caught on Marriot's Way, was tracked back to a roost in Salle Park (Roost 39) approximately 8 km north of the proposed NDR footprint.

3.8.3.3 Summary of June and August tracking surveys by species

Barbastelle

A total of 35 barbastelle roosts were identified during the two radio tracking sessions combined. Three of these were night roosts. The majority of the barbastelle bats tracked were found to be roosting in trees. Only one bat, a single male (bat 2), was noted using a building roost (Roost 2) approximately 2 km north of the proposed NDR footprint. Details of the identified roosts are provided in Table 46 below.

Table 46: Details of Barbastelle roosts

Roost number	Bat number	Roost location	Roost description
2	2	Felthorpe	Chicken Shed
3	3	Felthorpe Hall	Roost location unknown due to limited access.
4	4	Little Wood House	Possible night roost
5	3	Swannington Bottom Plantation	Oak tree approximately 45 m in from woodland edge and approximately 40 m from water course. Roost in a vertical split – 2 other bats seen emerging during visual survey.
6	4		Triple stemmed Ash tree.
8	5	Wroxham Hall	Sweet Chestnut tree
9	3	Edge of Felthorpe Hall	Sweet Chestnut tree. No count completed due to limited access. Lifted bark on trunk – potential throughout
14	9	Cottesey	Ash fallen into and Oak tree – too dangerous to survey
16	14	Haveringham Lane	Oak tree in a line of veteran oaks (3 rd one east of the road). Roost in a large hollow branch with vertical split.
21	15	Tollgate Wood	Sweet Chestnut tree with extensive lifted bark, cracks and splits.
22	14	Long Covert	Double stemmed Sycamore – roost in cavity between the two stems.
23	14	Long Covert	Exact tree not identified.
24	15	Tollgate Wood	Beech tree in woodland. The tree was lying on the ground with a split/cavity to the south, approximately 3 m AGL.
26	19	Red Hall	Oak tree on paddock boundary. Roost in a 3 m spit approx. 10 m AGL in a limb overhanging the field. A second feature was also identified in another limb.
28	14	Long Covert	Dead pole in the south east corner of the woodland – Flaky bark throughout.
30	15	Tollgate wood	Chestnut tree. Roost is thought likely to be in a split of a snapped branch, approximately 8 m AGL.
31	28, 30	Morton Plantation, Weston Golf Course	Oak tree containing the main maternity roost, with 40+ bats counted emerging. 40 cm DBH, stag headed above canopy, with extensive flaking bark. Most of the bats emerged from the south east side of the tree.
32	29	Morton Plantation, Weston Golf Course	Sweet chestnut tree. Vertical split approximately 12 m AGL on the eastern side.
33	39, 42	Morton Plantation, Weston Golf Course	Oak tree with flaking and lifted bark on the trunk throughout. At least 6 bats seen emerging from 6 and 8 m AGL.
34	30, 40, 41	Morton Plantation, Weston Golf Course	Oak tree. Flaking bark at 8 m on dead limb on the west side of the tree, extending to 2 m. Approximately 13 bats counted emerging from the tree during trapping work.
35	33, 40, 41	Morton Plantation, Weston Golf Course	Oak tree, with a feature on the south west side approximately 6 m AGL. Split in trunk and on limb extending from approximately 4.5 to 7 m AGL.
36	29	Morton Plantation, Weston Golf Course	Oak tree with flaking bark on branches on the north side of the tree approximately 14 m AGL and 9 m AGL
37	30, 40, 41	Oak Plantation, Weston Golf Course	Sweet Chestnut with horizontal split on the north east side of the trunk. Bat 10 identified approximately 10 – 15 m up.
38	Multiple	Hardingham Hills	Dead tree (possibly an oak) with extensive areas of lifted bark. Exposed heart wood from ground level to approximately 1.5 m AGL. Bats appeared to emerge from low down.
39	24	Salle Park	Large oak tree with multiple features. Flaking bark on trunk from 0 – 5 m AGL. Bat identified in snapped branch on north east side approximately 5 m AGL.

Roost number	Bat number	Roost location	Roost description
40	32, 33, 34, 35, 36, 37, 38, 39	Scotchwood Hills	Oak tree with a split vertical limb to the north with woodpecker holes and raised bark, approximately 8 – 15 m AGL. Bats thought to have emerged from under the bark.
41	38	Morton Plantation, Weston Golf Course	Oak tree with flaking bark on the south west side approximately 10 m AGL.
42	26	Deighton Hills B&B	Oak tree behind the B&B. Ivy covered tree with extensive dead wood and lifted bark.
43	25	Uppgate Common	Oak tree with dead, snagged limbs at 8 m AGL.
44	23	Bylaugh Wood	Specific tree not found due to limited access.
45	25	Deighton Hills, Behind the shooting school	Multi-stemmed ash tree with central leader snapped at 14 m AGL and good ivy cover.
46	26	Deighton Hills	Oak tree with small dead limbs to the north west and south west of the tree, with lifted bark.
47	21	Small Hope Plantation	Night roost
48	21		Night roost either in the outhouse or in a tree in the woodland behind the building.
49	33	Approximately 100 m west of Junction of Mill Lane and North Lane on the north side of the road.	Night roost in a large Oak tree, with ivy cover on the trunk.

The home ranges of the breeding female barbastelles tracked ranged from 393ha (bat 42) to 1,637 ha (bat 19), with the average MCP area measuring 904ha (excluding bats 12 and 40). The average home range for non-breeding and lactating females measured 337ha and 904 ha respectively.

Male barbastelles were found to be more wide spread than the females, with roosts sites identified in a variety of woodlands, including Tollshill wood, Deighton Hills, along the Wensum flood plain and near Wroxham (approximately 3 km north of the proposed footprint). The home ranges of male barbastelles tracked ranged from 30.76 ha (bat 15) to 498.73 ha (bat 4). However, the MCP areas for the male bats is limited as they were not tracked with as much intensity as the female bats, therefore the outer ranges of movement for individuals was not recorded.

A number of male and female barbastelles radio tracked included areas of the proposed NDR footprint within their home ranges (Appendix M).

Results for individual bats tracked are provided in Table 47 below. Calculated home ranges are also shown on the drawings in Appendix M and detailed results can be found in the survey report in Appendix T (BSG, 2009).